# Samchon Framework for CPP

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# Chapter 1

# Samchon Framework

#### Samchon Framework is a framework for

- Providing libraries.
- Realizing cloud server(service).
- Constituting Distributed, Parallel processing system.
- Realizing composite and logical retrivalance model; Nam-Tree.

#### Related Homepages

- `Homepage of Samchon Framework`
- `Github - Samchon Framework`
- Examples
  - `Samchon Simulation Cloud`
  - `Hansung Timetable v3.0` (id: guest, password: N/A)

#### Related Documents

- Guidance for Developers
  - `English`
  - `Korean`
- Architecture Designs
  - `Class Diagram of CPP`
  - `Class Diagram of JS(TypeScript and Flex(JS))`
  - `Sequence Diagram`
  - `Entity Relationship Diagram`
- Another API Documents
  - `C++ as PDF file`
  - `Flex`
  - `TypeScript`

#### Author

Jeongho Nam

- E-mail: `samchon@samchon.org`
- Mobile: 82-10-3627-0016

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# Chapter 2

# Namespace Index

## 2.1 Namespace List

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A chat service inherited from cloud service . . . . . ??
samchon::example::console_chat_server
A chat server . . . . . ??
samchon::example::tsp
A packer with number of wrapper type and products . . . . . ??
samchon::library
Package of libraries . . . . . ??
samchon::namtree
Package of Nam-Tree . . . . . ??
samchon::protocol
Package of network protocol and libraries . . . . . ??
samchon::protocol::master
Package for external system, within the framework of master . . . . . ??
samchon::protocol::service
Package of cloud service as a server . . . . . ??
samchon::protocol::slave
Package of external system, within the framework of slave . . . . . ??

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# Chapter 4

# Class Index

## 4.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:


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ByteArray
Binary data class . . . . . ??
CaseGenerator
Case generator . . . . . ??
Charset
A utility class supporting conversion between multiple character-sets . . . . . ??
ChatClient
A client . . . . . ??
ChatClient
A chat client . . . . . ??
ChatMessage
A chat message . . . . . ??
ChatRoom
A chat room . . . . . ??
ChatRoomArray
A manager of chat rooms . . . . . ??
ChatServer
A chat server . . . . . ??
ChatServer
A chat server . . . . . ??
ChatService
A chat service . . . . . ??
ChatUser
An user in chat server . . . . . ??
Client
A network boundary with the client in an User . . . . . ??
CombinedPermutationGenerator
A combined-permutation case generator . . . . . ??
CriticalAllocator< _Ty >
An allocator ensuring concurrency . . . . . ??
Date
Date (year, month, day in month) . . . . . ??
Datetime
Date and time . . . . . ??
DistributedClient
A network driver for a distributed client . . . . . ??

DistributedClientArray
An array of DistributedClient(s) . . . . . ??
DistributedClientArrayMediator
A mediator of distributed system between master and slaves . . . . . ??
DistributedClientServerMediator
A distributed slave client for mediation . . . . . ??
DistributedServer
A network driver for a distributed server . . . . . ??
DistributedServerArray
An array of DistributedServer(s) . . . . . ??
DistributedServerArrayMediator
A mediator of distributed system between master and slaves . . . . . ??
DistributedSlaveServerMediator
A distributed slave server for mediation . . . . . ??
DistributedSlaveSystemMediator
A distributed slave system for mediation . . . . . ??
DistributedSystem
A network driver for a distributed system . . . . . ??
DistributedSystemArray
An array of distributed system drivers . . . . . ??
DistributedSystemArrayMediator
A mediator of distributed system between master and slaves . . . . . ??
DistributedSystemRole
A role of distributed processing system . . . . . ??
DSInvokeHistory
A reported history of an Invoke message . . . . . ??
DSInvokeHistoryList
A list of DSInvokeHistory . . . . . ??
Entity
An entity, a standard data class . . . . . ??
EntityArray< _Ty >
An Entity and a static array containing Entity objects . . . . . ??
EntityGroup< _Container, _ETy, _Ty >
An Entity and a container of children Entity objects . . . . . ??
EntityList< _Ty >
An Entity and a static list containing Entity objects . . . . . ??
ErrorEvent
Event representing an error . . . . . ??
Event
Represent an event running on background . . . . . ??
EventDispatcher
Abstract class for dispatching Event . . . . . ??
ExternalClient
A network driver for an external client . . . . . ??
ExternalClientArray
An array of ExternalClient(s) . . . . . ??
ExternalServer
A network driver for an external server . . . . . ??
ExternalServerArray
An array of ExternalServer(s) . . . . . ??
ExternalSystem
A network driver for an external system . . . . . ??
ExternalSystemArray
An array of ExternalSystem(s) . . . . . ??
ExternalSystemRole
A role belongs to an external system . . . . . ??
FactorialGenerator
Factorical case generator . . . . . ??

FlashPolicyServer
A flash policy server . . . ??
FTByteFile
A binary file . . . ??
FTFactory
A Factory and manager for file-tree . . . ??
FTFile
A file . . . ??
FTFolder
A folder . . . ??
FTInstance
An interface of file-tree . . . ??
FTTextFile
A text file . . . ??
GAParameters
Parameters for Genetic-Algorithm . . . ??
GAParameters
A structure containing parameters of genetic algorithm . . . ??
GAPopulation< GeneArray, Compare >
A population of a generation in G.A . . . ??
GeneticAlgorithm< GeneArray, Compare >
A genetic algorithm class . . . ??
GeometryPoint
A geometry coordinates (point) . . . ??
HTTPLoader
A http, web-page loader . . . ??
IClient
An interface for a client . . . ??
IEntityChain
A chain of entity . . . ??
IEntityGroup
An iternface for entity group . . . ??
IEntityPtrGroup< _Container > . . . ??
IHTMLEntity
An interface supporting conversion to html . . . ??
IndexPair< _Ty >
A pair of index and its value(_Ty) . . . ??
Instance
A physical instance . . . ??
INTExplore
An interface for exploration . . . ??
Invoke
Standard message of network I/O . . . ??
InvokeHistory
A history of an Invoke message . . . ??
InvokeHistoryArray
An array of InvokeHistory . . . ??
InvokeParameter
A parameter of an Invoke . . . ??
IOperator< _Ty >
Interface for comparision operator . . . ??
IProtocol
An interface of Invoke message chain . . . ??
IPUserPair
Relationship between IP address and User for issuing session . . . ??
IServer
An interface of a physical server . . . ??

ISQLEntity
An interface supporting DB-I/O . . . . . ??
IWebClient
An interface for a web-client . . . . . ??
IWebServer
An interface for a physical server following web-socket . . . . . ??
ListService
A list service of chat rooms . . . . . ??
Map< _Kty, _Ty, _Pr, _Alloc >
Map . . . . . ??
Math
Utility of Math . . . . . ??
MySQLi
A SQL interface for My-SQL . . . . . ??
NTCriteria
Criteria, a conditional expression with weight . . . . . ??
NTEntityGroup
A historical, studying data . . . . . ??
NTFactory
A factory for Nam-Tree objects . . . . . ??
NTFile
A file archiving metadata of a function . . . . . ??
NTIterator
Iterator of historical data . . . . . ??
NTParameter
A metadata of a parameter in a function . . . . . ??
NTParameterArray
An Array of NTParameter . . . . . ??
NTParameterDetermined
A pre-determined value of a parameter . . . . . ??
NTSide
A side of a conditional expresson . . . . . ??
Packer
A packer planning the best packaging . . . . . ??
ParallelClient
A slave parallel client . . . . . ??
ParallelClient
A network driver for a parallel client . . . . . ??
ParallelClientArray
An array of ParallelClient(s) . . . . . ??
ParallelClientArrayMediator
A mediator of parallel system between master and slaves . . . . . ??
ParallelServer
A network driver for a parallel server . . . . . ??
ParallelServer
A slave parallel server . . . . . ??
ParallelServerArray
An array of ParallelServer(s) . . . . . ??
ParallelServerArrayMediator
A mediator of parallel system between master and slaves . . . . . ??
ParallelSlaveClientMediator
A parallel slave client for mediation . . . . . ??
ParallelSlaveServerMediator
A parallel slave server for mediation . . . . . ??
ParallelSlaveSystemMediator
A parallel slave system for mediation . . . . . ??
ParallelSystem
A network driver for a parallel system . . . . . ??

ParallelSystem
A slave parallel system . . . . . ??
ParallelSystemArray
An array of parallel system drivers . . . . . ??
ParallelSystemArrayMediator
A mediator of parallel system between master and slaves . . . . . ??
PermutationGenerator
A permutation case generator . . . . . ??
PRInvokeHistory
A reported history of an Invoke message . . . . . ??
PRInvokeHistoryArray
An array of PRInvokeHistory . . . . . ??
Product
A product, merchandise . . . . . ??
ProgressEvent
Event representing a progress . . . . . ??
RWMutex
Rw_mutex . . . . . ??
Scheduler
A scheduler . . . . . ??
Semaphore
A semaphore . . . . . ??
Server
A server for (cloud) service . . . . . ??
ServerConnector
A server connector for a physical client . . . . . ??
Service
A service . . . . . ??
ServiceKeeper
A keeper blocking destrunction of User and Client . . . . . ??
SharedAcquire
Shared acquire from a Semaphore . . . . . ??
SharedReadLock
Shared lock from a RWMutex . . . . . ??
SharedWriteLock
Shared lock from a RWMutex . . . . . ??
SlaveClient
A slave client . . . . . ??
SlaveServer
A slave server . . . . . ??
SlaveSystem
A slave system . . . . . ??
SmartPointer< _Ty >
Global shared pointer
??
SQLi
A SQL interface; DBMS connector . . . . . ??
SQLStatement
A sql statement . . . . . ??
StringUtil
Utility class for string . . . . . ??
SystemRole
A role belongs to a system . . . . . ??
Travel
Represent a travel containning Point(s) . . . . . ??
TSQLi
A SQL interface for T-SQL . . . . . ??

TSQLStatement
A t-sql statement . . . . . ??
UniqueAcquire
Unique acquire from a Semaphore . . . . . ??
UniqueReadLock
Unique lock for reading . . . . . ??
UniqueWriteLock
Unique lock for writing . . . . . ??
URLVariables
URLVariables class is for representing variables of HTTP . . . . . ??
User
User containing Client(s) with session-id . . . . . ??
WeakString
A string class only references characeters, reference only . . . . . ??
WebServerConnector
A web-socket server connector . . . . . ??
Wrapper
A wrapper can contain products . . . . . ??
WrapperArray
An array of wrapper with same category (name) . . . . . ??
XML
XML is a class representing xml object . . . . . ??

# Chapter 5

# Namespace Documentation

## 5.1 samchon Namespace Reference

Top level namespace of products built from samchon.

### Namespaces

- library

  *Package of libraries.*
- namtree

  *Package of Nam-Tree.*
- protocol

  *Package of network protocol and libraries.*

### Classes

- class ByteArray

  *Binary data class.*
- class IndexPair

  *A pair of index and its value(_Ty)*
- class Map

  *Map.*
- class SmartPointer

  *Global shared pointer*

  .
- class WeakString

  *A string class only references characeters, reference only.*

### Typedefs

- template<typename _Ty , typename _Pr = std::less<std::string>, typename _Alloc = std::allocator<std::pair<const std::string, _↩ Ty>>>

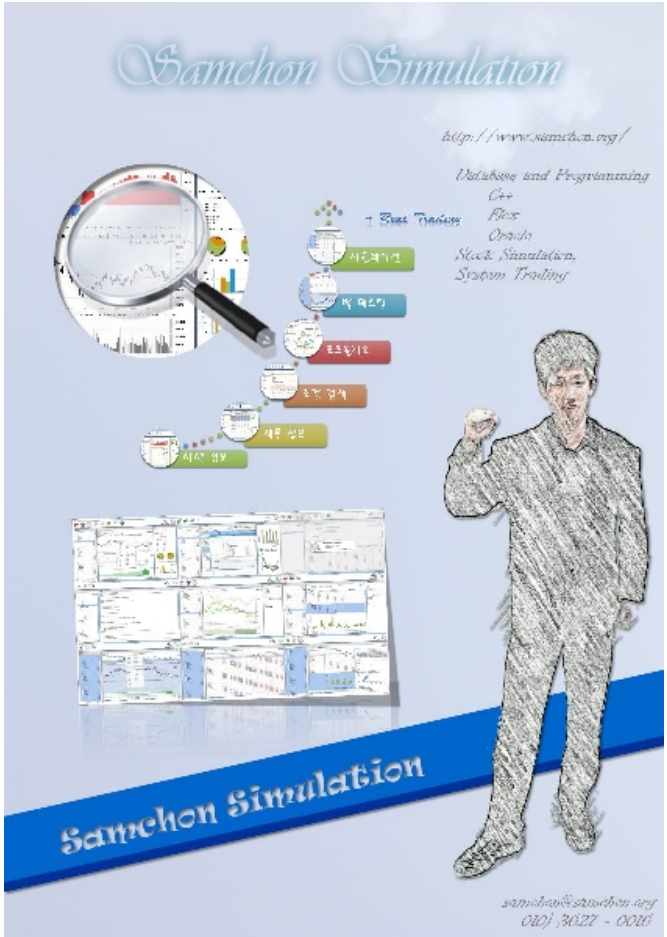
  using Dictionary = Map< std::string, _Ty, _Pr, _Alloc >

  *A Map key is string.*

### 5.1.1 Detailed Description

Top level namespace of products built from samchon.

- http://samchon.org/
- https://github.com/samchon/




**Author**

Jeongho Nam

### 5.1.2 Typedef Documentation

#### 5.1.2.1 using Dictionary = Map<std::string, _Ty, _Pr, _Alloc>

A Map key is string.

**See also**

library::Map

**Author**

Jeongho Nam

## 5.2 samchon::example::chat_service Namespace Reference

A chat service inherited from cloud service.

### Classes

- class ChatClient

  *A client.*

- class ChatMessage

  *A chat message.*

- class ChatRoom

  *A chat room.*

- class ChatRoomArray

  *A manager of chat rooms.*

- class ChatServer

  *A chat server.*

- class ChatService

  *A chat service.*

- class ChatUser

  *An user in chat server.*

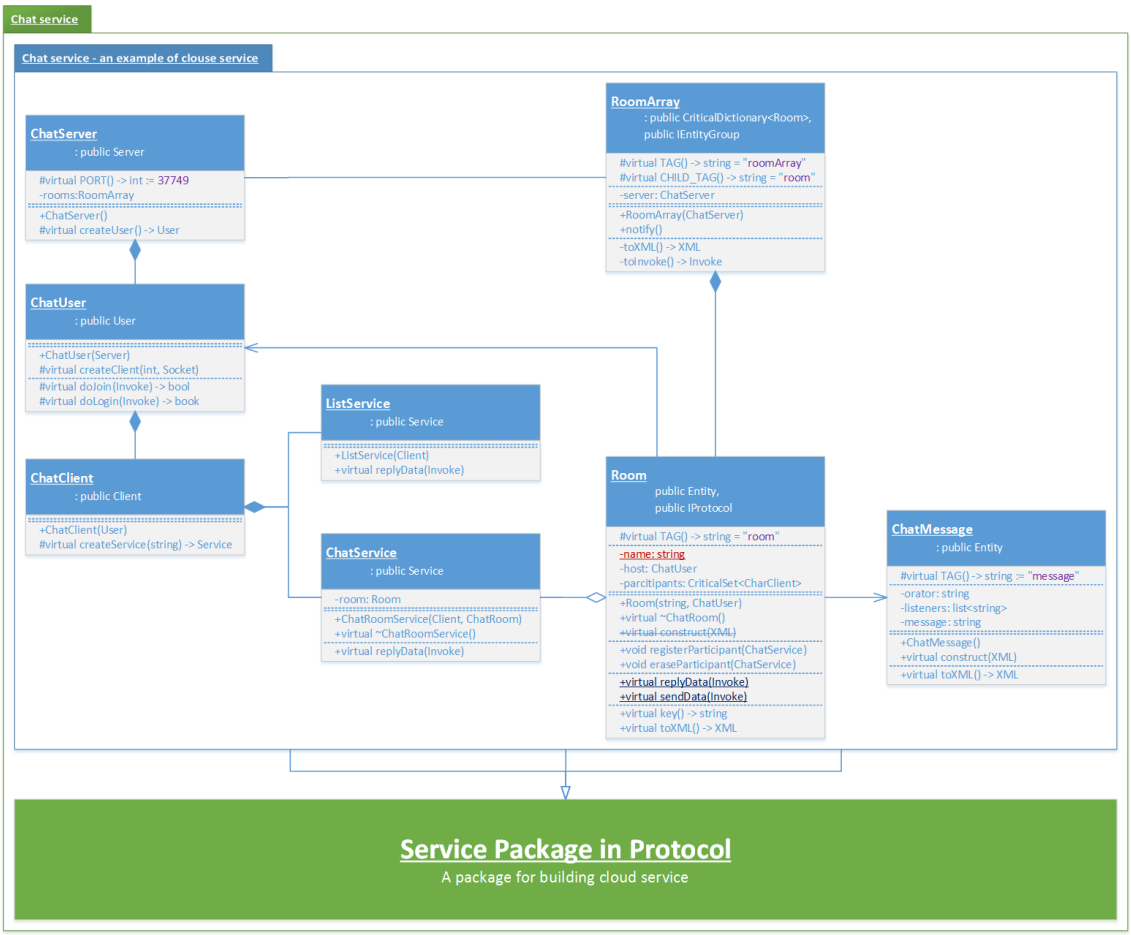
- class ListService

  *A list service of chat rooms.*

### 5.2.1 Detailed Description

A chat service inherited from cloud service.

An example for realizing cloud service and using critical allocators.




**Author**

Jeongho Nam

## 5.3 samchon::example::console_chat_server Namespace Reference

A chat server.

### Classes

- class ChatClient

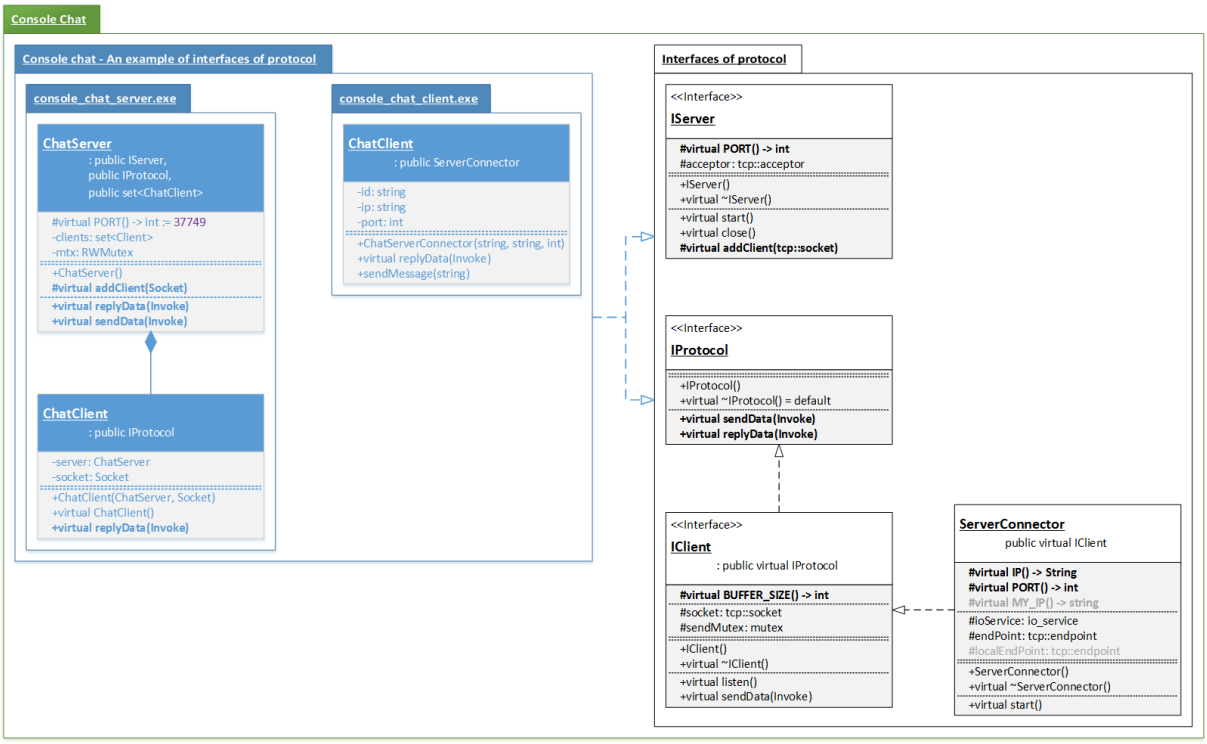
  *A chat client.*
- class ChatServer

  *A chat server.*

### 5.3.1 Detailed Description

A chat server.

A simple chat server operates on a console.




**Author**

Jeongho Nam

## 5.4 samchon::example::tsp Namespace Reference

A packer with number of wrapper type and products.

### Classes

- struct GAParameters

  *Parameters for Genetic-Algorithm.*
- class GeometryPoint

  *A geometry coordinates (point)*
- class Scheduler

  *A scheduler.*
- class Travel

  *Represent a travel containning Point(s)*

### 5.4.1 Detailed Description

A packer with number of wrapper type and products.

Traveling Salesman Problem Solver.

Retrieves the solution of packaging by combination permuation and factorial case.

```
D:\OneDrive\Project\Samchon\framework\cpp\x64\Release\packer.exe
$480
Category - Large
        Wrapper Large: $100, 200cm^3, 1000g
                Product Umbrella: $4000, 200cm^3, 1000g
        Wrapper Large: $100, 200cm^3, 1000g
                Product Eraser: $500, 10cm^3, 70g
                Product Pencil: $400, 30cm^3, 35g
                Product Notebook-PC: $800000, 150cm^3, 850g

Category - Medium
        Wrapper Medium: $70, 150cm^3, 500g
                Product Drink: $1000, 75cm^3, 250g
                Product Pencil: $400, 30cm^3, 35g
                Product Pencil: $400, 30cm^3, 35g
        Wrapper Medium: $70, 150cm^3, 500g
                Product Book: $8000, 150cm^3, 300g
        Wrapper Medium: $70, 150cm^3, 500g
                Product Book: $8000, 150cm^3, 300g
        Wrapper Medium: $70, 150cm^3, 500g
                Product Tablet-PC: $600000, 120cm^3, 450g

Category - Small


Press any key to continue . . .
```


```
D:\OneDrive\Project\Samchon\framework\cpp\x64\Release\packer.exe
$480
Category - Large
        Wrapper Large: $100, 200cm^3, 1000g
                Product Umbrella: $4000, 200cm^3, 1000g
        Wrapper Large: $100, 200cm^3, 1000g
                Product Eraser: $500, 10cm^3, 70g
                Product Pencil: $400, 30cm^3, 35g
                Product Notebook-PC: $800000, 150cm^3, 850g

Category - Medium
        Wrapper Medium: $70, 150cm^3, 500g
                Product Drink: $1000, 75cm^3, 250g
                Product Pencil: $400, 30cm^3, 35g
                Product Pencil: $400, 30cm^3, 35g
        Wrapper Medium: $70, 150cm^3, 500g
                Product Book: $8000, 150cm^3, 300g
        Wrapper Medium: $70, 150cm^3, 500g
                Product Book: $8000, 150cm^3, 300g
        Wrapper Medium: $70, 150cm^3, 500g
                Product Tablet-PC: $600000, 120cm^3, 450g

Category - Small


Press any key to continue . . .
```


**See also**

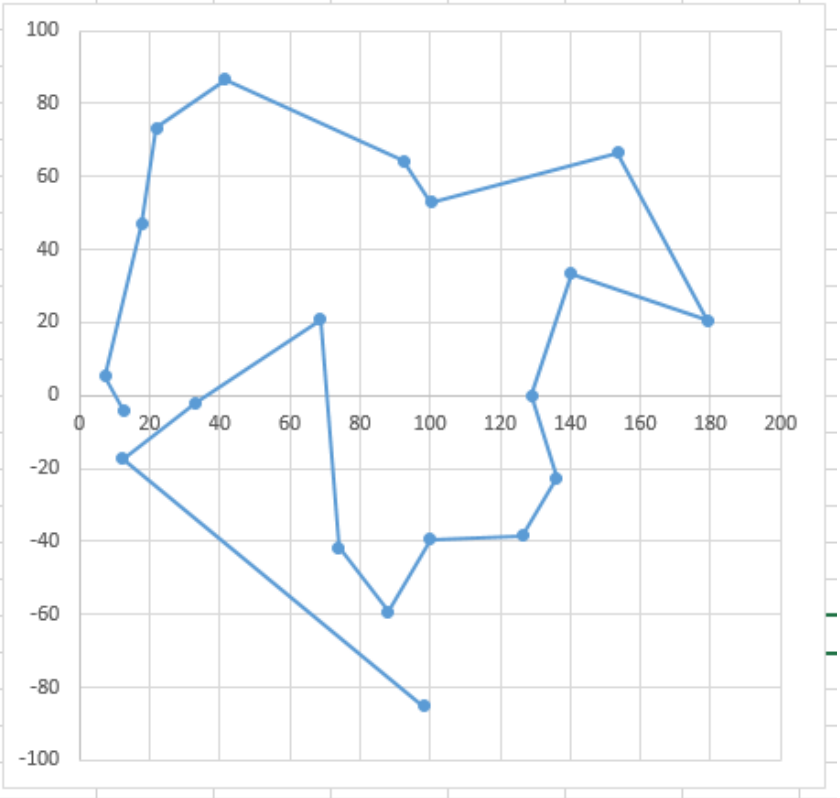
library::CaseGenerator

**Author**

Jeongho Nam

Deducts an optimal traveling scheduel by genetic algorithm.

| Distance: 64,896.70 km | | |
|---|---|---|
| uid | longitude | latitude |
| 18 | 12.5233 | -3.95529 |
| 15 | 7.23275 | 5.18342 |
| 7 | 17.7528 | 46.8665 |
| 2 | 22.0434 | 73.4133 |
| 20 | 41.6615 | 86.5372 |
| 13 | 92.427 | 64.3369 |
| 1 | 100.345 | 53.1067 |
| 9 | 153.521 | 66.5119 |
| 3 | 179.118 | 20.5073 |
| 10 | 140.113 | 33.3537 |
| 17 | 128.885 | 0.054607 |
| 4 | 136.012 | -22.4915 |
| 6 | 126.352 | -38.5031 |
| 16 | 99.9775 | -39.3696 |
| 11 | 87.8859 | -59.3663 |
| 14 | 73.8477 | -41.5867 |
| 5 | 68.6563 | 20.8528 |
| 12 | 33.2162 | -1.92823 |
| 8 | 12.1839 | -17.3552 |
| 19 | 98.0967 | -85.195 |



cpp/resultexample_tsp.png

**Author**

Jeongho Nam

## 5.5 samchon::library Namespace Reference

Package of libraries.

### Classes

- class Base64

  *Utility class for base64 format's en-decoding.*
- class CaseGenerator

  *Case generator.*
- class Charset

  *A utility class supporting conversion between multiple character-sets.*
- class CombinedPermutationGenerator

  *A combined-permutation case generator.*
- class CriticalAllocator

  *An allocator ensuring concurrency.*
- class Date

  *Date (year, month, day in month)*
- class Datetime

*Date and time.*

- class ErrorEvent

  *Event representing an error.*
- class Event

  *Represent an event running on background.*
- class EventDispatcher

  *Abstract class for dispatching Event.*
- class FactorialGenerator

  *Factorical case generator.*
- class FTByteFile

  *A binary file.*
- class FTFactory

  *A Factory and manager for file-tree.*
- class FTFile

  *A file.*
- class FTFolder

  *A folder.*
- class FTInstance

  *An interface of file-tree.*
- class FTTextFile

  *A text file.*
- struct GAParameters

  *A structure containing parameters of genetic algorithm.*
- class GAPopulation

  *A population of a generation in G.A.*
- class GeneticAlgorithm

  *A genetic algorithm class.*
- class HTTPLoader

  *A http, web-page loader.*
- class IOperator

  *Interface for comparision operator.*
- class Math

  *Utility of Math.*
- class MySQLi

  *A SQL interface for My-SQL.*
- class PermutationGenerator

  *A permutation case generator.*
- class ProgressEvent

  *Event representing a progress.*
- class RWMutex

  *rw_mutex*
- class Semaphore

  *A semaphore.*
- class SharedAcquire

  *Shared acquire from a Semaphore.*
- class SharedReadLock

  *Shared lock from a RWMutex.*
- class SharedWriteLock

  *Shared lock from a RWMutex.*
- class SQLi

  *A SQL interface; DBMS connector.*

- class SQLStatement

  *A sql statement.*
- class StringUtil

  *Utility class for string.*
- class TSQLi

  *A SQL interface for T-SQL.*
- class TSQLStatement

  *A t-sql statement.*
- class UniqueAcquire

  *Unique acquire from a Semaphore.*
- class UniqueReadLock

  *Unique lock for reading.*
- class UniqueWriteLock

  *Unique lock for writing.*
- class URLVariables

  *URLVariables class is for representing variables of HTTP.*
- class XML

  *XML is a class representing xml object.*

### Typedefs

- template<typename _Ty , typename _Pr = std::less<std::string>>
  using CriticalDictionary = CriticalMap< std::string, _Ty, _Pr >

  *A Dictionary ensures concurrency.*
- template<typename _Ty >
  using CriticalList = std::list< _Ty, CriticalAllocator< _Ty >>

  *A std::list ensures concurrency.*
- template<typename _Kty , typename _Ty , typename _Pr = std::less<_Kty>>
  using CriticalMap = Map< _Kty, _Ty, _Pr, CriticalAllocator< std::pair< const std::string, _Ty >>>

  *A Map ensures concurrency.*
- template<typename _Ty , typename _Pr = std::less<_Ty>>
  using CriticalSet = Set< _Ty, _Pr, CriticalAllocator< _Ty >>

  *A Set ensures concurrency.*
- template<typename _Ty >
  using CriticalVector = std::vector< _Ty, CriticalAllocator< _Ty >>

  *A std::vector ensures concurrency.*
- typedef std::vector< std::shared_ptr< XML > > XMLList

  *A list of XML, tags are same.*

### 5.5.1 Detailed Description

Package of libraries.

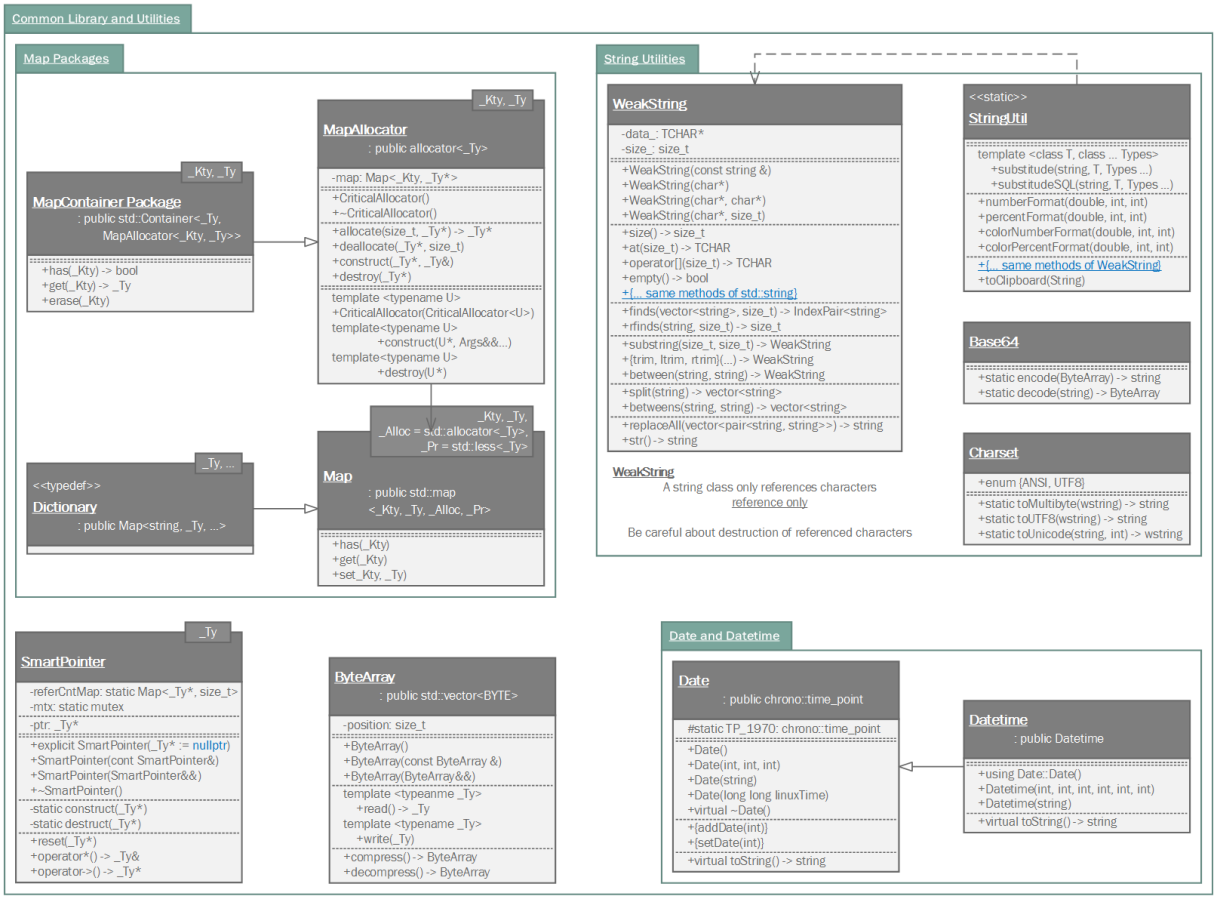
The library package supports some classes for package of protocol and nam-tree.

Furthermore, library package provides some utility libraries, which are not being supported by standard library (STL). Those can be helpful for users and those are like STL, independent from operating systems, so that can compile in any operating system.

The library package can be divided into some sectinos.

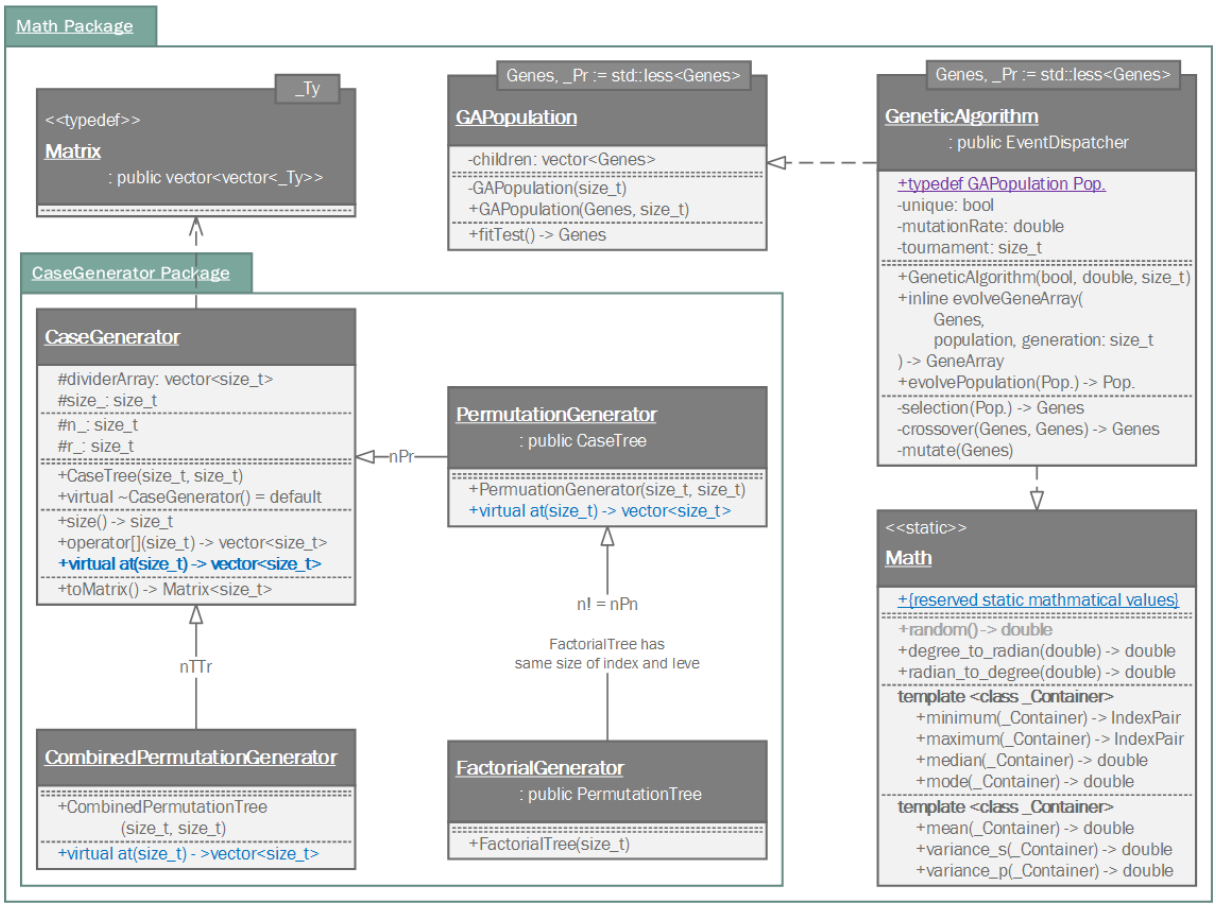
- **Common libraries.**

  Common containers with utility methods.




- **Mathmatical libaries.**

  Utilty classes for mathmatical methods, or libraries of case generator and genetic algorithm. In those mathmatical part, lots of examples are supported.

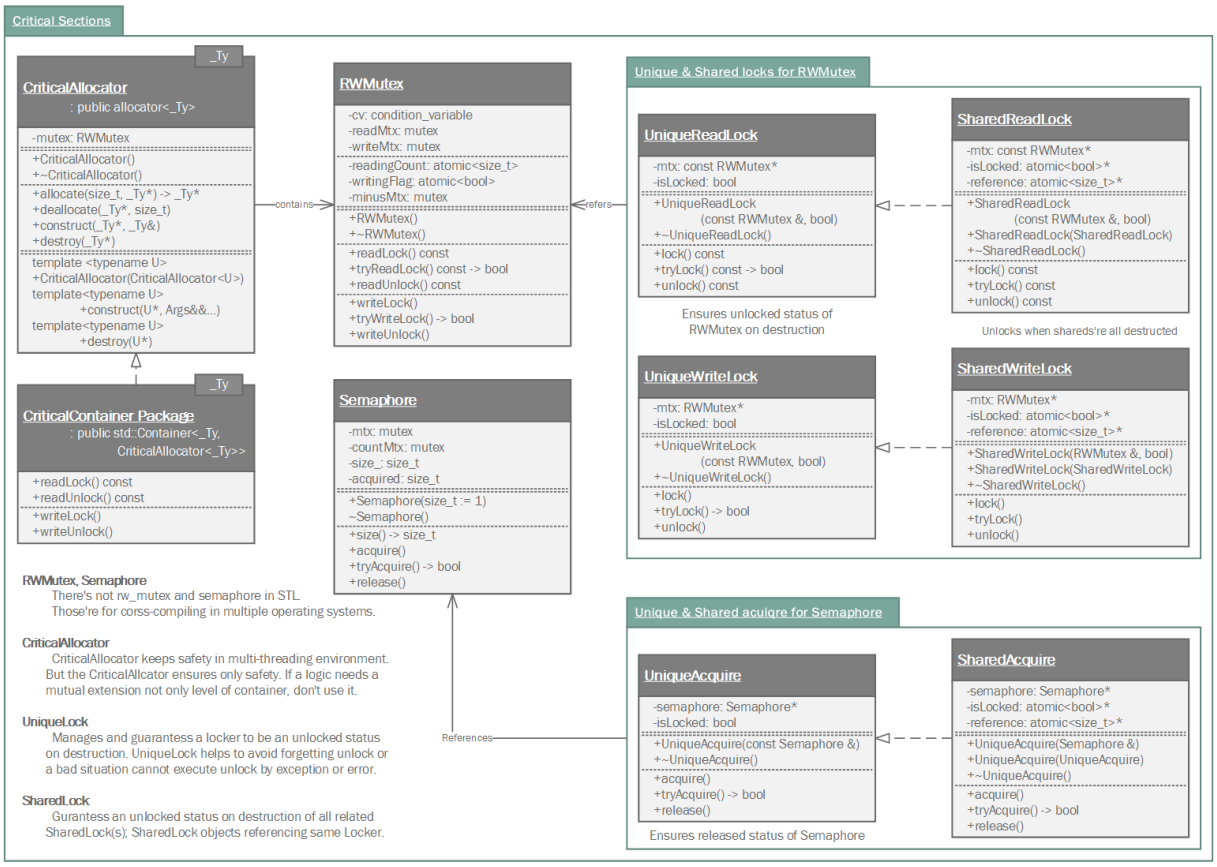



- **Critical section libraries.**

Classes handling critical section, like RWMutex and Semaphore which are not supported in STL yet.

Of course, rw_mutex is already defined in linux C, semaphore is already defined in MFC. But they are dependent on their own operating system, so that cannot compile in multiple operating systems. It's the reason why Samchon Framework provides those classes.

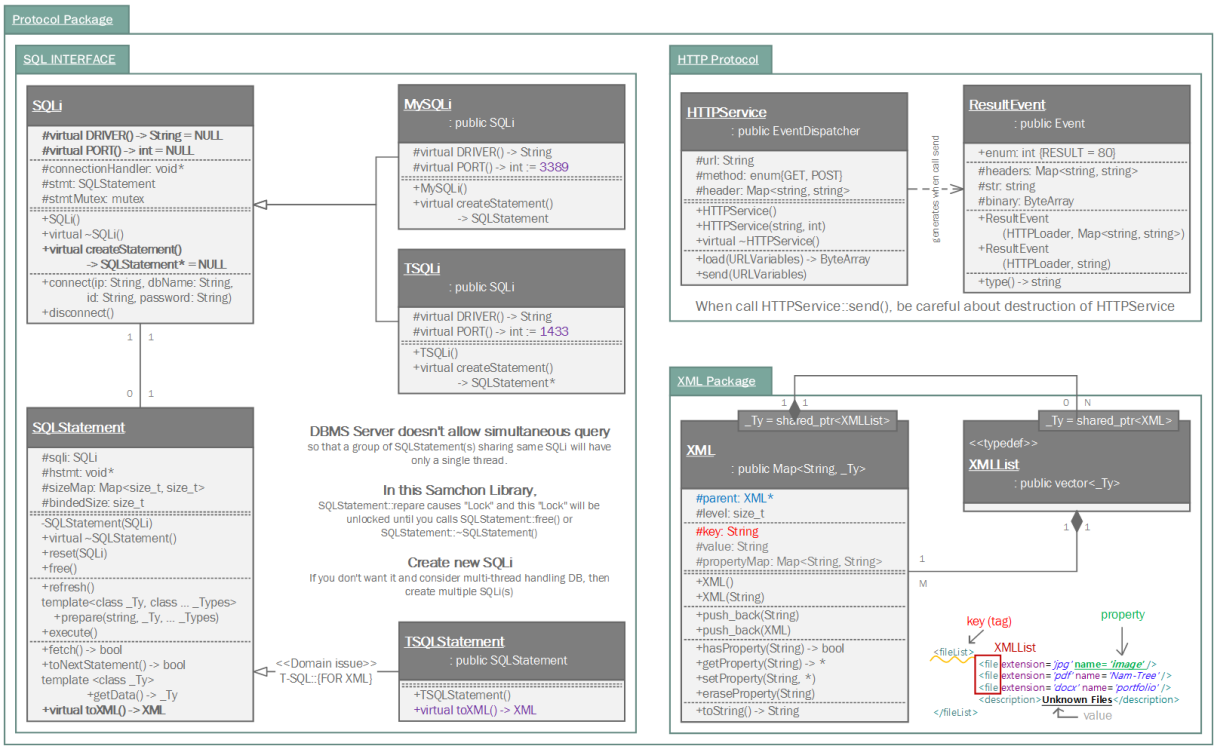
Furthermore, unique and shared lock of those critical section classes, which are managing locking and unlocking, and critical allocator are provided.




- **Data I/O libraries.**

  Provides libraries about data I/O.

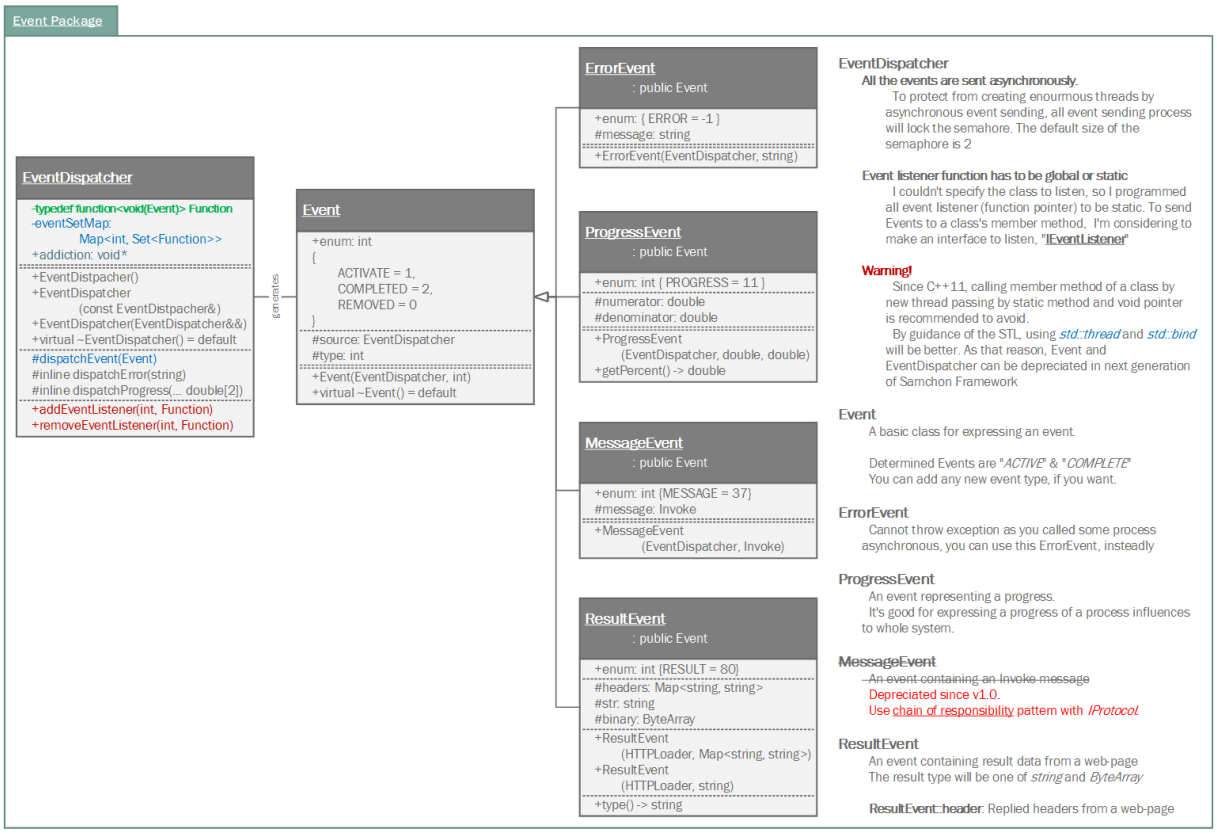
  SQLi and SQLStatement are the ODBC drivier designed to follow principles of OOP by adapter pattern. XML class is designed to follow composite relationship.



- **Event libraries.**

Libraries representing events and dispatching those events, which are running on background, with own exclusive thread.

But there's something to notice. Since C++11, calling member method of a class by new thread passing by static method and void pointer is recommended to avoid. By guidance of the STL, using std::thread and std::bind will be better. As that reason, Event and EventDispatcher can be depreciated in next generation of Samchon Framework.

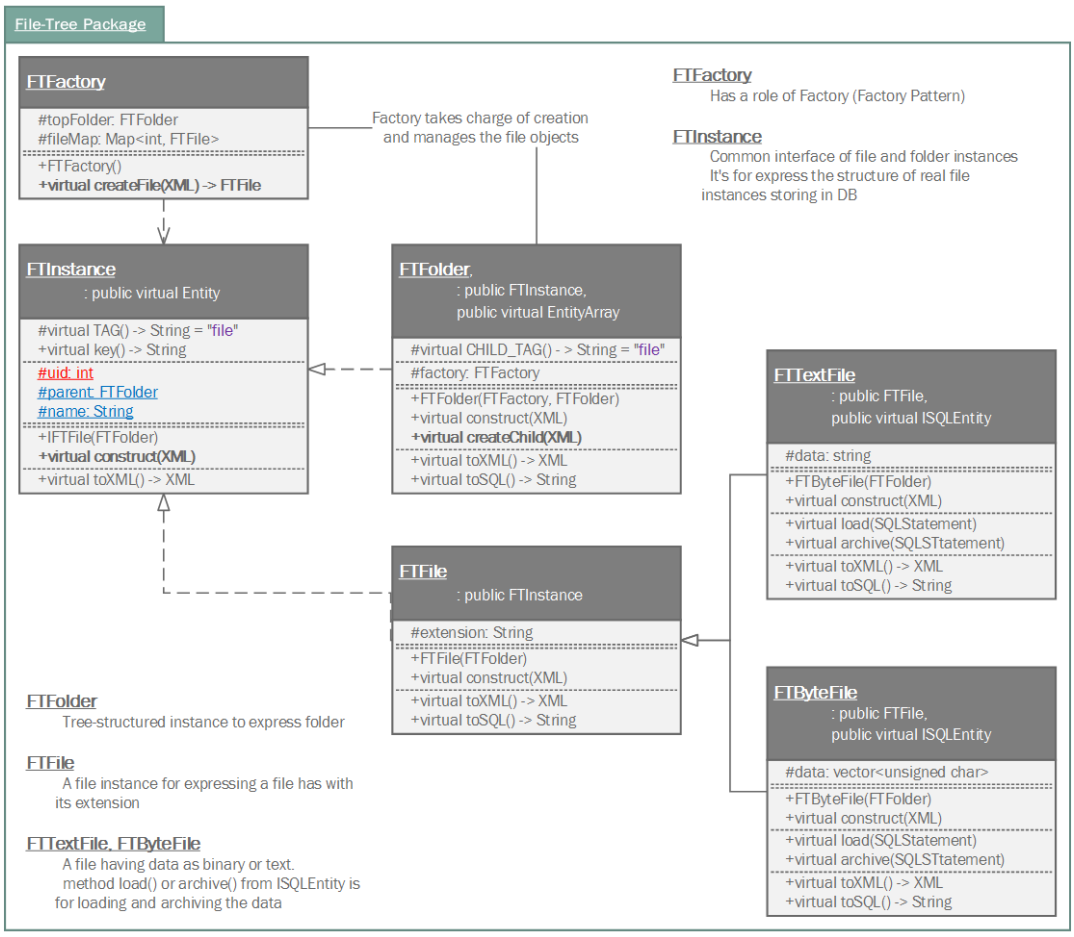



- **File-tree libraries.**

A module for expressing folder and file instances. The objects in file-tree module are realized by protocol::Entity.

They have recursive and hierarchical relationship and created by Factory class (FTFactory, factory pattern). Those objects can be archived in and loaded from Database. Using the pre-defined methods interaction with Databse, you can not only express real file and folder instances but also realize virtual file system.

Classes in the Module of file-tree are all abstract, but package nam-tree can be an example inheriting and having real model from those abstract classes.




**Author**

Jeongho Nam

### 5.5.2 Typedef Documentation

#### 5.5.2.1 using CriticalDictionary = CriticalMap<std::string, _Ty, _Pr>

A Dictionary ensures concurrency.

**See also**

library::CriticalAllocator
samchon::library

**Author**

Jeongho Nam

#### 5.5.2.2 using CriticalList = std::list<_Ty, CriticalAllocator<_Ty>>

A std::list ensures concurrency.

**See also**

library::CriticalAllocator
samchon::library

**Author**

Jeongho Nam

#### 5.5.2.3 using CriticalMap = Map<_Kty, _Ty, _Pr, CriticalAllocator<std::pair<const std::string, _Ty>>>

A Map ensures concurrency.

**See also**

library::CriticalAllocator
samchon::library

**Author**

Jeongho Nam

#### 5.5.2.4 using CriticalSet = Set<_Ty, _Pr, CriticalAllocator<_Ty>>

A Set ensures concurrency.

**See also**

library::CriticalAllocator
samchon::library

**Author**

Jeongho Nam

#### 5.5.2.5 using CriticalVector = std::vector<_Ty, CriticalAllocator<_Ty>>

A std::vector ensures concurrency.

**See also**

library::CriticalAllocator
samchon::library

**Author**

Jeongho Nam

#### 5.5.2.6 typedef std::vector<std::shared_ptr<XML> > XMLList

A list of XML, tags are same.

**See also**

samchon::library

**Author**

Jeongho Nam

## 5.6 samchon::namtree Namespace Reference

Package of Nam-Tree.

### Classes

- class INTExplore

  *An interface for exploration.*

- class NTCriteria

  *Criteria, a conditional expression with weight.*

- class NTEntityGroup

  *A historical, studying data.*

- class NTFactory

  *A factory for Nam-Tree objects.*

- class NTFile

  *A file archiving metadata of a function.*

- class NTIterator

  *Iterator of historical data.*

- class NTParameter

  *A metadata of a parameter in a function.*

- class NTParameterArray

  *An Array of NTParameter.*

- class NTParameterDetermined

  *A pre-determined value of a parameter.*

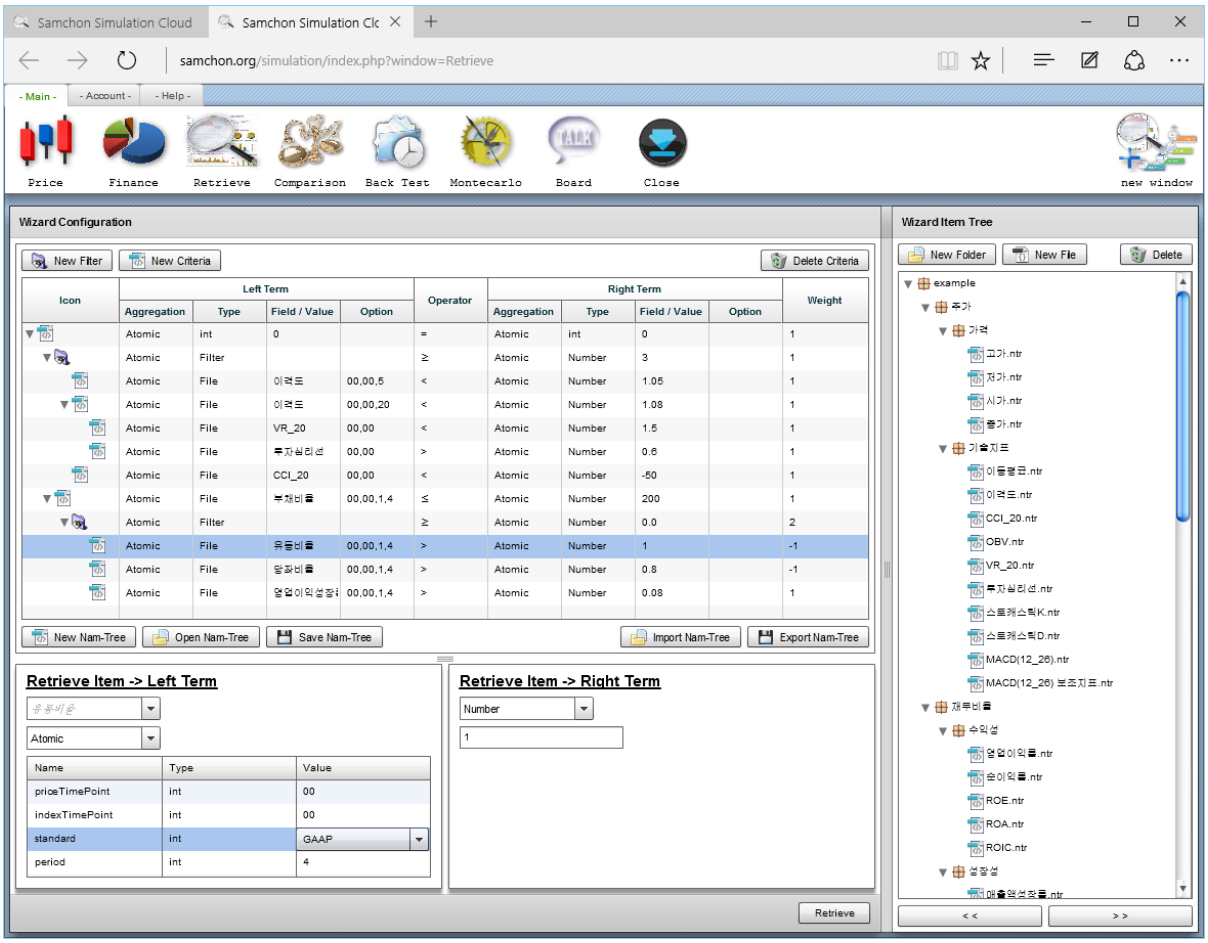
- class NTSide

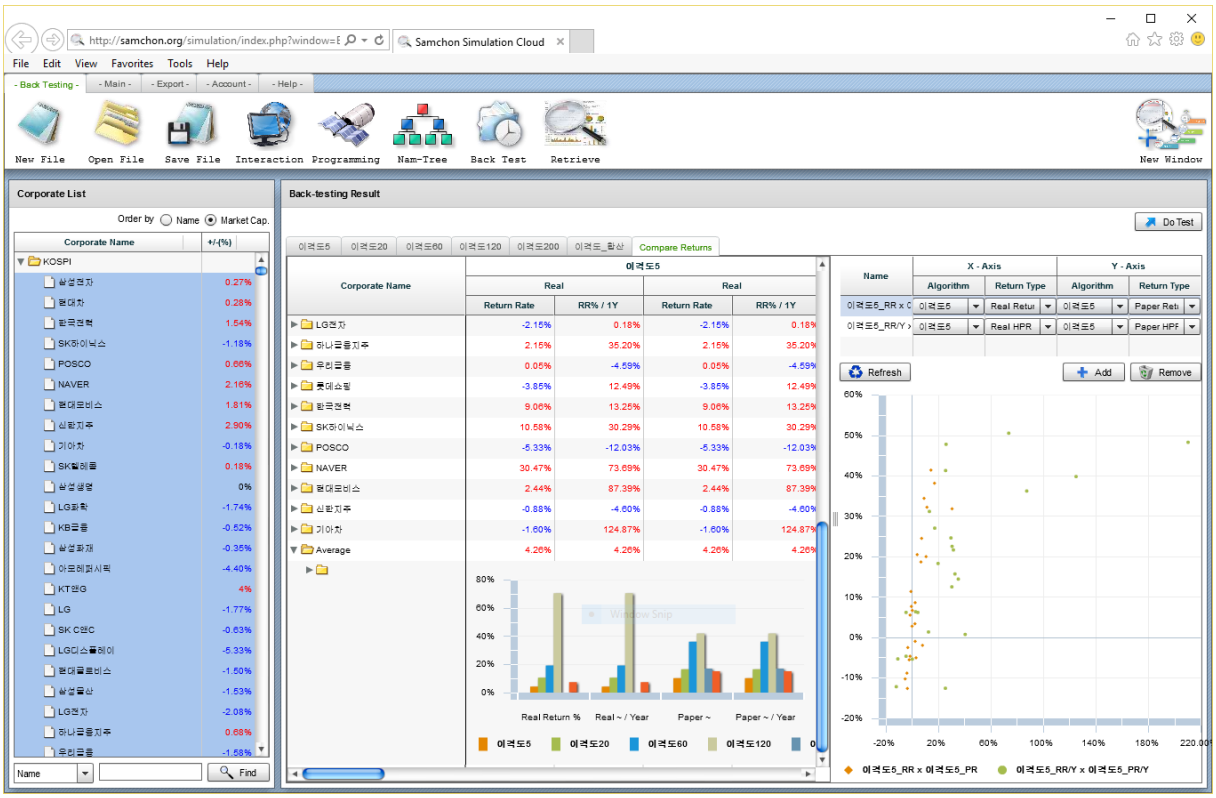
  *A side of a conditional expresson.*

### 5.6.1 Detailed Description

Package of Nam-Tree.

Nam-Tree is a module of tree-strucrued complicate logical condition model for realizing A.N.N. (Artificial Neural Network). You can make the ANN model with weight and bias and express not only logical condition by your hand, but also construct the logical condition by automaticaly with optimization of genetic algorithm and grid method.




The basic pricinple of Nam-Tree are follow:

1. A conditional expression with weight

   F(x) = (NTSide < NTSide ? 1: 0) X weight

   NTCrietria is made up for conditional expression.

   - When the expression is true, returns 1 ∗ weight
   - When the expression is false, returns 0

2. Hierarchical relationship

   - In vertical relationship: multiply (X)
   - In horizontal relationship: plus (+)

   With that rule, you can make enormous conditions. I can sure there's not any condition can'be be expressed by the model.

3. Making bias

   Just make a NTCriteria returns only true.

   It's the bias returns only weight.

4. Explore

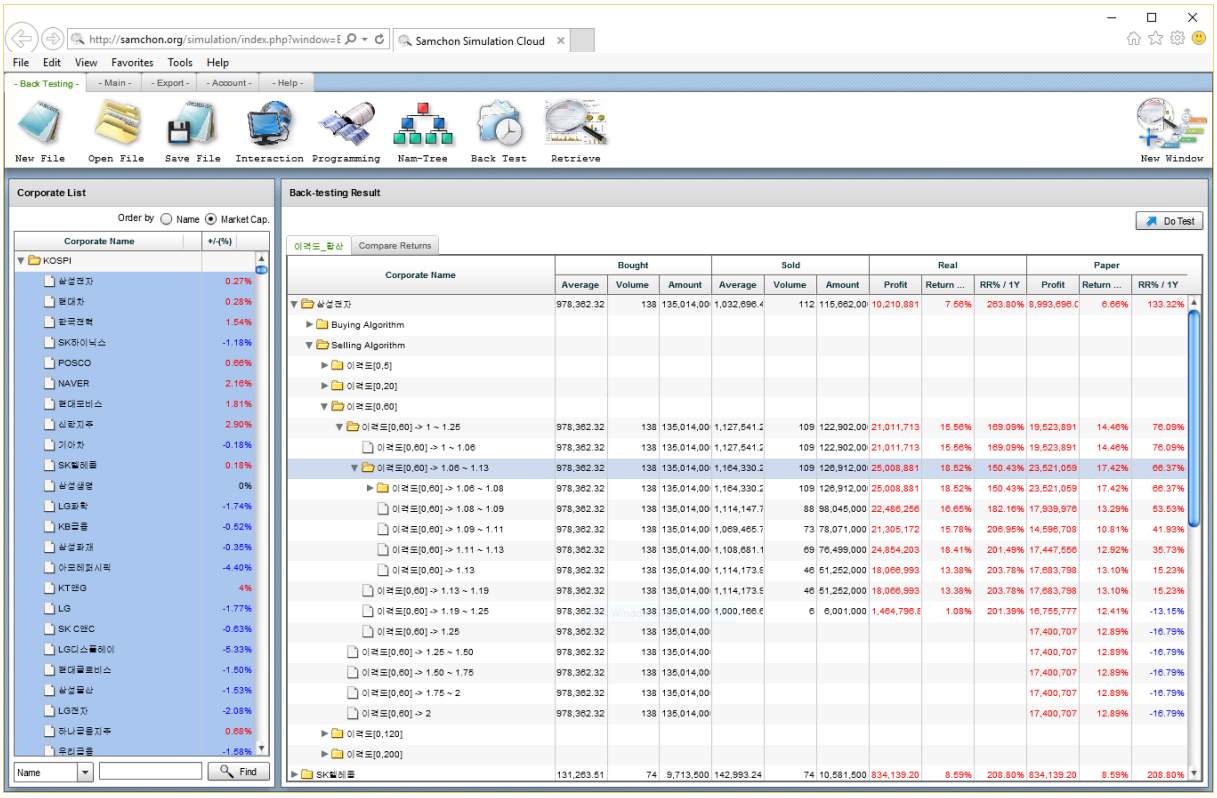
   (a) Exporing in a NTCriteria (optimize a side)

   Make a NTSide to be nullptr, then NTCriteria will explore the best value.

   Nam-Tree will calculate the condtions from minimum to maximum in INTExplore reach to the precision, by the method of multi-demensional grid.

   (b) Exploring parameter in NTSide

   If you set the parameterMNap to be empty, Nam-Tree will explore the best parameter until reach to the precision in INTExploreParameter from minimum to maximum.

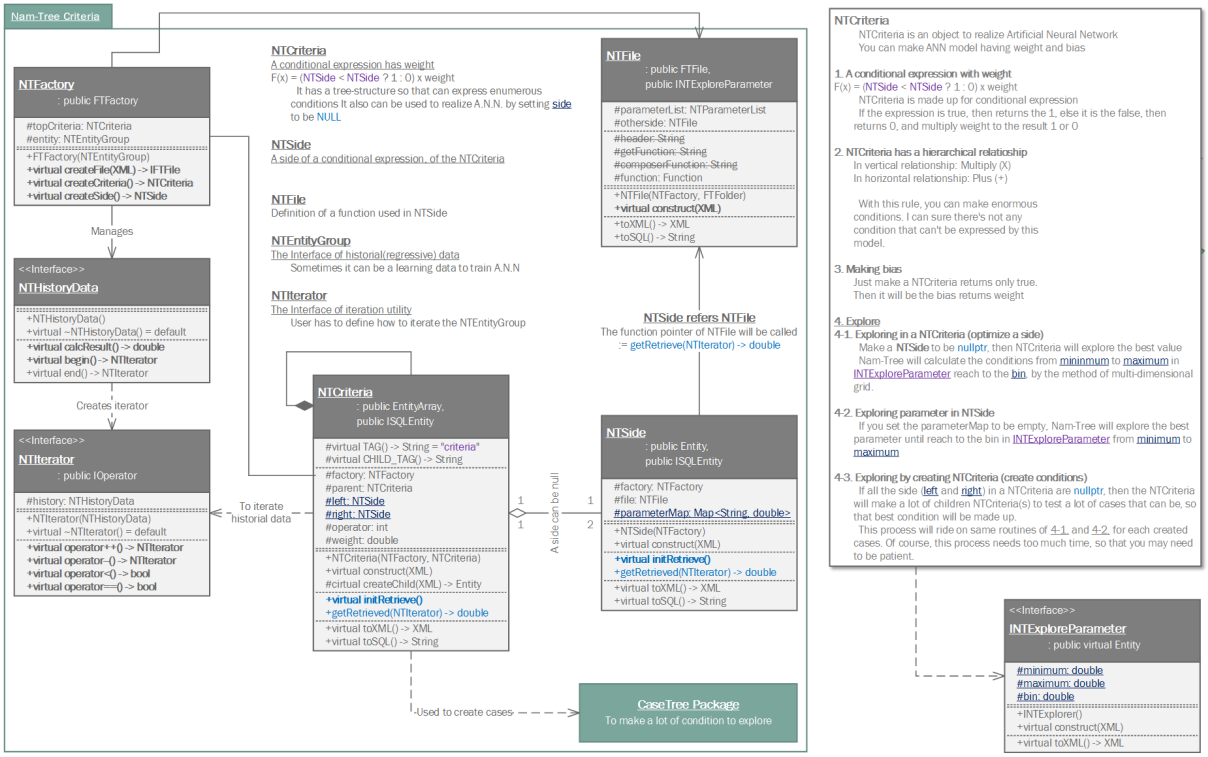


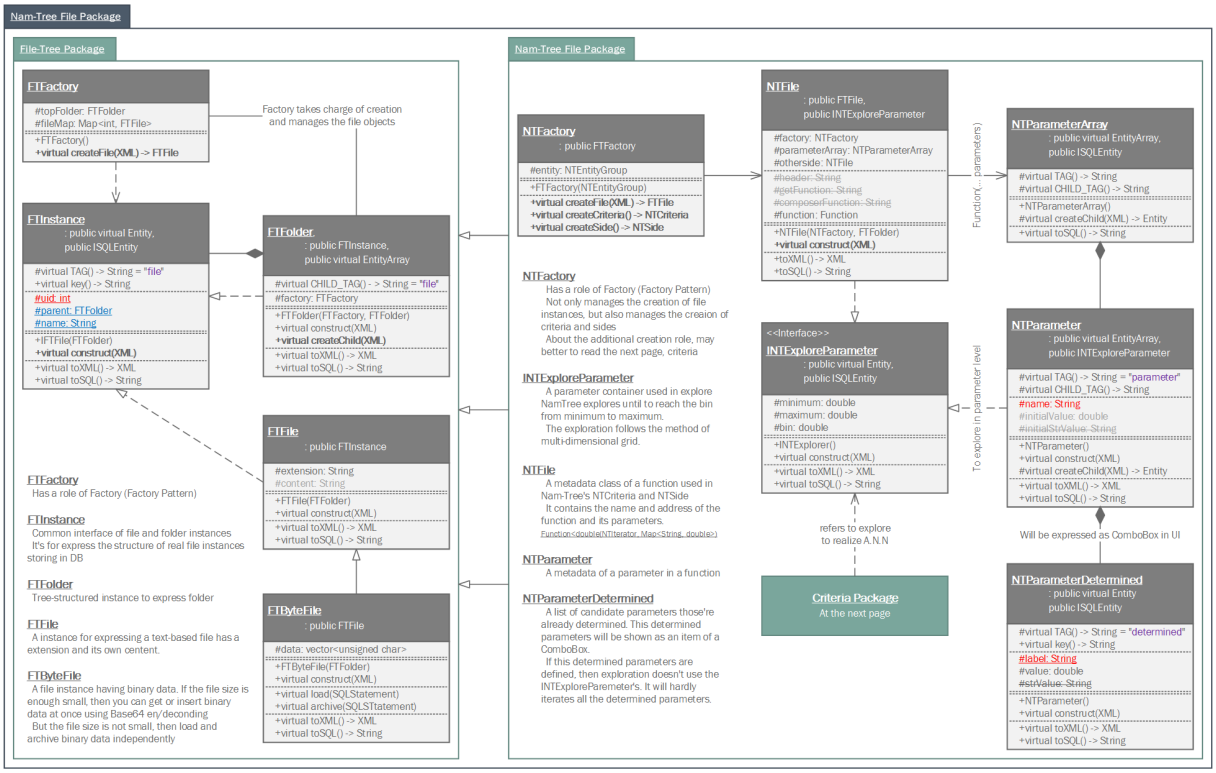

   (c) Exploring by creating NTCriteria

   (Creates lots of hierarchical conditions and tests them)

If all the side (left and right) in a NTCriteria are nullptr, the NTCriteria will make a lot of children NT↩ Criteria(s) to test lots of cases, so that derives the best condition set will be made up.

This process will ride on same routines of 4-1 and 4-2, for each created cases. Of course, this process needs too much time, so that you may need to be patient.



**Note**

Previous version of the Samchon Framework, NTFile class had a function script on the NTFile and Nam-Tree module compiled the script like Nam-Tree moudle of Flex standalone that is keeping the compiling method.

However, modern Samchon Framework's C++ NTFile class doesn't have a function script and does not compile. I don't know a way to compile a script in lots of operating systems, so I dropped the compiling method. Until update, NTFactory has function pointers in a Dictionary and NTFile reference them. Users must put own methods into the Dictionary by their hands.

I will solve the problem sooon. Until next generation of Samchon Framework, put your own function pointers to a Dictionary in NTFactory by your hand please. Sorry for my unripe skill on programming.

**Author**

Jeongho Nam

## 5.7 samchon::protocol Namespace Reference

Package of network protocol and libraries.

### Namespaces

- master

  *Package for external system, within the framework of master.*
- service

  *Package of cloud service as a server.*
- slave

  *Package of external system, within the framework of slave.*

### Classes

- class Entity

  *An entity, a standard data class.*
- class EntityArray

  *An Entity and a static array containing Entity objects.*
- class EntityGroup

  *An Entity and a container of children Entity objects.*
- class EntityList

  *An Entity and a static list containing Entity objects.*
- class ExternalClient

  *A network driver for an external client.*
- class ExternalClientArray

  *An array of ExternalClient(s)*
- class ExternalServer

  *A network driver for an external server.*
- class ExternalServerArray

  *An array of ExternalServer(s)*
- class ExternalSystem

  *A network driver for an external system.*
- class ExternalSystemArray

*An array of ExternalSystem(s).*

- class ExternalSystemRole

  *A role belongs to an external system.*
- class FlashPolicyServer

  *A flash policy server.*
- class IClient

  *An interface for a client.*
- class IEntityChain

  *A chain of entity.*
- class IEntityGroup

  *An iternface for entity group.*
- class IEntityPtrGroup
- class IHTMLEntity

  *An interface supporting conversion to html.*
- class Invoke

  *Standard message of network I/O.*
- class InvokeHistory

  *A history of an Invoke message.*
- class InvokeHistoryArray

  *An array of InvokeHistory.*
- class InvokeParameter

  *A parameter of an Invoke.*
- class IProtocol

  *An interface of Invoke message chain.*
- class IServer

  *An interface of a physical server.*
- class ISQLEntity

  *An interface supporting DB-I/O.*
- class IWebClient

  *An interface for a web-client.*
- class IWebServer

  *An interface for a physical server following web-socket.*
- class ServerConnector

  *A server connector for a physical client.*
- class SystemRole

  *A role belongs to a system.*
- class WebServerConnector

  *A web-socket server connector.*

## Typedefs

- template<typename _Ty = Entity>
  using SharedEntityArray = EntityGroup< std::vector< std::shared_ptr< _Ty >>, _Ty, std::shared_ptr< _Ty > >

  *An EntityGroup with vector container and children capsuled in shared pointers.*
- template<typename _Ty = Entity>
  using SharedEntityList = EntityGroup< std::list< std::shared_ptr< _Ty >>, _Ty, std::shared_ptr< _Ty > >

  *An EntityGroup with list container and children capsuled in shared pointers.*
- template<typename _Ty = Entity>
  using UniqueEntityArray = EntityGroup< std::vector< std::unique_ptr< _Ty >>, _Ty, std::unique_ptr< _Ty > >

*An EntityGroup with vector container and children capsuled in unique pointers.*

- template<typename _Ty = Entity>
  using UniqueEntityList = EntityGroup< std::list< std::unique_ptr< _Ty >>, _Ty, std::unique_ptr< _Ty > >

  *An EntityGroup with list container and children capsuled in unique pointers.*

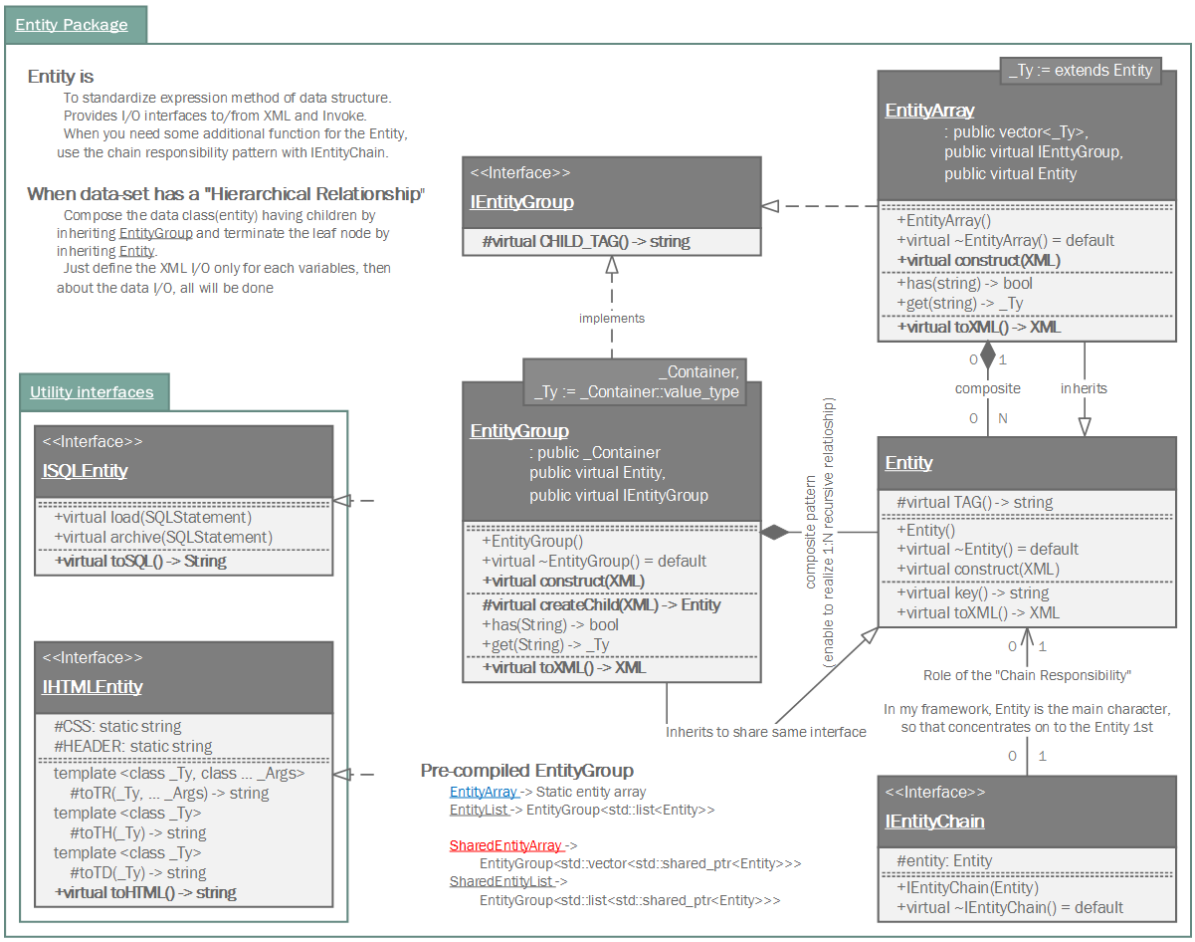
### 5.7.1 Detailed Description

Package of network protocol and libraries.

- **Entity - data classes with utility methods**

  In Samchon Framework, with entity, boundary and control, entity is the main. The entity package provides I/O interface to/from XML, Invoke and DBMS. If you need some additional function (role of boundary or control) for an entity, use chain of responsibility pattern starting from the entity.

  When data-set has a "hierarchical relationship", do not have the children objects by having a container member variable. Directly inherits container set. Composes the data class (entity) having children by inheriting EntityGroup and terminate the leaf node by inheriting Entity (single object).




- **Invoke - standard network I/O message**

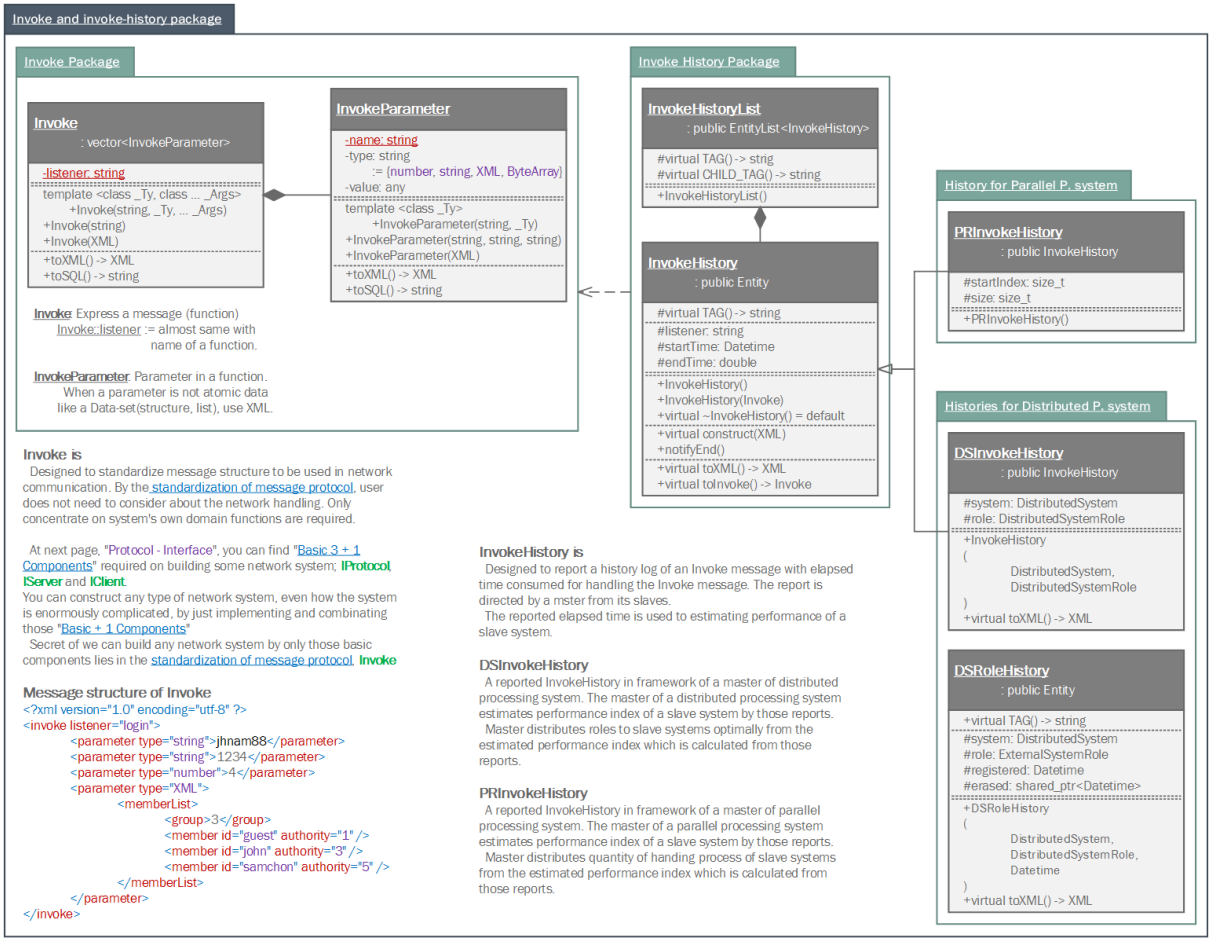
  Invoke is a standard message structure using network I/O in Samchon Framework.

  The Invoke message has an XML structure like the piacture in below. We can enjoy lots of benefits by the normalized and standardized message structure used in network I/O.

  The greatest advantage is that we can make any type of network system, even how the system is enourmously complicated. As network communication message is standardized, we only need to concentrate on logical

relationships between network systems. We can handle each network system like a object (class) in OOD. And those relationships can be easily designed by using design pattern.

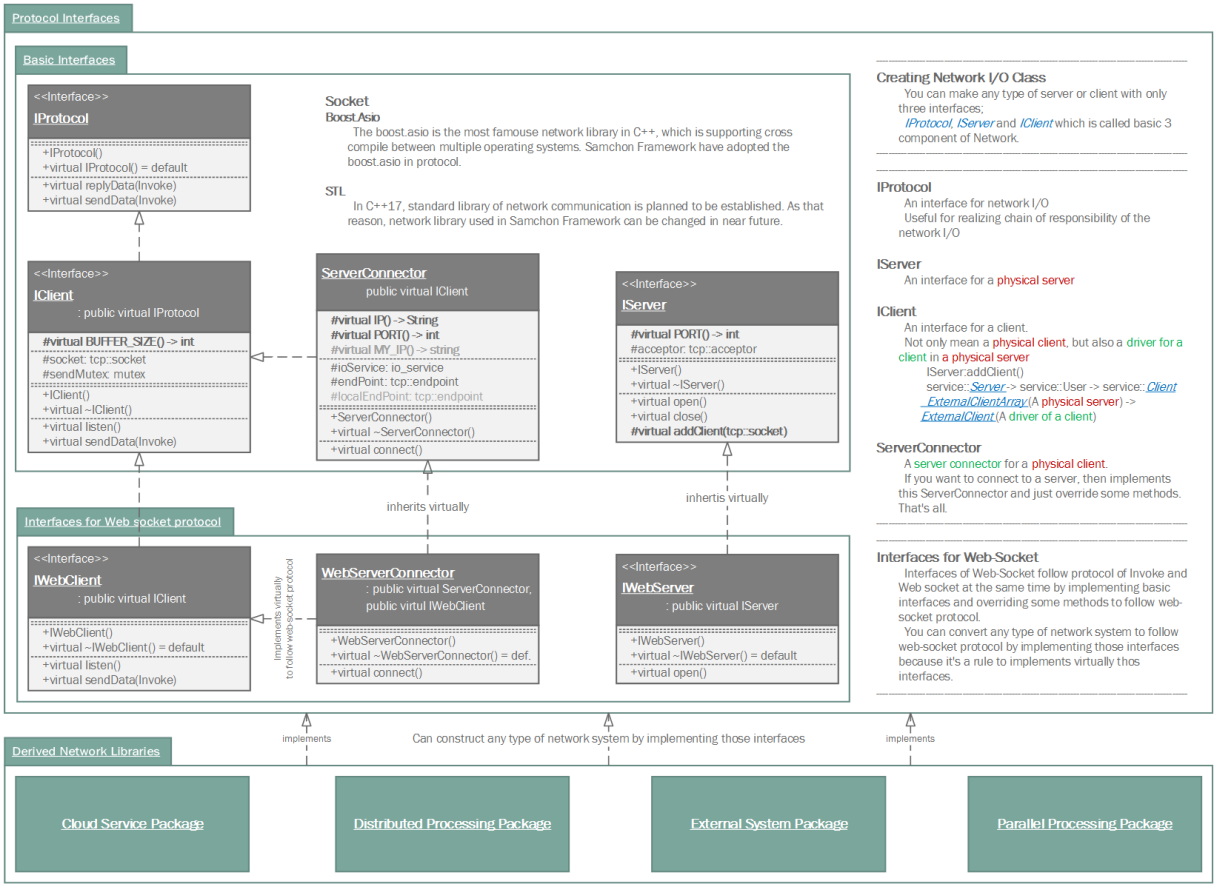
Furthermore, The module invoke not only provides parsing and converting from/to Invoke message, but also history classes can be used to archiving log or estimating performance of a system. The purpose of estimating performance a system, especially, used in module of distributed processing and parallel processing systems.

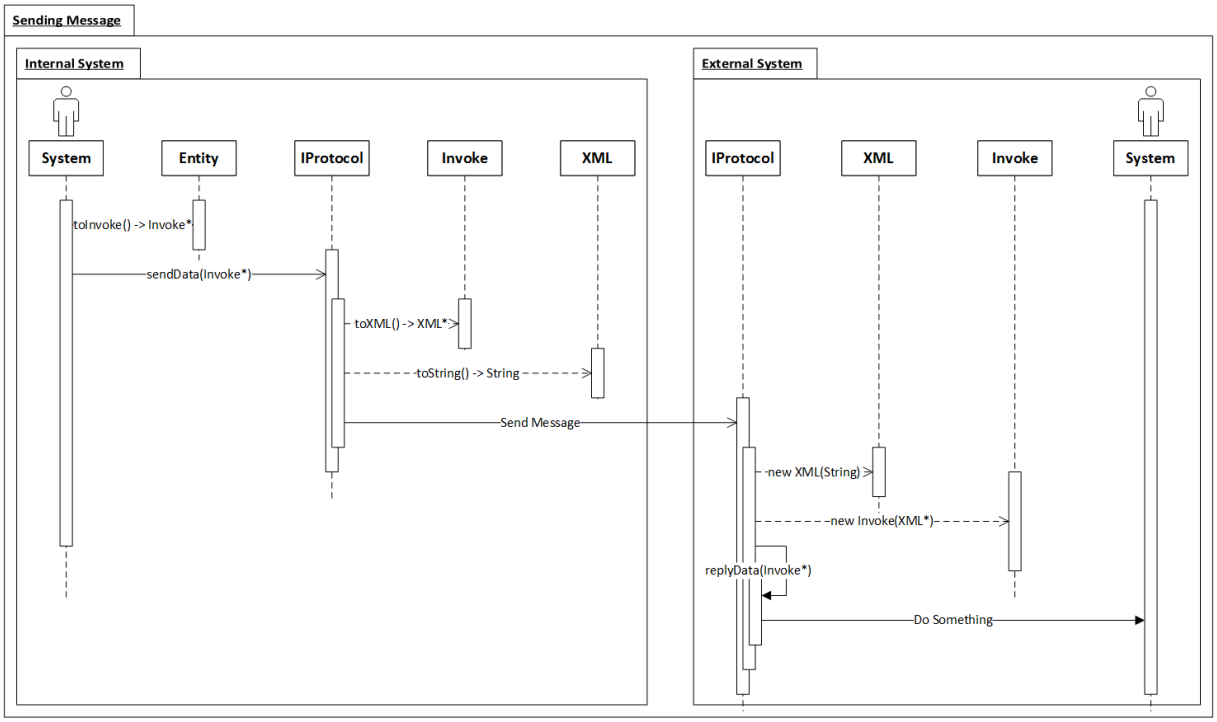



- **Intefaces**

You can make any type of network system with only three + one interfaces; IProtocol, IServer and IClient + ServerConnector which are called basic 3 + 1 components. As I've mentiond in previous invoke module, because of standardization of message of network I/O, we only need to concentrate on logical relationship like handling OOD objects

The basic 3 + 1 components are top level abstract interfaces for designing network system like handling OOD objects. When you see the protocol module from a different view, out of framework, you can find that all the other classes in protocol are another examples combinationing and utilizing those basic 3 + 1 components (interaces).




- **External System**

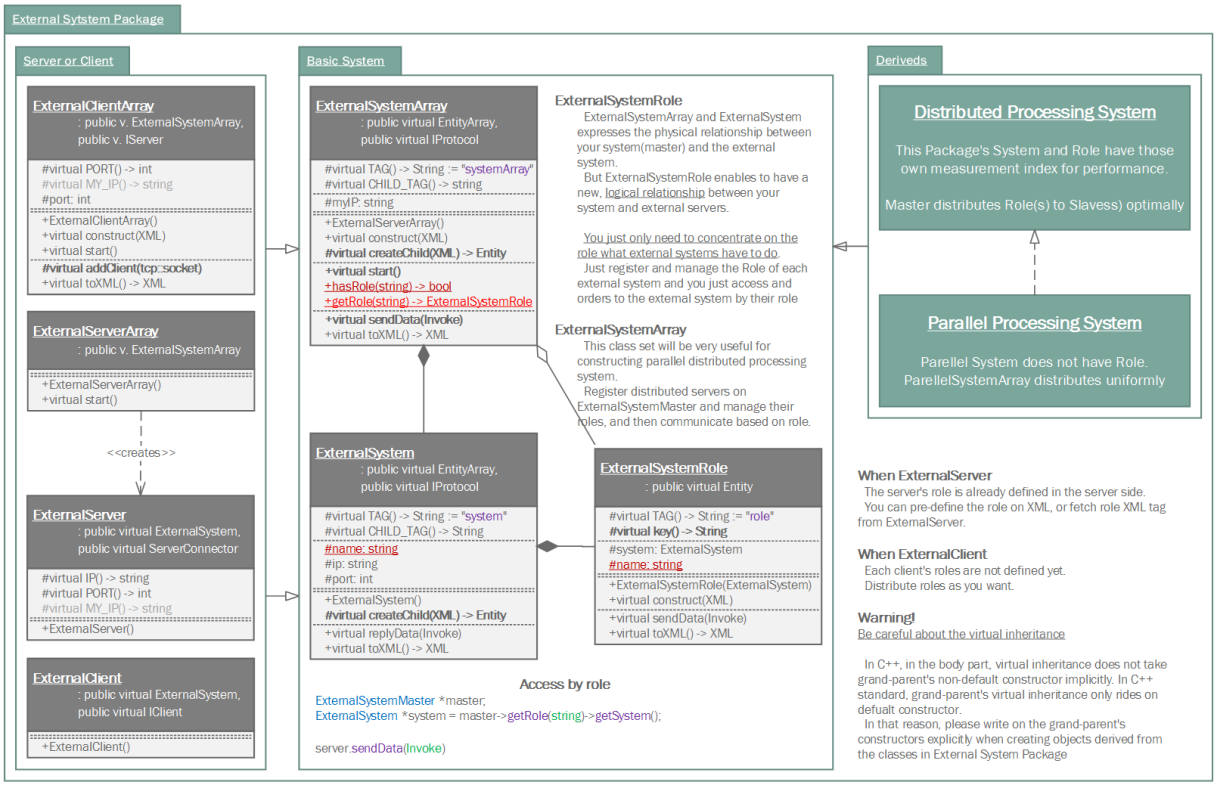
  Module *external_system* provides interfaces for interaction with external network system. Although, the module *external_system* acts boundary as main role, what you've to concentrate on is the entity. Samchon Framework takes responsibility of network communication and you only consider about relationship and role of each *external network systems*.

ExternalSystem objects are managed by ExternalSystemArray and the ExternalSystemArray can access to an ExternalSystemRole belongs to an ExternalSystem directly. When you send an Invoke message to ExternalSystemArray, the ExternalSystemArray finds matched ExternalSystemRole and the External↩ SystemRole shifts the network I/O responsibility to belonged ExternalSystem.

The relationship called as "Proxy Pattern". With the pattern, "Proxy", you can concentrate on roles irrespective of where each role is belonged to (you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem).

- ExternalSystemArray::sendData() -> ExternalSystemRole(Proxy)::sendData() -> ExternalSystem↩ ::sendData()
- ExternalSystem::replyData() -> ExternalSystemRole(Proxy)::replyData()

Whether using the "Proxy pattern" is on your mind in *external_system module* level. "Proxy pattern" is recommend to use in *external_system* module, but not forced. However, since *parallel_processing_system* module, you've to follow the pattern.

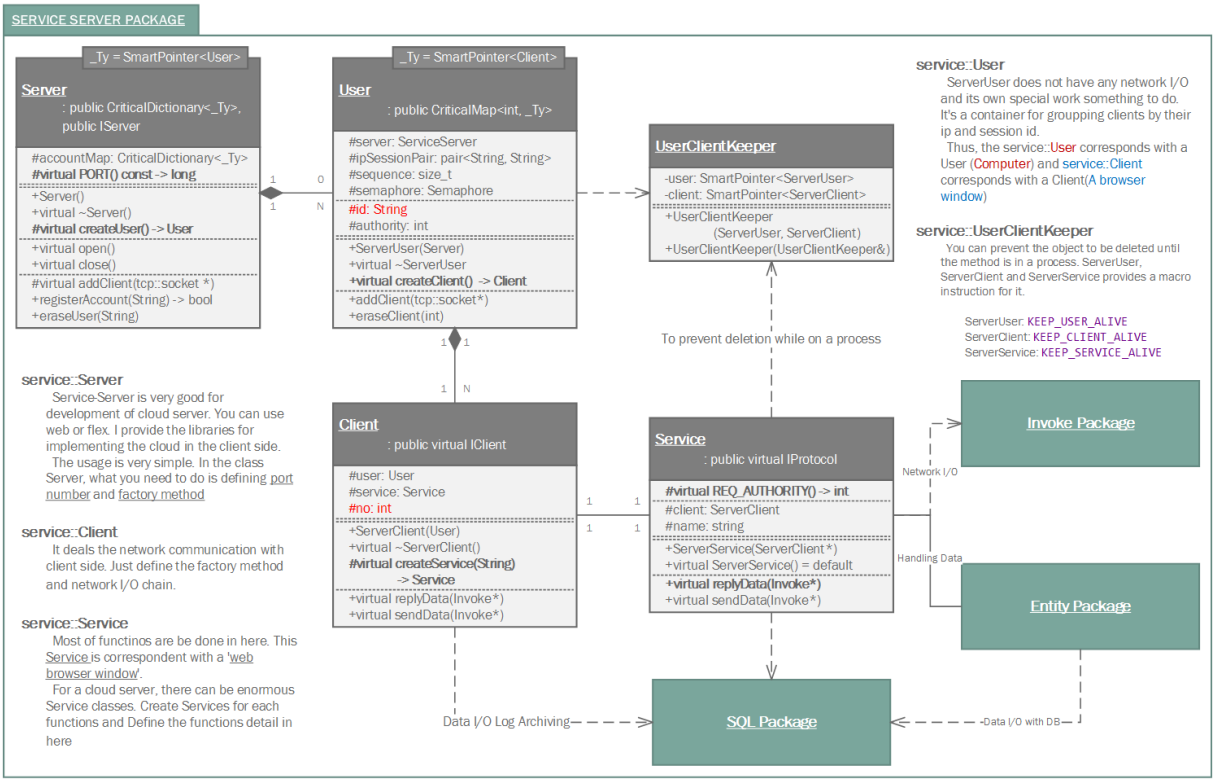



- **Packages in protocol**

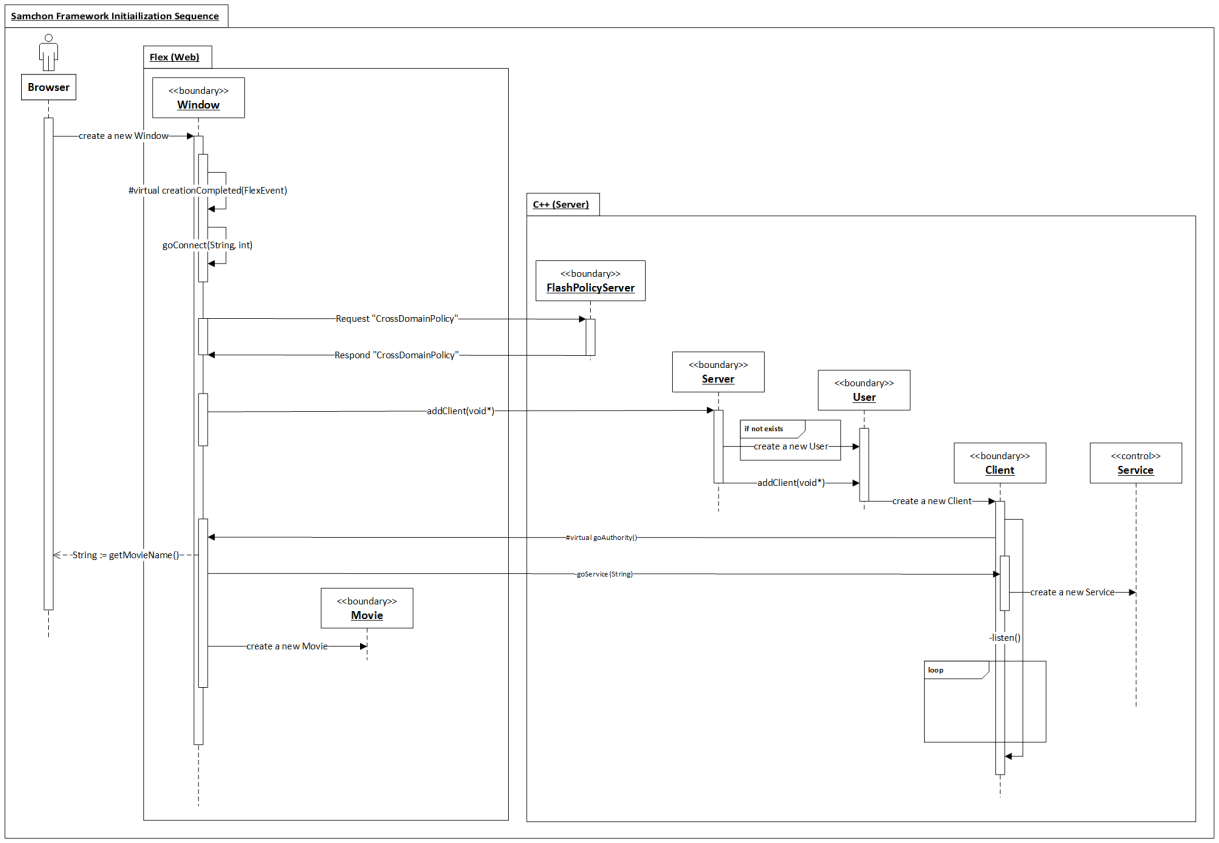
### Cloud service

The "service" package is for realizing cloud service. In Samchon Framework, realizing cloud service, there're two classes representing physical server and client as service::Server and service::Client. Between the two classes representing boundaries, there is a class representing logical conception user as service::User. In the terminal node under the service::Client, service::Service class represents a control. The default protocol of the service package is not 'web socket'. The default only has message protocol of Invoke, does not have handshake or another pre-defined protocol. By the default protocol, you can connect to the cloud server (built from c++, by service package) as a client by a program or plug-in like Flex or C#. However you can't connect by web-browser only allowing socket protocol as web-socket. To build a cloud service to follow web-socket protocol, inherits derviced classes not from service::Server, service::Client, but from service::WebServer, service::WebClient or implements IWebServer, IWebClient which are derived from service::Server and service::Client. **Class Diagram**

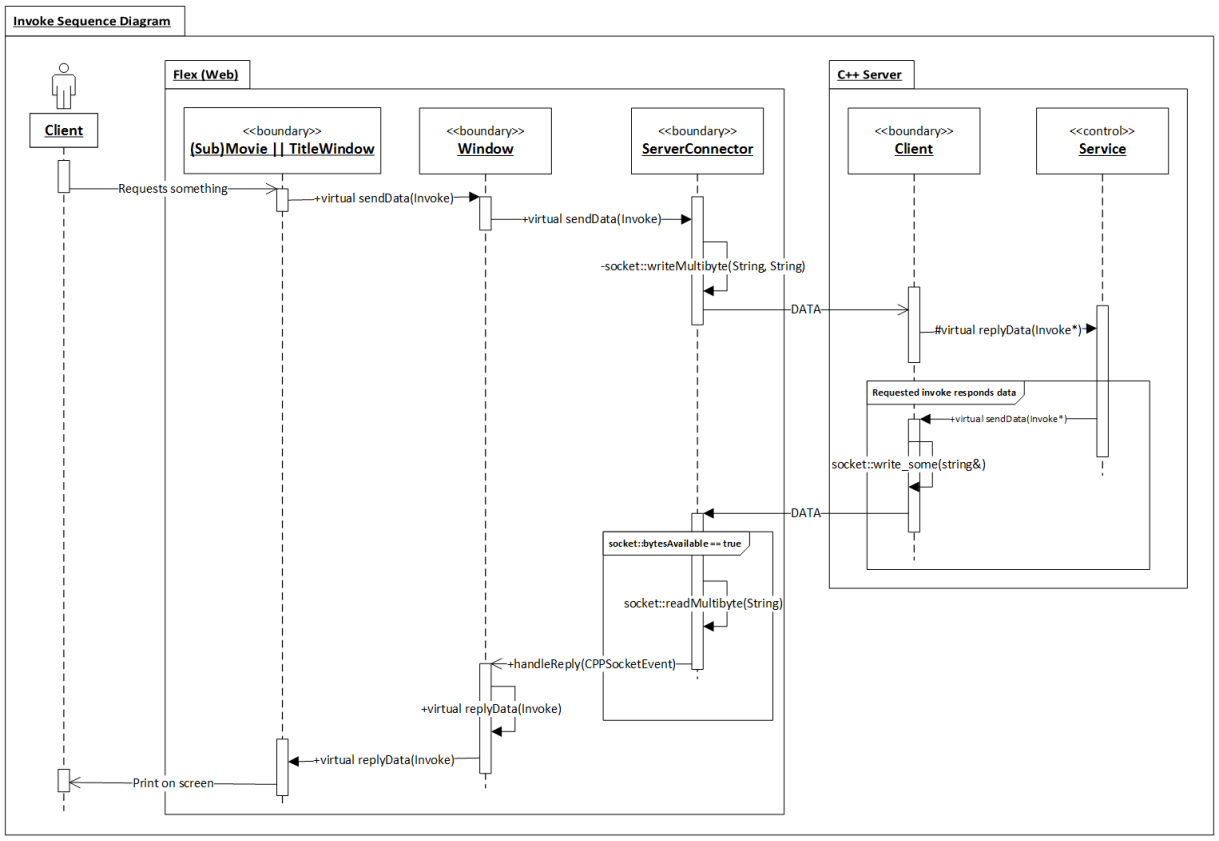
–



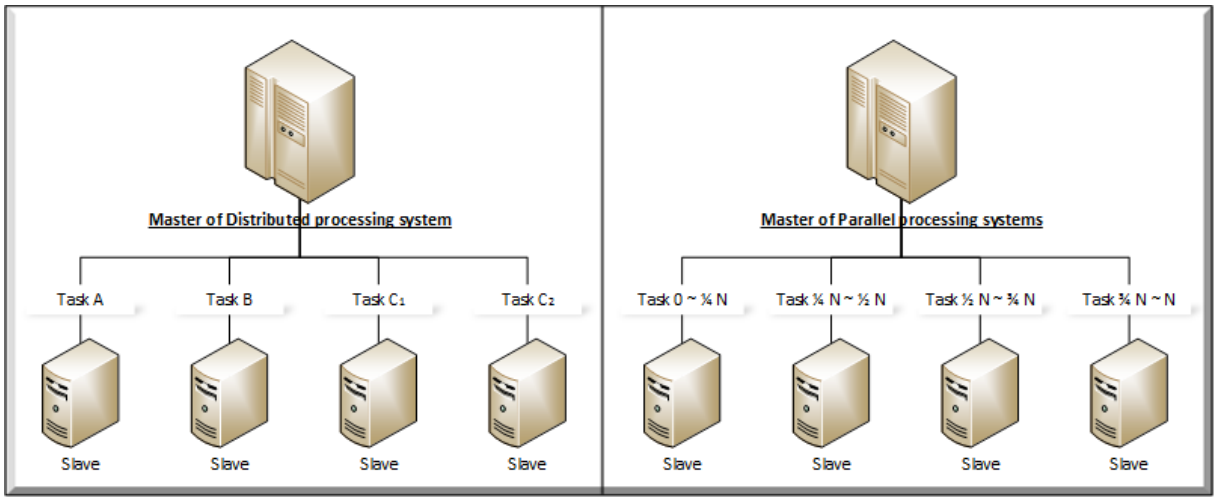
### Sequence Diagram - A client's connection




### Sequence Diagram - Network communication



– Master system




In master package, provides distributed and parallel processing system modules which are in framework of master. With classes in master package, you can realize any type of distributed or parallel processing system in master side, even how enormouse scale those have.

#### Distributed Processing System

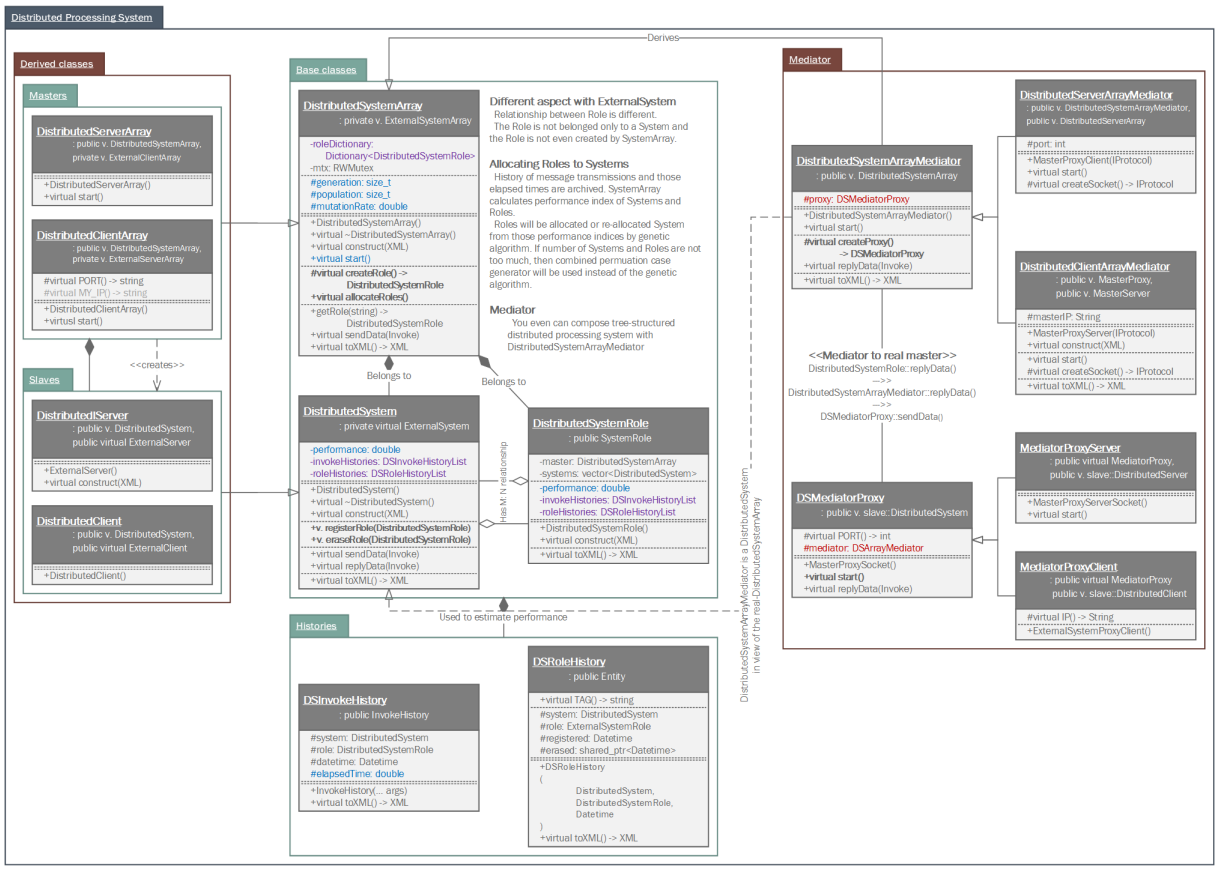
A distributed processing system of master, a master (master::DistributedSystemArray) allocates roles (master::DistributedSystemRole) to systems (master::DistributedSystem). User does not consider about which roles are allocated to which systems. User just accesses to a *role* and send or reply message from those roles.

* It's the proxy pattern have mentioned in external system
  ExternalSystem objects are managed by ExternalSystemArray and the ExternalSystemArray can access to a role belongs to a system directly. When you send an Invoke message to External↩SystemArray, the ExternalSystemArray finds matched ExternalSystemRole and the External↩SystemRole shifts the network I/O responsibility to belonged ExternalSystem. This relationship called "Proxy Pattern". By the pattern, "Proxy", you can concentrate on roles irrespective of where each role is belonged to.

  · ExternalSystemArray::sendData() -> ExternalSystemRole(Proxy)::sendData() -> External↩System::sendData()

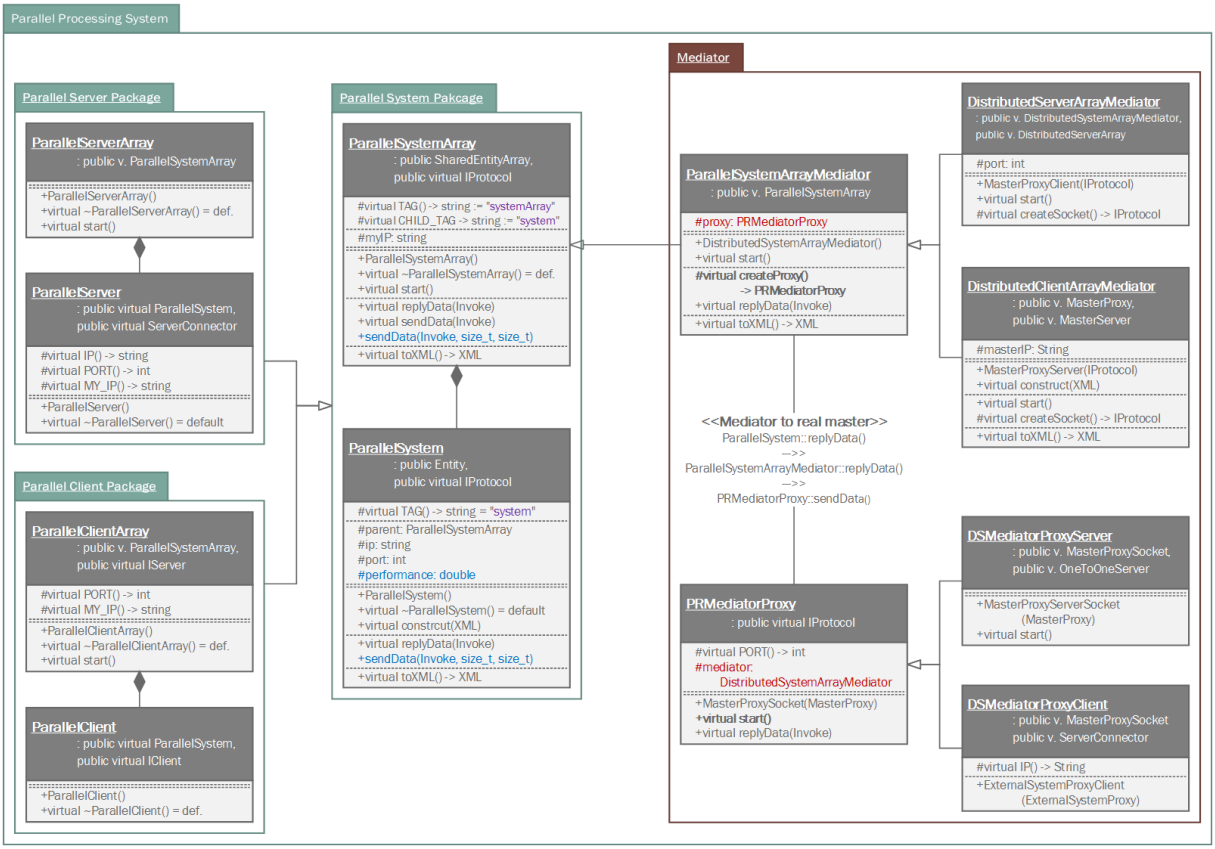
  · ExternalSystem::replyData() -> ExternalSystemRole(Proxy)::replyData()

However, unlike the case of managing roles from ExternalSystemArray, in DistributedSystemArray, roles can be allocated in multiple systems duplicately. And the roles can be moved to another systems. Those management and allocation of roles are determined by estimation of performance of each system, and required performance of each role.




## Parallel Processing System

Unlike distributed processing system, the parallel processing system is not complicate. It has very simple logic. About requested processes, master(master::ParallelSystemArray) allocates each process to each slave system by their own performance index have estimated.




– **Slave system**

A package for composing distributed or parallel processing system in slave side.

Slave system get orders from master, processes the orders and report the result with its elapsed time for estimating performance of the slave system.

cpp/protocol_slave.png

**Note**

- Boost Libraries: http://www.boost.org/
- Boot.Asio: http://www.boost.org/doc/libs/1_59_0/doc/html/boost_asio.html

**Author**

Jeongho Nam

### 5.7.2 Typedef Documentation

#### 5.7.2.1 SharedEntityArray

An EntityGroup with vector container and children capsuled in shared pointers.

**Template Parameters**

| | |
|---|---|
| *_Ty* | A type of children Entity. Must be a class derived from an Entity or Entity itself. |

For a case of inheritance of SharedEntityArray and the inherited SharedEntityArray also contains entity objects which are inherited from original child entity type, SharedEntityArray supports macros changing returned type of accessor methods.

- SHARED_ENTITY_ARRAY_ELEMENT_ACCESSOR_HEADER
- SHARED_ENTITY_ARRAY_ELEMENT_ACCESSOR_BODY

**See also**

samchon::protocol

**Author**

Jeongho Nam

#### 5.7.2.2 using SharedEntityList = EntityGroup < std::list<std::shared_ptr<_Ty>>, _Ty, std::shared_ptr<_Ty> >

An EntityGroup with list container and children capsuled in shared pointers.

**Template Parameters**

| | |
|---|---|
| *_Ty* | A type of children Entity. Must be a class derived from an Entity or Entity itself. |

**See also**

samchon::protocol

**Author**

Jeongho Nam

#### 5.7.2.3 using UniqueEntityArray = EntityGroup < std::vector<std::unique_ptr<_Ty>>, _Ty, std::unique_ptr<_Ty> >

An EntityGroup with vector container and children capsuled in unique pointers.

**Template Parameters**

| | |
|---|---|
| *_Ty* | A type of children Entity. Must be a class derived from an Entity or Entity itself. |

For a case of inheritance of UniqueEntityArray and the inherited UniqueEntityArray also contains entity objects which are inherited from original child entity type, UniqueEntityArray supports macros changing returned type of accessor methods.

- UNIQUE_ENTITY_ARRAY_ELEMENT_ACCESSOR_HEADER
- UNIQUE_ENTITY_ARRAY_ELEMENT_ACCESSOR_BODY

**Note**

std::unique_ptr doesn't allow copy construction. It allows only move construction. When inserts children objcets not by construct() method but by your hand, Be careful to insert deriving copy construction. You've use move constructor.

- *UniqueEntityArray<?>::push_back( move( std::unique_ptr<?>(new ?(...)) ) );*

**See also**

samchon::protocol

**Author**

Jeongho Nam

#### 5.7.2.4 using UniqueEntityList = EntityGroup < std::list<std::unique_ptr<_Ty>>, _Ty, std::unique_ptr<_Ty> >

An EntityGroup with list container and children capsuled in unique pointers.

**Template Parameters**

| | |
|---|---|
| *_Ty* | A type of children Entity. Must be a class derived from an Entity or Entity itself. |

**Note**

std::unique_ptr doesn't allow copy construction. It allows only move construction. When inserts children objcets not by construct() method but by your hand, Be careful to insert deriving copy construction. You've use move constructor.

- *UniqueEntityList<?>::push_back( move( std::unique_ptr<?>(new ?(...)) ) );*

**See also**

samchon::protocol

**Author**

Jeongho Nam

## 5.8 samchon::protocol::master Namespace Reference

Package for external system, within the framework of master.

### Classes

- class DistributedClient

  *A network driver for a distributed client.*
- class DistributedClientArray

  *An array of DistributedClient(s).*
- class DistributedClientArrayMediator

  *A mediator of distributed system between master and slaves.*
- class DistributedClientServerMediator

  *A distributed slave client for mediation.*
- class DistributedServer

  *A network driver for a distributed server.*
- class DistributedServerArray

  *An array of DistributedServer(s).*
- class DistributedServerArrayMediator

  *A mediator of distributed system between master and slaves.*
- class DistributedSlaveServerMediator

  *A distributed slave server for mediation.*
- class DistributedSlaveSystemMediator

  *A distributed slave system for mediation.*
- class DistributedSystem

  *A network driver for a distributed system.*
- class DistributedSystemArray

  *An array of distributed system drivers.*
- class DistributedSystemArrayMediator

  *A mediator of distributed system between master and slaves.*

- class DistributedSystemRole

  *A role of distributed processing system.*
- class DSInvokeHistory

  *A reported history of an Invoke message.*
- class DSInvokeHistoryList

  *A list of DSInvokeHistory.*
- class ParallelClient

  *A network driver for a parallel client.*
- class ParallelClientArray

  *An array of ParallelClient(s).*
- class ParallelClientArrayMediator

  *A mediator of parallel system between master and slaves.*
- class ParallelServer

  *A network driver for a parallel server.*
- class ParallelServerArray

  *An array of ParallelServer(s).*
- class ParallelServerArrayMediator

  *A mediator of parallel system between master and slaves.*
- class ParallelSlaveClientMediator

  *A parallel slave client for mediation.*
- class ParallelSlaveServerMediator

  *A parallel slave server for mediation.*
- class ParallelSlaveSystemMediator

  *A parallel slave system for mediation.*
- class ParallelSystem

  *A network driver for a parallel system.*
- class ParallelSystemArray

  *An array of parallel system drivers.*
- class ParallelSystemArrayMediator

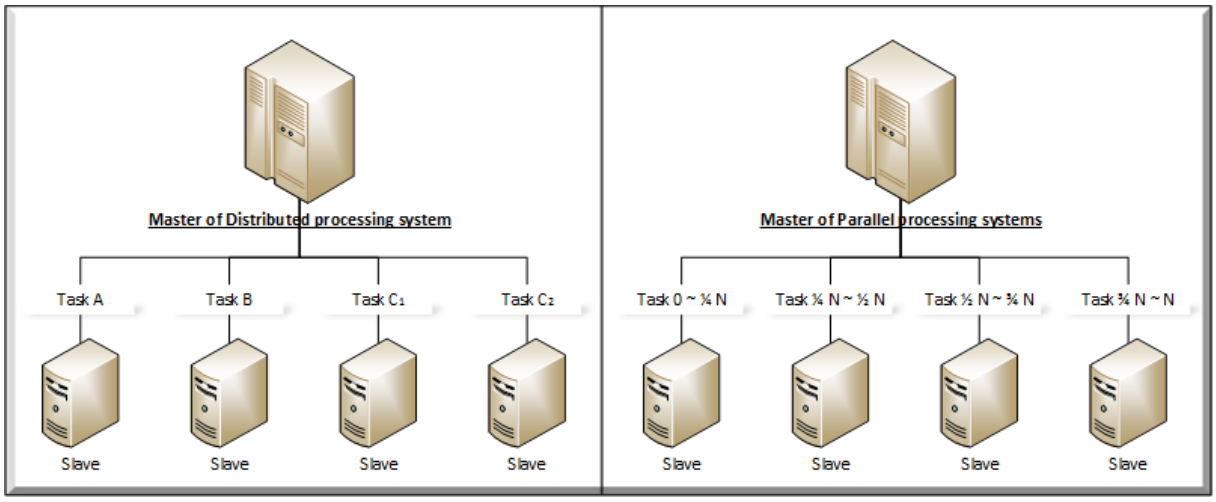
  *A mediator of parallel system between master and slaves.*
- class PRInvokeHistory

  *A reported history of an Invoke message.*
- class PRInvokeHistoryArray

  *An array of PRInvokeHistory.*

### 5.8.1 Detailed Description

Package for external system, within the framework of master.



In master package, provides distributed and parallel processing system modules which are in framework of master. With classes in master package, you can realize any type of distributed or parallel processing system in master side, even how enormouse scale those have.

### Distributed Processing System

A distributed processing system of master, a master (master::DistributedSystemArray) allocates roles (master↩::DistributedSystemRole) to systems (master::DistributedSystem). User does not consider about which roles are allocated to which systems. User just accesses to a *role* and send or reply message from those roles.

- It's the proxy pattern have mentioned in external system

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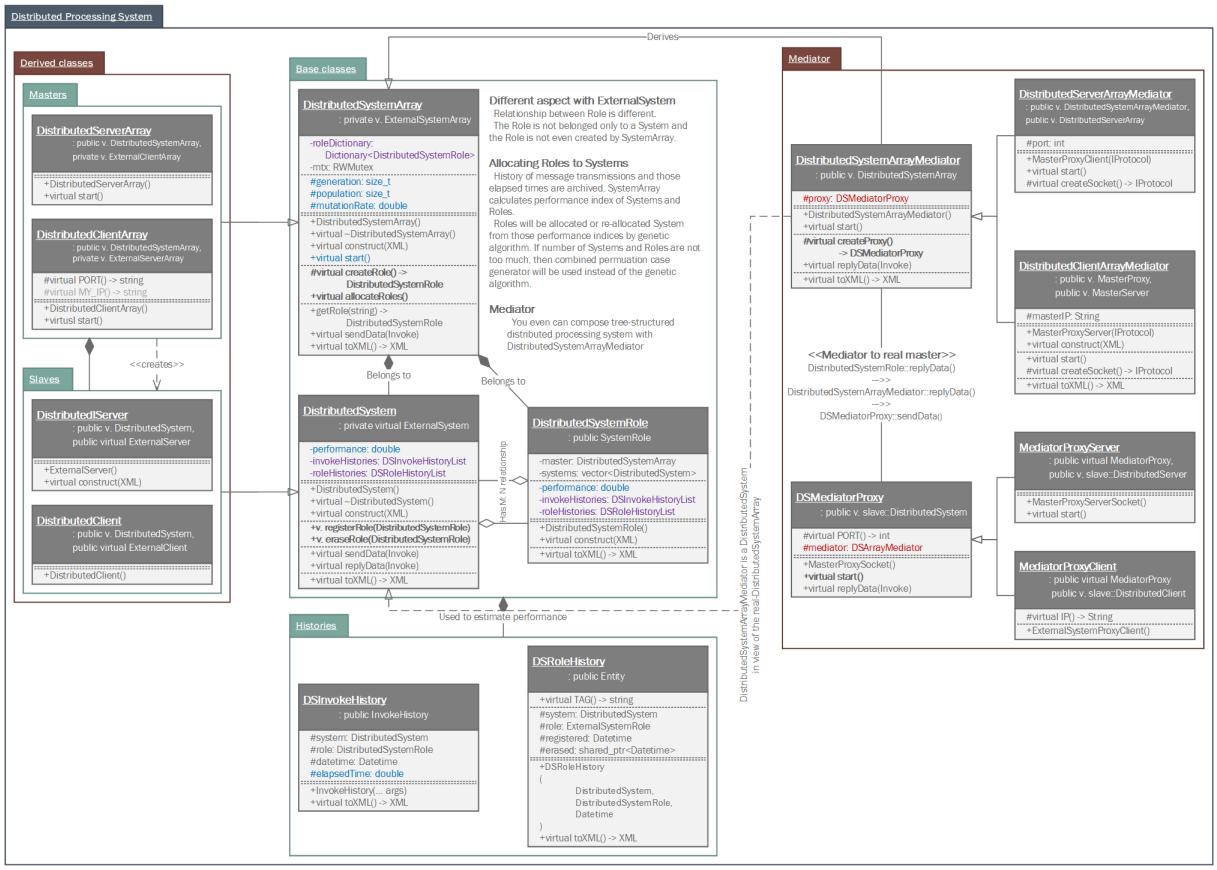
However, unlike the case of managing roles from ExternalSystemArray, in DistributedSystemArray, roles can be allocated in multiple systems duplicately. And the roles can be moved to another systems. Those management and allocation of roles are determined by estimation of performance of each system, and required performance of each role.




### Parallel Processing System

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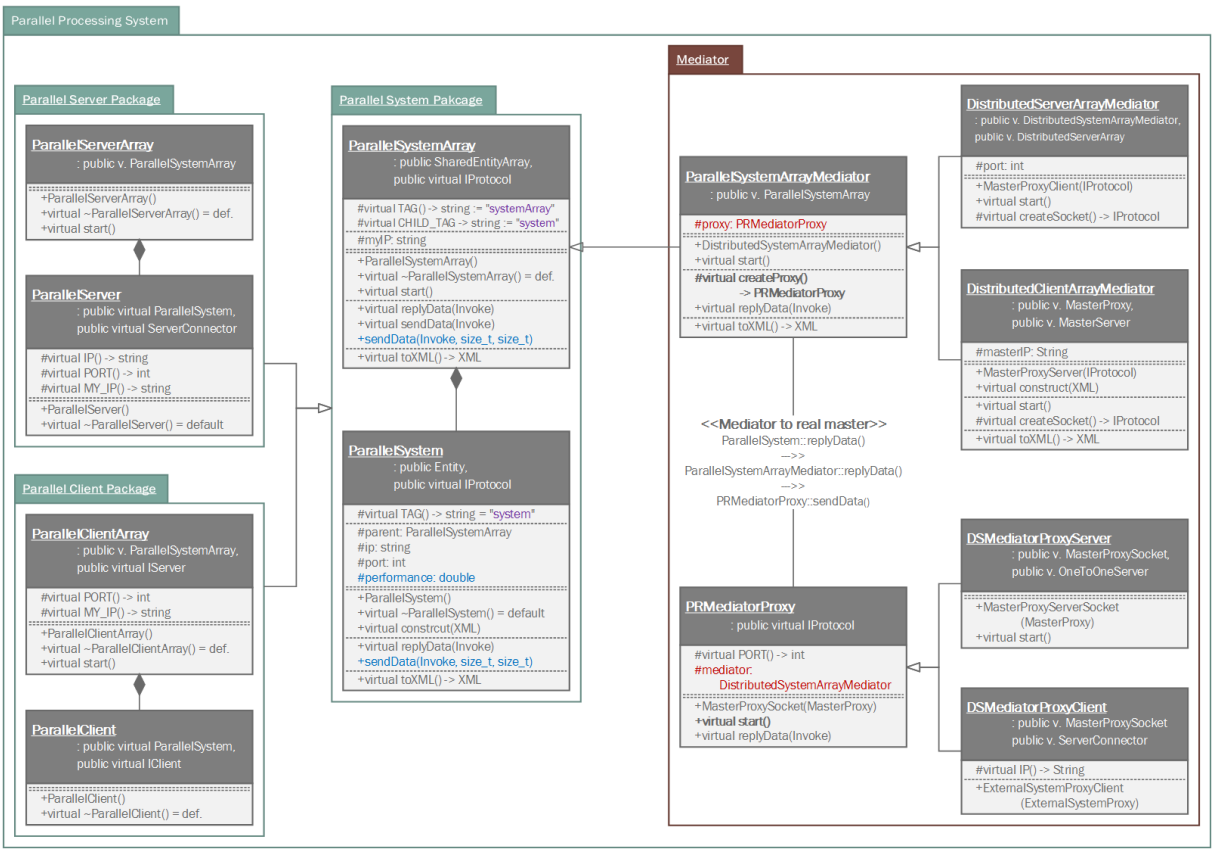



**Author**

Jeongho Nam

## 5.9 samchon::protocol::service Namespace Reference

Package of cloud service as a server.

### Classes

- class Client

  *A network boundary with the client in an User.*
- class IPUserPair

  *Relationship between IP address and User for issuing session.*
- class Server

  *A server for (cloud) service.*
- class Service

  *A service.*
- class ServiceKeeper

  *A keeper blocking destrunction of User and Client.*
- class User

  *User containing Client(s) with session-id.*

### 5.9.1 Detailed Description

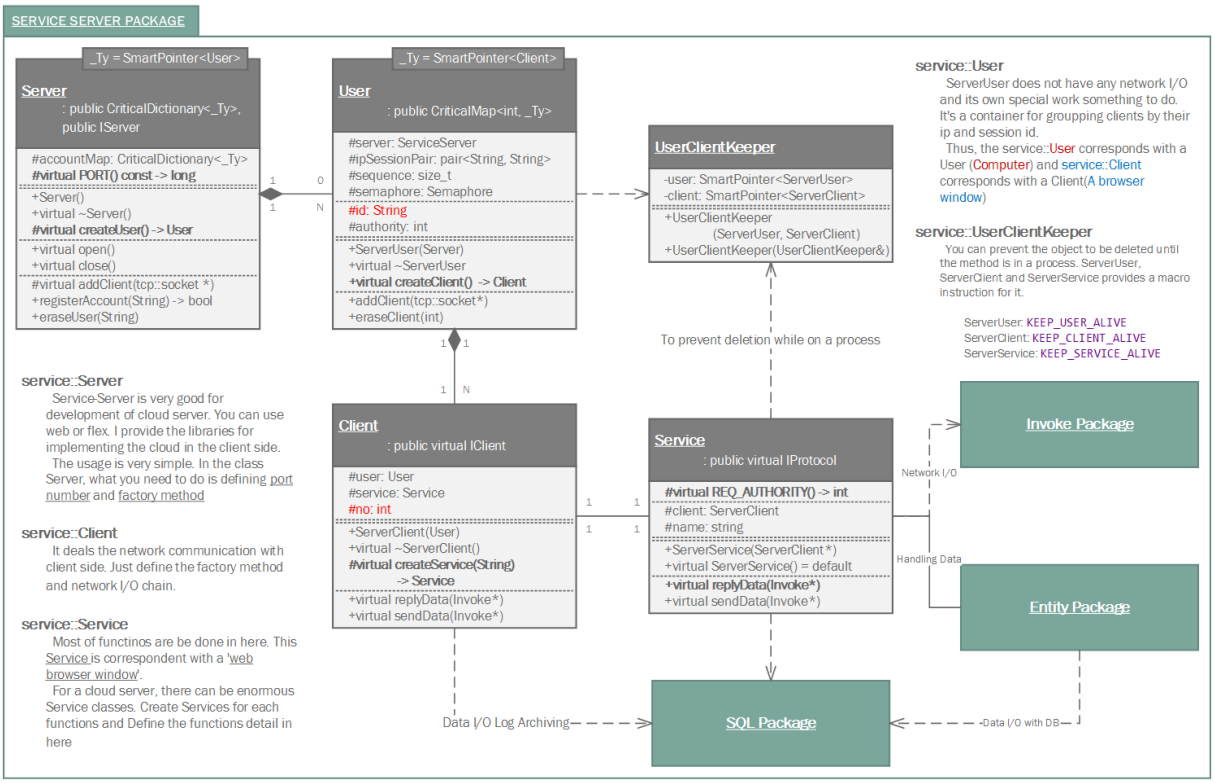
Package of cloud service as a server.

In Samchon Framework, realizing cloud service, there're two classes representing physical server and client as Server and Client. Between the two classes representing boundaries, there is a class representing logical conception user as User. In the terminal node under the Client, Service class represents a control.

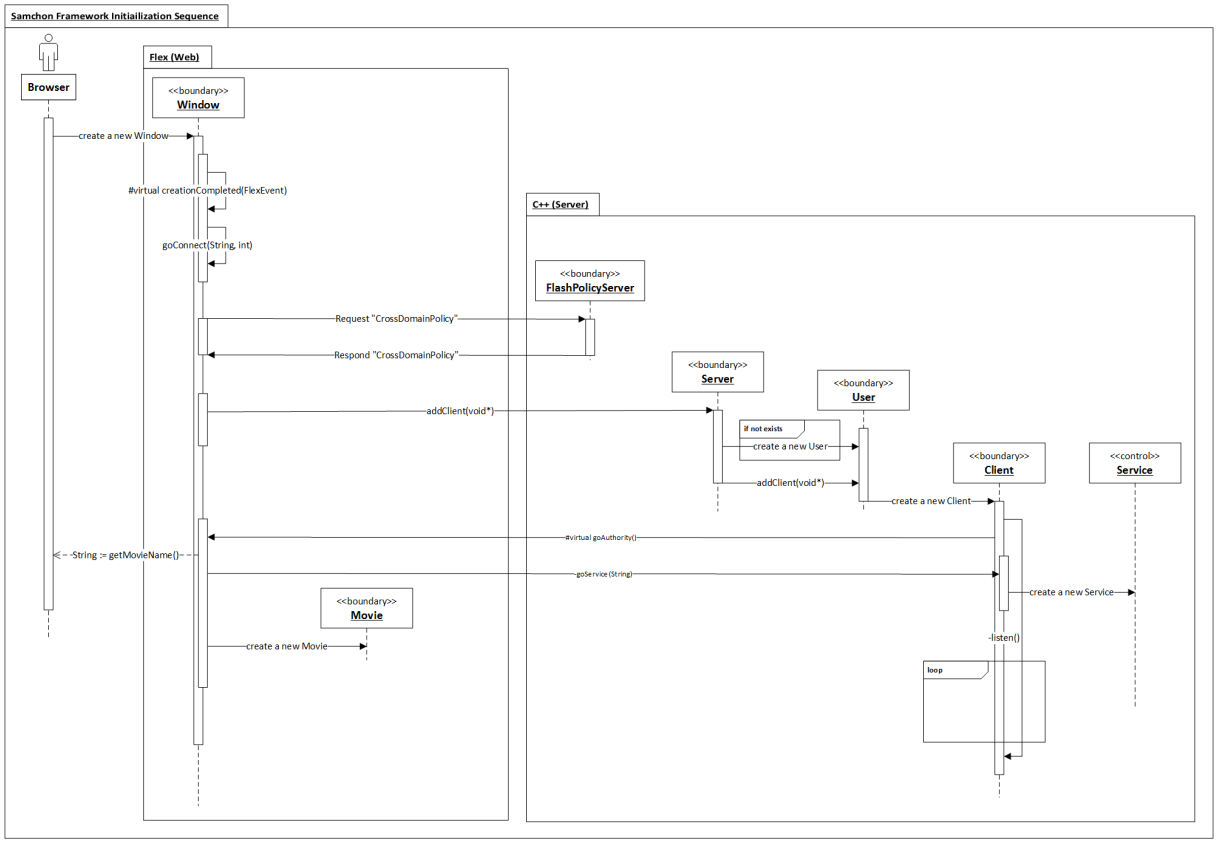
The default protocol of the service package is not 'web socket'. The default only has message protocol of Invoke, does not have handshake or another pre-defined protocol. By the default protocol, you can connect to the cloud server (built from c++, by service package) as a client by a program or plug-in like Flex or C#. However you can't connect by web-browser only allowing socket protocol as web-socket.

To build a cloud service to follow web-socket protocol, inherits derviced classes not from Server, Client, but from WebServer, WebClient or implements IWebServer, IWebClient which are derived from Server and Client.

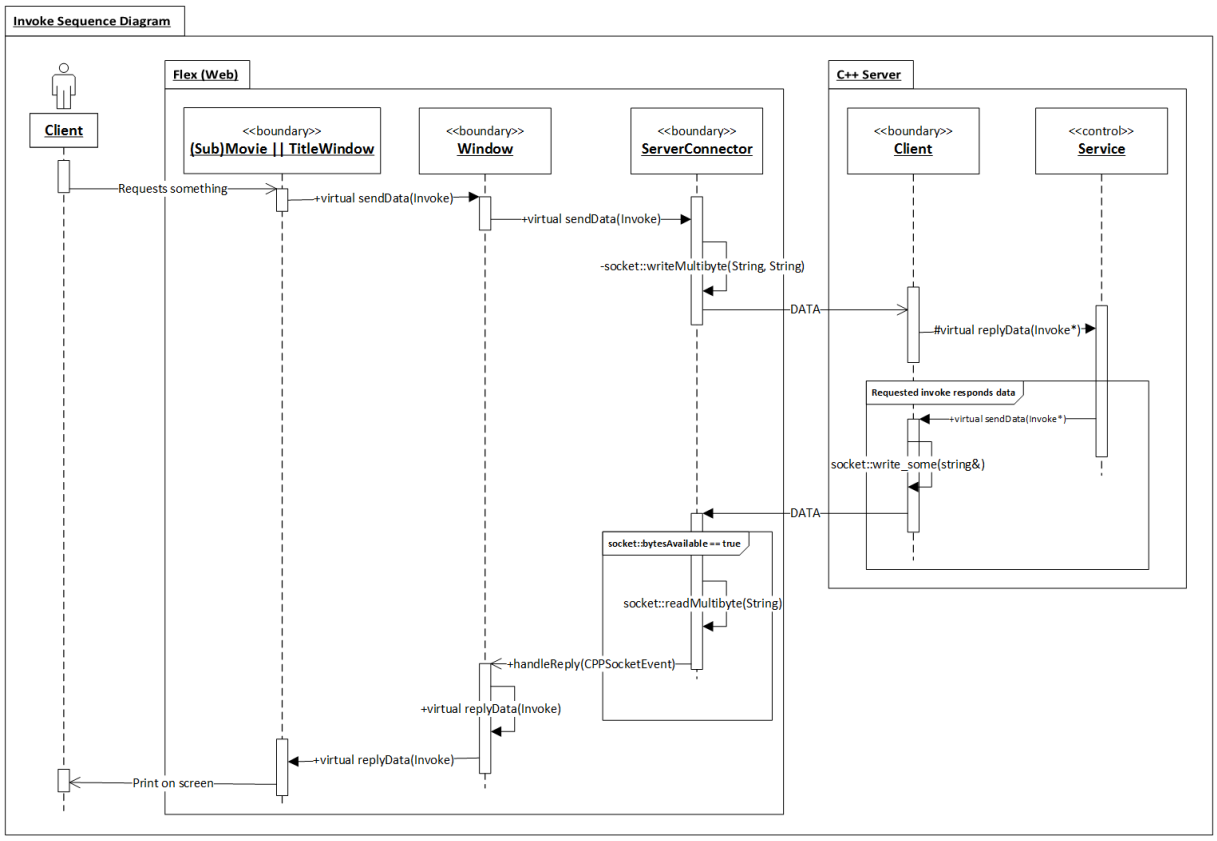
#### Class Diagram



### Sequence Diagram - A client's connection




### Sequence Diagram - Network communication



### Simple example - Chat service

#### examples/chat_service/ChatServer.hpp

```
1 #pragma once
2 #include <samchon/protocol/service/Server.hpp>
3
4 namespace samchon
5 {
6     namespace example
7     {
8         namespace chat_service
9         {
10             class ChatRoomArray;
11             class ChatRoom;
12
22             class ChatServer
23                 : public protocol::service::Server
24             {
25             protected:
26                 typedef protocol::service::Server super;
27
28                 virtual auto PORT() const -> int override
29                 {
30                     return 37749;
31                 };
32
33             private:
37                 ChatRoomArray *roomArray;
38
39             public:
43                 ChatServer();
44                 virtual ~ChatServer();
45
46             protected:
47                 virtual auto createUser() -> protocol::service::User* override;
48
49             public:
53                 auto getChatRoomArray() const -> ChatRoomArray*;
54             };
55         };
56     };
57 };
```

#### examples/chat_service/ChatUser.hpp

```
1 #pragma once
2 #include <samchon/protocol/service/User.hpp>
3
4 namespace samchon
5 {
6     namespace example
7     {
8         namespace chat_service
9         {
19             class ChatUser
20                 : public protocol::service::User
21             {
22             public:
26                 ChatUser(protocol::service::Server*);
27                 virtual ~ChatUser() = default;
28
29             protected:
30                 virtual auto createClient() -> protocol::service::Client* override;
31             };
32         };
33     };
34 };
```

#### examples/chat_service/ChatClient.hpp

```
1 #pragma once
2 #include <samchon/protocol/service/Client.hpp>
3
4 namespace samchon
5 {
6     namespace example
7     {
8         namespace chat_service
9         {
19             class ChatClient
20                 : public protocol::service::Client
21             {
22             public:
```

```
26                  ChatClient(protocol::service::User*);
27                  virtual ~ChatClient() = default;
28
29              protected:
30                  auto createService(const std::string &) -> protocol::service::Service* override;
31              };
32          };
33      };
34 };
```

### examples/chat_service/ChatService.hpp

```
1 #pragma once
2 #include <samchon/protocol/service/Service.hpp>
3
4 namespace samchon
5 {
6     namespace example
7     {
8         namespace chat_service
9         {
10              class ChatRoom;
11
22              class ChatService
23                  : public protocol::service::Service
24              {
25              private:
26                  typedef protocol::service::Service super;
27
32                  ChatRoom *room;
33
34              public:
38                  ChatService(protocol::service::Client*);
39                  virtual ~ChatService();
40
41                  virtual void replyData(std::shared_ptr<protocol::Invoke>) override;
42              };
43          };
44      };
45 };
```

### examples/chat_service/ListService.hpp

```
1 #pragma once
2 #include <samchon/protocol/service/Service.hpp>
3
4 namespace samchon
5 {
6     namespace example
7     {
8         namespace chat_service
9         {
10              class ListService;
11
21              class ListService
22                  : public protocol::service::Service
23              {
24              private:
25                  typedef protocol::service::Service super;
26
27              public:
31                  ListService(protocol::service::Client*);
32                  virtual ~ListService() = default;
33
34                  virtual void replyData(std::shared_ptr<protocol::Invoke> invoke) override;
35
36              private:
42                  void createRoom(const std::string &);
43
44                  void handleRoomArray(std::shared_ptr<library::XML>);
45                  void handleMakeRoom(bool);
46                  void handleRoomArray(bool);
47              };
48          };
49      };
50 };
```

### examples/chat_service/ChatRoomArray.hpp

```
1 #pragma once
2 #include <samchon/library/CriticalDictionary.hpp>
3 #include <samchon/protocol/IEntityGroup.hpp>
4
```

```
namespace samchon
{
    namespace library { class XML; };
    namespace protocol { class Invoke; };

     namespace example
     {
         namespace chat_service
         {
             class ChatRoom;

             class ChatServer;
             class ChatUser;

             class ChatRoomArray
                 : public CriticalDictionary<std::shared_ptr<ChatRoom>>,
                 public protocol::IEntityGroup
             {
             protected:
                 typedef CriticalDictionary<std::shared_ptr<ChatRoom>> super;

                 virtual auto TAG() const -> std::string { return "roomArray"; };
                 virtual auto CHILD_TAG() const -> std::string { return "room"; };

             private:
                 ChatServer *server;

             public:
                 /* ----------------------------------------------------------------
                     CONSTRUCTORS
                 ---------------------------------------------------------------- */
                 ChatRoomArray(ChatServer*);
                 virtual ~ChatRoomArray() = default;

                 /* ----------------------------------------------------------------
                     NOTIFIER
                 ---------------------------------------------------------------- */
                 void notify();

             private:
                 /* ----------------------------------------------------------------
                     EXPORTERS
                 ---------------------------------------------------------------- */
                 auto toXML() const -> std::shared_ptr<library::XML>;

                 auto toInvoke() const -> std::shared_ptr<protocol::Invoke>;
             };
         };
     };
};
```

### examples/chat_service/ChatRoom.hpp

```
#pragma once
#include <samchon/protocol/Entity.hpp>
#include <samchon/protocol/IProtocol.hpp>

#include <string>
#include <samchon/library/CriticalSet.hpp>


namespace samchon
{
    namespace example
    {
        namespace chat_service
        {
            class ChatUser;
            class ChatService;

            class ChatRoomArray;

            class ChatRoom
                : public protocol::Entity,
                public protocol::IProtocol
            {
            protected:
                typedef protocol::Entity super;

                virtual auto TAG() const -> std::string { return "room"; };

            private:
                ChatRoomArray *roomArray;

                std::string name;

```

```
57                  ChatUser *host;
58
62                  library::CriticalSet<ChatService*> participants;
63
64              public:
65                  /* ----------------------------------------------------------
66                      CONSTRUCTORS
67                  ---------------------------------------------------------- */
75                  ChatRoom(ChatRoomArray*, const std::string &, ChatUser*);
76                  virtual ~ChatRoom() = default;
77
82                  void registerClient(ChatService*);
83
88                  void eraseClient(ChatService*);
89
90                  /* ----------------------------------------------------------
91                      CHAIN OF RESPONSIBILITY
92                  ---------------------------------------------------------- */
93                  virtual void replyData(std::shared_ptr<protocol::Invoke>) override;
94                  virtual void sendData(std::shared_ptr<protocol::Invoke>) override;
95
96              public:
97                  /* ----------------------------------------------------------
98                      GETTERS
99                  ---------------------------------------------------------- */
100                  virtual auto toXML() const -> std::shared_ptr<library::XML> override;
101              };
102          };
103      };
104 };
```

### examples/chat_service/ChatMessage.hpp

```
1 #pragma once
2 #include <set>
3 #include <string>
4
5 #include <samchon/protocol/Entity.hpp>
6
7 namespace samchon
8 {
9     namespace example
10     {
11         namespace chat_service
12         {
24             class ChatMessage
25                 : public protocol::Entity
26             {
27             protected:
28                 typedef protocol::Entity super;
29
30                 virtual auto TAG() const -> std::string
31                 {
32                     return "message";
33                 };
34
35             private:
39                 std::string orator;
40
45                 std::string listener;
46
50                 std::string message;
51
52             public:
53                 /* ----------------------------------------------------------
54                     CONSTRUCTORS
55                 ---------------------------------------------------------- */
59                 ChatMessage();
60                 virtual ~ChatMessage() = default;
61
62                 virtual void construct(std::shared_ptr<library::XML>);
63
64                 /* ----------------------------------------------------------
65                     GETTERS
66                 ---------------------------------------------------------- */
71                 auto getListener() const -> std::string;
72
73                 virtual auto toXML() const -> std::shared_ptr<library::XML>;
74             };
75         };
76     };
77 };
```

### examples/chat_service/ChatServer.cpp

### examples/chat_service/ChatUser.cpp

### examples/chat_service/ChatClient.cpp

### examples/chat_service/ChatService.cpp

```
#include "ChatService.hpp"
#include "ChatRoom.hpp"

#include <samchon/protocol/Invoke.hpp>

using namespace std;
using namespace samchon::protocol;
using namespace samchon::protocol::service;
using namespace samchon::example::chat_service;

ChatService::ChatService(Client *client)
    : super(client)
{

}
ChatService::~ChatService()
{
    if(room == nullptr)
        return;

    room->eraseClient(this);
}

void ChatService::replyData(shared_ptr<Invoke> invoke)
{
    if(invoke->getListener() == "sendMessage")
        room->replyData(invoke);
}
```

### examples/chat_service/ListService.cpp

### examples/chat_service/ChatRoomArray.cpp

```
#include "ChatRoomArray.hpp"
#include "ChatRoom.hpp"

#include "ChatServer.hpp"
#include "ChatUser.hpp"
#include "ChatClient.hpp"
#include "ListService.hpp"

#include <thread>
#include <samchon/library/XML.hpp>
#include <samchon/protocol/Invoke.hpp>

using namespace std;
using namespace samchon::library;
using namespace samchon::protocol;
using namespace samchon::example::chat_service;

ChatRoomArray::ChatRoomArray(ChatServer *server)
    : super(),
    IEntityGroup()
{
    this->server = server;
}

void ChatRoomArray::notify()
{
    shared_ptr<Invoke> &invoke = this->toInvoke();

    UniqueReadLock uk(get_allocator().getMutex());
    for (auto it = server->begin(); it != server->end(); it++)
    {
        auto user = it->second;
```

```

        for (auto u_it = user->begin(); u_it != user->end(); u_it++)
        {
            auto client = u_it->second;
            auto service = client->getService();

            if (dynamic_cast<ListService>(service) != nullptr)
                thread(&IProtocol::sendData, service, invoke).detach();
        }
    }
}

auto ChatRoomArray::toXML() const -> shared_ptr<XML>
{
    shared_ptr<XML> xml(new XML());
    xml->setTag(TAG());

    UniqueReadLock uk(get_allocator().getMutex());
    for(auto it = begin(); it != end(); it++)
        xml->push_back(it->second->toXML());

    return xml;
}
auto ChatRoomArray::toInvoke() const -> shared_ptr<Invoke>
{
    Invoke *invoke = new Invoke("handleRoomArray", toXML());
    return shared_ptr<Invoke>(invoke);
}
```

### examples/chat_service/ChatRoom.cpp

```
#include "ChatRoom.hpp"
#include "ChatRoomArray.hpp"
#include "ChatMessage.hpp"

#include "ChatUser.hpp"
#include "ChatClient.hpp"
#include "ChatService.hpp"

#include <samchon/library/XML.hpp>
#include <samchon/protocol/Invoke.hpp>

using namespace std;
using namespace samchon::library;
using namespace samchon::protocol;
using namespace samchon::example::chat_service;

/* ----------------------------------------------------------
    CONSTRUCTORS
---------------------------------------------------------- */
ChatRoom::ChatRoom(ChatRoomArray *roomArray, const string &name,
    ChatUser *host)
    : super(),
    IProtocol()
{
    this->roomArray = roomArray;

    this->name = name;
    this->host = host;
}

void ChatRoom::registerClient(ChatService *service)
{
    participants.insert(service);

    sendData(shared_ptr<Invoke>(new Invoke("handleRoom", toXML())));
    roomArray->notify();
}
void ChatRoom::eraseClient(ChatService *service)
{
    if (participants.erase(service) == 0)
        roomArray->erase(this->name);
    else
        sendData(shared_ptr<Invoke>(new Invoke("handleRoom", toXML())));

    roomArray->notify();
}

/* ----------------------------------------------------------
    CHAIN OF RESPONSIBILITY
---------------------------------------------------------- */
void ChatRoom::replyData(shared_ptr<Invoke> invoke)
{
    if(invoke->getListener() == "sendMessage")
    {
        shared_ptr<Invoke> ivk(new Invoke("handleMessage"));
```

```
        ivk->at(0) = invoke->at(0);

        sendData(ivk);
    }
}
void ChatRoom::sendData(shared_ptr<Invoke> invoke)
{
    UniqueReadLock uk(participants.get_allocator().getMutex());

    if(invoke->getListener() == "handleMessage")
    {
        ChatMessage message;
        message.construct(invoke->at(0)->getValueAsXML());

        if(message.getListener().empty() == true)
            for (auto it = participants.begin(); it != participants.end(); it++)
                (*it)->sendData(invoke);
        else
            for (auto it = participants.begin(); it != participants.end(); it++)
                if((*it)->getClient()->getUser()->getID() == message.getListener())
                    (*it)->sendData(invoke);
    }
    else
        for (auto it = participants.begin(); it != participants.end(); it++)
            (*it)->sendData(invoke);
}

/* ------------------------------------------------------------
    EXPORTS
------------------------------------------------------------ */
auto ChatRoom::toXML() const -> shared_ptr<XML>
{
    shared_ptr<XML> &xml = super::toXML();
    xml->setProperty("name", name);
    xml->setProperty("host", host->getID());

    for (auto it = participants.begin(); it != participants.end(); it++)
    {
        shared_ptr<XML> participant(new XML());
        participant->setTag("participant");
        participant->setValue((*it)->getClient()->getUser()->getID());

        xml->push_back(participant);
    }
    return xml;
}
```

### examples/chat_service/ChatMessage.cpp

```
#include "ChatMessage.hpp"

#include <samchon/library/XML.hpp>

using namespace std;
using namespace samchon::library;
using namespace samchon::protocol;
using namespace samchon::example::chat_service;

/* ------------------------------------------------------------
    CONSTRUCTORS
------------------------------------------------------------ */
ChatMessage::ChatMessage()
    : super()
{
}
void ChatMessage::construct(shared_ptr<XML> xml)
{
    this->orator = xml->getProperty("orator");
    this->message = xml->getProperty("message");

    if(xml->hasProperty("listener") == true)
        this->listener = xml->getProperty("listener");
    else
        this->listener.clear();
}

/* ------------------------------------------------------------
    GETTERS
------------------------------------------------------------ */
auto ChatMessage::getListener() const -> string
{
    return listener;
}
auto ChatMessage::toXML() const -> shared_ptr<XML>
{
    shared_ptr<XML> &xml = super::toXML();
```

```
    xml->setProperty("orator", orator);
    xml->setProperty("message", message);

    if(listener.empty() == false)
        xml->setProperty("listener", listener);
    return xml;
}

```

**Author**

Jeongho Nam

## 5.10 samchon::protocol::slave Namespace Reference

Package of external system, within the framework of slave.

### Classes

- class ParallelClient

  *A slave parallel client.*

- class ParallelServer

  *A slave parallel server.*

- class ParallelSystem

  *A slave parallel system.*

- class SlaveClient

  *A slave client.*

- class SlaveServer

  *A slave server.*

- class SlaveSystem

  *A slave system.*

### 5.10.1 Detailed Description

Package of external system, within the framework of slave.

A package for composing distributed or parallel processing system in slave side.

Slave system get orders from master, processes the orders and report the result with its elapsed time for estimating performance of the slave system.

cpp/protocol_slave.png

**Author**

Jeongho Nam

# Chapter 6

# Class Documentation

## 6.1 Base64 Class Reference

Utility class for base64 format's en-decoding.

```
#include <Base64.hpp>
```

### Static Public Member Functions

- static auto encode (const ByteArray &) -> std::string

  *Encode from binary data to base64-string.*

- static auto decode (const std::string &) -> ByteArray

  *Decode from base64-string to binary data.*

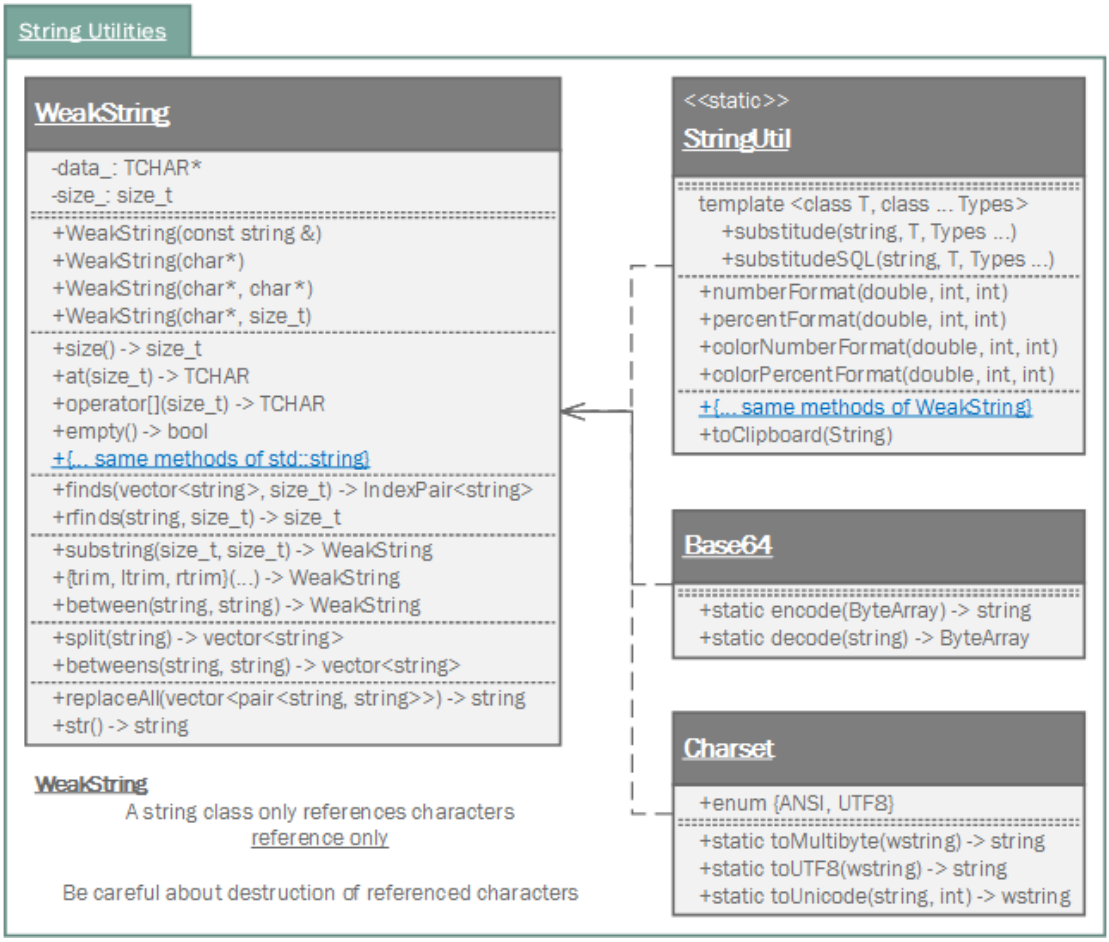
### 6.1.1 Detailed Description

Utility class for base64 format's en-decoding.

Base64 supports

- Encoding from binary data to base64-string

- Decoding from base64-string to binary data




**See also**

samchon::library

**Author**

Jeongho Nam

### 6.1.2 Member Function Documentation

#### 6.1.2.1 auto encode ( const ByteArray & *byteArray* ) -> std::string [static]

Encode from binary data to base64-string.

Encodes a binary data to base64-string

**Parameters**

| | |
|---|---|
| *byteArray* | binary data you want to encode |

**Returns**

A base64-string encoded from binary data

#### 6.1.2.2 auto decode ( const std::string & *str* ) -> ByteArray [static]

Decode from base64-string to binary data.

Decodes a base64 encoded string to binary data

**Note**

If the encoded string is not whole but a part of the binary data, Base64Decoder will be better

**Parameters**

| | |
|---|---|
| *str* | A encoded string representing binary data as base64 format |

**Returns**

A binary data decoded from string

The documentation for this class was generated from the following files:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Base64.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Base64.cpp

## 6.2 ByteArray Class Reference

Binary data class.

```
#include <ByteArray.hpp>
```

### Public Member Functions

- ByteArray ()

  *Default Constructor.*
- ByteArray (const ByteArray &)

  *Copy Constructor.*
- ByteArray (ByteArray &&)

  *Move Constructor.*
- auto getPosition () const -> size_t

  *Get position.*
- void setPosition (size_t)

  *Set poisition.*
- template<typename _Ty >
  auto read () const -> _Ty

  *Read data.*
- template<typename _Ty >
  auto readReversely () const -> _Ty

  *Read a reversed data.*
- template<typename _Ty >
  void write (const _Ty &val)

  *Write a data.*
- template<typename _Ty >
  void writeReversely (const _Ty &val)

  *Write a data.*
- auto compress () const -> ByteArray

  *Compress the binary data*

  .
- auto decompress () const -> ByteArray

  *Decompress the binary data.*

### Static Public Member Functions

- template<typename _Ty >
  static auto reverse (const _Ty &val) -> _Ty

  *Reverse byte ordering.*

### Private Attributes

- size_t position

  *Current position of the ByteArray.*

  .

## 6.2.1 Detailed Description

Binary data class.

ByteArray is the standard class for handling binary data in Samchon Framework.

ByteArray provides methods for reading and writing binary data.

In addition, zlib compression and decompression are supported.

**Note**

ByteArray is a class only for advanced developer who can access data on byte level as the reason of:

- Handling File Data
- Custom protocol for network I/O
- Optimizing the size of data for performance

If you're not trying to use ByteArray as the reason of what I've mentioned but only for representing entity data, I recomment you to use Entity instead.

**See also**

samchon::library

**Author**

Jeongho Nam

## 6.2.2 Member Function Documentation

### 6.2.2.1 auto getPosition ( ) const -> size_t

Get position.

Get a position represents starting point of bytes to read

### 6.2.2.2 void setPosition ( size_t *val* )

Set poisition.

Set a position represents starting point of bytes to read

#### 6.2.2.3 static auto reverse ( const _Ty & *val* ) -> _Ty [inline], [static]

Reverse byte ordering.

Creates a copy of data which of byte ordering is reversed.

- BIG_ENDIAN to SMALL_ENDIAN li SMALL_ENDIAN to BIG_ENDIAN

#### 6.2.2.4 auto read ( ) const -> _Ty [inline]

Read data.

Reads a data(_Ty) from (starting) position of the ByteArray and adds the position following the size.

**Template Parameters**

| | |
|---|---|
| *_Ty* | A type of data to be returned |

**Exceptions**

| | |
|---|---|
| *exception* | out of range |

**Returns**

Read data from the byte stream

#### 6.2.2.5 auto readReversely ( ) const -> _Ty [inline]

Read a reversed data.

Reads data(_Ty) from (starting) position of the ByteArray, which byte ordering is reversed, from the ByteArray and adds the position following the size.

- BIG_ENDIAN to SMALL_ENDIAN li SMALL_ENDIAN to BIG_ENDIAN

**Template Parameters**

| | |
|---|---|
| *_Ty* | A type of data to be returned |

**Exceptions**

| | |
|---|---|
| *exception* | out of range |

**Returns**

Read data from the byte stream

#### 6.2.2.6 void write ( const _Ty & *val* ) [inline]

Write a data.

Writes a data(_Ty) to tail of the ByteArray

**Template Parameters**

| | |
|---|---|
| *_Ty* | A type of data to write |

**Parameters**

| | |
|---|---|
| *val* | Something to write on ByteArray |

#### 6.2.2.7 void writeReversely ( const _Ty & *val* ) [inline]

Write a data.

Writes a data(_Ty), which byte order is reversed, to tail of the ByteArray

- BIG_ENDIAN to SMALL_ENDIAN li SMALL_ENDIAN to BIG_ENDIAN

**Template Parameters**

| | |
|---|---|
| *_Ty* | A type of data to write |

**Parameters**

| | |
|---|---|
| *val* | Something to write on ByteArray |

#### 6.2.2.8 auto compress ( ) const -> ByteArray

Compress the binary data

.

Generates a binary data compressed from the ByteArray.

The binary data will be compressed by zlib library.

**Returns**

ByteArray which is compressed

#### 6.2.2.9 auto decompress ( ) const -> ByteArray

Decompress the binary data.

Generates a decompressed binary data form the ByteArray.

The binary data will be decompressed by zlib library.

**Returns**

ByteArray that is decompressed

### 6.2.3 Member Data Documentation

#### 6.2.3.1 size_t position [private]

Current position of the ByteArray.

.

If you call read, starting pointer will be the position

- (_Ty *ptr* = *(_Ty)*data() + position)

The documentation for this class was generated from the following files:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/ByteArray.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/ByteArray.cpp

## 6.3 CaseGenerator Class Reference

Case generator.

```
#include <CaseGenerator.hpp>
```

### Public Member Functions

- CaseGenerator (size_t n, size_t r)

  *Construct from size of N and R.*
- auto size () const -> size_t

  *Get size of all cases.*
- virtual auto operator[ ] (size_t) const -> std::vector< size_t >=0

  *Get x'th case.*
- auto at (size_t) const -> std::vector< size_t >
- auto n () const -> size_t

  *Get size of the N.*
- auto r () const -> size_t

  *Get size of the R.*
- auto toMatrix () const -> std::vector< std::vector< size_t >>

  *Create a matrix containing all cases.*

### Protected Attributes

- size_t n_

  *N, size of the candidates.*
- size_t r_

  *R, size of elements of each case.*
- size_t size_

  *Size, the number of all cases.*

### 6.3.1 Detailed Description

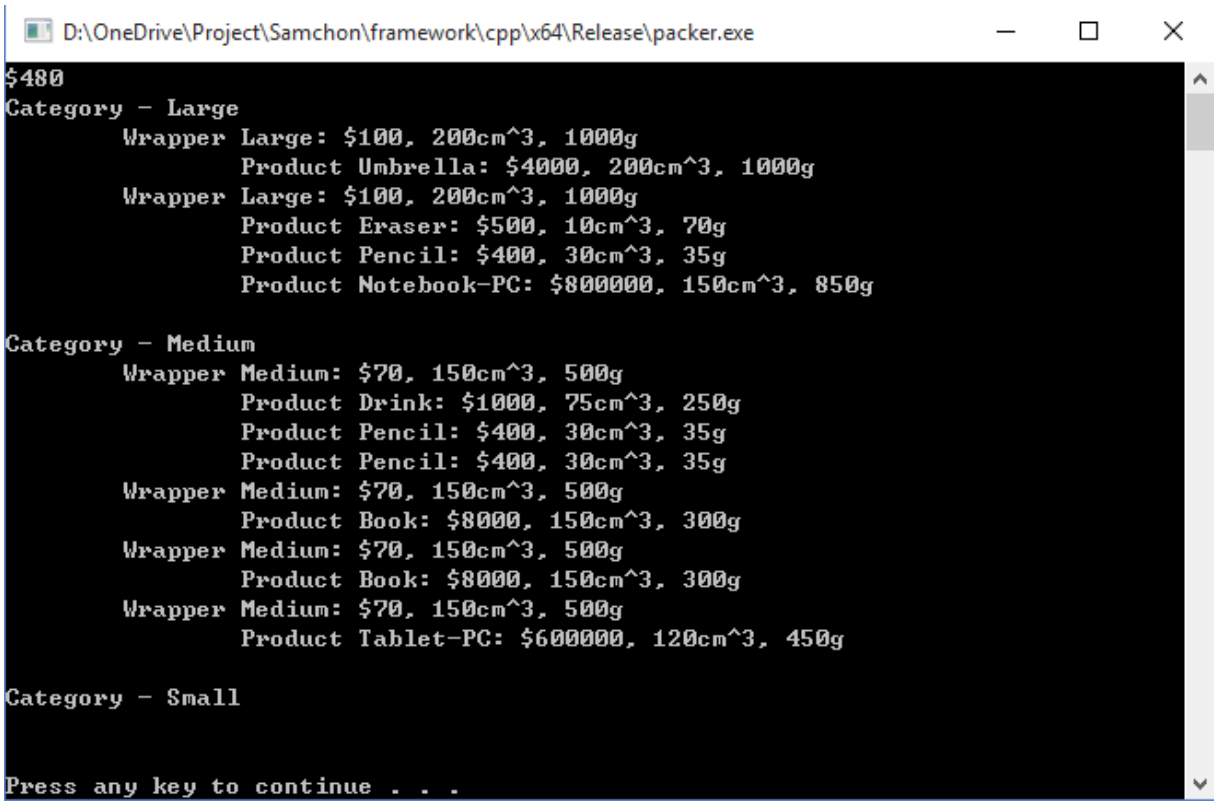
Case generator.

An abstract case generator using like a matrix

- nTTr(n^r) -> CombinedPermutationGenerator
- nPr -> PermutationGenerator
- n! -> FactorialGenerator

### Example source

Packer - Find the best packaging solution




### examples/packer/Packer.hpp

```
#pragma once
#include <vector>
#include <memory>
#include <string>

namespace samchon
{
    namespace example
    {
        namespace packer
        {
            class WrapperArray;
            class Wrapper;
            class Product;

            class Packer
                : public std::vector<std::shared_ptr<WrapperArray>>
            {
            private:
                typedef std::vector<std::shared_ptr<WrapperArray>> super;

                std::vector<Product> *productArray;

                std::vector<Wrapper> *wrapperArray;

            public:
                /* ----------------------------------------------------------
                    CONSTRUCTORS
                ---------------------------------------------------------- */
                Packer(std::vector<Product> *, std::vector<Wrapper> *);

                Packer(const Packer &);

                /* ----------------------------------------------------------
                    CALCULATE AND OPTIMIZE
                ---------------------------------------------------------- */
                void optimize();

                auto calcPrice() const -> int;

```

```
                /* -------------------------------------------------------
                    EXPORT
                ------------------------------------------------------- */
                auto toString() const -> std::string;
            };
        };
    };
};
```

### examples/packer/WrapperArray.hpp

```
#pragma once
#include <vector>
#include <memory>

namespace samchon
{
    namespace example
    {
        namespace packer
        {
            class Wrapper;
            class Product;

            class WrapperArray
                : private std::vector<std::shared_ptr<Wrapper>>
            {
            private:
                typedef std::vector<std::shared_ptr<Wrapper>> super;

                std::vector<Product*> reserved;

                Wrapper *sample;

            public:
                /* -------------------------------------------------------
                    CONSTRUCTORS
                ------------------------------------------------------- */
                WrapperArray(Wrapper *);

                auto tryInsert(Product*) -> bool;

                /* -------------------------------------------------------
                    CALCULATE AND OPTIMIZE
                ------------------------------------------------------- */
                void optimize();

                auto calcPrice() const -> int;

                /* -------------------------------------------------------
                    EXPORT
                ------------------------------------------------------- */
                auto toString() const -> std::string;
            };
        };
    };
};
```

### examples/packer/Wrapper.hpp

```
#pragma once
#include <vector>
#include "Instance.hpp"

namespace samchon
{
    namespace example
    {
        namespace packer
        {
            class Product;

            class Wrapper
                : public Instance,
                private std::vector<Product*>
            {
            private:
                typedef Instance super;

            public:
                /* -------------------------------------------------------
                    CONSTRUCTORS
                ------------------------------------------------------- */
                Wrapper(const std::string &name, int price, int volume, int weight);

```

```
49                  Wrapper(const Wrapper &wrapper);
50                  virtual ~Wrapper() = default;
51
62                  auto tryInsert(Product *) -> bool;
63
64                  /* ----------------------------------------------------------
65                      EXPORT
66                  ---------------------------------------------------------- */
73                  virtual auto toString() const -> std::string override;
74              };
75          };
76      };
77 };
```

### examples/packer/Product.hpp

```
1 #pragma once
2 #include "Instance.hpp"
3
4 namespace samchon
5 {
6     namespace example
7     {
8         namespace packer
9         {
21              class Product
22                  : public Instance
23              {
24              private:
25                  typedef Instance super;
26
27              public:
28                  /* ----------------------------------------------------------
29                      CONSTRUCTOR
30                  ---------------------------------------------------------- */
39                  Product(const std::string &name, int price, int volume, int weight);
40                  virtual ~Product() = default;
41
42                  /* ----------------------------------------------------------
43                      EXPORT
44                  ---------------------------------------------------------- */
48                  virtual auto toString() const -> std::string override;
49              };
50          };
51      };
52 };
```

### examples/packer/Instance.hpp

```
1 #pragma once
2 #include <string>
3
4 namespace samchon
5 {
6     namespace example
7     {
8         namespace packer
9         {
21              class Instance
22              {
23              protected:
27                  std::string name;
28
32                  int price;
33
37                  int volume;
38
42                  int weight;
43
44              public:
45                  /* ----------------------------------------------------------
46                      CONSTRUCTORS
47                  ---------------------------------------------------------- */
56                  Instance(const std::string &name, int price, int volume, int weight);
57                  virtual ~Instance() = default;
58
59                  /* ----------------------------------------------------------
60                      GETTERS
61                  ---------------------------------------------------------- */
65                  auto getName() const -> std::string;
66
70                  auto getPrice() const -> int;
71
75                  auto getVolume() const -> int;
76
```

```
                auto getWeight() const -> int;

                /* -------------------------------------------------------
                    EXPORT
                ------------------------------------------------------- */
                virtual auto toString() const -> std::string;
            };
        };
    };
};
```

### examples/packer/main.cpp

```
#include <iostream>
#include <vector>

#include "Packer.hpp"
#   include "Product.hpp"
#   include "Wrapper.hpp"

#ifdef _WIN64
#   ifdef _DEBUG
#       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "x64/Release/SamchonFramework.lib")
#   endif
#else
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

using namespace std;
using namespace samchon::example::packer;

void main()
{
    vector<Product> productArray =
    {

        Product("Eraser", 500, 10, 70),
        Product("Pencil", 400, 30, 35),
        Product("Pencil", 400, 30, 35),
        Product("Pencil", 400, 30, 35),
        Product("Book", 8000, 150, 300),
        Product("Book", 8000, 150, 300),
        Product("Drink", 1000, 75, 250),
        Product("Umbrella", 4000, 200, 1000),
        Product("Notebook-PC", 800000, 150, 850),
        Product("Tablet-PC", 600000, 120, 450)
    };
    vector<Wrapper> wrapperArray =
    {
        Wrapper("Large", 100, 200, 1000),
        Wrapper("Medium", 70, 150, 500),
        Wrapper("Small", 50, 100, 250)
    };

    Packer packer(&productArray, &wrapperArray);
    packer.optimize();

    cout << packer.toString() << endl;
    system("pause");
}
```

### examples/packer/Packer.cpp

```
#include "Packer.hpp"

#include "WrapperArray.hpp"
#include "Wrapper.hpp"
#include "Product.hpp"

#include <samchon/library/CombinedPermutationGenerator.hpp>

using namespace std;
using namespace samchon::library;
using namespace samchon::example::packer;

Packer::Packer(vector<Product> *productArray, vector<Wrapper> *wrapperArray)
    : super()
{
    this->productArray = productArray;
```

```
    this->wrapperArray = wrapperArray;

    for(size_t i = 0; i < wrapperArray->size(); i++)
        emplace_back(new WrapperArray(&wrapperArray->at(i)));
}
Packer::Packer(const Packer &packer)
    : Packer(packer.productArray, packer.wrapperArray)
{
}

/* ---------------------------------------------------------
    CALCULATE AND OPTIMIZE
--------------------------------------------------------- */
void Packer::optimize()
{
    if(empty() == true || productArray->empty() == true)
        return;

    CombinedPermutationGenerator caseGenerator(size(), productArray->size());
    shared_ptr<Packer> minPacker = nullptr;

    for (size_t i = 0; i < caseGenerator.size(); i++)
    {
        vector<size_t> &row = caseGenerator[i];
        shared_ptr<Packer> packer(new Packer(*this));
        bool validity = true;

        for (size_t j = 0; j < row.size(); j++)
        {
            Product *product = &productArray->at(j);
            shared_ptr<WrapperArray> &wrapperArray = packer->at( row[j] );

            if (wrapperArray->tryInsert(product) == false)
            {
                validity = false;
                break;
            }
        }

        if(validity == false)
            continue;

        //OPTIMIZE ALL WRAPPERS IN A PACKER
        for (size_t j = 0; j < packer->size(); j++)
            packer->at(j)->optimize();

        if (minPacker == nullptr ||
            packer->calcPrice() < minPacker->calcPrice())
        {
            minPacker = packer;
        }
    }

    //COPY
    assign(minPacker->begin(), minPacker->end());
}
auto Packer::calcPrice() const -> int
{
    int price = 0;
    for (size_t i = 0; i < size(); i++)
        price += at(i)->calcPrice();

    return price;
}

/* ---------------------------------------------------------
    EXPORT
--------------------------------------------------------- */
auto Packer::toString() const -> string
{
    string str = "$" + to_string(calcPrice()) + "\n";
    for (int i = 0; i < size(); i++)
        str += at(i)->toString() + "\n";

    return move(str);
}
```

### examples/packer/WrapperArray.cpp

```
#include "WrapperArray.hpp"
#   include "Wrapper.hpp"
#   include "Product.hpp"

#include <samchon/library/FactorialGenerator.hpp>
#include <mutex>

```

```
using namespace std;
using namespace samchon::library;
using namespace samchon::example::packer;

/* ---------------------------------------------------------
    CONSTRUCTOR
--------------------------------------------------------- */
WrapperArray::WrapperArray(Wrapper *sample)
    : super()
{
    this->sample = sample;
}

/* ---------------------------------------------------------
    CALCULATE AND OPTIMIZE
--------------------------------------------------------- */
auto WrapperArray::tryInsert(Product *product) -> bool
{
    if (product->getVolume() > sample->getVolume() ||
        product->getWeight() > sample->getWeight())
    {
        return false;
    }

    reserved.push_back(product);
    return true;
}
void WrapperArray::optimize()
{
    if(reserved.empty() == true)
        return;

    FactorialGenerator factorial(reserved.size());
    shared_ptr<WrapperArray> minWrapperArray = nullptr;

    mutex mtx;

    //#pragma omp parallel for
    for (int i = 0; i < factorial.size(); i++)
    {
        shared_ptr<WrapperArray> wrapperArray(new WrapperArray(this->sample));
        vector<size_t> &row = factorial[i];

        for (size_t j = 0; j < row.size(); j++)
        {
            Product *product = this->reserved[row[j]];

            if (wrapperArray->empty() == true ||
                wrapperArray->at(wrapperArray->size() - 1)->tryInsert(product) == false)
            {
                Wrapper *wrapper = new Wrapper(*this->sample);
                wrapper->tryInsert(product);

                wrapperArray->emplace_back(wrapper);
            }
        }

        //unique_lock<mutex> uk(mtx);
        if (minWrapperArray == nullptr ||
            wrapperArray->size() < minWrapperArray->size())
        {
            minWrapperArray = wrapperArray;
        }
    }

    assign(minWrapperArray->begin(), minWrapperArray->end());
}
auto WrapperArray::calcPrice() const -> int
{
    return sample->getPrice() * (int)size();
}

/* ---------------------------------------------------------
    EXPORT
--------------------------------------------------------- */
auto WrapperArray::toString() const -> string
{
    string str = "Category - " + sample->getName() + "\n";
    for (size_t i = 0; i < size(); i++)
        str += at(i)->toString() + "\n";

    return move(str);
}
```

### examples/packer/Wrapper.cpp

```
#include "Wrapper.hpp"
#   include "Product.hpp"

using namespace std;
using namespace samchon::example::packer;

/* ---------------------------------------------------------
    CONSTRUCTORS
--------------------------------------------------------- */
Wrapper::Wrapper(const string &name, int price, int volume, int weight)
    : super(name, price, volume, weight),
    vector<Product*>()
{
}
Wrapper::Wrapper(const Wrapper &wrapper)
    : super(wrapper),
    vector<Product*>()
{
}

auto Wrapper::tryInsert(Product *product) -> bool
{
    int volume = 0;
    int weight = 0;

    for (size_t i = 0; i < size(); i++)
    {
        volume += at(i)->getVolume();
        weight += at(i)->getWeight();
    }

    if (product->getVolume() + volume > this->volume ||
        product->getWeight() + weight > this->weight)
    {
        return false;
    }

    push_back(product);
    return true;
}

/* ---------------------------------------------------------
    EXPORT
--------------------------------------------------------- */
auto Wrapper::toString() const -> string
{
    string str = "\tWrapper " + super::toString() + "\n";
    for (size_t i = 0; i < size(); i++)
        str += "\t\t" + at(i)->toString() + ((i == size() - 1) ? "" : "\n");

    return move(str);
};
```

### examples/packer/Product.cpp

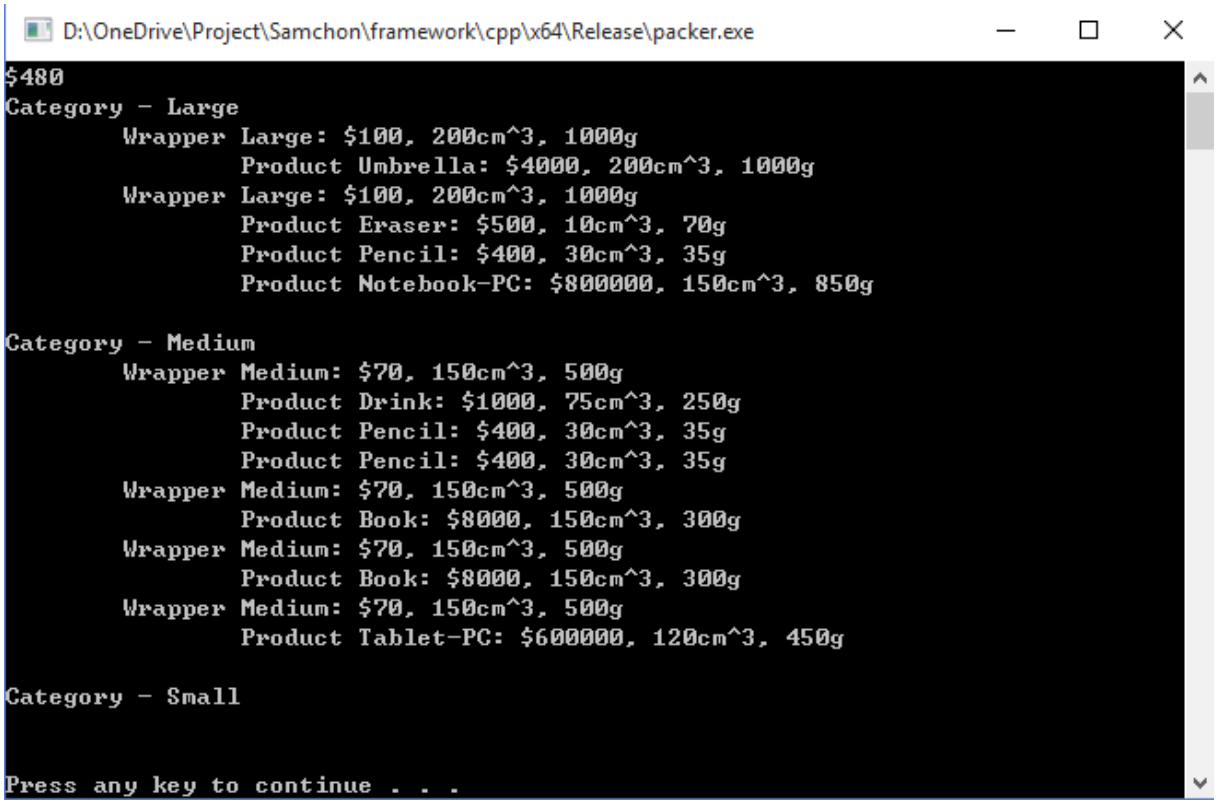
```
#pragma once
#include "Product.hpp"

using namespace std;
using namespace samchon::example::packer;

Product::Product(const string &name, int price, int volume, int weight)
    : super(name, price, volume, weight)
{
}
auto Product::toString() const -> string
{
    return "Product " + super::toString();
}
```

### examples/packer/Instance.cpp

```
#include "Instance.hpp"

#include <samchon/library/StringUtil.hpp>

using namespace std;
using namespace samchon::library;
using namespace samchon::example::packer;

/* ---------------------------------------------------------
    CONSTRUCTORS
--------------------------------------------------------- */
```

```
Instance::Instance(const string &name, int price, int volume, int weight)
{
    this->name = name;
    this->price = price;
    this->volume = volume;
    this->weight = weight;
}

/* -------------------------------------------------------
    GETTERS
------------------------------------------------------- */
auto Instance::getName() const -> string
{
    return name;
}
auto Instance::getPrice() const -> int
{
    return price;
}
auto Instance::getVolume() const -> int
{
    return volume;
}
auto Instance::getWeight() const -> int
{
    return weight;
}

/* -------------------------------------------------------
    EXPORT
------------------------------------------------------- */
auto Instance::toString() const -> string
{
    return StringUtil::substitute
        (
            "{1}: ${2}, {3}cm^3, {4}g",
            name, price, volume, weight
        );
}
```

### Result of the example



**See also**

samchon::library

**Author**

Jeongho Nam

### 6.3.2 Constructor & Destructor Documentation

#### 6.3.2.1 CaseGenerator ( size_t *n*, size_t *r* )

Construct from size of N and R.

**Parameters**

| | |
|---|---|
| *n* | Size of candidates |
| *r* | Size of elements of each case |

### 6.3.3 Member Function Documentation

#### 6.3.3.1 auto size ( ) const -> size_t

Get size of all cases.

**Returns**

Get a number of the all cases

#### 6.3.3.2 virtual auto operator[ ] ( size_t ) const -> std::vector< size_t > [pure virtual]

Get x'th case.

**Returns**

The row of the x'th in combined permuation case

Implemented in CombinedPermutationGenerator, and PermutationGenerator.

#### 6.3.3.3 auto at ( size_t *index* ) const -> std::vector<size_t>

CaseGenerator::operator[ ]()

#### 6.3.3.4 auto toMatrix ( ) const -> std::vector<std::vector<size_t>>

Create a matrix containing all cases.

**Warning**

Size of n or r is enourmouse, then stack overflow can be occured.

**Returns**

A matrix containing all cases.

The documentation for this class was generated from the following files:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/CaseGenerator.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/CaseGenerator.cpp

## 6.4 Charset Class Reference

A utility class supporting conversion between multiple character-sets.

```
#include <Charset.hpp>
```

### Static Public Member Functions

- static auto toMultibyte (const std::string &) -> std::string

  *Convert utf-8 to multibyte.*

- static auto toMultibyte (const std::wstring &) -> std::string

  *Convert unicode to multibyte.*

- static auto toUTF8 (const std::string &) -> std::string

  *Convert multibyte to utf-8.*

- static auto toUTF8 (const std::wstring &) -> std::string

  *Convert unicode to utf-8.*

- static auto toUnicode (const std::string &, int) -> std::wstring

  *Convert multibyte or utf-8 to unicode.*

### 6.4.1 Detailed Description

A utility class supporting conversion between multiple character-sets.

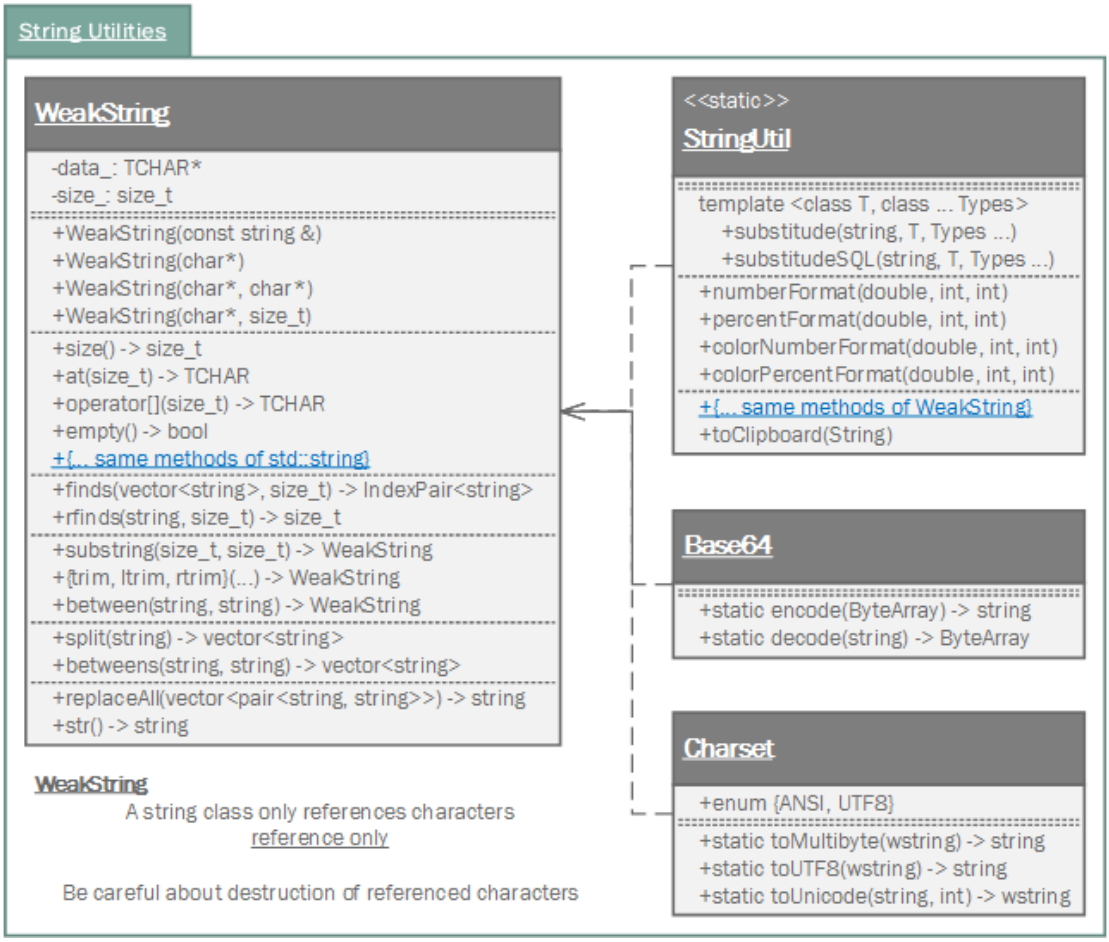
Charset class, it's easier to think iconv in linux

Supported character-sets

- Multibyte (ANSI)

- UTF-8

- Unicode (UTF-16)




**Warning**

In some system, std::wstring is not for utf-8 but for unicode (utf-16).

**See also**

samchon::library

**Author**

Jeongho Nam

### 6.4.2 Member Function Documentation

#### 6.4.2.1 static auto toMultibyte ( const std::string & ) -> std::string [static]

Convert utf-8 to multibyte.

Converts utf-8 string to multibyte string.

If the utf-8 string has header int the front, it will be erased.

**Warning**

If utf-8 header is not at the front of string, it can't be erased and may cause breakage on letters

**Parameters**

| | |
|---|---|
| *str* | A utf-8 string would be converted to multibyte |

**Returns**

A multibyte string

#### 6.4.2.2 static auto toMultibyte ( const std::wstring & ) -> std::string [static]

Convert unicode to multibyte.

Converts unicode string to multibyte string
If the unicode string has header in the front, it will be erased

**Warning**

If unicode header is not at the front of string, it can't be erased and may cause breakage on letters

**Parameters**

| | |
|---|---|
| *str* | A unicode string to be converted |

**Returns**

A multibyte string

#### 6.4.2.3 static auto toUTF8 ( const std::string & ) -> std::string [static]

Convert multibyte to utf-8.

Converts multibyte string to utf-8 string
If the inputted string is not multibyte, then may cause breakage on letters

**Warning**

Converted utf-8 string does not contain the header

**Parameters**

| | |
|---|---|
| *str* | A multibyte string would be converted |

**Returns**

A utf-8 string

#### 6.4.2.4 static auto toUTF8 ( const std::wstring & ) -> std::string [static]

Convert unicode to utf-8.

Converts unicode string to utf-8 string
Generated utf-8 string follows unicode string wheter to have header or not

- If the unicode string has header on first, utf-8 will also have the header, too
- If not, generated utf-8 string doesn't have the header, either

**Parameters**

| | |
|---|---|
| *str* | A unicode string would be converted |

**Returns**

A utf-8 string

#### 6.4.2.5 static auto toUnicode ( const std::string & , int ) -> std::wstring [static]

Convert multibyte or utf-8 to unicode.

**Parameters**

| | |
|---|---|
| *str* | A multibyte or utf-8 string would be converted |
| *Designate* | str is multibyte or utf-8 string |

**Returns**

A unicode string

The documentation for this class was generated from the following file:

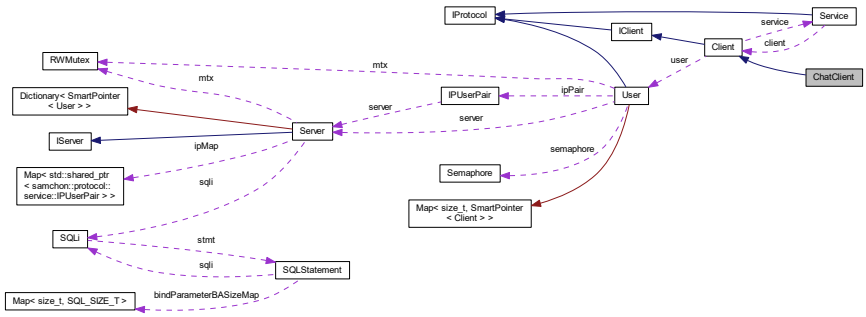
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Charset.hpp

## 6.5 ChatClient Class Reference

A client.

`#include <ChatClient.hpp>`

Collaboration diagram for ChatClient:




### Public Member Functions

- ChatClient (protocol::service::User *)

  *Construct from an user.*

### Protected Member Functions

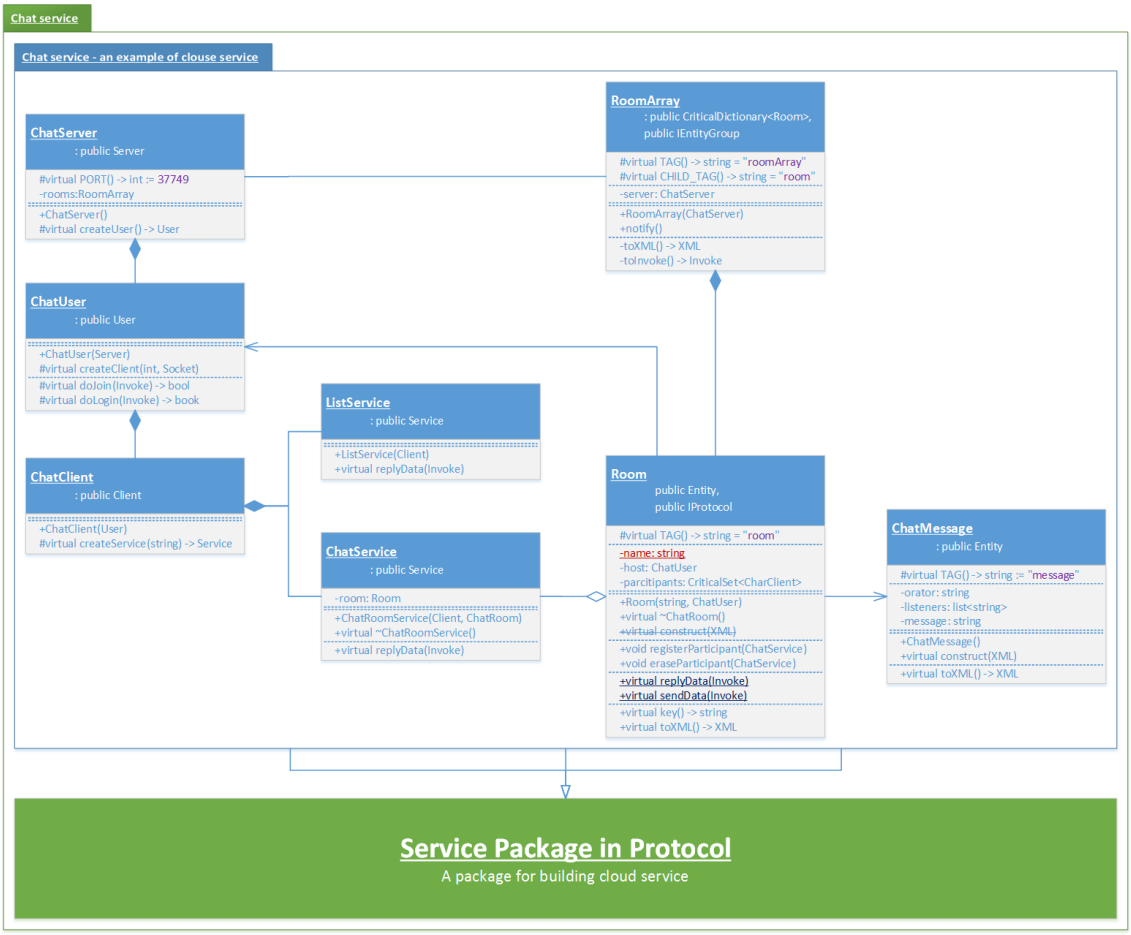
- auto createService (const std::string &) -> protocol::service::Service *override

  *Factory method of Service.*

## Additional Inherited Members

### 6.5.1 Detailed Description

A client.




**Author**

Jeongho Nam

### 6.5.2 Member Function Documentation

#### 6.5.2.1 auto createService ( const std::string & ) -> protocol::service::Service *override [override], [protected], [virtual]

Factory method of Service.

**Parameters**

| | |
|---|---|
| *name* | Requested name representing a Service from the (physical) client |

**Returns**

A new Service belongs the the Client

Implements Client.

The documentation for this class was generated from the following file:

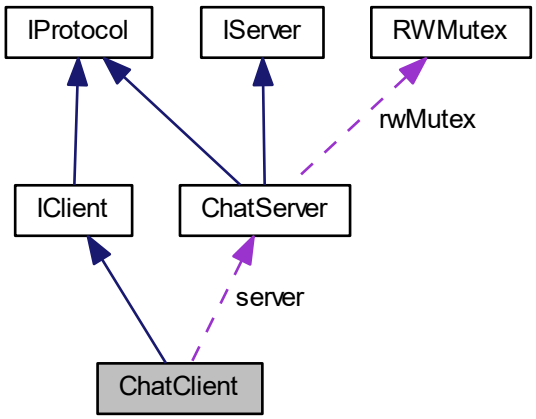
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/chat_service/ChatClient.hpp

## 6.6 ChatClient Class Reference

A chat client.

`#include <ChatClient.hpp>`

Collaboration diagram for ChatClient:




### Public Member Functions

- ChatClient (ChatServer ∗, protocol::Socket ∗)

  *Construct from a server and socket.*
- virtual ∼ChatClient ()

  *Default Destructor.*
- virtual void replyData (std::shared_ptr< protocol::Invoke >) override

  *Shift responsibility to related chain.*

### Private Attributes

- ChatServer ∗ server

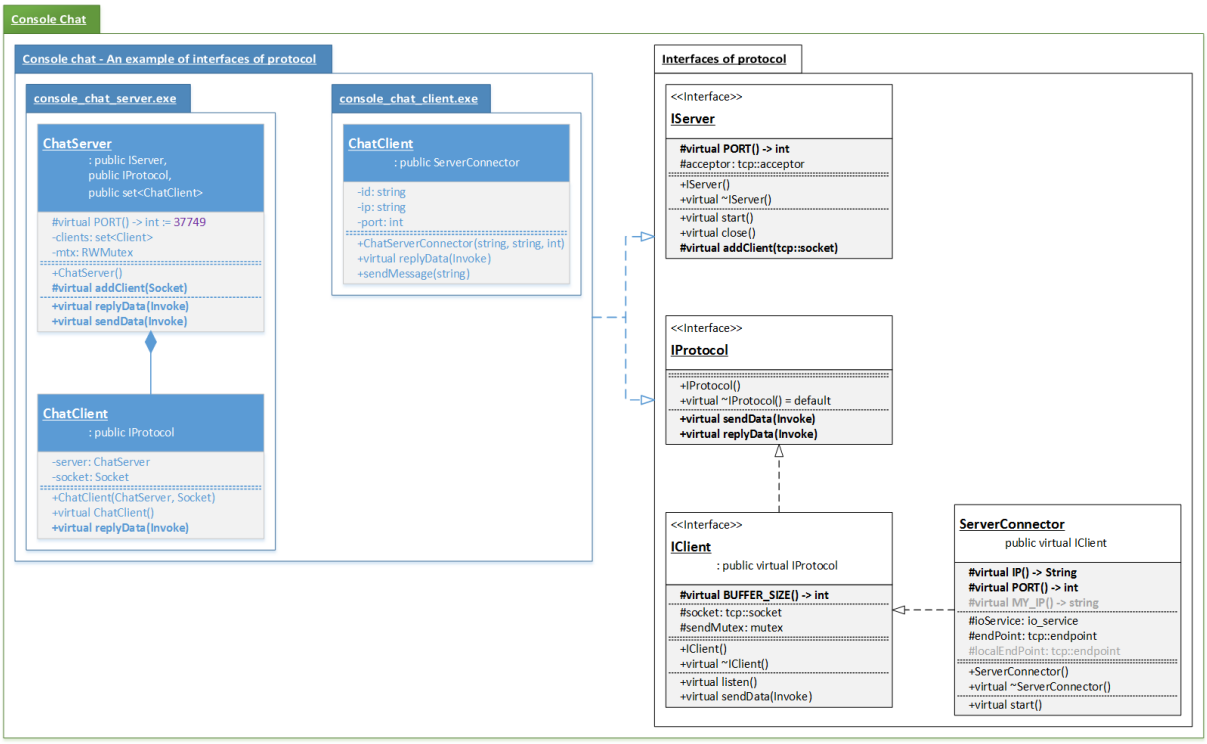
  *A ChatServer that the ChatClient is belonged to.*

### Additional Inherited Members

### 6.6.1 Detailed Description

A chat client.

A simple chat client belonged to a chat server




**Author**

Jeongho Nam

## 6.6.2 Constructor & Destructor Documentation

### 6.6.2.1 ChatClient ( ChatServer * *server*, protocol::Socket * *socket* )

Construct from a server and socket.

**Parameters**

| | |
|---|---|
| *server* | A server the client is belonged to. |
| *socket* | A socket interacting with physical client. |

### 6.6.2.2 ~ChatClient ( ) [virtual]

Default Destructor.

Erase from ChatServer::clientSet.

## 6.6.3 Member Function Documentation

### 6.6.3.1 void replyData ( std::shared_ptr< protocol::Invoke > ) [override], [virtual]

Shift responsibility to related chain.

Call ChatServer::replyData().

The documentation for this class was generated from the following files:

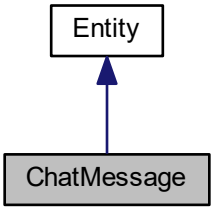
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/console_chat_server/ChatClient.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/console_chat_server/ChatClient.cpp

## 6.7 ChatMessage Class Reference

A chat message.

`#include <ChatMessage.hpp>`

Collaboration diagram for ChatMessage:




### Public Member Functions

- ChatMessage ()

  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >)

  *Construct data of the Entity from an XML object.*
- auto getListener () const -> std::string

  *Get listener.*
- virtual auto toXML () const -> std::shared_ptr< library::XML >

  *Get an XML object represents the Entity.*

### Protected Member Functions

- virtual auto TAG () const -> std::string

  *A tag name when represented by XML.*

### Private Attributes

- std::string orator

  *An orator, who told.*
- std::string listener

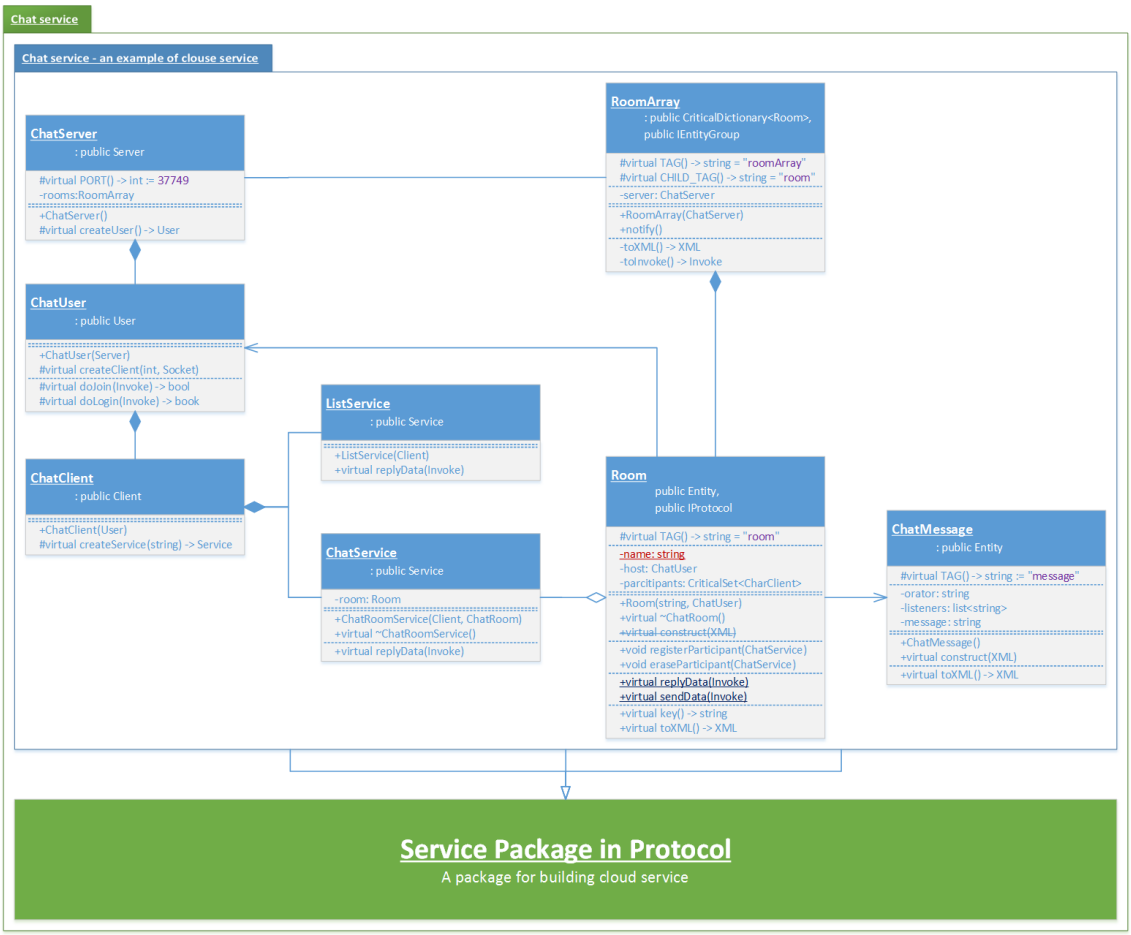
  *A listener, target of whispering.*
- std::string message

  *A message, what to say.*

### 6.7.1 Detailed Description

A chat message.

An entity class representing a chat message.




**Author**

Jeongho Nam

## 6.7.2 Member Function Documentation

### 6.7.2.1 virtual auto TAG ( ) const -> std::string [inline], [protected], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

### 6.7.2.2 void construct ( std::shared_ptr< library::XML > ) [virtual]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Implements Entity.

#### 6.7.2.3 auto getListener ( ) const -> std::string

Get listener.

Used to determine which (physical) client will get the message.

#### 6.7.2.4 auto toXML ( ) const -> std::shared_ptr<library::XML> [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

### 6.7.3 Member Data Documentation

#### 6.7.3.1 std::string listener [private]

A listener, target of whispering.

If there's not a listener to whisper, the value is "ALL".

The documentation for this class was generated from the following files:

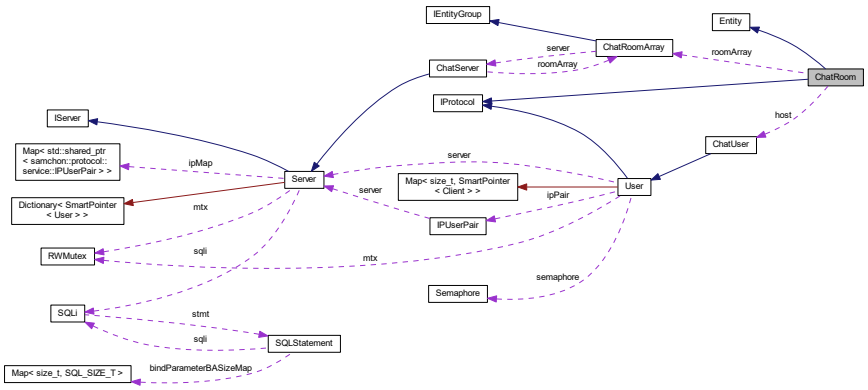
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/chat_service/ChatMessage.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/chat_service/ChatMessage.cpp

## 6.8 ChatRoom Class Reference

A chat room.

```
#include <ChatRoom.hpp>
```

Collaboration diagram for ChatRoom:




## Public Member Functions

- ChatRoom (ChatRoomArray ∗, const std::string &, ChatUser ∗)

  *Construct from rooms, name and host.*
- void registerClient (ChatService ∗)

  *Register a participant client.*
- void eraseClient (ChatService ∗)

  *Erase a participant client.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the Entity.*

## Protected Member Functions

- virtual auto TAG () const -> std::string

  *A tag name when represented by XML.*

## Private Attributes

- ChatRoomArray ∗ roomArray

  *All rooms that the room is belonged to.*
- std::string name

  *Name of the room.*
- ChatUser ∗ host

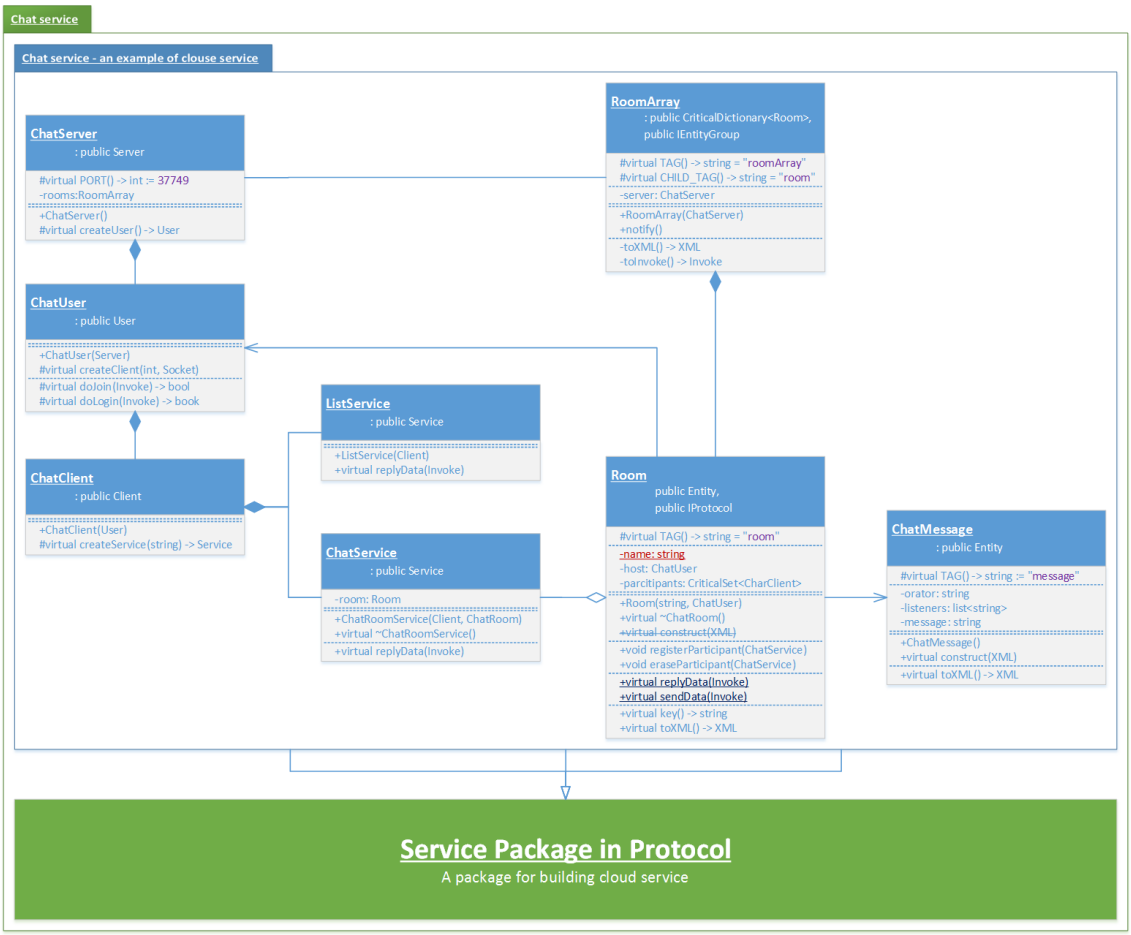
  *A host, who established the room.*
- library::CriticalSet< ChatService ∗ > participants

  *Participants, ChatUser(s) in the room.*

### 6.8.1 Detailed Description

A chat room.

An entity class representing a chat room containing participants. The ChatRoom class takes a responsibility of Invoke message chain between clients (participating ChatUser(s)) objects.




**Author**

Jeongho Nam

## 6.8.2 Constructor & Destructor Documentation

### 6.8.2.1 ChatRoom ( ChatRoomArray * , const std::string & , ChatUser * )

Construct from rooms, name and host.

**Parameters**

| | |
|---|---|
| *rooms* | Rooms managing ChatRoom(s). |
| *name* | Name of the room, the identifier. |
| *host* | A host who established the room. |

## 6.8.3 Member Function Documentation

### 6.8.3.1 virtual auto TAG ( ) const -> std::string [inline], [protected], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

#### 6.8.3.2 void registerClient ( ChatService * *service* )

Register a participant client.

Registers a participant and notify the participation to another clients.

#### 6.8.3.3 void eraseClient ( ChatService * *service* )

Erase a participant client.

Erases a participant and notify others about the exiting.

#### 6.8.3.4 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

### 6.8.4 Member Data Documentation

#### 6.8.4.1 std::string name [private]

Name of the room.

The name is the identifier of the ChatRoom.

The documentation for this class was generated from the following files:

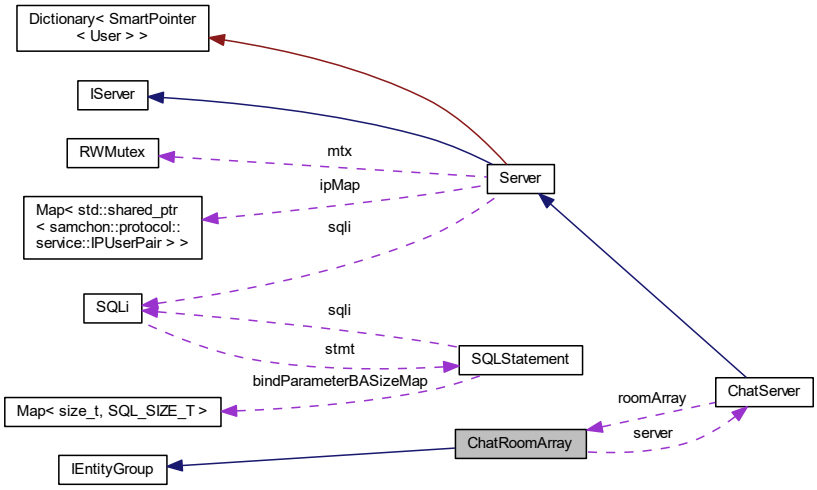
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/chat_service/ChatRoom.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/chat_service/ChatRoom.cpp

## 6.9 ChatRoomArray Class Reference

A manager of chat rooms.

```
#include <ChatRoomArray.hpp>
```

Collaboration diagram for ChatRoomArray:




## Public Member Functions

- ChatRoomArray (ChatServer *)

  *Construct from a chat server.*
- void notify ()

  *Notify changes of chat rooms.*

## Protected Member Functions

- virtual auto CHILD_TAG () const -> std::string

  *A tag name of children.*

## Private Member Functions

- auto toXML () const -> std::shared_ptr< library::XML >

  *Get an XML object representing the ChatRoomArray.*
- auto toInvoke () const -> std::shared_ptr< protocol::Invoke >

  *Get an Invoke message used to notifying change.*

## Private Attributes

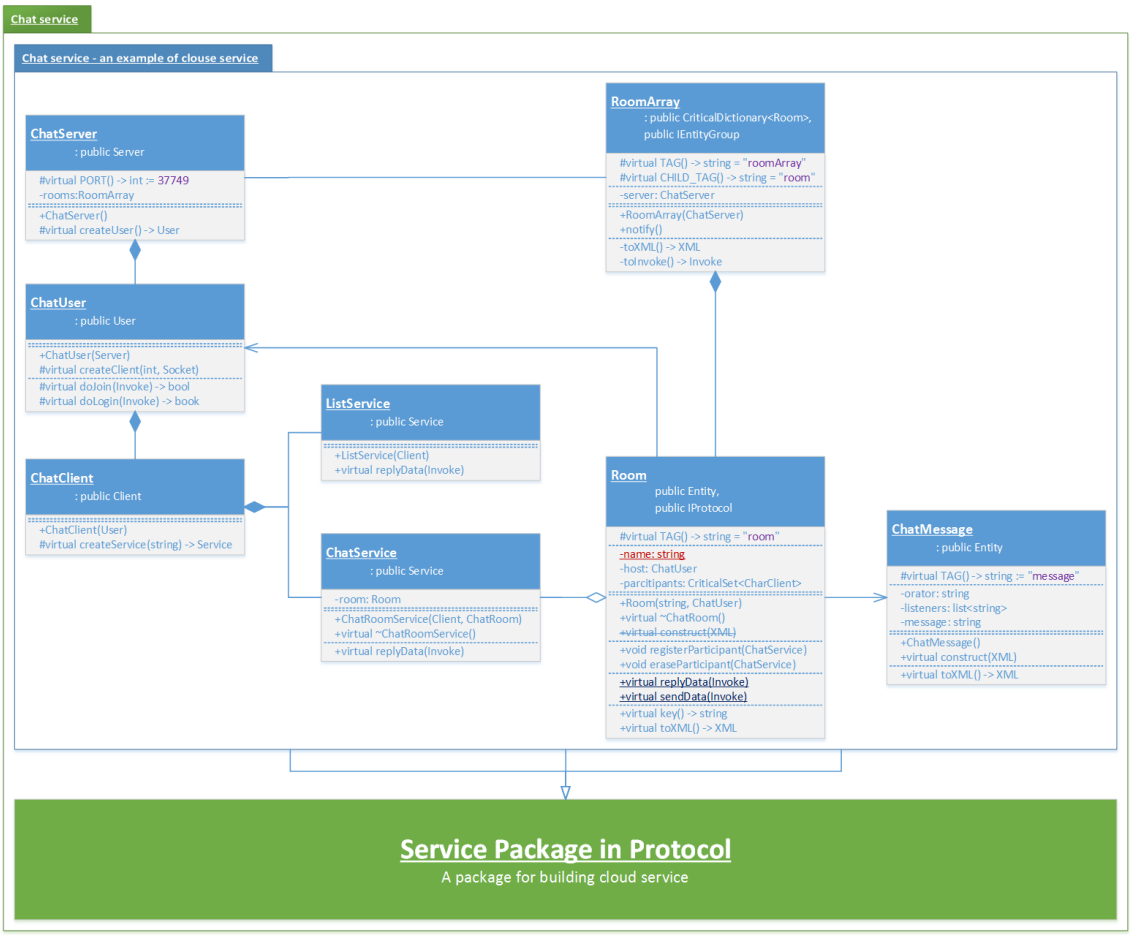
- ChatServer * server

  *A chat server that rooms are belonged to.*

### 6.9.1 Detailed Description

A manager of chat rooms.

An entity list of chat rooms and a manager of chat rooms taking a responsibility of notifying changes of children chat rooms to a related chat server.




**Author**

Jeongho Nam

## 6.9.2 Member Function Documentation

### 6.9.2.1 virtual auto CHILD_TAG ( ) const -> std::string [inline], [protected], [virtual]

A tag name of children.

< TAG>
<CHILD_TAG />
<CHILD_TAG />
</TAG>

Implements IEntityGroup.

### 6.9.2.2 void notify ( )

Notify changes of chat rooms.

Notify changes of chat rooms to all clients in the chat server.

The documentation for this class was generated from the following files:

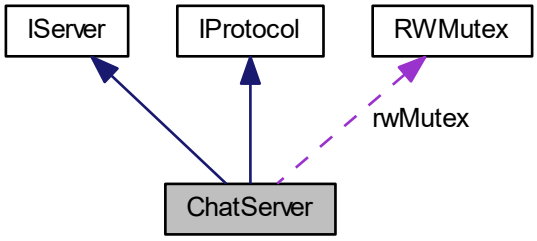
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/chat_service/ChatRoomArray.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/chat_service/ChatRoomArray.cpp

## 6.10 ChatServer Class Reference

A chat server.

`#include <ChatServer.hpp>`

Collaboration diagram for ChatServer:




### Public Member Functions

- ChatServer ()

  *Default Constructor.*
- void eraseClient (ChatClient *client)

  *Erase client when disconnected.*
- virtual void replyData (std::shared_ptr< protocol::Invoke >) override

  *Handling replied message.*
- virtual void sendData (std::shared_ptr< protocol::Invoke >) override

  *Sending a message.*

### Protected Member Functions

- virtual auto PORT () const -> int override

  *Port number: #33749.*
- virtual void addClient (protocol::Socket *socket) override

  *Add a client.*

### Private Attributes

- std::set< ChatClient * > clientSet

  *List of clients.*
- library::RWMutex rwMutex

  *A rw_mutex managing clientSet.*

### Additional Inherited Members

### 6.10.1 Detailed Description

A chat server.

**Author**

Jeongho Nam

### 6.10.2 Member Function Documentation

#### 6.10.2.1 void replyData ( std::shared_ptr< protocol::Invoke > ) [override], [virtual]

Handling replied message.

When got a message from a client, sends the message to all clients.

**Parameters**

| | |
|---|---|
| *invoke* | An invoke message represents a chat. |

#### 6.10.2.2 void sendData ( std::shared_ptr< protocol::Invoke > ) [override], [virtual]

Sending a message.

Send a message to all clients. Called by replyData().

**Parameters**

| | |
|---|---|
| *invoke* | An invoke message represents a chat. |

The documentation for this class was generated from the following files:

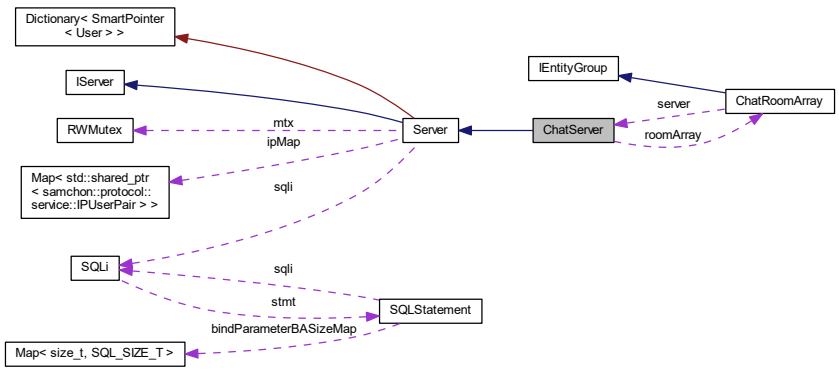
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/console_chat_server/ChatServer.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/console_chat_server/ChatServer.cpp

## 6.11 ChatServer Class Reference

A chat server.

`#include <ChatServer.hpp>`

Collaboration diagram for ChatServer:




### Public Member Functions

- ChatServer ()

*Default Constructor.*

- auto getChatRoomArray () const -> ChatRoomArray *

  *Get chat room list.*

## Protected Member Functions

- virtual auto PORT () const -> int override

  *Port number of the server.*

- virtual auto createUser () -> protocol::service::User *override

  *Factory method of User.*

## Private Attributes

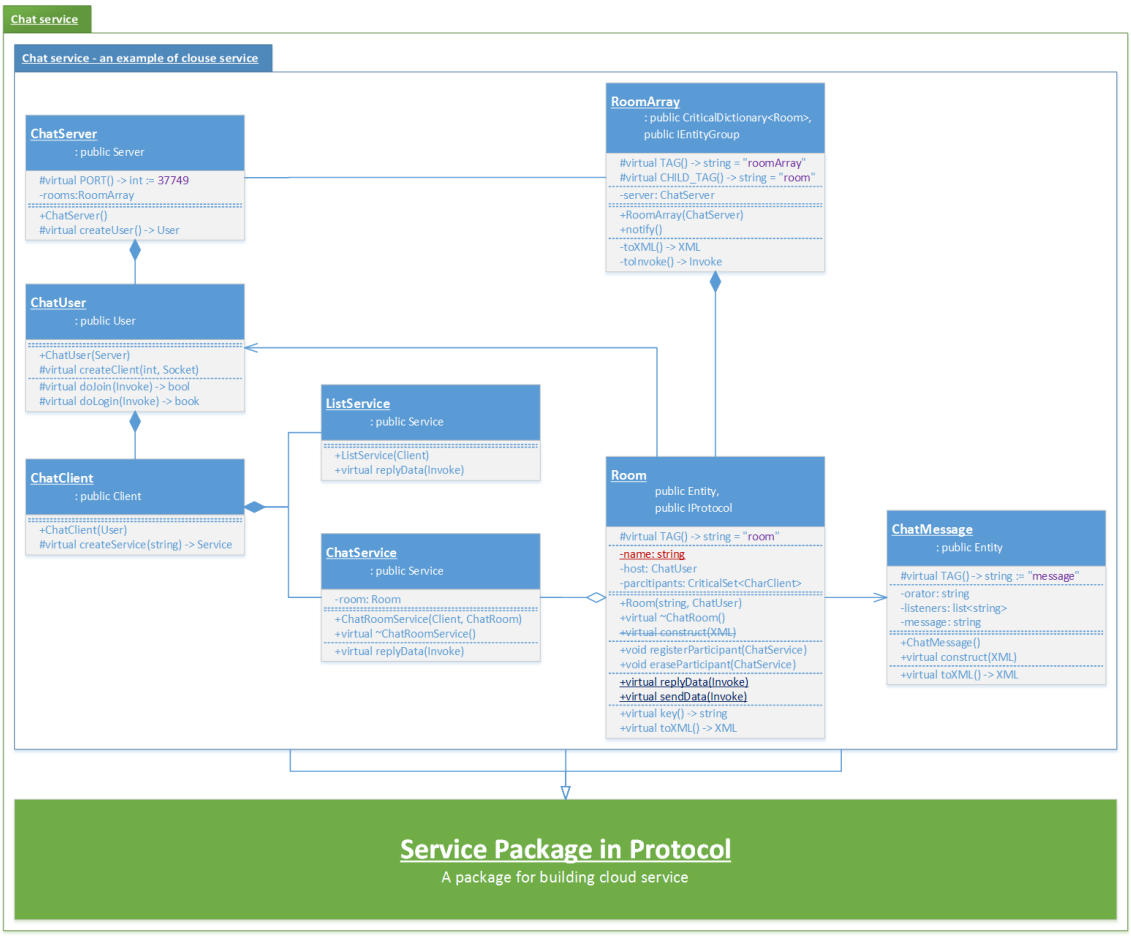
- ChatRoomArray * roomArray

  *A manager of chat rooms.*

## Additional Inherited Members

### 6.11.1 Detailed Description

A chat server.



**Author**

Jeongho Nam

The documentation for this class was generated from the following file:

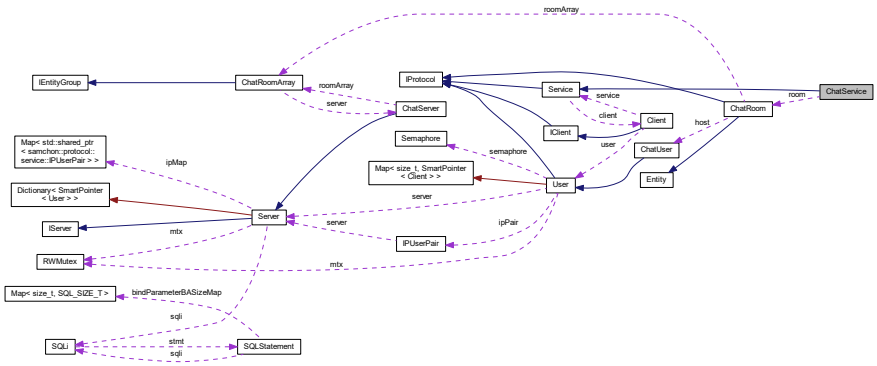
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/chat_service/ChatServer.hpp

## 6.12 ChatService Class Reference

A chat service.

`#include <ChatService.hpp>`

Collaboration diagram for ChatService:




### Public Member Functions

- ChatService (protocol::service::Client ∗)

  *Construct from a client.*

### Private Attributes

- ChatRoom ∗ room

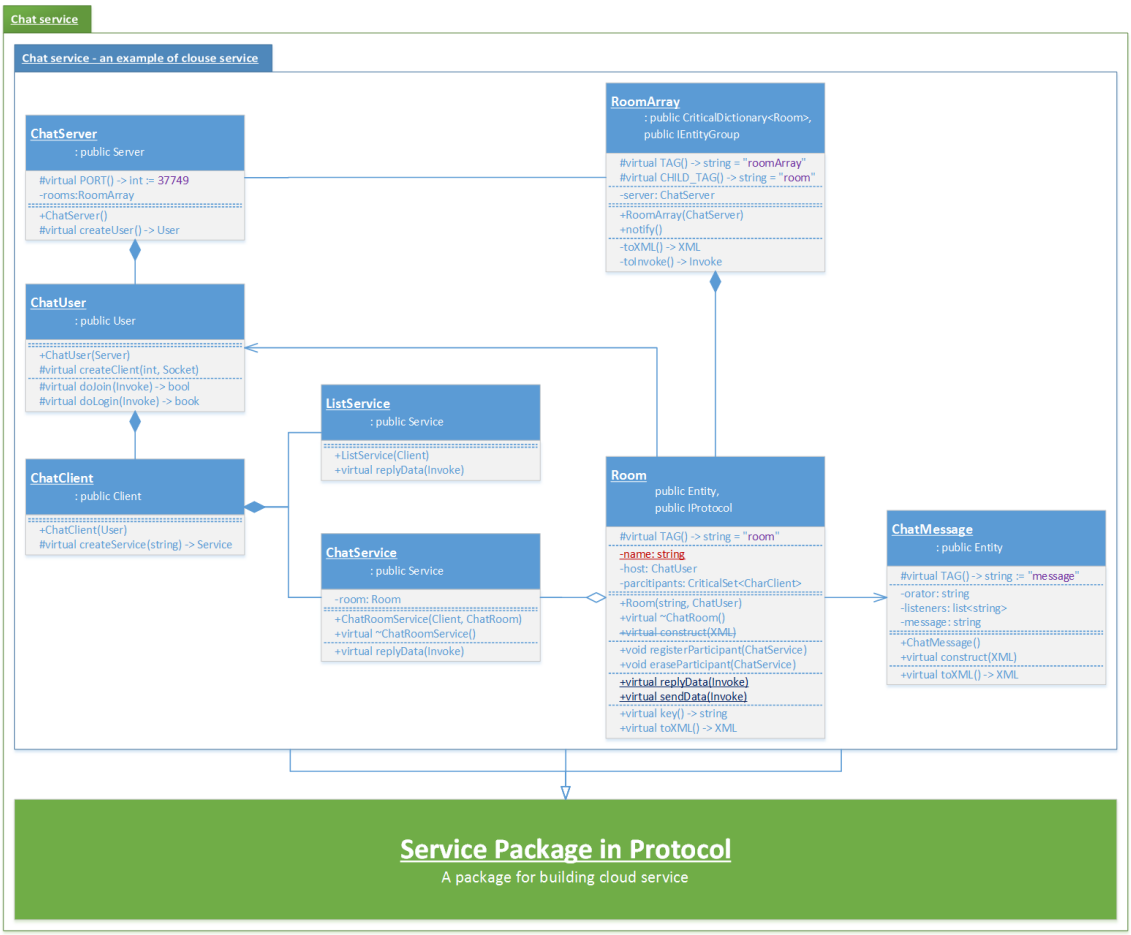
  *A chat room.*

### Additional Inherited Members

### 6.12.1 Detailed Description

A chat service.

A chat service about a chat room.




**Author**

Jeongho Nam

### 6.12.2 Member Data Documentation

#### 6.12.2.1 ChatRoom* room [private]

A chat room.

A chat room that related client is participating in.

The documentation for this class was generated from the following files:

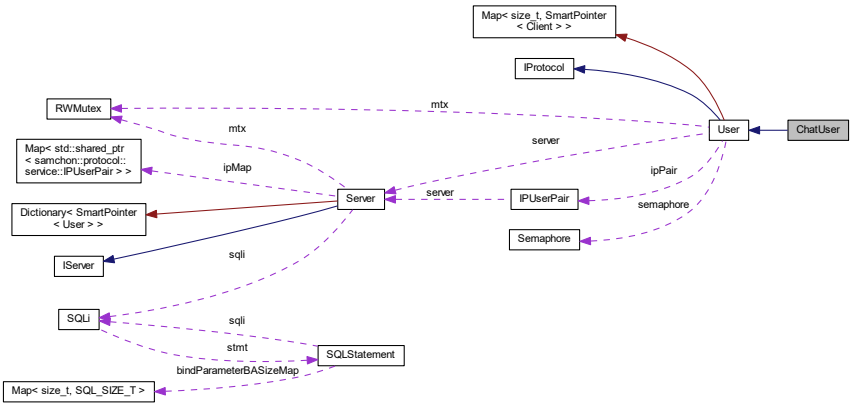
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/chat_service/ChatService.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/chat_service/ChatService.cpp

## 6.13 ChatUser Class Reference

An user in chat server.

```
#include <ChatUser.hpp>
```

Collaboration diagram for ChatUser:




## Public Member Functions

- ChatUser (protocol::service::Server ∗)

  *Construct from server.*

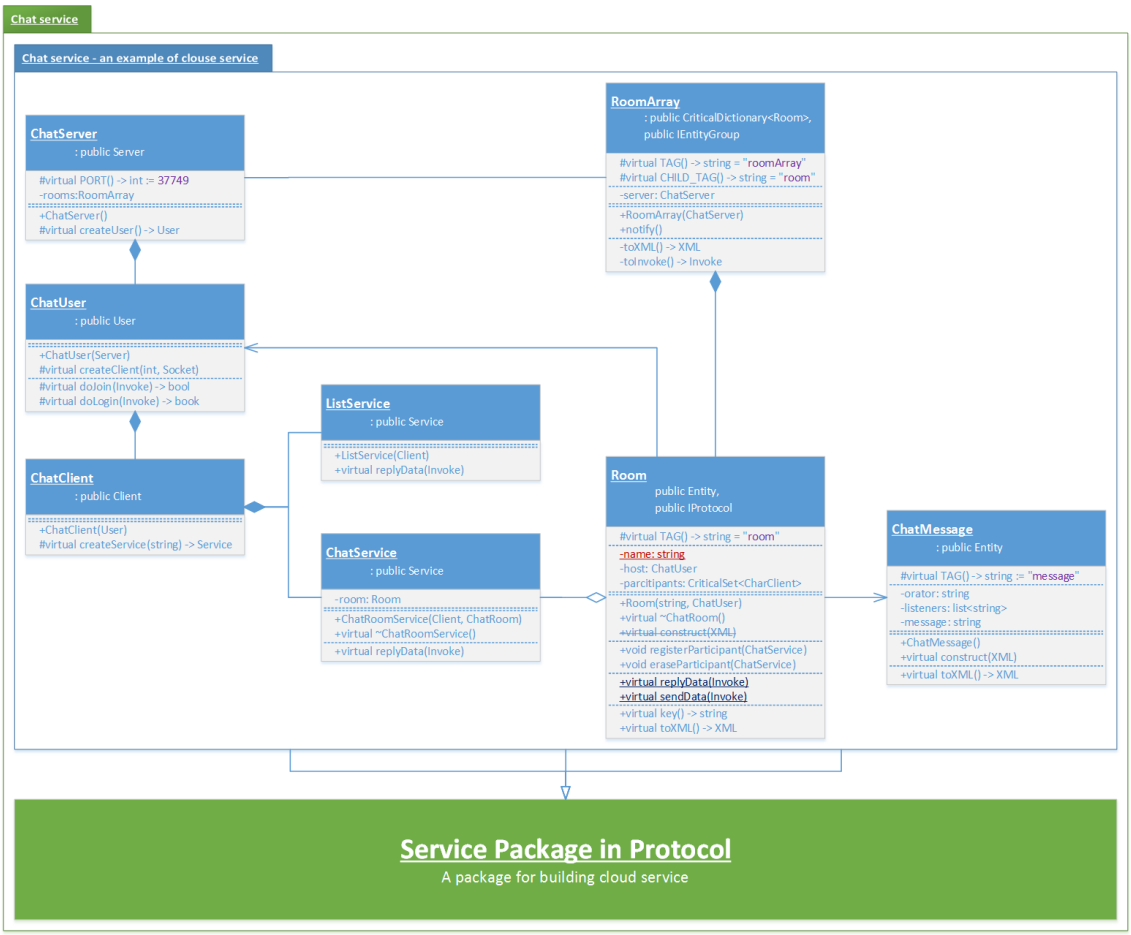
## Protected Member Functions

- virtual auto createClient () -> protocol::service::Client ∗override

  *Factory method of a Client.*

### 6.13.1 Detailed Description

An user in chat server.




**Author**

Jeongho Nam

The documentation for this class was generated from the following file:

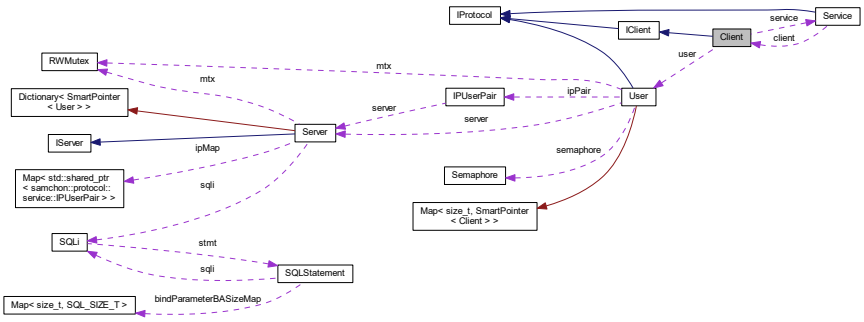
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/chat_service/ChatUser.hpp

## 6.14 Client Class Reference

A network boundary with the client in an User.

```
#include <Client.hpp>
```

Collaboration diagram for Client:




## Public Member Functions

- Client (User ∗)

  *Construct from User, No and socket.*
- auto getUser () const -> User ∗

  *Get User.*
- auto getService () const -> Service ∗

  *Get Service.*
- auto getNo () const -> size_t

  *Get no.*
- void sendData (std::shared_ptr< Invoke >)

  *Send Invoke message to (physical) client.*
- void replyData (std::shared_ptr< Invoke >)

  *Reply Invoke message from (physical) client.*

## Protected Member Functions

- virtual auto createService (const std::string &) -> Service ∗=0

  *Factory method of Service.*

## Protected Attributes

- User ∗ user

  *An User of the Client.*
- size_t no

  *A sequence number of the Client in an User.*
- Service ∗ service

  *A Service belongs to the Client.*

## Private Member Functions

- void constructService (const std::string &)

  *Construct Service.*

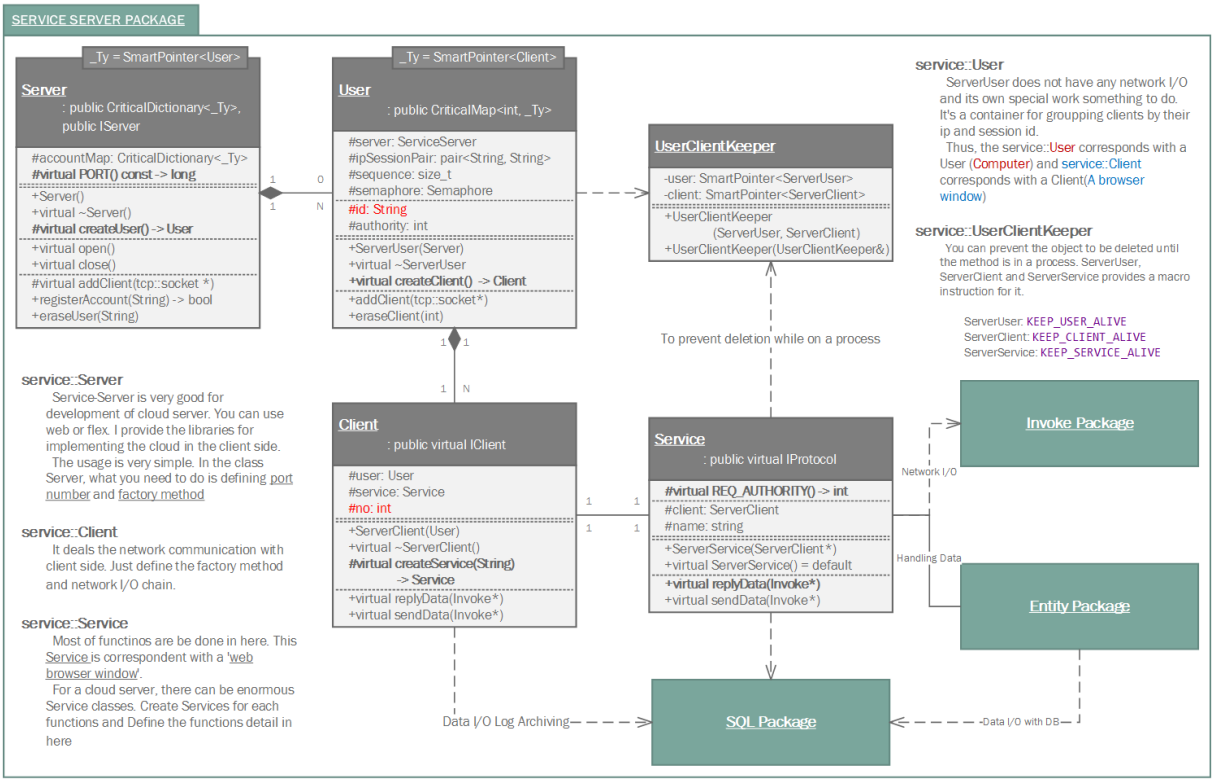
### 6.14.1 Detailed Description

A network boundary with the client in an User.

Client is an object interacting with physical client by socket.

The Client is correspond with a Window in JS (UI) 1:1

- A Window, the object in UI
- A Window, matching with window of a internet browser




#### Note

Method to override

- createUser()

#### See also

samchon::protocol
samchon::protocol::service

#### Author

Jeongho Nam

### 6.14.2 Constructor & Destructor Documentation

#### 6.14.2.1 Client ( User * *user* )

Construct from User, No and socket.

**Parameters**

| | |
|---|---|
| *user* | An User containing the Client |

### 6.14.3 Member Function Documentation

#### 6.14.3.1 virtual auto createService ( const std::string & ) -> Service * [protected], [pure virtual]

Factory method of Service.

**Parameters**

| | |
|---|---|
| *name* | Requested name representing a Service from the (physical) client |

**Returns**

A new Service belongs the the Client

Implemented in ChatClient.

#### 6.14.3.2 void sendData ( std::shared_ptr< Invoke > ) [virtual]

Send Invoke message to (physical) client.

Method sendData of Client does not only send Invoke message to client system, but also archives the Invoke message to database system as a historical-log.

**Note**

Method sendData monopolies a critical section.

How many threads have called that sendData, the Invoke messages are delivered sequentially.

- Using sendData with a new thread is not recommended

**Warning**

You can't override this method, sendData.

**Parameters**

| | |
|---|---|
| *invoke* | Invoke message to send |

Reimplemented from IClient.

#### 6.14.3.3 void replyData ( std::shared_ptr< Invoke > ) [virtual]

Reply Invoke message from (physical) client.

Handles replied Invoke message from client system.

1. Constructs Service
   - Constructs Service by requested service name.
   - Notifies client system whether the user satisfies the authority.
2. Shifts responsibility to related chain.

- Invoke message is about member (join, login, etc.), shift to User.
- Except that all, shifts to Service.

3. Archives the Invoke message to Database system as a historical-log.
   - Invoke to HISTORY_INVOKE table, with User's session and Client's sequence id.
   - InvokeParameters(s) to HISTORY_INVOKE_PARAMETER with key of HISTORY_INVOKE as foriegn key.

#### Note

#### Historical-log

HISTORY_INVOKE and HISTORY_INVOKE_PARAMETER has a 1:N relationship

If you want to modify archiving method, override method of Server::archiveReplyData()

#### Shifting responsibility to Service

Service::replyData will be called by a new thread. The thread will acquire an admission from semaphore in User to avoid exhausted allocation of threads.

#### Exception handling

If an std::exception has thrown from Service::replyData, the exception will archived in Database (HISTORY_INV↩OKE_EXCEPTION)

The most famous thrown parameters like std::exception, std::invalid_argument and std::runtime_error, those are all derived from std::exception.
-> http://www.cplusplus.com/reference/stdexcept/

- std::exception
  - std::logic_error
    - std::domain_error
    - std::invalid_argument
    - std::length_error
    - std::out_of_range
    - std::future_error
  - std::runtime_error
    - std::range_error
    - std::overflow_error
    - std::underflow_error
    - std::system_error

#### Warning

You can't override this method, replyData.

If you want to modify replyData's rule, override related objects' replyData

**Parameters**

| | |
|---|---|
| *invoke* | Invoke message replied from client system |

Reimplemented from IProtocol.

#### 6.14.3.4 void constructService ( const std::string & *name* ) [private]

Construct Service.

Constructs Service by requested name from client and notify whether the User is satisfying authority.

**Parameters**

| | |
|---|---|
| *name* | A name representing type of Service |

The documentation for this class was generated from the following files:

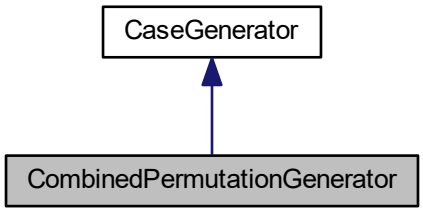
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/service/Client.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/service/Client.cpp

## 6.15 CombinedPermutationGenerator Class Reference

A combined-permutation case generator.

`#include <CombinedPermutationGenerator.hpp>`

Collaboration diagram for CombinedPermutationGenerator:




### Public Member Functions

- CombinedPermutationGenerator (size_t n, size_t r)

  *Construct from size of N and R.*
- virtual auto operator[ ] (size_t) const -> std::vector< size_t > override

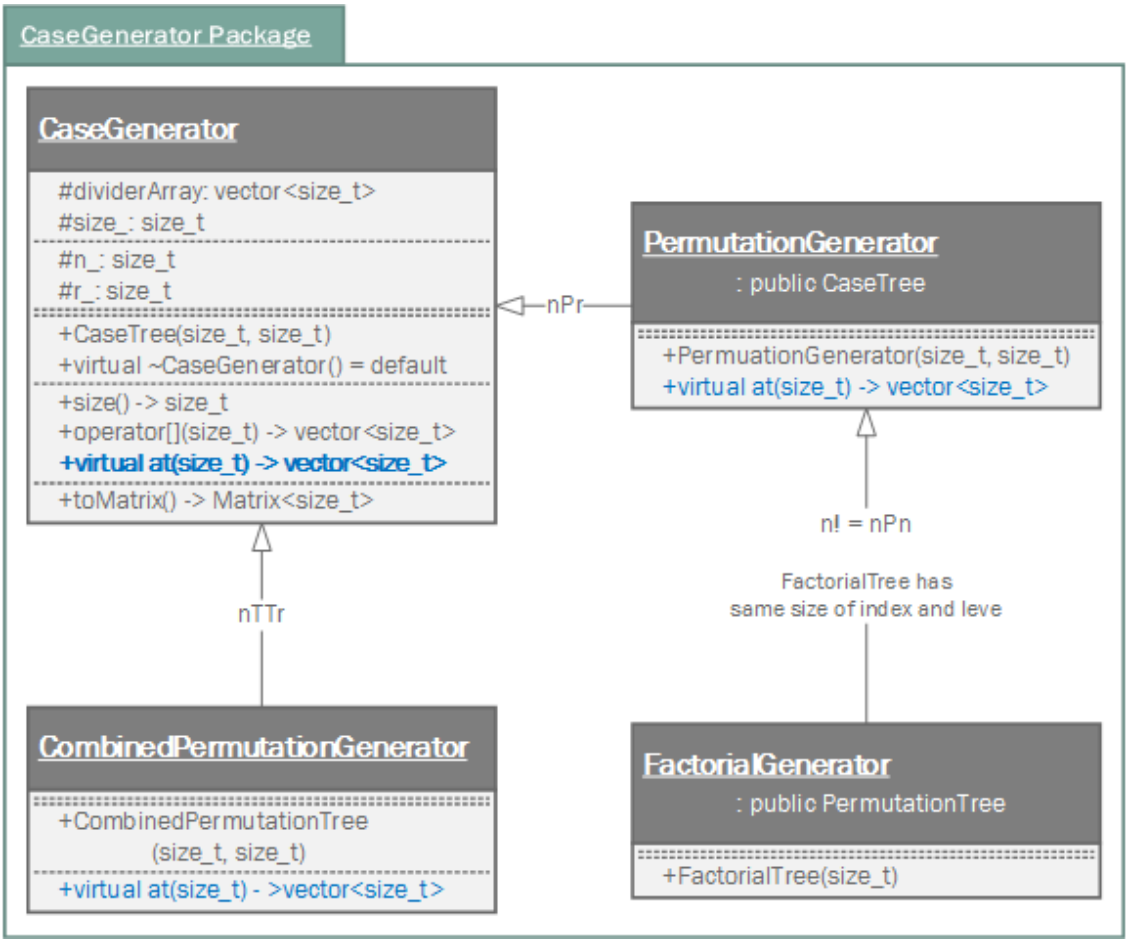
  *Get x'th case.*

### Additional Inherited Members

### 6.15.1 Detailed Description

A combined-permutation case generator.

$_nTT_r$




**See also**

samchon::library

**Author**

Jeongho Nam

### 6.15.2 Constructor & Destructor Documentation

#### 6.15.2.1 CombinedPermutationGenerator ( size_t *n*, size_t *r* )

Construct from size of N and R.

**Parameters**

| | |
|---|---|
| *n* | Size of candidates |
| *r* | Size of elements of each case |

### 6.15.3 Member Function Documentation

#### 6.15.3.1 auto operator[] ( size_t ) const -> std::vector< size_t > [override], [virtual]

Get x'th case.

**Returns**

The row of the x'th in combined permuation case

Implements CaseGenerator.

The documentation for this class was generated from the following files:

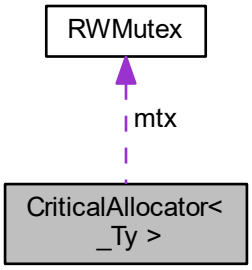
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/CombinedPermutationGenerator.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/CombinedPermutationGenerator.cpp

## 6.16 CriticalAllocator< _Ty > Class Template Reference

An allocator ensuring concurrency.

`#include <CriticalAllocator.hpp>`

Collaboration diagram for CriticalAllocator< _Ty >:




### Public Member Functions

- auto getMutex () -> RWMutex &

  *Get rw_mutex.*

- template<class _U , class... _Args>
  void construct (_U *ptr, _Args &&...args)

  *Lock when constructed.*
  *[Inherited] Construct an object.*
  *.*

- template<class _U >
  void destroy (_U *ptr)

  *Lock when destroyed*
  *[Inherited] Destory an object.*

- auto allocate (size_type n, std::allocator< void >::const_pointer hint=NULL) -> pointer

  *Lock when allocated*
  *[Inherited] Allocate block of storage.*

- void deallocate (pointer ptr, size_type size)

  *Lock when deallocated*
  *[Inherited] Release block of storage.*

### Private Attributes

- RWMutex mtx

  *A rw_mutex for handling concurrency.*

### 6.16.1 Detailed Description

**template<class _Ty>class samchon::library::CriticalAllocator< _Ty >**

An allocator ensuring concurrency.

CriticalAllocator is a std::allocator ensuring concurrency.

CriticalAllocator keeps safety in multi-threading environment automatically. But it ensures only safety. If a logic needs a mutual exclusion not only level of the container, it'd better to avoid using the CriticalAllocator and use RWMutex by yourself.

**[Inherited]]**

Allocators are classes that define memory models to be used by some parts of the Standard Library, and most specifically, by STL containers.

This section describes the default allocator template allocator (lowercase). This is the allocator that all standard containers will use if their last (and optional) template parameter is not specified, and is the only predefined allocator in the standard library. </p<

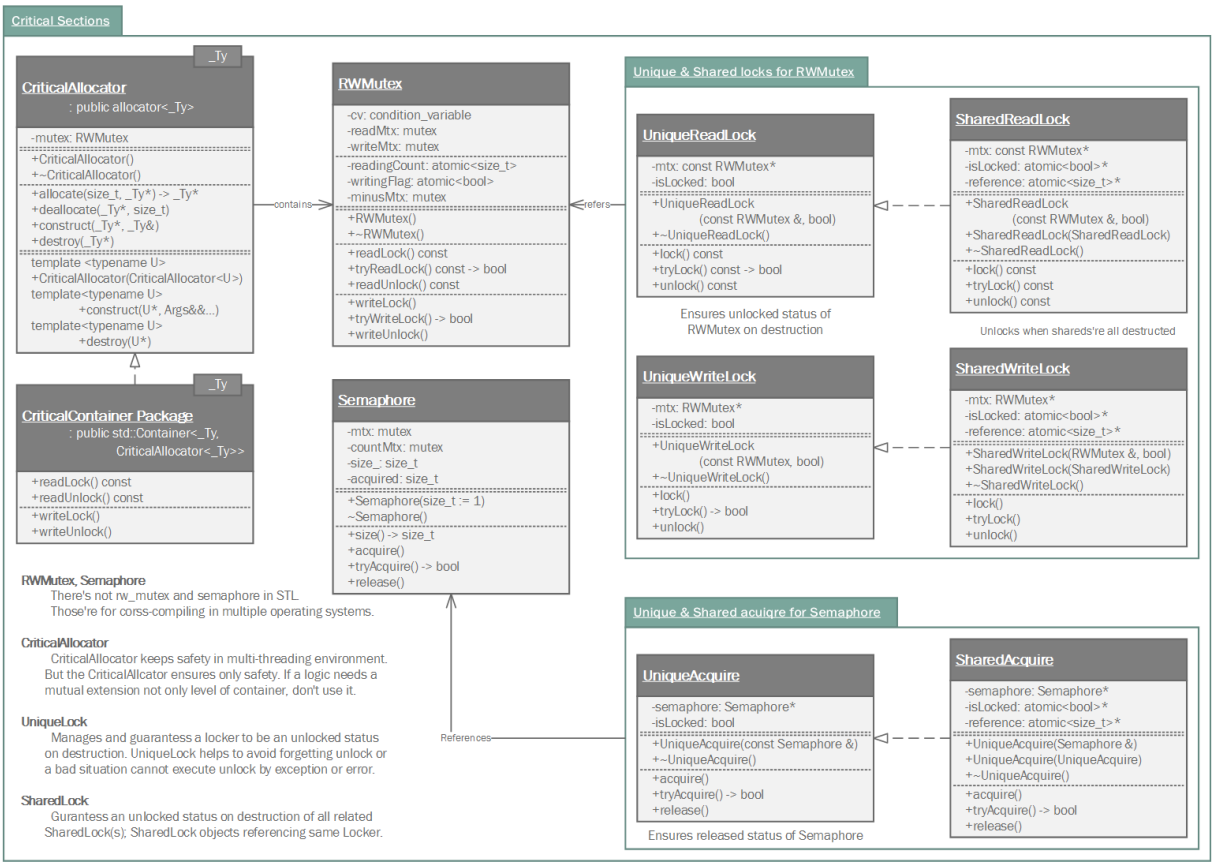
Other allocators may be defined. Any class Alloc for which allocator_traits<Alloc> produces a valid instantiation with the appropriate members defined can be used as an allocator on standard containers (Alloc may or may not implement the functionality through member functions). </p<

Except for its destructor, no member of the standard default allocator class template shall introduce data races. Calls to member functions that allocate or deallocate storage shall occur in a single total order, and each such deallocation shall happen before the next allocation (if any) in this order.

Technically, a memory model described by allocators might be specialized for each type of object to be allocated and even may store local data for each container they work with. Although this does not happen with the default allocator.

Referenced comments of std::allocator

- http://www.cplusplus.com/reference/memory/allocator/




### Template Parameters

| | |
|---|---|
| *_Ty* | Type of the elements allocated by the object (aliased as member type value_type). |

### See also

samchon::library

### Author

Jeongho Nam

## 6.16.2 Member Function Documentation

### 6.16.2.1 void construct ( _U * *ptr*, _Args &&... *args* ) [inline]

Lock when constructed.
[Inherited] Construct an object.
.

Locks a mutex for concurrency when an elmented is constructed.

**[Inherited]**

Constructs an element object on the location pointed by p.

Notice that this does not allocate space for the element. It should already be available at p (see member allocate to allocate space).

**Template Parameters**

| | |
|---|---|
| *_U* | |
| *_Args* | |

**Parameters**

| | |
|---|---|
| *ptr* | Pointer to a location with enough storage space to contain an element of type _U. |
| *args* | Arguments forwarded to the constructor.<br>Args is a list of zero or more types. |

#### 6.16.2.2 void destroy ( _U * *ptr* ) [inline]

Lock when destroyed
[Inherited] Destory an object.

Locks a mutex for concurrency when an child is destroyed

**[Inherited]**

Destroys in-place the object pointed by p.

Notice that this does not deallocate the storage for the element (see member deallocate to release storage space).

**Template Parameters**

| | |
|---|---|
| *_U* | |

**Parameters**

| | |
|---|---|
| *ptr* | Pointer to the object to be destroyed. |

#### 6.16.2.3 auto allocate ( size_type *n*, std::allocator< void >::const_pointer *hint* = NULL ) -> pointer [inline]

Lock when allocated
[Inherited] Allocate block of storage.

Locks a mutex for concurrency when children elements are deallocated.

**[Inherited]**

Attempts to allocate a block of storage with a size large enough to contain n elements of member type value_type (an alias of the allocator's template parameter), and returns a pointer to the first element.

The storage is aligned appropriately for objects of type value_type, but they are not constructed.

In the standard default allocator, the block of storage is allocated using ::operator new one or more times, and throws bad_alloc if it cannot allocate the total amount of storage requested.

**Parameters**

| | |
|---|---|
| *n* | Number of elements (each of size sizeof(value_type)) to be allocated.<br>The member type size_type is an alias of size_t (in the standard default allocator) size_t is an unsigned integral type. |
| *hint* | Either 0 or a value previously obtained by another call to allocate and not yet freed with deallocate. When it is not 0, this value may be used as a hint to improve performance by allocating the new block near the one specified. The address of an adjacent element is often a good choice. |

**Returns**

**A pointer to the initial element in the block of storage.**

**pointer and const_pointer are member types (defined as aliases of T∗ and const T∗ respectively in std::allocator).**

**The standard default allocator throws bad_alloc if it cannot allocate the requested amount of storage.**

#### 6.16.2.4 void deallocate ( pointer *ptr*, size_type *size* ) [inline]

Lock when deallocated
[Inherited] Release block of storage.

Locks a mutex for concurrency when children elements are deallocated.

**[Inherited]**

Releases a block of storage previously allocated with member allocate and not yet released.

The elements in the array are not destroyed by a call to this member function.

In the default allocator, the block of storage is at some point deallocated using ::operator delete (either during the function call, or later).

**Parameters**

| | |
|---|---|
| *ptr* | Pointer to a block of storage previously allocated with allocator::allocate.<br>pointer is a member type (defined as an alias of T∗ in std::allocator<_Ty>). |
| *size* | Number of elements allocated on the call to allocator::allocate for this block of storage. The member type size_type is an alias of size_t (in the standard default allocator). size_t is an unsigned integral type. |

The documentation for this class was generated from the following file:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/CriticalAllocator.hpp

## 6.17 Date Class Reference

Date (year, month, day in month)

`#include <Date.hpp>`

## Public Member Functions

- Date ()

  *Default Constructor.*
- Date (const super &)

  *Copy Constructor.*
- Date (super &&)
- Date (int year, int month, int date)

  *Construct from date elements.*
- Date (const WeakString &)

  *Constructor by std::string.*
- Date (long long linuxTime)

  *Construct from linux_time.*
- void set (const std::string &)

  *Setter by string.*
- virtual void set (const WeakString &)

  *Setter by weak_string.*
- void set (int year, int month, int date)

  *Setter by elements of date.*
- void set (long long linuxTime)

  *Setter by linux_time.*
- virtual void setYear (int)

  *Set year of the Date.*
- virtual void setMonth (int)

  *Set month of the Date.*
- virtual void setDate (int)
- virtual void addYear (int)

  *Add years to the Date.*
- virtual void addMonth (int)

  *Add months to the Date.*
- virtual void addWeek (int)

  *Add weeks to the Date.*
- virtual void addDate (int)

  *Add days to the Date.*
- auto getYear () const -> int

  *Get year of the Date.*
- auto getMonth () const -> int

  *Get month of the Date.*
- auto getDate () const -> int

  *Get the day in month of the Date.*
- auto getDay () const -> int

  *Get the day in week of the Date.*
- auto toLinuxTime () const -> long long

  *Converts the Date to linux_time.*
- virtual auto toString () const -> std::string

  *Converts the Date to std::string.*

## Protected Member Functions

- auto toTM () const -> struct::tm

  *Converts the Date to struct tm.*

### Static Protected Member Functions

- static auto calcSeconds (int year, int month, int date) -> long long

  *Calculates how many seconds have flowen since 0000-01-01 00:00:00.*
- static auto calcLastDates (int year) -> std::array< int, 12 >

  *Calculates and gets an array of final date of each month for that year.*

### Static Protected Attributes

- static std::chrono::system_clock::time_point TP_1970 = chrono::system_clock::from_time_t(0)

  *time_point for 1970-01-01 09:00:00*

## 6.17.1 Detailed Description

Date (year, month, day in month)

Date class is a chrono::time_point<std::chrono::system_clock>.

Date represents the date with year, month and day in month. The basic date (local time) is from your operating system.

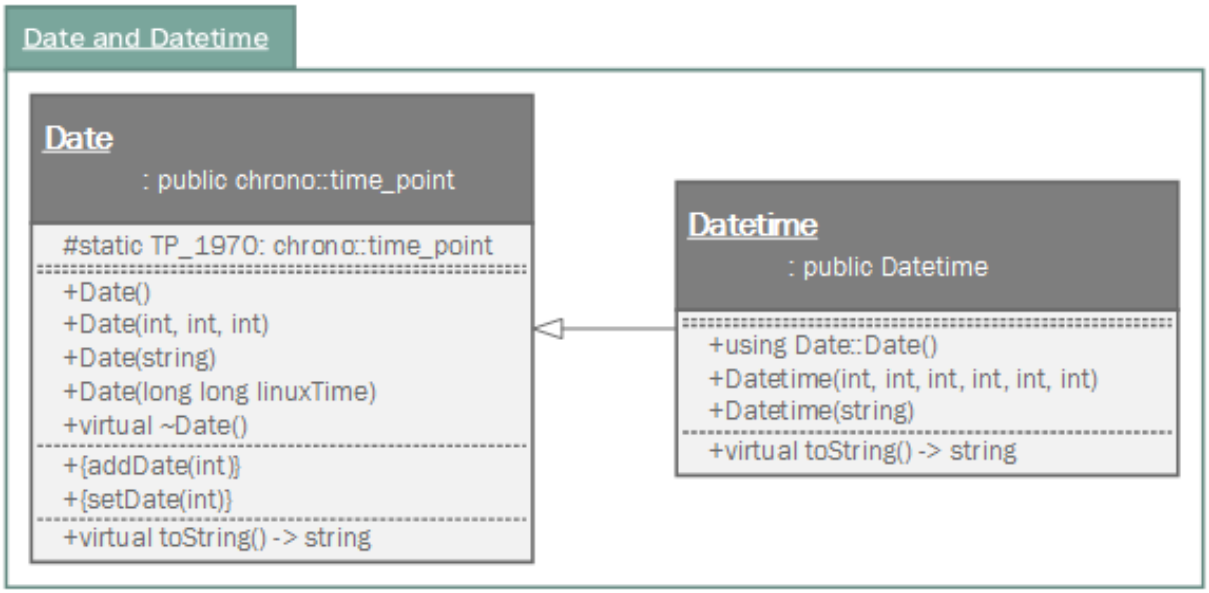
**[Inherited]**

A time_point object expresses a point in time relative to a clock's epoch.

Internally, the object stores an object of a duration type, and uses the Clock type as a reference for its epoch.

Referenced comments of std::chrono::time_point

- http://www.cplusplus.com/reference/chrono/time_point/




**See also**

samchon::library

**Author**

Jeongho Nam

### 6.17.2 Constructor & Destructor Documentation

#### 6.17.2.1 Date ( )

Default Constructor.

The date will be now (Now's date from operating system)

#### 6.17.2.2 Date ( const super & *date* )

Copy Constructor.

Copy the date from another Date

**Parameters**

| | |
|---|---|
| *date* | Target to be copied |

#### 6.17.2.3 Date ( super && *date* )

Move Constructor

Gets the date from other and truncate the other

**Parameters**

| | |
|---|---|
| *date* | Target to be moved |

#### 6.17.2.4 Date ( int *year*, int *month*, int *date* )

Construct from date elements.

**Parameters**

| | |
|---|---|
| *year* | ex) 2015 |
| *month* | January to December. 1 $\sim$ 12 |
| *date* | day in month. 1 $\sim$ 31 |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | month or date is invalid. |

#### 6.17.2.5 Date ( const WeakString & *wStr* )

Constructor by std::string.

**Parameters**

| | |
|---|---|
| *str* | A weak_string expressing the date. (1991-01-01) |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | month or date is invalid. |

#### 6.17.2.6 Date ( long long *linuxTime* )

Construct from linux_time.

**Parameters**

| | |
|---|---|
| *linuxTime* | linux_time to be converted |

### 6.17.3 Member Function Documentation

#### 6.17.3.1 long long calcSeconds ( int *year*, int *month*, int *date* ) -> long long [static], [protected]

Calculates how many seconds have flowen since 0000-01-01 00:00:00.

This static method is used for calculate the linux_time (since 1970-01-01 09:00:00)

**Returns**

linux_time of the Date

#### 6.17.3.2 auto calcLastDates ( int *year* ) -> std::array<int, 12> [static], [protected]

Calculates and gets an array of final date of each month for that year.

**Parameters**

| | |
|---|---|
| *year* | The target year |

**Returns**

Array of fianl date of each month for that year

#### 6.17.3.3 void set ( const std::string & )

Setter by string.

**Parameters**

| | |
|---|---|
| *str* | Y-m-d |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | month or date is invalid. |

#### 6.17.3.4 void set ( const WeakString & *wStr* ) [virtual]

Setter by weak_string.

**Parameters**

| | |
|---|---|
| *wstr* | Y-m-d |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | month or date is invalid. |

Reimplemented in Datetime.

#### 6.17.3.5 void set ( int *year*, int *month*, int *date* )

Setter by elements of date.

**Parameters**

| | |
|---|---|
| *year* | ex) 2015 |
| *month* | January to December. 1 ∼ 12 |
| *date* | day in month. 1 ∼ 31 |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | month or date is invalid. |

#### 6.17.3.6 void set ( long long *linuxTime* )

Setter by linux_time.

**Parameters**

| | |
|---|---|
| *linuxTime* | linux_time to be converted |

#### 6.17.3.7 void setYear ( int *year* ) [virtual]

Set year of the Date.

If previous date is leaf month's expiration date and target year what you want is not leaf, the date will be 28

- 2000-02-29 -> setYear(2001) -> 2001-02-28
- 2001-02-28 -> setYear(2000) -> 2000-02-08

**Parameters**

| | |
|---|---|
| *val* | Target year |

Reimplemented in Datetime.

#### 6.17.3.8 void setMonth ( int *month* ) [virtual]

Set month of the Date.

If the expiration date of the month will be shrinked, the date will be changed to the expiration date

- 2000-03-31 -> setMonth(4) -> 2000-04-30
- 2007-08-31 -> setMonth(9) -> 2007-09-30

**Parameters**

| | |
|---|---|
| *val* | Target month (1 - 12) |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | month is out of range |

Reimplemented in Datetime.

#### 6.17.3.9 void setDate ( int *val* ) [virtual]

Set date of the Date

**Parameters**

| | |
|---|---|
| *val* | Target day in month |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | When date is over expiration date in month |

Reimplemented in Datetime.

#### 6.17.3.10 void addYear ( int *val* ) [virtual]

Add years to the Date.

**Parameters**

| | |
|---|---|
| *val* | Years to add |

Reimplemented in Datetime.

#### 6.17.3.11 void addMonth ( int *val* ) [virtual]

Add months to the Date.

Not a matter to val is over 12. If the month is over 12, then years will be added.

**Parameters**

| | |
|---|---|
| *val* | Months to add |

Reimplemented in Datetime.

#### 6.17.3.12 void addWeek ( int *val* ) [virtual]

Add weeks to the Date.

Not a matter that val is too huge. If the adding weeks derives modification in month or year, then it will be.

**Parameters**

| | |
|---|---|
| *val* | Weeks to add |

Reimplemented in Datetime.

#### 6.17.3.13 void addDate ( int *val* ) [virtual]

Add days to the Date.

Not a matter that val is too huge. If the adding dates derives modification in month or year, then it will be.

**Parameters**

| | |
|---|---|
| *val* | Days to add |

Reimplemented in Datetime.

#### 6.17.3.14 int getYear ( ) const -> int

Get year of the Date.

**Returns**

Year

#### 6.17.3.15 int getMonth ( ) const -> int

Get month of the Date.

**Returns**

Month as integer (1: January, 12: December)

#### 6.17.3.16 int getDate ( ) const -> int

Get the day in month of the Date.

**Returns**

Day in month (1 to 31)

#### 6.17.3.17 int getDay ( ) const -> int

Get the day in week of the Date.

**Returns**

Day in week to integer (0: Sunday, 1: Monday, ..., 6: Saturday)

#### 6.17.3.18 auto toTM ( ) const -> struct ::tm [protected]

Converts the Date to struct tm.

**Returns**

struct tm representing the Date

#### 6.17.3.19 auto toLinuxTime ( ) const -> long long

Converts the Date to linux_time.

**Returns**

linux_time of the Date

#### 6.17.3.20 auto toString ( ) const -> std::string [virtual]

Converts the Date to std::string.

**Returns**

std::string expressing the Date

Reimplemented in Datetime.

### 6.17.4 Member Data Documentation

#### 6.17.4.1 chrono::system_clock::time_point TP_1970 = chrono::system_clock::from_time_t(0) [static], [protected]

time_point for 1970-01-01 09:00:00

It's the zero(0) in linux_time

The documentation for this class was generated from the following files:

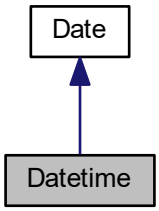
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Date.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Date.cpp

## 6.18 Datetime Class Reference

Date and time.

```
#include <Datetime.hpp>
```

Collaboration diagram for Datetime:




### Public Member Functions

- Datetime ()
- Datetime (const super::super &)

  *Copy Constructor.*
- Datetime (super::super &&)
- Datetime (int year, int month, int date, int hour=0, int min=0, int sec=0)

  *Construct from datetime elements.*
- Datetime (const WeakString &)

*Construct from WeakString.*

- Datetime (long long linuxTime)

  *Construct from linux_time.*
- virtual void set (const WeakString &) override

  *Set by weak_string.*
- void set (int year, int month, int date, int hours=0, int minutes=0, int seconds=0)
- void set (long long linuxTime)
- virtual void setYear (int)

  *Set year of the Date.*
- virtual void setMonth (int)

  *Set month of the Date.*
- virtual void setDate (int)
- void setHour (int)

  *Set hour.*
- void setMinute (int)

  *Set minute.*
- void setSecond (int)

  *Set hour.*
- virtual void addYear (int) override

  *Add years to the Date.*
- virtual void addMonth (int) override

  *Add months to the Date.*
- virtual void addWeek (int) override

  *Add weeks to the Date.*
- virtual void addDate (int) override

  *Add days to the Date.*
- void addHour (int)

  *Add hours.*
- void addMinute (int)

  *Add minutes.*
- void addSecond (int)

  *Add seconds.*
- auto getHour () const -> int

  *Get hour.*
- auto getMinute () const -> int

  *Get minute.*
- auto getSecond () const -> int

  *Get second.*
- virtual auto toString () const -> std::string override

  *Converts the Datetime to std::string.*

## Additional Inherited Members

### 6.18.1 Detailed Description

Date and time.

Datetime is a Date having hours, minutes and seconds addictionally.

**[Inherited]**

Date class is a chrono::time_point<std::chrono::system_clock>.

Date represents the date with year, month and day in month. The basic date (local time) is from your operating system.

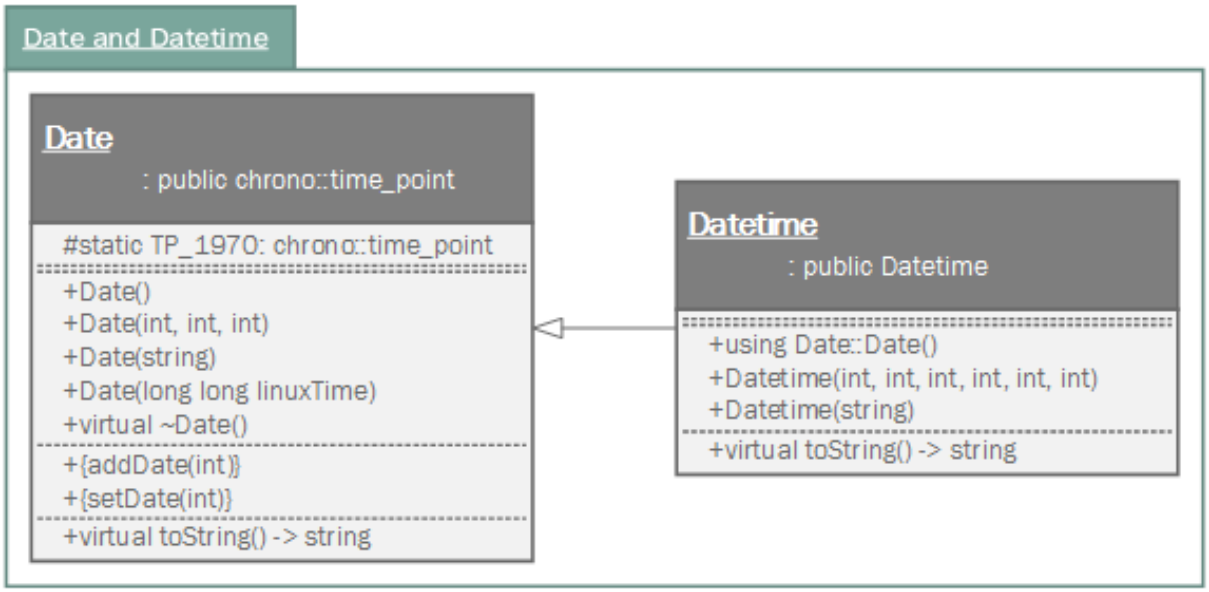
**[Inherited]**

A time_point object expresses a point in time relative to a clock's epoch.

Internally, the object stores an object of a duration type, and uses the Clock type as a reference for its epoch.

Referenced comments of std::chrono::time_point

- http://www.cplusplus.com/reference/chrono/time_point/




**See also**

samchon::library

**Author**

Jeongho Nam

## 6.18.2 Constructor & Destructor Documentation

### 6.18.2.1 Datetime ( )

Default Constructor

The datetime will be now (Now from operating system)

### 6.18.2.2 Datetime ( const super::super & *date* )

Copy Constructor.

Copy the date from another Date

**Parameters**

| | |
|---|---|
| *date* | Target to be copied |

#### 6.18.2.3 Datetime ( super::super && *date* )

Move Constructor

Gets the date from other and truncate the other

**Parameters**

| | |
|---|---|
| *date* | Target to be moved |

#### 6.18.2.4 Datetime ( int *year*, int *month*, int *date*, int *hour* = 0, int *min* = 0, int *sec* = 0 )

Construct from datetime elements.

**Parameters**

| | |
|---|---|
| *year* | ex) 2015 |
| *month* | January to December. 1 $\sim$ 12 |
| *date* | Day in month. 1 $\sim$ 31 |
| *hour* | Hours (0-23) |
| *min* | Minutes (0-59) |
| *sec* | Seconds (0-59) |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | parameter is out of its own range. |

#### 6.18.2.5 Datetime ( const WeakString & *wStr* )

Construct from WeakString.

**Parameters**

| | |
|---|---|
| *wstr* | A weak_string expressing the date. (1991-01-01 09:27:03) |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | parameter is out of its own range. |

#### 6.18.2.6 Datetime ( long long *linuxTime* )

Construct from linux_time.

**Parameters**

| | |
|---|---|
| *linuxTime* | linux_time to be converted |

### 6.18.3 Member Function Documentation

#### 6.18.3.1 void set ( const WeakString & *wStr* ) [override], [virtual]

Set by weak_string.

**Parameters**

| | |
|---|---|
| *wstr* | A weak_string expressing the date. (1991-01-01 09:27:03) |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | parameter is out of its own range. |

Reimplemented from Date.

#### 6.18.3.2 void set ( int *year*, int *month*, int *date*, int *hours* = 0, int *minutes* = 0, int *seconds* = 0 )

**Exceptions**

| | |
|---|---|
| *invalid_argument* | parameter is out of range (ex: month -> 13) |

#### 6.18.3.3 void set ( long long *linuxTime* )

#### 6.18.3.4 void setYear ( int *val* ) [virtual]

Set year of the Date.

If previous date is leaf month's expiration date and target year what you want is not leaf, the date will be 28

- 2000-02-29 -> setYear(2001) -> 2001-02-28
- 2001-02-28 -> setYear(2000) -> 2000-02-08

**Parameters**

| | |
|---|---|
| *val* | Target year |

Reimplemented from Date.

#### 6.18.3.5 void setMonth ( int *val* ) [virtual]

Set month of the Date.

If the expiration date of the month will be shrinked, the date will be changed to the expiration date

- 2000-03-31 -> setMonth(4) -> 2000-04-30
- 2007-08-31 -> setMonth(9) -> 2007-09-30

**Parameters**

| | |
|---|---|
| *val* | Target month (1 - 12) |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | month is out of range |

Reimplemented from Date.

#### 6.18.3.6 void setDate ( int *val* ) [virtual]

Set date of the Date

**Parameters**

| | |
|---|---|
| *val* | Target day in month |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | When date is over expiration date in month |

Reimplemented from Date.

#### 6.18.3.7 void setHour ( int *val* )

Set hour.

**Parameters**

| | |
|---|---|
| *val* | Target hour (0 - 23) |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | When hour is out of range |

#### 6.18.3.8 void setMinute ( int *val* )

Set minute.

**Parameters**

| | |
|---|---|
| *val* | Target minute (0 - 59) |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | When minute is out of range |

#### 6.18.3.9 void setSecond ( int *val* )

Set hour.

**Parameters**

| | |
|---|---|
| *val* | Target second (0 - 59) |

**Exceptions**

| | |
|---|---|
| *invalid_argument* | When second is out of range |

#### 6.18.3.10 void addYear ( int *val* ) [override], [virtual]

Add years to the Date.

**Parameters**

| | |
|---|---|
| *val* | Years to add |

Reimplemented from Date.

#### 6.18.3.11 void addMonth ( int *val* ) [override], [virtual]

Add months to the Date.

Not a matter to val is over 12. If the month is over 12, then years will be added.

**Parameters**

| | |
|---|---|
| *val* | Months to add |

Reimplemented from Date.

#### 6.18.3.12 void addWeek ( int *val* ) [override], [virtual]

Add weeks to the Date.

Not a matter that val is too huge. If the adding weeks derives modification in month or year, then it will be.

**Parameters**

| | |
|---|---|
| *val* | Weeks to add |

Reimplemented from Date.

#### 6.18.3.13 void addDate ( int *val* ) [override], [virtual]

Add days to the Date.

Not a matter that val is too huge. If the adding dates derives modification in month or year, then it will be.

**Parameters**

| | |
|---|---|
| *val* | Days to add |

Reimplemented from Date.

#### 6.18.3.14 void addHour ( int *val* )

Add hours.

It's same with operator+=(chrono::hours(val))

Do not worry about the out of range of the hour(val) Parent items like date, month and years will be adjusted automatically.

**Parameters**

| | |
|---|---|
| *val* | hours to add |

#### 6.18.3.15 void addMinute ( int *val* )

Add minutes.

**It's same with operator+=(chrono::minutes(val))**

Do not worry about the out of range of the minutes(val) Parent items like date, month and years will be adjusted automatically.

**Parameters**

| | |
|---|---|
| *val* | minutes to add |

#### 6.18.3.16 void addSecond ( int *val* )

Add seconds.

**It's same with operator+=(chrono::seconds(val))**

Do not worry about the out of range of the seconds(val) Parent items like date, month and years will be adjusted automatically.

**Parameters**

| | |
|---|---|
| *val* | seconds to add |

#### 6.18.3.17 int getHour ( ) const -> int

Get hour.

**Returns**

hour of the Datetime to integer

#### 6.18.3.18 int getMinute ( ) const -> int

Get minute.

**Returns**

minute of the Datetime to integer

#### 6.18.3.19 int getSecond ( ) const -> int

Get second.

**Returns**

second of the Datetime to integer

#### 6.18.3.20 auto toString ( ) const -> std::string [override], [virtual]

Converts the Datetime to std::string.

**Returns**

std::string expressing the Datetime

Reimplemented from Date.

The documentation for this class was generated from the following files:

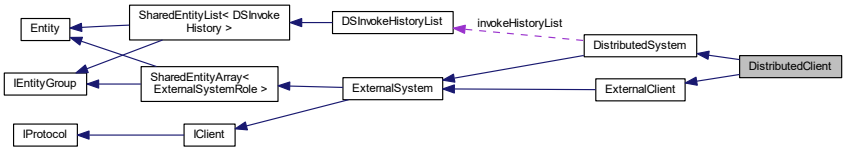
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Datetime.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Datetime.cpp

## 6.19 DistributedClient Class Reference

A network driver for a distributed client.

`#include <DistributedClient.hpp>`

Collaboration diagram for DistributedClient:




### Public Member Functions

- DistributedClient ()

  *Default Constructor.*

### Additional Inherited Members

### 6.19.1 Detailed Description

A network driver for a distributed client.

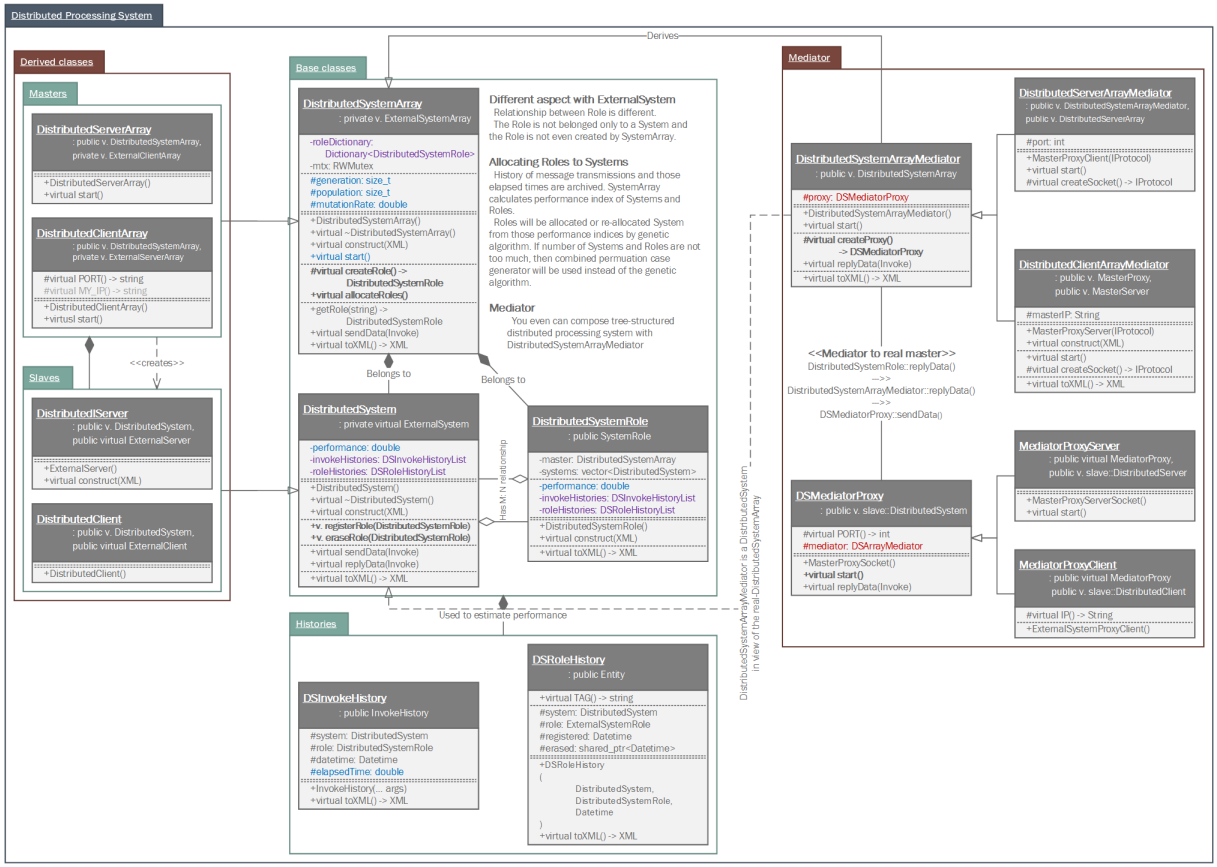
DistributedClient is an DistributedSystem specialized in client driver.

**[Inherited]**

DistributedSystem class is an ExternalSystem having role as DistributedSystemRole objects with performance index and history log allocation of DistributedSystemRole objects and have requsted Invoke message to related external system.

The greatest difference between DistributedSystem and ExternalSystem is, unlike the ExternalSystem class which having is ExternalSystemRole objects exclusively, DistributedSystem does not monopoly a DistributedSystemRole. The DistributedSystemRole can allocatedto multiple DistributedSystem.

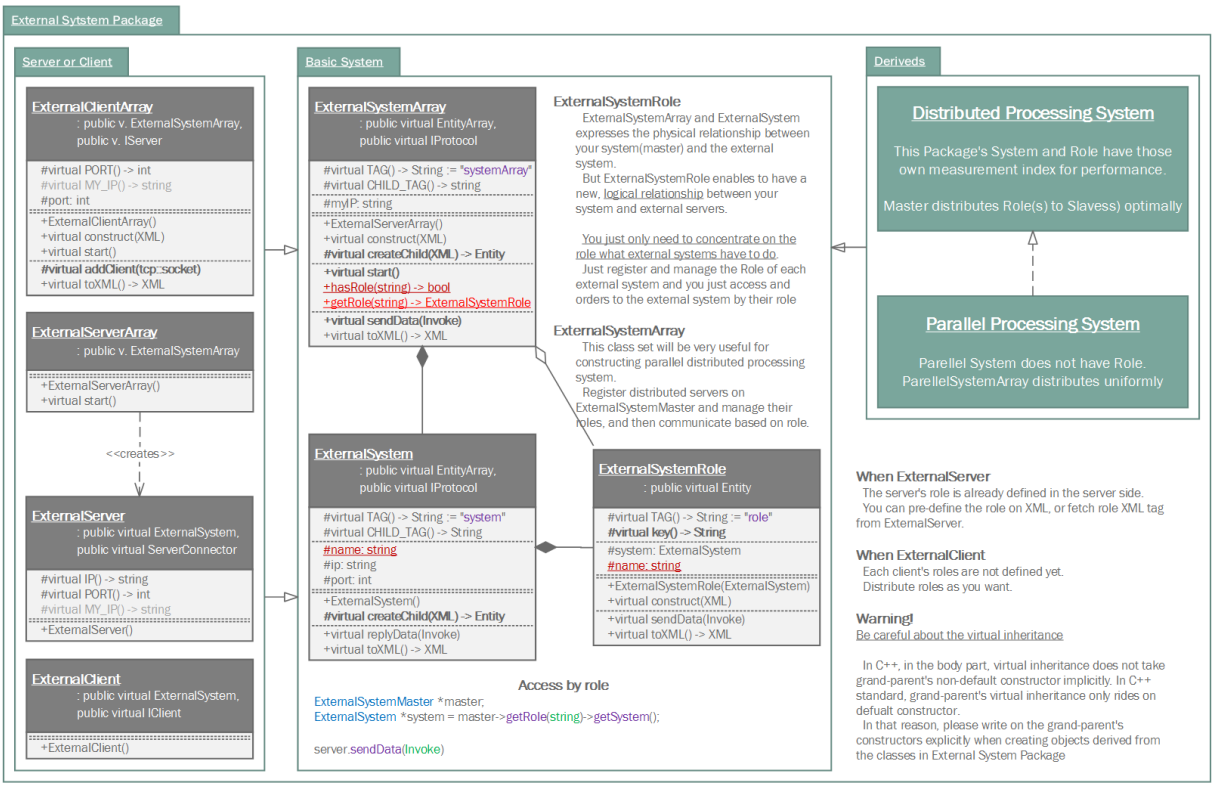
DistributedSystem and DistributedSystemRole classes have performance index and history log archiving what they've requested to the related distributed system. Allocating DistributedSystemRole objects to DistributedSyste will be determined those performance index and history log for optimize distribution of elasped time about each Invoke message processing.




**[Inherited]**

ExternalSystem is a boundary class interacting with an external system by network communication. Also, External↩System is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




### Note

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystemRole.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩ SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an ExternalSystem. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

### See also

samchon::protocol

### Author

Jeongho Nam

The documentation for this class was generated from the following file:

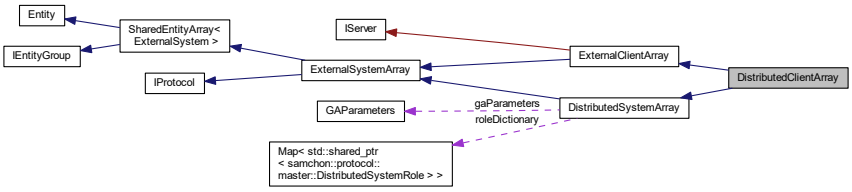
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedClient.hpp

## 6.20 DistributedClientArray Class Reference

An array of DistributedClient(s).

```
#include <DistributedClientArray.hpp>
```

Collaboration diagram for DistributedClientArray:




## Public Member Functions

- DistributedClientArray ()

  *Default Constructor.*

- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*

- virtual void start () override

  *Start interaction.*

- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the EntityGroup.*

## Additional Inherited Members

### 6.20.1 Detailed Description

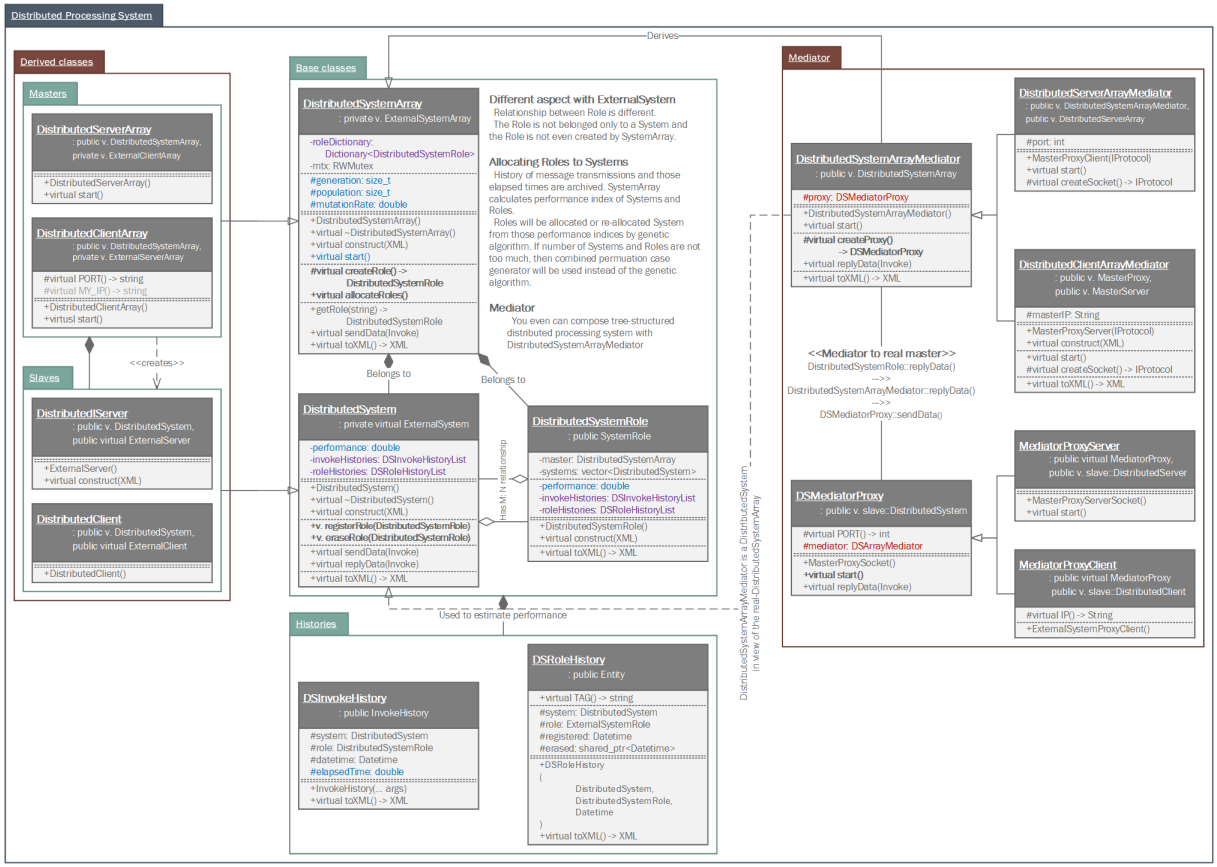
An array of DistributedClient(s).

DistributedClientArray is an DistributedSystemArray specialized in clients' driver.

**[Inherited]**

DistributedSystemArray class is an ExternalSystemArray and an abstract class containing and managing distributed system drivers within framework of master. The DistributedSystemArray class allocates DistributedSystemRole objects to DistributedSystem objects for optimization.

Unlike the ExternalSystemRole class which is dependent on an ExternalSystem, DistributedSystemRole is not dependent on a DistributedSystem and even can be allocated to multiple DistributedSystem objects. Allocation of DistributedSystemRole(s) to DistributedSystem(s) is determined by estimation of performance index pursuing best distribution. If number of DistributedSystem and DistributedSystemRole objects is not a lot, optimize by combined permuation algorithm. Else the objects are a lot, the allocation will be optimized by genetic algorithm.



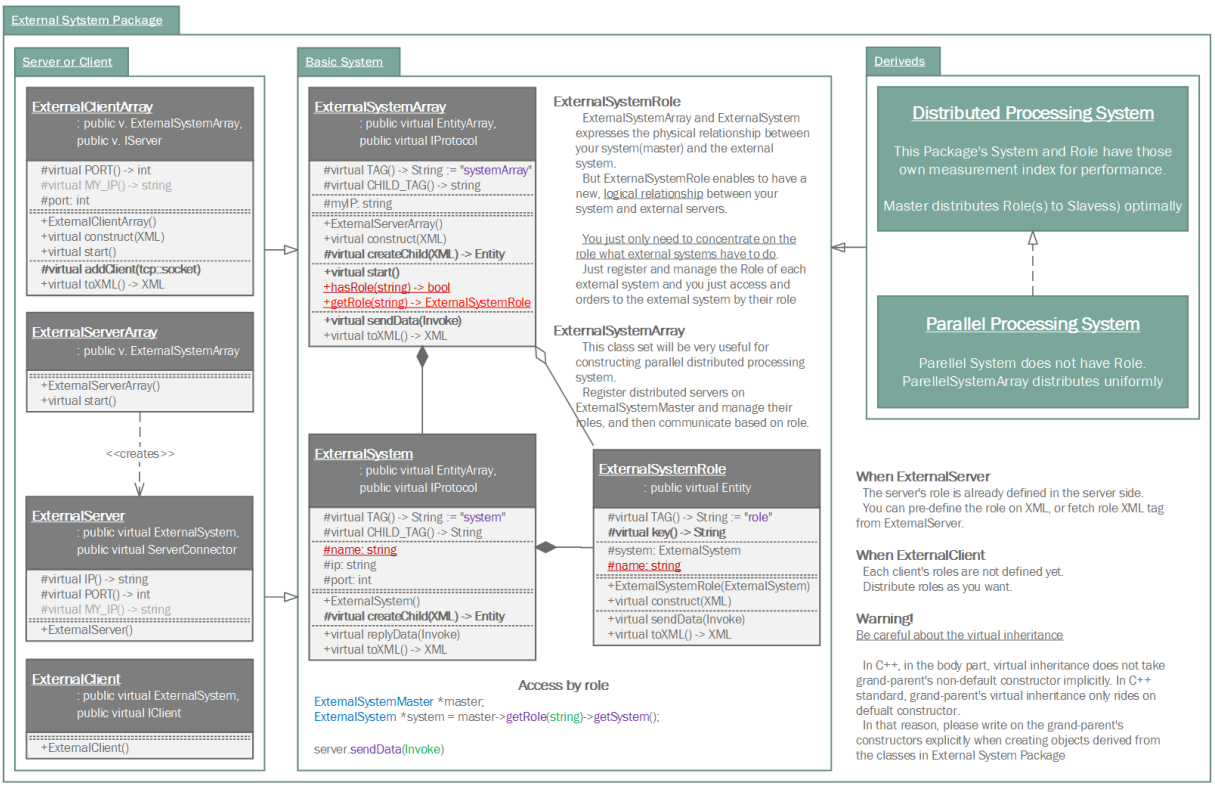

**[Inherited]**

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




### See also

samchon::protocol

### Author

Jeongho Nam

## 6.20.2 Member Function Documentation

### 6.20.2.1 virtual void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from ExternalClientArray.

Reimplemented in DistributedClientArrayMediator.

#### 6.20.2.2 virtual void start ( ) [override], [virtual]

Start interaction.

An abstract method starting interaction with external systems.

If external systems are servers, starts connection to them, else clients, opens a server and accepts the external systems. You can addict your own procudures of starting drivers, but if you directly override method of abstract ExternalSystemArray, be careful about virtual inheritance.

- DistributedClientArray::start() calls DistributedSystemArray::start() and ExternalClientArray:start()

Reimplemented from ExternalClientArray.

Reimplemented in DistributedClientArrayMediator.

#### 6.20.2.3 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from ExternalClientArray.

Reimplemented in DistributedClientArrayMediator.

The documentation for this class was generated from the following file:

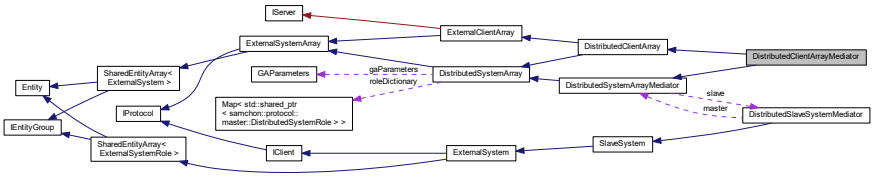
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedClientArray.hpp

## 6.21 DistributedClientArrayMediator Class Reference

A mediator of distributed system between master and slaves.

`#include <DistributedClientArrayMediator.hpp>`

Collaboration diagram for DistributedClientArrayMediator:




### Public Member Functions

- DistributedClientArrayMediator ()

  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*
- virtual void start () override

  *Start interaction.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the EntityGroup.*

### Additional Inherited Members

#### 6.21.1 Detailed Description

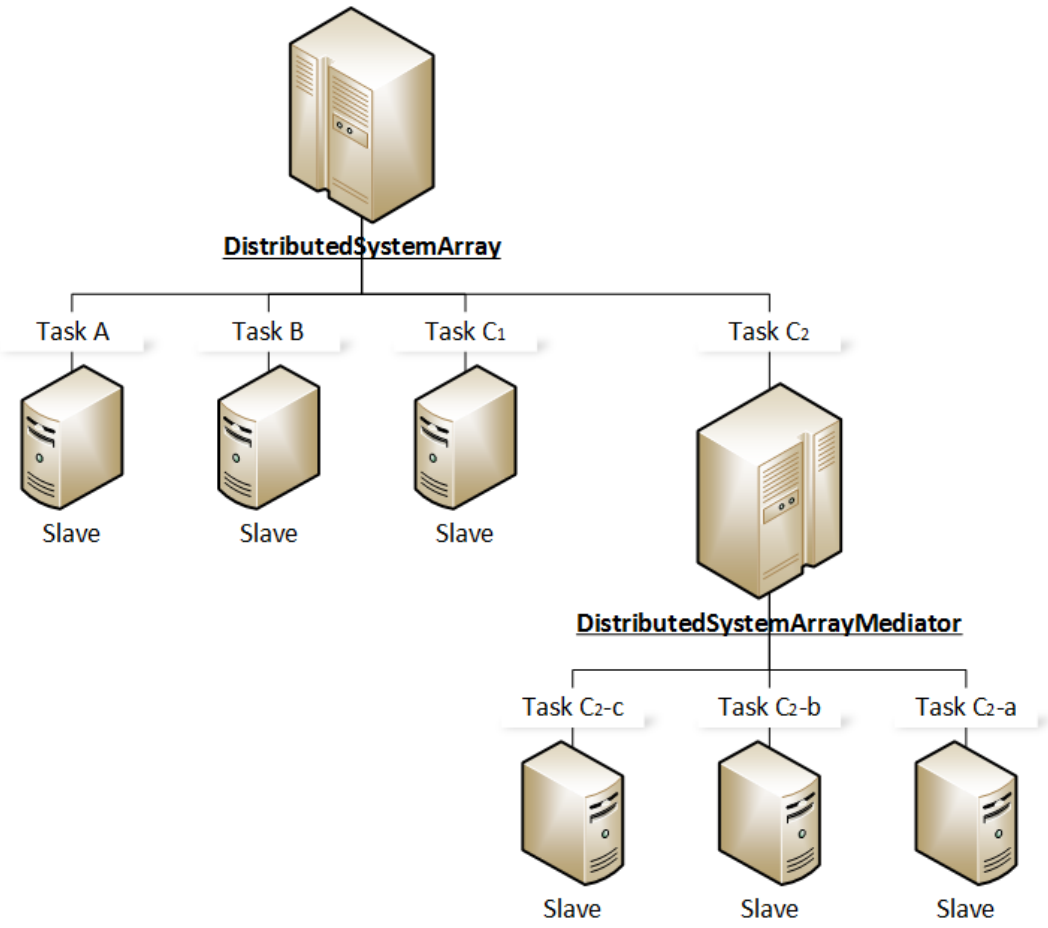
A mediator of distributed system between master and slaves.

DistributedClientArrayMediator is a DistributedSystemArrayMediator specialized in clients' driver. DistributedClientArrayMediator is a client for its master and also manages children clients' slaves.

**[Inherited]**

DistributedSystemArrayMediator class is used to realizing a mediator system of tree-structured distributed processing system. DistributedSystemArrayMediator intermediates between origin-master(DistributedSystemArray) and its slaves(slave::DistributedSystem).

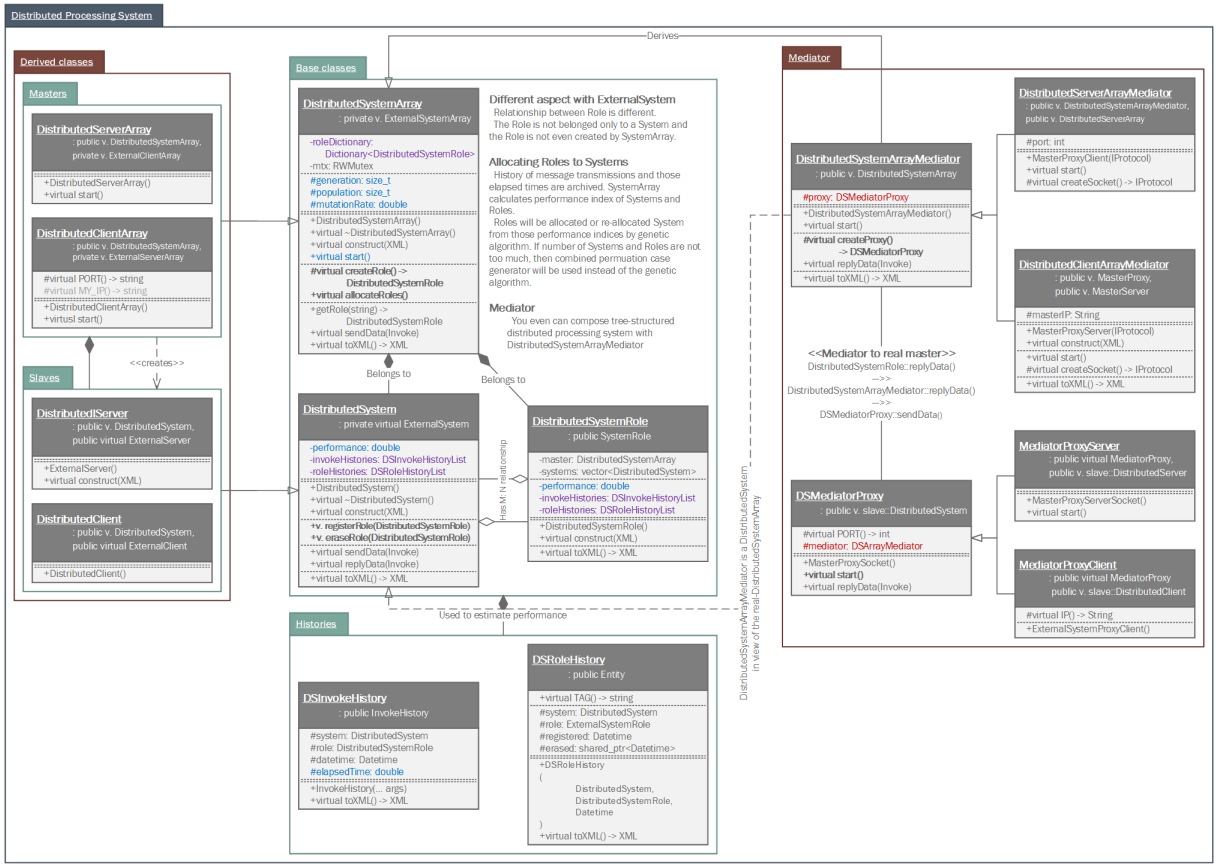
DistributedSystemArrayMediator is a master(DistributedSystemArray) within the framework of slaves systems (slave::DistributedSystem objects) and also can be a slave system (slave::DistributedSystem) within framework of its master(DistributedSystemArray) by having DistributedSlaveSystemMediator.




[Inherited]

DistributedSystemArray class is an ExternalSystemArray and an abstract class containing and managing distributed system drivers within framework of master. The DistributedSystemArray class allocates DistributedSystemRole objects to DistributedSystem objects for optimization.

Unlike the ExternalSystemRole class which is dependent on an ExternalSystem, DistributedSystemRole is not dependent on a DistributedSystem and even can be allocated to multiple DistributedSystem objects. Allocation of DistributedSystemRole(s) to DistributedSystem(s) is determined by estimation of performance index pursuing best distribution. If number of DistributedSystem and DistributedSystemRole objects is not a lot, optimize by combined permuation algorithm. Else the objects are a lot, the allocation will be optimized by genetic algorithm.



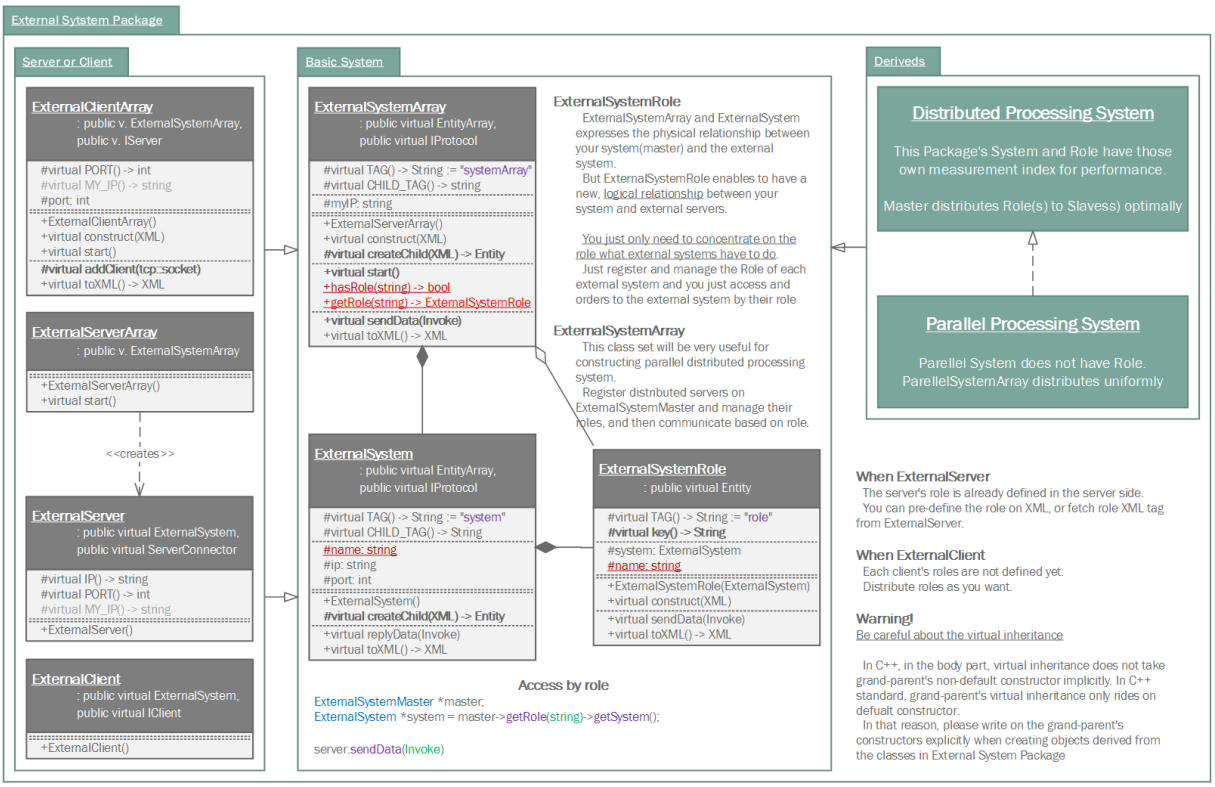

**[Inherited]**

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.21.2 Member Function Documentation

#### 6.21.2.1 virtual void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from DistributedClientArray.

#### 6.21.2.2 virtual void start ( ) [override], [virtual]

Start interaction.

An abstract method starting interaction with external systems.

If external systems are servers, starts connection to them, else clients, opens a server and accepts the external systems. You can addict your own procudures of starting drivers, but if you directly override method of abstract ExternalSystemArray, be careful about virtual inheritance.

- DistributedClientArray::start() calls DistributedSystemArray::start() and ExternalClientArray:start()

Reimplemented from DistributedClientArray.

#### 6.21.2.3 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from DistributedClientArray.

The documentation for this class was generated from the following file:

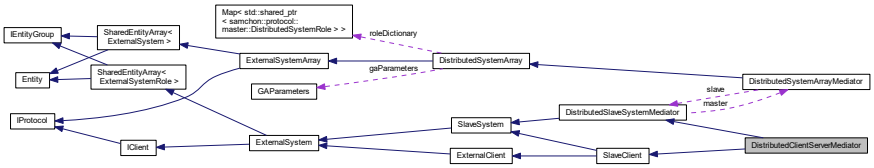
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedClientArrayMediator.hpp

## 6.22 DistributedClientServerMediator Class Reference

A distributed slave client for mediation.

`#include <DistributedSlaveClientMediator.hpp>`

Collaboration diagram for DistributedClientServerMediator:




### Public Member Functions

- DistributedClientServerMediator ()

  *Default Constructor.*

### Additional Inherited Members

#### 6.22.1 Detailed Description

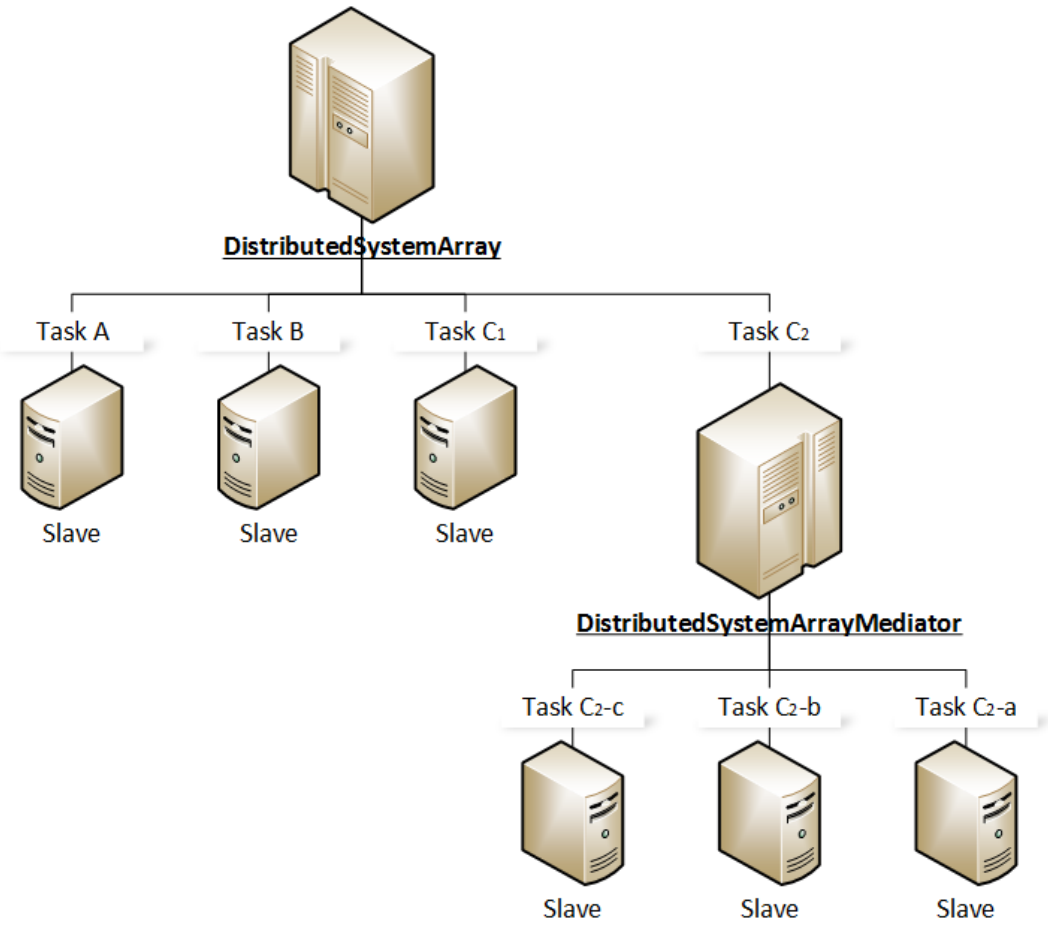
A distributed slave client for mediation.

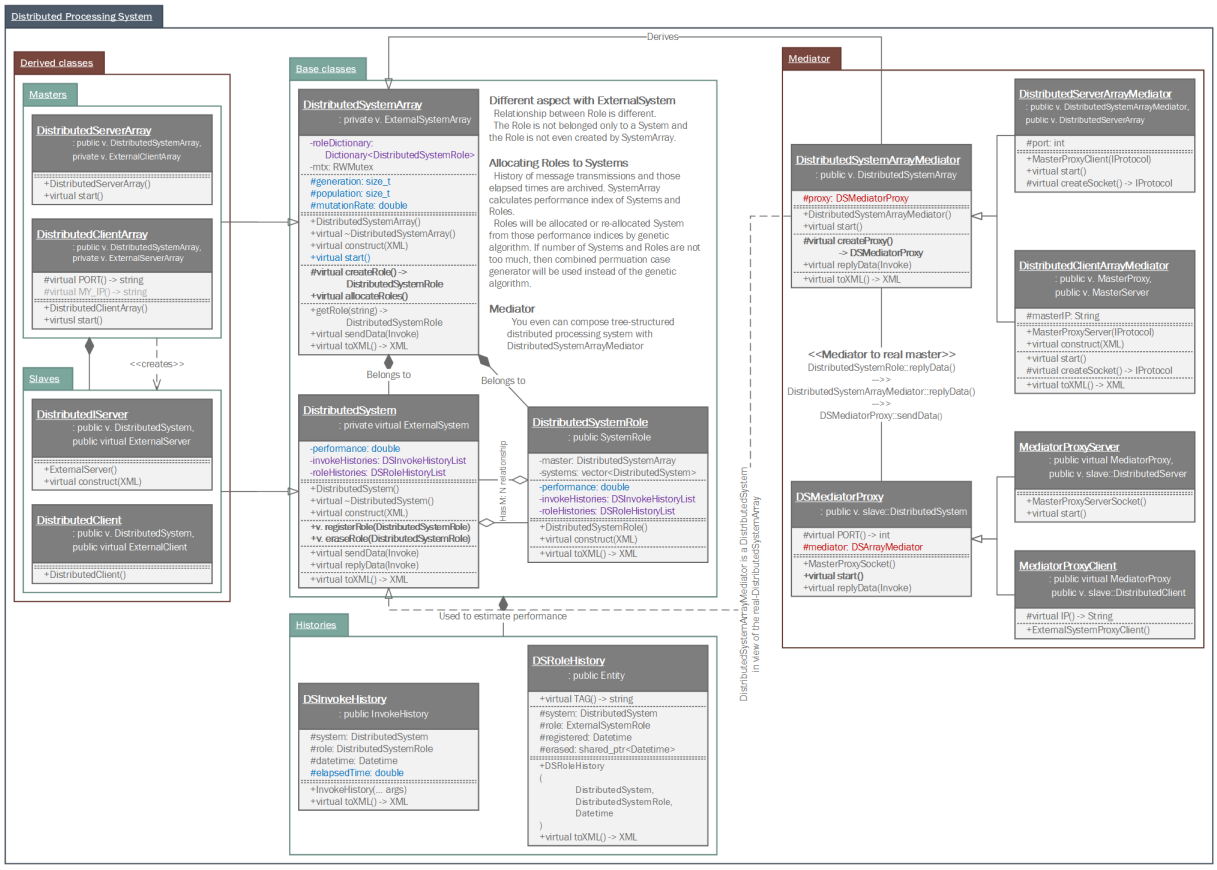
DistributedClientServerMediator is a DistributedSlaveSystemMediator class specialized in client driver.

**[Inherited]**

DistributedSlaveSystemMediator is an abstract class derived from slave::SlaveSystem for realizing tree-structured distriuted processins system. DistributedSlaveSystemMediator acts a slave system's role for its master, on the above level.

DistributedSystemArrayMediator and DistributedSlaveSystemMediator classes are paired to act a mediator system role by acting their own role, master system role for below slaves and slave system role for above master system.


DistributedSystemArray
Task A
Task B
Task C1
Task C2
Slave
Slave
Slave
DistributedSystemArrayMediator
Task C2-c
Task C2-b
Task C2-a
Slave
Slave
Slave


Distributed Processing System
Derived classes
Masters
DistributedServerArray
: public v. DistributedSystemArray,
private v. ExternalClientArray
+DistributedServerArray()
+virtual start()
DistributedClientArray
: public v. DistributedSystemArray,
private v. ExternalServerArray
#virtual PORT() -> string
#virtual MY_IP() -> string
+DistributedClientArray()
+virtual start()
<<creates>>
Slaves
DistributedIServer
: public v. DistributedSystem,
public virtual ExternalServer
+ExternalServer()
+virtual construct(XML)
DistributedClient
: public v. DistributedSystem,
public virtual ExternalClient
+DistributedClient()
Derives
Base classes
DistributedSystemArray
: private v. ExternalSystemArray
-roleDictionary:
Dictionary<DistributedSystemRole>
-mtx: RWMutex
#generation: size_t
#population: size_t
#mutationRate: double
+DistributedSystemArray()
+virtual ~DistributedSystemArray()
+virtual construct(XML)
+virtual start()
#virtual createRole() ->
DistributedSystemRole
+virtual allocateRoles()
+getRole(string) ->
DistributedSystemRole
+virtual sendData(Invoke)
+virtual toXML() -> XML
Different aspect with ExternalSystem
Relationship between Role is different.
The Role is not belonged only to a System and the Role is not even created by SystemArray.
Allocating Roles to Systems
History of message transmissions and those elapsed times are archived. SystemArray calculates performance index of Systems and Roles.
Roles will be allocated or re-allocated System from those performance indices by genetic algorithm. If number of Systems and Roles are not too much, then combined permuation case generator will be used instead of the genetic algorithm.
Mediator
You even can compose tree-structured distributed processing system with DistributedSystemArrayMediator
Belongs to
Belongs to
DistributedSystem
: private virtual ExternalSystem
-performance: double
-invokeHistories: DSInvokeHistoryList
-roleHistories: DSRoleHistoryList
+DistributedSystem()
+virtual ~DistributedSystem()
+virtual construct(XML)
+v. registerRole(DistributedSystemRole)
+v. eraseRole(DistributedSystemRole)
+virtual sendData(Invoke)
+virtual replyData(Invoke)
+virtual toXML() -> XML
Has N: N relationship
DistributedSystemRole
: public SystemRole
-master: DistributedSystemArray
-systems: vector<DistributedSystem>
-performance: double
-invokeHistories: DSInvokeHistoryList
-roleHistories: DSRoleHistoryList
+DistributedSystemRole()
+virtual construct(XML)
+virtual toXML() -> XML
Used to estimate performance
Histories
DSInvokeHistory
: public InvokeHistory
#system: DistributedSystem
#role: DistributedSystemRole
#datetime: Datetime
#elapsedTime: double
+InvokeHistory(... args)
+virtual toXML() -> XML
DSRoleHistory
: public Entity
+virtual TAG() -> string
#system: DistributedSystem
#role: ExternalSystemRole
#registered: Datetime
#erased: shared_ptr<Datetime>
+DSRoleHistory
(
DistributedSystem,
DistributedSystemRole,
Datetime
)
+virtual toXML() -> XML
DistributedSystemArrayMediator is a DistributedSystem in view of the real-DistributedSystemArray
Mediator
DistributedSystemArrayMediator
: public v. DistributedSystemArray
#proxy: DSMediatorProxy
+DistributedSystemArrayMediator()
+virtual start()
#virtual createProxy()
-> DSMediatorProxy
+virtual replyData(Invoke)
+virtual toXML() -> XML
DistributedServerArrayMediator
: public v. DistributedSystemArrayMediator,
public v. DistributedServerArray
#port: int
+MasterProxyClient(IProtocol)
+virtual start()
#virtual createSocket() -> IProtocol
DistributedClientArrayMediator
: public v. MasterProxy,
public v. MasterServer
#masterIP: String
+MasterProxyServer(IProtocol)
+virtual construct(XML)
+virtual start()
#virtual createSocket() -> IProtocol
+virtual toXML() -> XML
<<Mediator to real master>>
DistributedSystemRole::replyData()
-->>
DistributedSystemArrayMediator::replyData()
-->>
DSMediatorProxy::sendData()
DSMediatorProxy
: public v. slave::DistributedSystem
#virtual PORT() -> int
#mediator: DSArrayMediator
+MasterProxySocket()
+virtual start()
+virtual replyData(Invoke)
MediatorProxyServer
: public virtual MediatorProxy,
public v. slave::DistributedServer
+MasterProxyServerSocket()
+virtual start()
MediatorProxyClient
: public virtual MediatorProxy
public v. slave::DistributedClient
#virtual IP() -> String
+ExternalSystemProxyClient()

[Inherited]

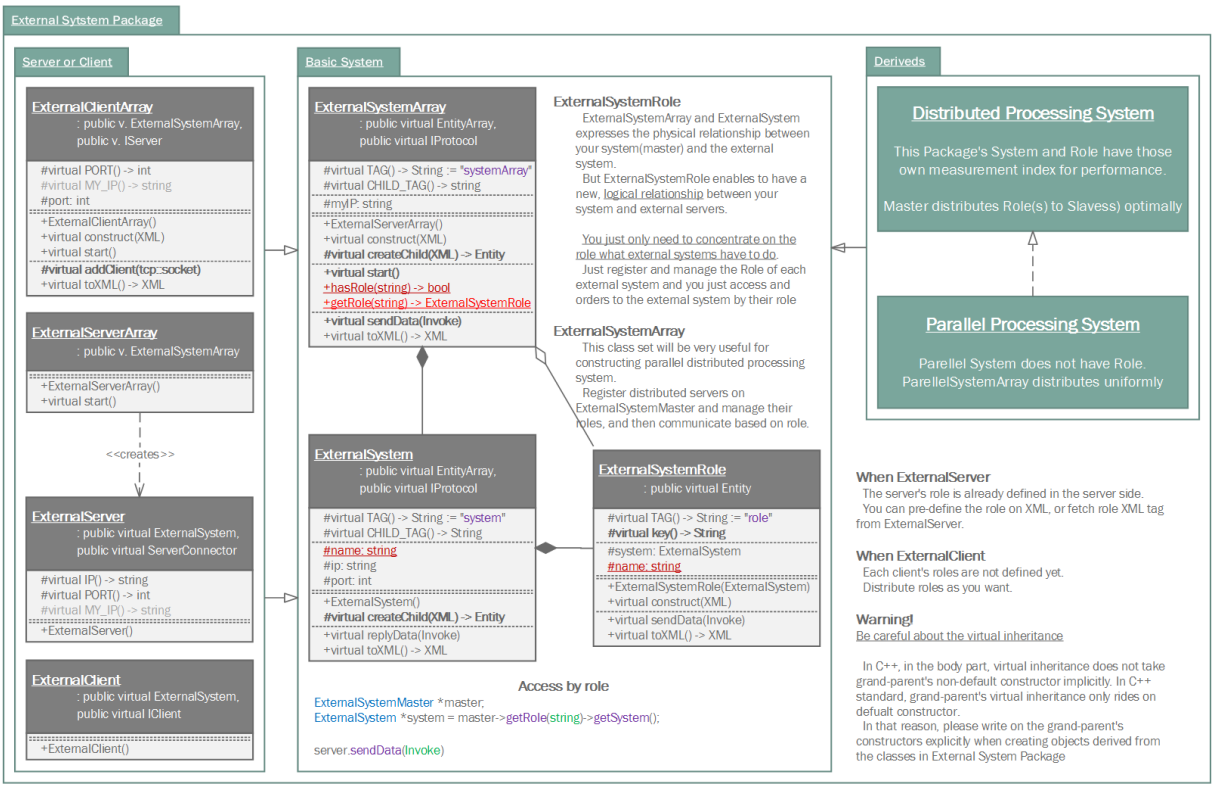
SlaveSystem, literally, means a slave system belongs to a maste system.

The SlaveSystem class is used in opposite side system of master::DistributedSystem and master::ParallelSystem and reports elapsed time of each commmand (by Invoke message) for estimation of its performance.

[Inherited]

ExternalSystem is a boundary class interacting with an external system by network communication. Also, External↩System is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystemRole.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an ExternalSystem. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

The documentation for this class was generated from the following file:

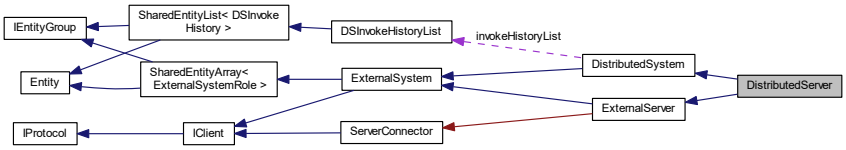
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedSlaveClientMediator.hpp

## 6.23 DistributedServer Class Reference

A network driver for a distributed server.

`#include <DistributedServer.hpp>`

Collaboration diagram for DistributedServer:




### Public Member Functions

- DistributedServer ()

  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the EntityGroup.*

### Additional Inherited Members

### 6.23.1 Detailed Description

A network driver for a distributed server.

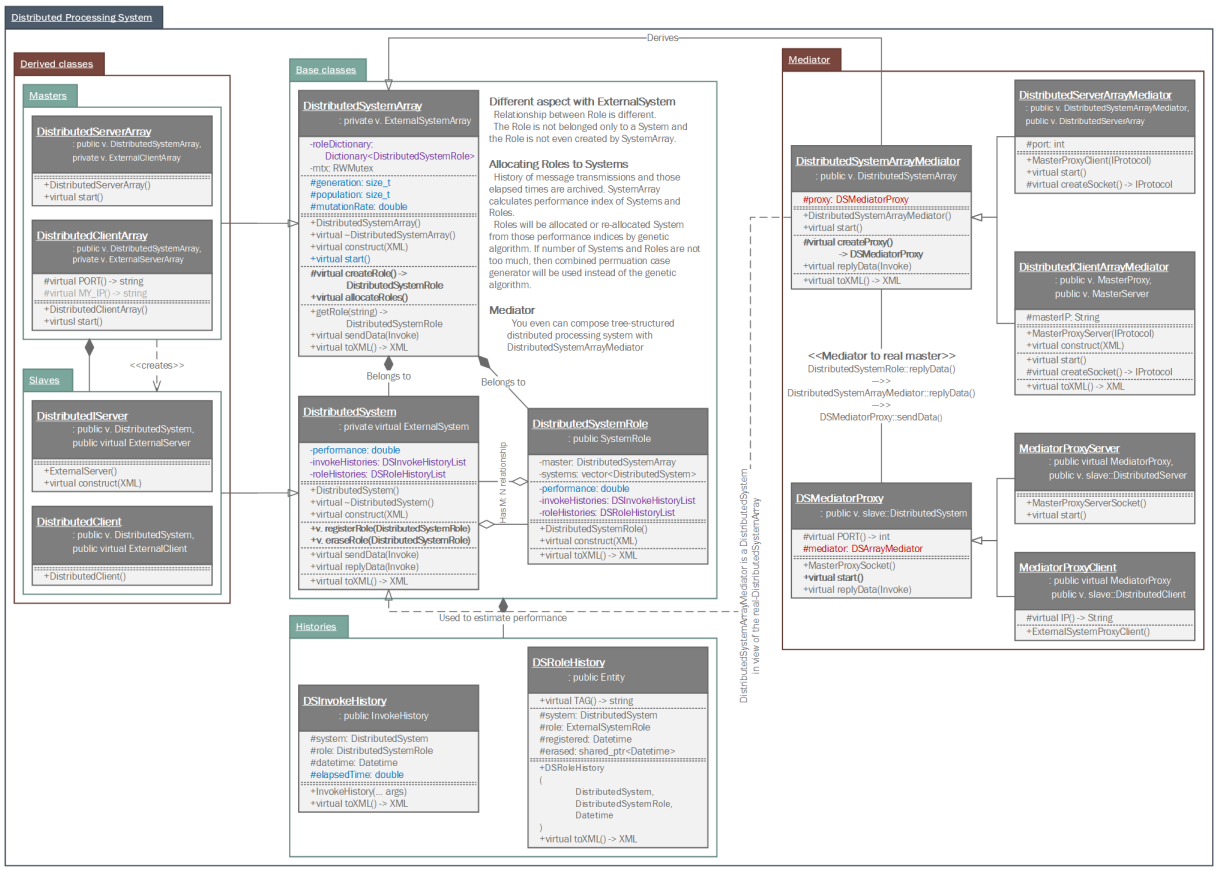
DistributedServer is an DistributedSystem specialized in server driver.

**[Inherited]**

DistributedSystem class is an ExternalSystem having role as DistributedSystemRole objects with performance index and history log allocation of DistributedSystemRole objects and have requsted Invoke message to related external system.

The greatest difference between DistributedSystem and ExternalSystem is, unlike the ExternalSystem class which having is ExternalSystemRole objects exclusively, DistributedSystem does not monopoly a DistributedSystemRole. The DistributedSystemRole can allocatedto multiple DistributedSystem.

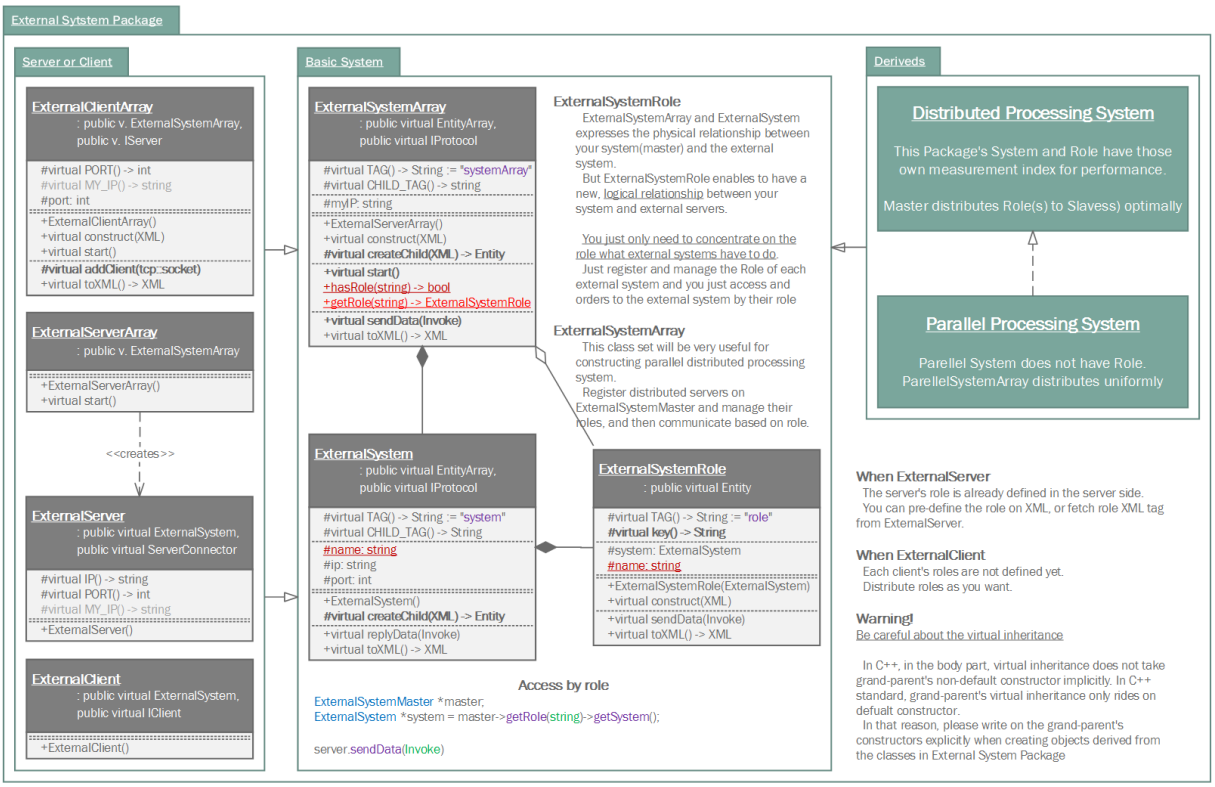
DistributedSystem and DistributedSystemRole classes have performance index and history log archiving what they've requested to the related distributed system. Allocating DistributedSystemRole objects to DistributedSyste will be determined those performance index and history log for optimize distribution of elasped time about each Invoke message processing.




**[Inherited]**

ExternalSystem is a boundary class interacting with an external system by network communication. Also, External↩System is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystemRole.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩ SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an ExternalSystem. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.23.2 Member Function Documentation

#### 6.23.2.1 virtual void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from ExternalServer.

#### 6.23.2.2 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from ExternalServer.

The documentation for this class was generated from the following file:

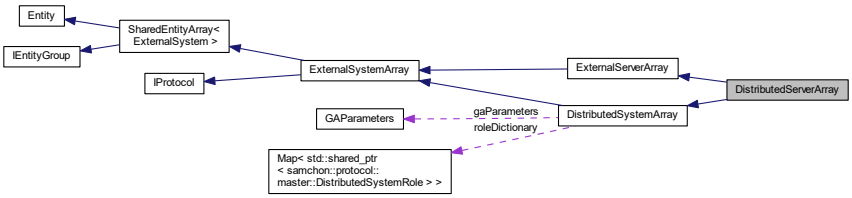
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedServer.hpp

## 6.24 DistributedServerArray Class Reference

An array of DistributedServer(s).

```
#include <DistributedServerArray.hpp>
```

Collaboration diagram for DistributedServerArray:




## Public Member Functions

- DistributedServerArray ()

  *Default Constructor.*

- virtual void start () override

  *Start interaction.*

## Additional Inherited Members

### 6.24.1 Detailed Description

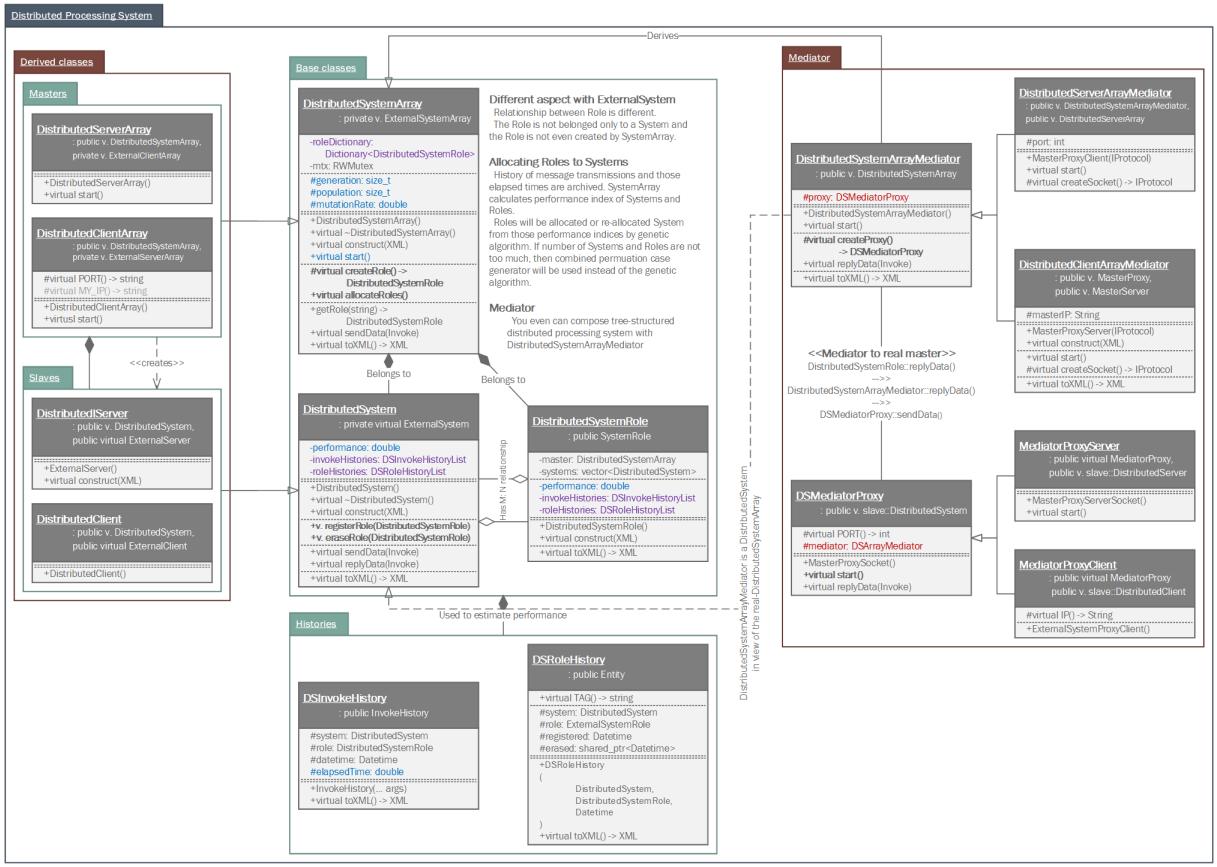
An array of DistributedServer(s).

DistributedServerArray is an DistributedSystemArray specialized in servers' driver.

**[Inherited]**

DistributedSystemArray class is an ExternalSystemArray and an abstract class containing and managing distributed system drivers within framework of master. The DistributedSystemArray class allocates DistributedSystemRole objects to DistributedSystem objects for optimization.

Unlike the ExternalSystemRole class which is dependent on an ExternalSystem, DistributedSystemRole is not dependent on a DistributedSystem and even can be allocated to multiple DistributedSystem objects. Allocation of DistributedSystemRole(s) to DistributedSystem(s) is determined by estimation of performance index pursuing best distribution. If number of DistributedSystem and DistributedSystemRole objects is not a lot, optimize by combined permuation algorithm. Else the objects are a lot, the allocation will be optimized by genetic algorithm.



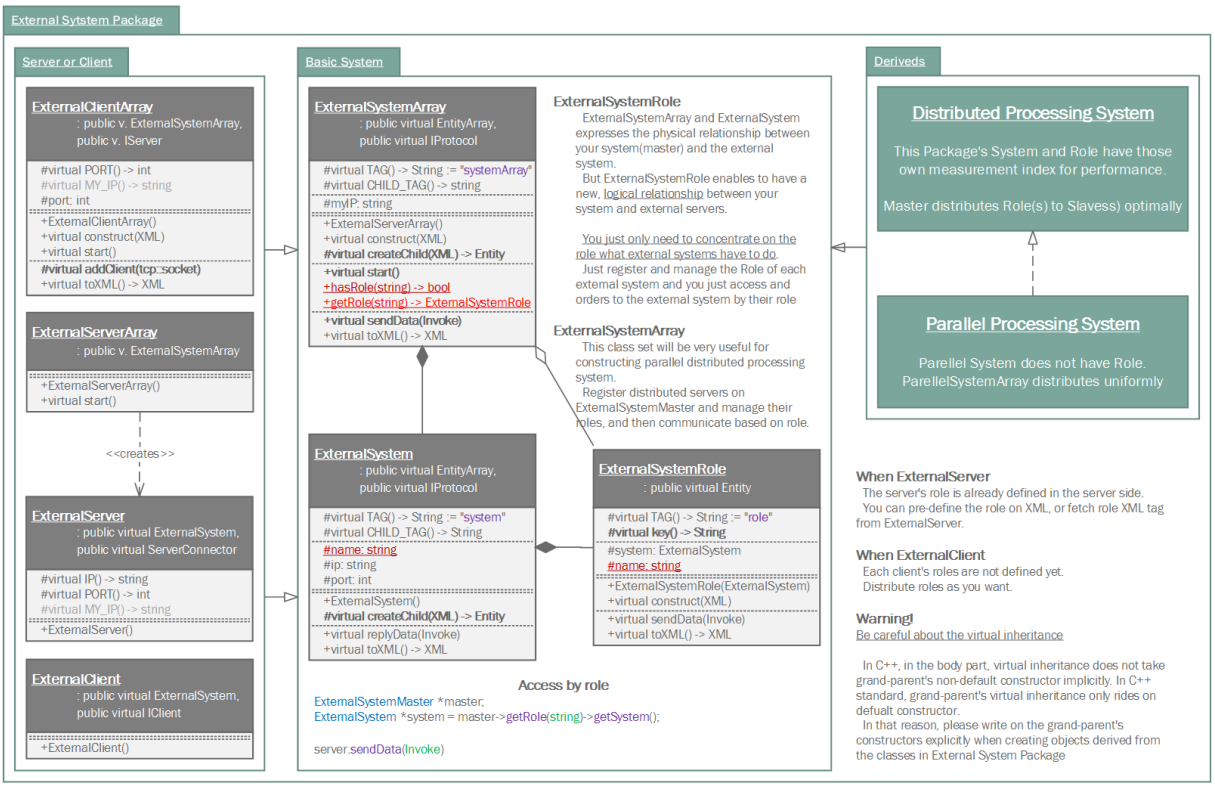

**[Inherited]**

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.24.2 Member Function Documentation

#### 6.24.2.1 virtual void start ( ) [override], [virtual]

Start interaction.

An abstract method starting interaction with external systems.

If external systems are servers, starts connection to them, else clients, opens a server and accepts the external systems. You can addict your own procudures of starting drivers, but if you directly override method of abstract ExternalSystemArray, be careful about virtual inheritance.

- DistributedClientArray::start() calls DistributedSystemArray::start() and ExternalClientArray:start()

Reimplemented from ExternalServerArray.

Reimplemented in DistributedServerArrayMediator.

The documentation for this class was generated from the following file:

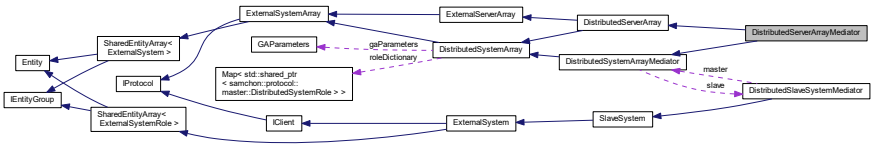
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedServerArray.hpp

## 6.25 DistributedServerArrayMediator Class Reference

A mediator of distributed system between master and slaves.

```
#include <DistributedServerArrayMediator.hpp>
```

Collaboration diagram for DistributedServerArrayMediator:




## Public Member Functions

- DistributedServerArrayMediator ()

  *Default Constructor.*

- virtual void start () override

  *Start interaction.*

## Additional Inherited Members

### 6.25.1 Detailed Description

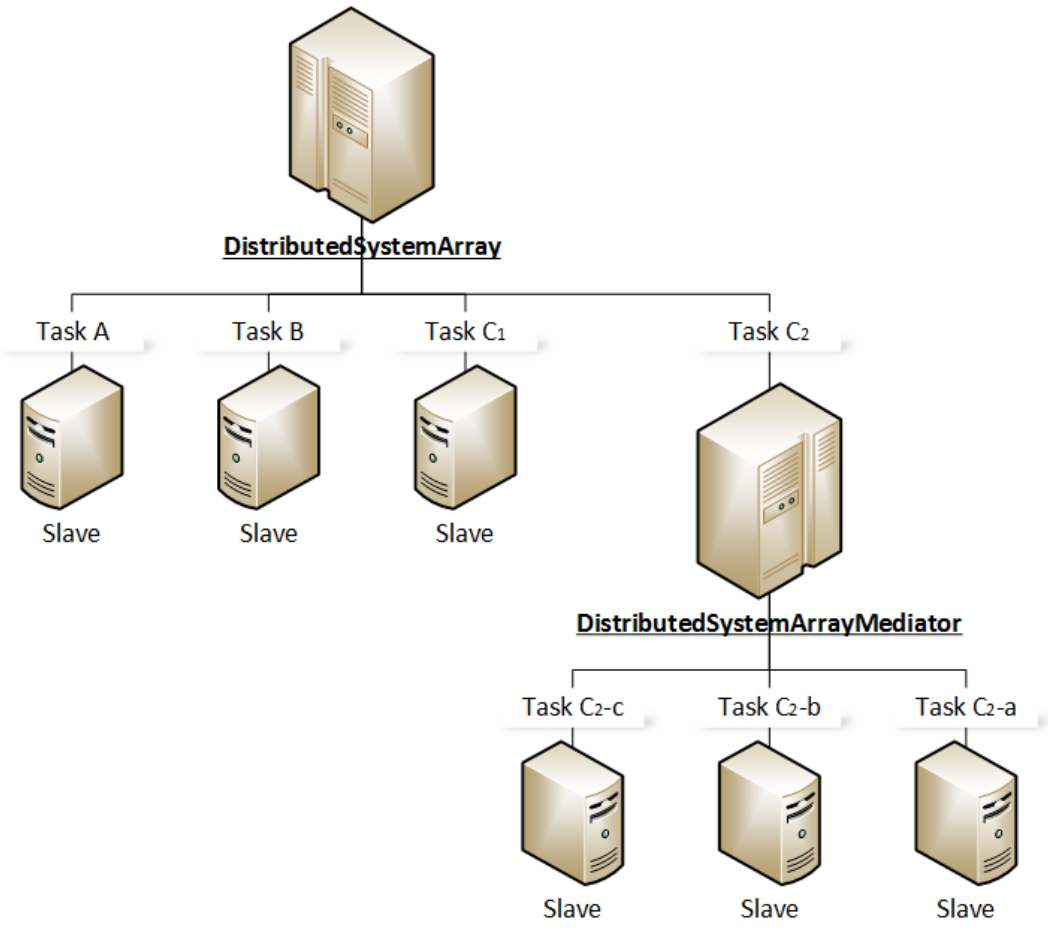
A mediator of distributed system between master and slaves.

DistributedServerArrayMediator is a DistributedSystemArrayMediator specialized in servers' driver. Distributed↩ ServerArrayMediator is a server for its master and also manages children servers' slaves.

**[Inherited]**

DistributedSystemArrayMediator class is used to realizing a mediator system of tree-structured distributed processing system. DistributedSystemArrayMediator intermediates between origin-master(DistributedSystemArray) and its slaves(slave::DistributedSystem).

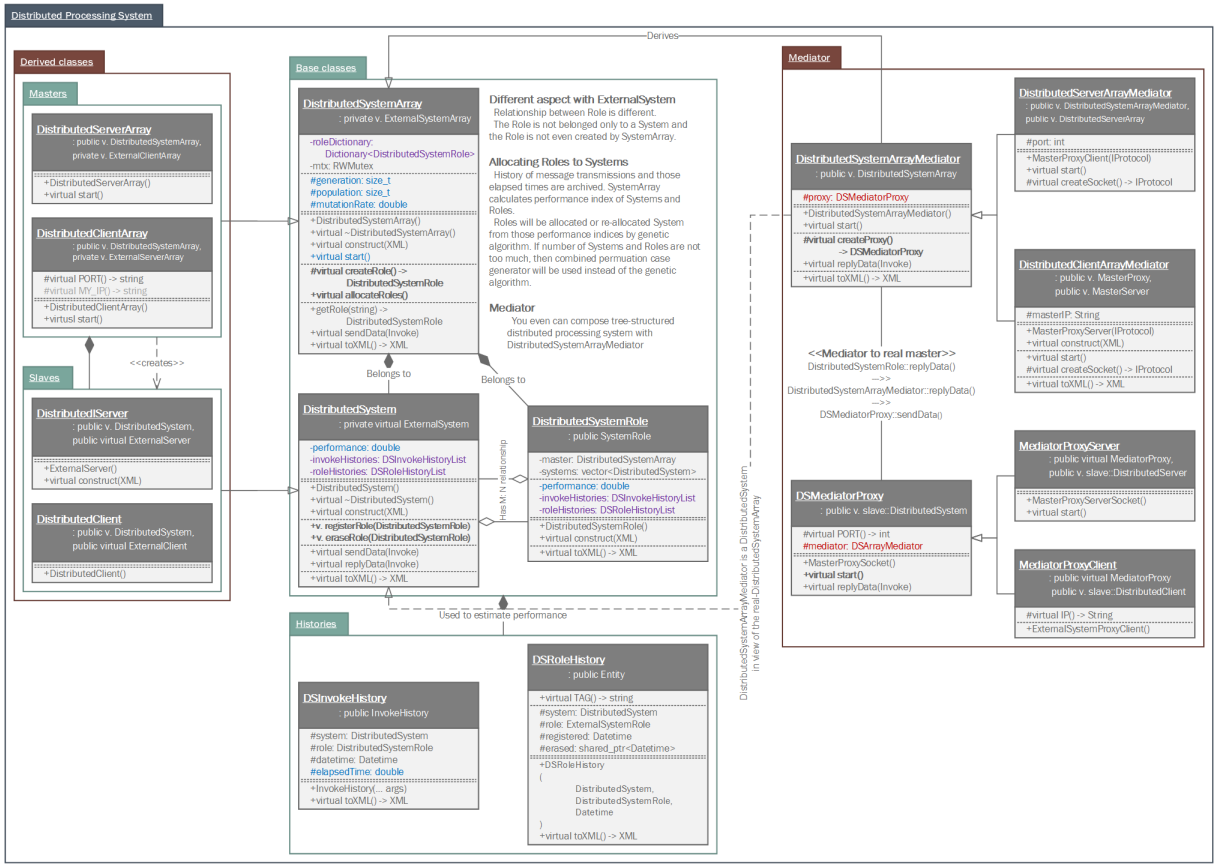
DistributedSystemArrayMediator is a master(DistributedSystemArray) within the framework of slaves systems (slave::DistributedSystem objects) and also can be a slave system (slave::DistributedSystem) within framework of its master(DistributedSystemArray) by having DistributedSlaveSystemMediator.




[Inherited]

DistributedSystemArray class is an ExternalSystemArray and an abstract class containing and managing distributed system drivers within framework of master. The DistributedSystemArray class allocates DistributedSystemRole objects to DistributedSystem objects for optimization.

Unlike the ExternalSystemRole class which is dependent on an ExternalSystem, DistributedSystemRole is not dependent on a DistributedSystem and even can be allocated to multiple DistributedSystem objects. Allocation of DistributedSystemRole(s) to DistributedSystem(s) is determined by estimation of performance index pursuing best distribution. If number of DistributedSystem and DistributedSystemRole objects is not a lot, optimize by combined permuation algorithm. Else the objects are a lot, the allocation will be optimized by genetic algorithm.



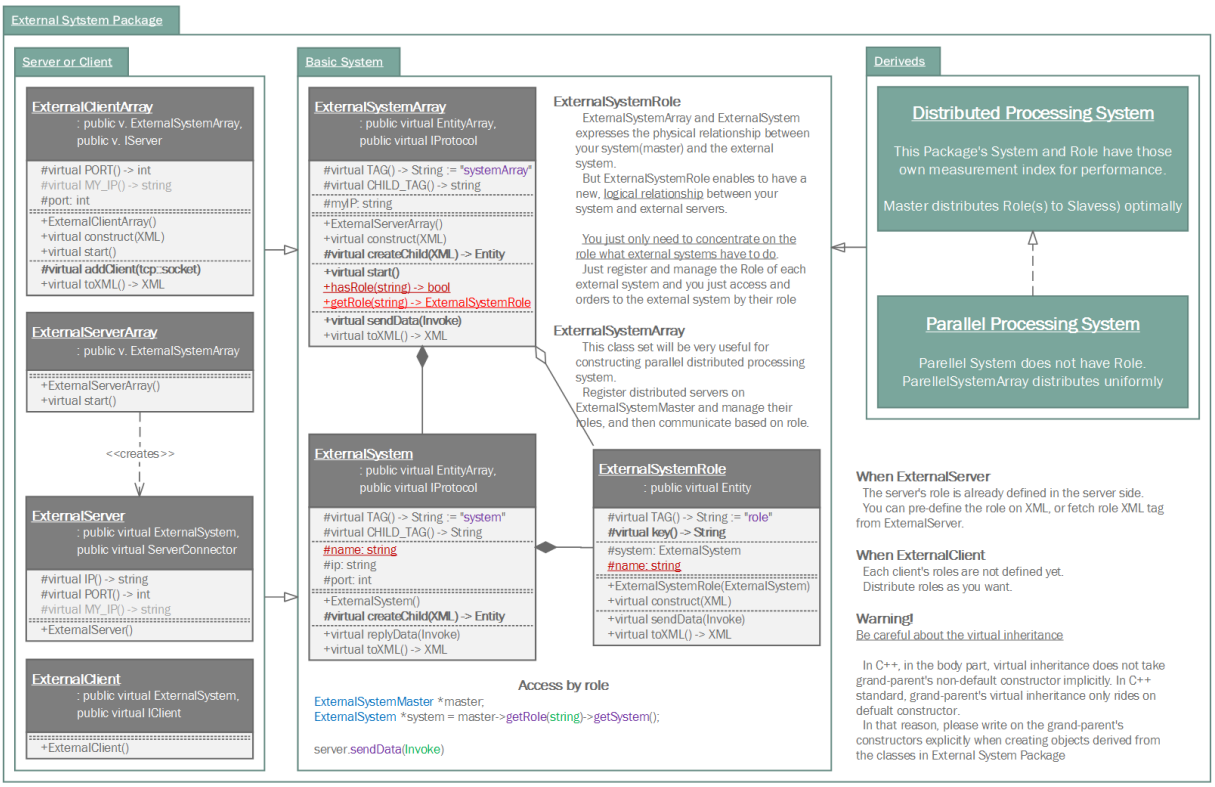

**[Inherited]**

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.25.2 Member Function Documentation

#### 6.25.2.1 virtual void start ( ) [override], [virtual]

Start interaction.

An abstract method starting interaction with external systems.

If external systems are servers, starts connection to them, else clients, opens a server and accepts the external systems. You can addict your own procudures of starting drivers, but if you directly override method of abstract ExternalSystemArray, be careful about virtual inheritance.

- DistributedClientArray::start() calls DistributedSystemArray::start() and ExternalClientArray:start()

Reimplemented from DistributedServerArray.

The documentation for this class was generated from the following file:

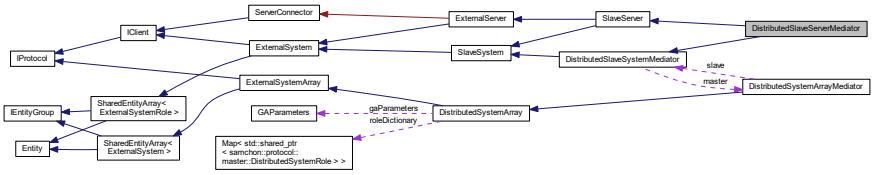
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedServerArrayMediator.↩ hpp

## 6.26 DistributedSlaveServerMediator Class Reference

A distributed slave server for mediation.

```
#include <DistributedSlaveServerMediator.hpp>
```

Collaboration diagram for DistributedSlaveServerMediator:




## Public Member Functions

- DistributedSlaveServerMediator ()

  *Default Constructor.*

## Additional Inherited Members

### 6.26.1 Detailed Description

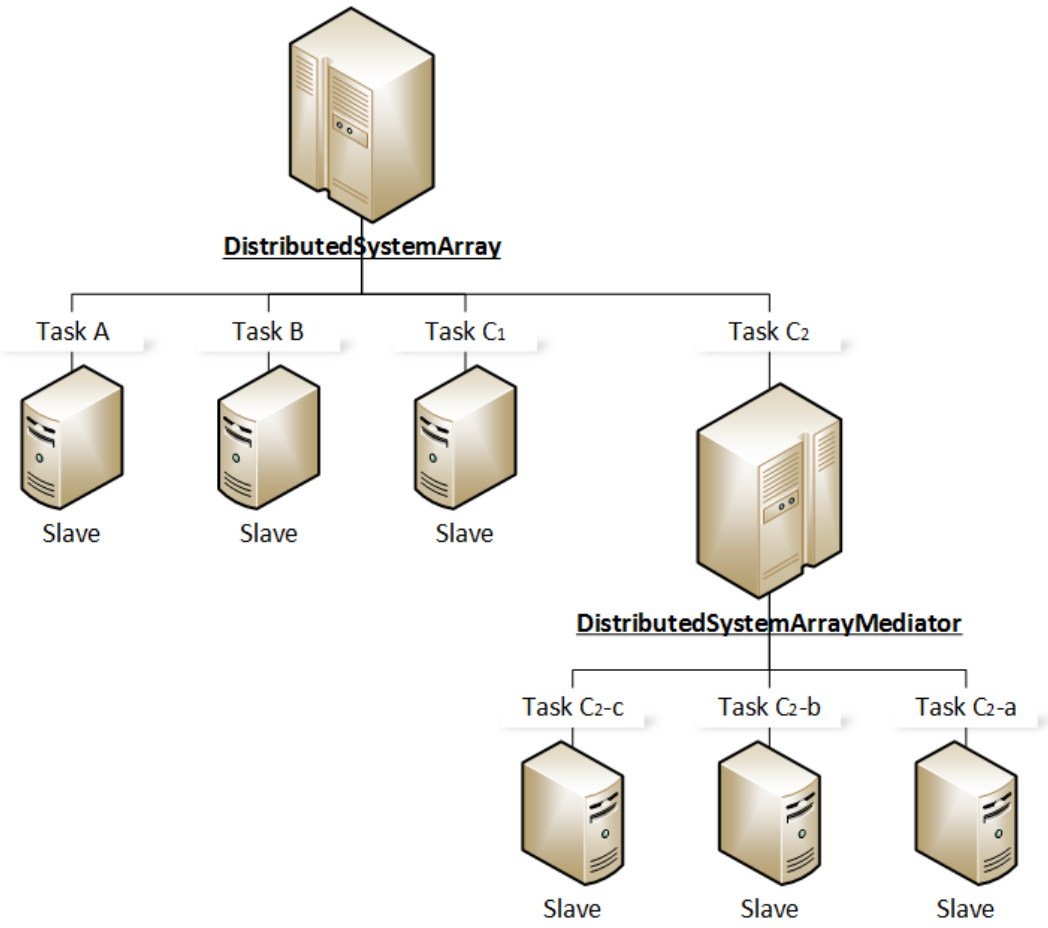
A distributed slave server for mediation.

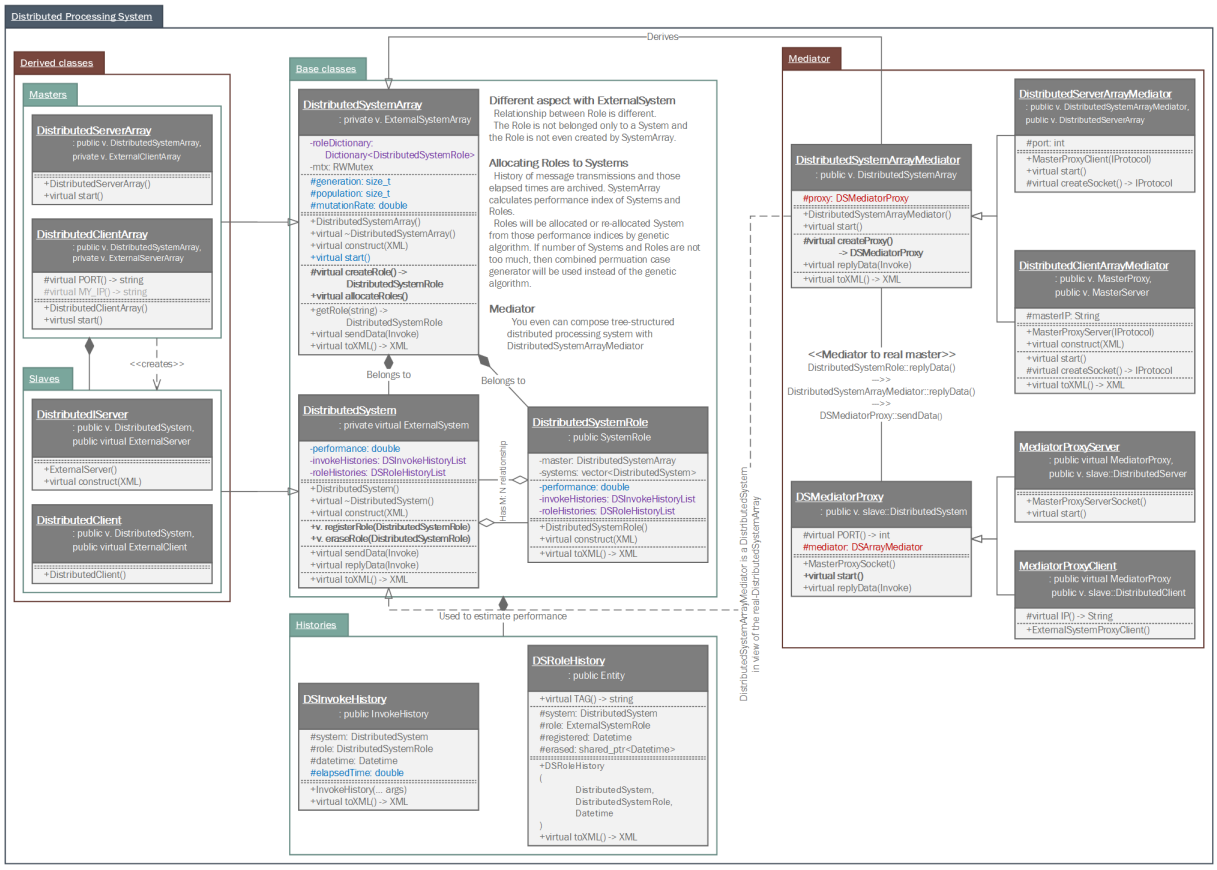
DistributedSlaveServerMediator is a DistributedSlaveSystemMediator class specialized in server driver.

**[Inherited]**

DistributedSlaveSystemMediator is an abstract class derived from slave::SlaveSystem for realizing tree-structured distriuted processins system. DistributedSlaveSystemMediator acts a slave system's role for its master, on the above level.

DistributedSystemArrayMediator and DistributedSlaveSystemMediator classes are paired to act a mediator system role by acting their own role, master system role for below slaves and slave system role for above master system.


DistributedSystemArray
Task A
Task B
Task C1
Task C2
Slave
Slave
Slave
DistributedSystemArrayMediator
Task C2-c
Task C2-b
Task C2-a
Slave
Slave
Slave


Distributed Processing System
Derived classes
Masters
DistributedServerArray
: public v. DistributedSystemArray,
private v. ExternalClientArray
+DistributedServerArray()
+virtual start()
DistributedClientArray
: public v. DistributedSystemArray,
private v. ExternalServerArray
#virtual PORT() -> string
#virtual MY_IP() -> string
+DistributedClientArray()
+virtual start()
<<creates>>
Slaves
DistributedIServer
: public v. DistributedSystem,
public virtual ExternalServer
+ExternalServer()
+virtual construct(XML)
DistributedClient
: public v. DistributedSystem,
public virtual ExternalClient
+DistributedClient()
Derives
Base classes
DistributedSystemArray
: private v. ExternalSystemArray
-roleDictionary:
Dictionary<DistributedSystemRole>
-mtx: RWMutex
#generation: size_t
#population: size_t
#mutationRate: double
+DistributedSystemArray()
+virtual ~DistributedSystemArray()
+virtual construct(XML)
+virtual start()
#virtual createRole() ->
DistributedSystemRole
+virtual allocateRoles()
+getRole(string) ->
DistributedSystemRole
+virtual sendData(Invoke)
+virtual toXML() -> XML
Different aspect with ExternalSystem
Relationship between Role is different.
The Role is not belonged only to a System and the Role is not even created by SystemArray.
Allocating Roles to Systems
History of message transmissions and those elapsed times are archived. SystemArray calculates performance index of Systems and Roles.
Roles will be allocated or re-allocated System from those performance indices by genetic algorithm. If number of Systems and Roles are not too much, then combined permuation case generator will be used instead of the genetic algorithm.
Mediator
You even can compose tree-structured distributed processing system with DistributedSystemArrayMediator
Belongs to
Belongs to
DistributedSystem
: private virtual ExternalSystem
-performance: double
-invokeHistories: DSInvokeHistoryList
-roleHistories: DSRoleHistoryList
+DistributedSystem()
+virtual ~DistributedSystem()
+virtual construct(XML)
+v. registerRole(DistributedSystemRole)
+v. eraseRole(DistributedSystemRole)
+virtual sendData(Invoke)
+virtual replyData(Invoke)
+virtual toXML() -> XML
Has N: N relationship
DistributedSystemRole
: public SystemRole
-master: DistributedSystemArray
-systems: vector<DistributedSystem>
-performance: double
-invokeHistories: DSInvokeHistoryList
-roleHistories: DSRoleHistoryList
+DistributedSystemRole()
+virtual construct(XML)
+virtual toXML() -> XML
Used to estimate performance
Histories
DSInvokeHistory
: public InvokeHistory
#system: DistributedSystem
#role: DistributedSystemRole
#datetime: Datetime
#elapsedTime: double
+InvokeHistory(... args)
+virtual toXML() -> XML
DSRoleHistory
: public Entity
+virtual TAG() -> string
#system: DistributedSystem
#role: ExternalSystemRole
#registered: Datetime
#erased: shared_ptr<Datetime>
+DSRoleHistory
(
DistributedSystem,
DistributedSystemRole,
Datetime
)
+virtual toXML() -> XML
DistributedSystemArrayMediator is a DistributedSystem
in view of the real-DistributedSystemArray
Mediator
DistributedSystemArrayMediator
: public v. DistributedSystemArray
#proxy: DSMediatorProxy
+DistributedSystemArrayMediator()
+virtual start()
#virtual createProxy()
-> DSMediatorProxy
+virtual replyData(Invoke)
+virtual toXML() -> XML
DistributedServerArrayMediator
: public v. DistributedSystemArrayMediator,
public v. DistributedServerArray
#port: int
+MasterProxyClient(IProtocol)
+virtual start()
#virtual createSocket() -> IProtocol
DistributedClientArrayMediator
: public v. MasterProxy,
public v. MasterServer
#masterIP: String
+MasterProxyServer(IProtocol)
+virtual construct(XML)
+virtual start()
#virtual createSocket() -> IProtocol
+virtual toXML() -> XML
<<Mediator to real master>>
DistributedSystemRole::replyData()
-->>
DistributedSystemArrayMediator::replyData()
-->>
DSMediatorProxy::sendData()
DSMediatorProxy
: public v. slave::DistributedSystem
#virtual PORT() -> int
#mediator: DSArrayMediator
+MasterProxySocket()
+virtual start()
+virtual replyData(Invoke)
MediatorProxyServer
: public virtual MediatorProxy,
public v. slave::DistributedServer
+MasterProxyServerSocket()
+virtual start()
MediatorProxyClient
: public virtual MediatorProxy
public v. slave::DistributedClient
#virtual IP() -> String
+ExternalSystemProxyClient()

[Inherited]

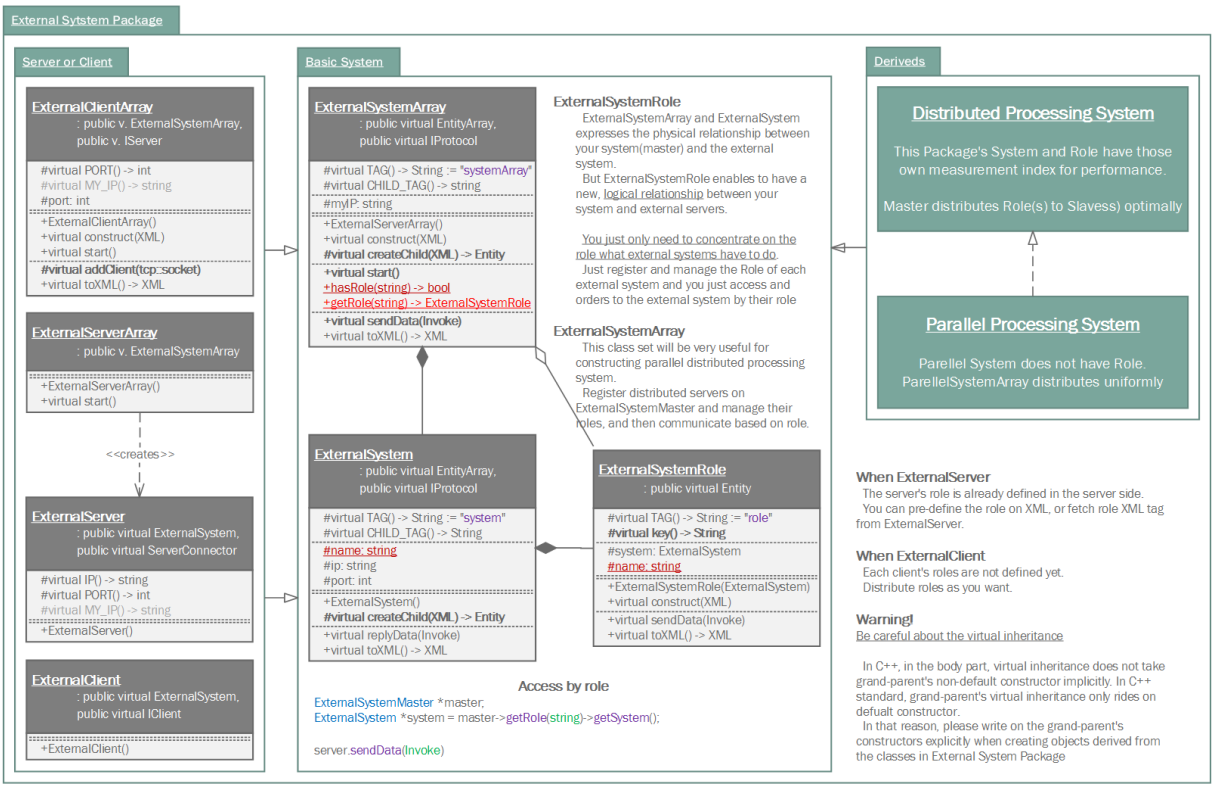
SlaveSystem, literally, means a slave system belongs to a maste system.

The SlaveSystem class is used in opposite side system of master::DistributedSystem and master::ParallelSystem and reports elapsed time of each commmand (by Invoke message) for estimation of its performance.

[Inherited]

ExternalSystem is a boundary class interacting with an external system by network communication. Also, External↩System is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystemRole.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an ExternalSystem. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

The documentation for this class was generated from the following file:

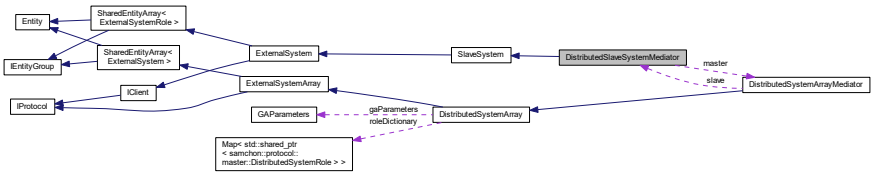
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedSlaveServerMediator.↩ hpp

## 6.27 DistributedSlaveSystemMediator Class Reference

A distributed slave system for mediation.

`#include <DistributedSlaveSystemMediator.hpp>`

Collaboration diagram for DistributedSlaveSystemMediator:




### Public Member Functions

- DistributedSlaveSystemMediator ()

  *Default Constructor.*
- virtual void replyData (std::shared_ptr< Invoke >) override

  *Handling replied message from an external system.*
- virtual auto TAG () const -> std::string override

  *A tag name when represented by XML.*

### Protected Attributes

- DistributedSystemArrayMediator * master

  *A master system for mediation.*

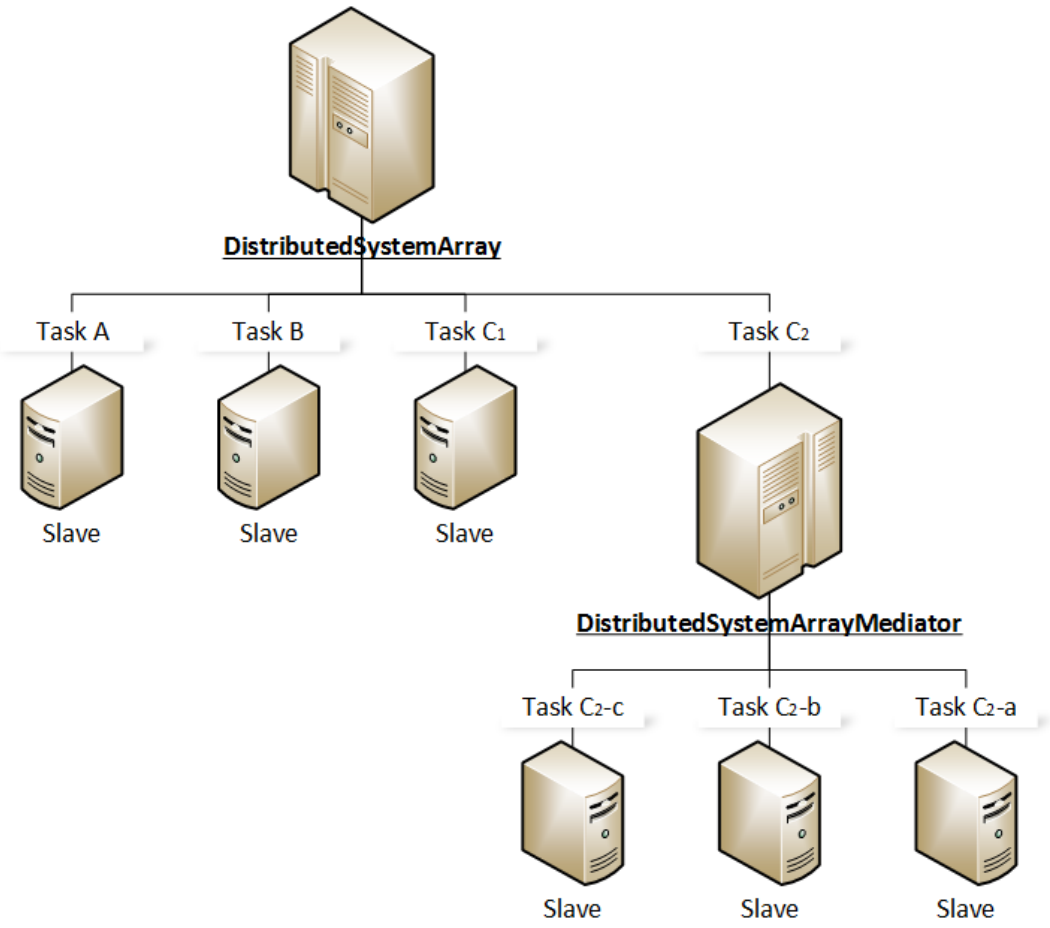
### Additional Inherited Members

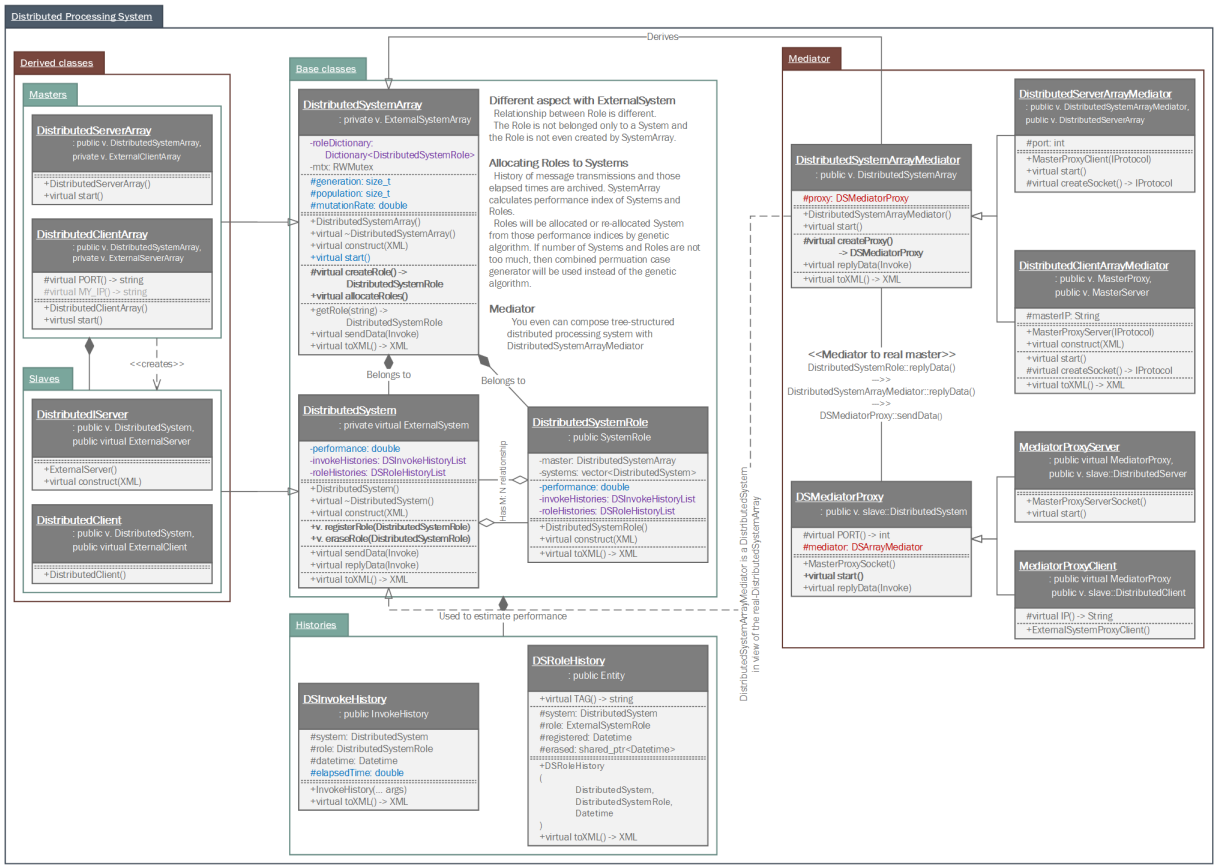
#### 6.27.1 Detailed Description

A distributed slave system for mediation.

DistributedSlaveSystemMediator is an abstract class derived from slave::SlaveSystem for realizing tree-structured distriuted processins system. DistributedSlaveSystemMediator acts a slave system's role for its master, on the above level.

DistributedSystemArrayMediator and DistributedSlaveSystemMediator classes are paired to act a mediator system role by acting their own role, master system role for below slaves and slave system role for above master system.


DistributedSystemArray
Task A
Task B
Task C1
Task C2
Slave
Slave
Slave
DistributedSystemArrayMediator
Task C2-c
Task C2-b
Task C2-a
Slave
Slave
Slave


Distributed Processing System
Derived classes
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DistributedClientArray
: public v. DistributedSystemArray,
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Slaves
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DistributedClient
: public v. DistributedSystem,
public virtual ExternalClient
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Derives
Base classes
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: private v. ExternalSystemArray
-roleDictionary:
Dictionary<DistributedSystemRole>
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Different aspect with ExternalSystem
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Mediator
You even can compose tree-structured distributed processing system with DistributedSystemArrayMediator
Belongs to
Belongs to
DistributedSystem
: private virtual ExternalSystem
-performance: double
-invokeHistories: DSInvokeHistoryList
-roleHistories: DSRoleHistoryList
+DistributedSystem()
+virtual ~DistributedSystem()
+virtual construct(XML)
+v. registerRole(DistributedSystemRole)
+v. eraseRole(DistributedSystemRole)
+virtual sendData(Invoke)
+virtual replyData(Invoke)
+virtual toXML() -> XML
Has N:N relationship
DistributedSystemRole
: public SystemRole
-master: DistributedSystemArray
-systems: vector<DistributedSystem>
-performance: double
-invokeHistories: DSInvokeHistoryList
-roleHistories: DSRoleHistoryList
+DistributedSystemRole()
+virtual construct(XML)
+virtual toXML() -> XML
Used to estimate performance
Histories
DSInvokeHistory
: public InvokeHistory
#system: DistributedSystem
#role: DistributedSystemRole
#datetime: Datetime
#elapsedTime: double
+InvokeHistory(... args)
+virtual toXML() -> XML
DSRoleHistory
: public Entity
+virtual TAG() -> string
#system: DistributedSystem
#role: ExternalSystemRole
#registered: Datetime
#erased: shared_ptr<Datetime>
+DSRoleHistory
(
DistributedSystem,
DistributedSystemRole,
Datetime
)
+virtual toXML() -> XML
DistributedSystemArrayMediator is a DistributedSystem in view of the real-DistributedSystemArray
Mediator
DistributedSystemArrayMediator
: public v. DistributedSystemArray
#proxy: DSMediatorProxy
+DistributedSystemArrayMediator()
+virtual start()
#virtual createProxy()
-> DSMediatorProxy
+virtual replyData(Invoke)
+virtual toXML() -> XML
<<Mediator to real master>>
DistributedSystemRole::replyData()
-->>
DistributedSystemArrayMediator::replyData()
-->>
DSMediatorProxy::sendData()
DSMediatorProxy
: public v. slave::DistributedSystem
#virtual PORT() -> int
#mediator: DSArrayMediator
+MasterProxySocket()
+virtual start()
+virtual replyData(Invoke)
DistributedServerArrayMediator
: public v. DistributedSystemArrayMediator,
public v. DistributedServerArray
#port: int
+MasterProxyClient(IProtocol)
+virtual start()
#virtual createSocket() -> IProtocol
DistributedClientArrayMediator
: public v. MasterProxy,
public v. MasterServer
#masterIP: String
+MasterProxyServer(IProtocol)
+virtual construct(XML)
+virtual start()
#virtual createSocket() -> IProtocol
+virtual toXML() -> XML
MediatorProxyServer
: public virtual MediatorProxy,
public v. slave::DistributedServer
+MasterProxyServerSocket()
+virtual start()
MediatorProxyClient
: public virtual MediatorProxy
public v. slave::DistributedClient
#virtual IP() -> String
+ExternalSystemProxyClient()

[Inherited]

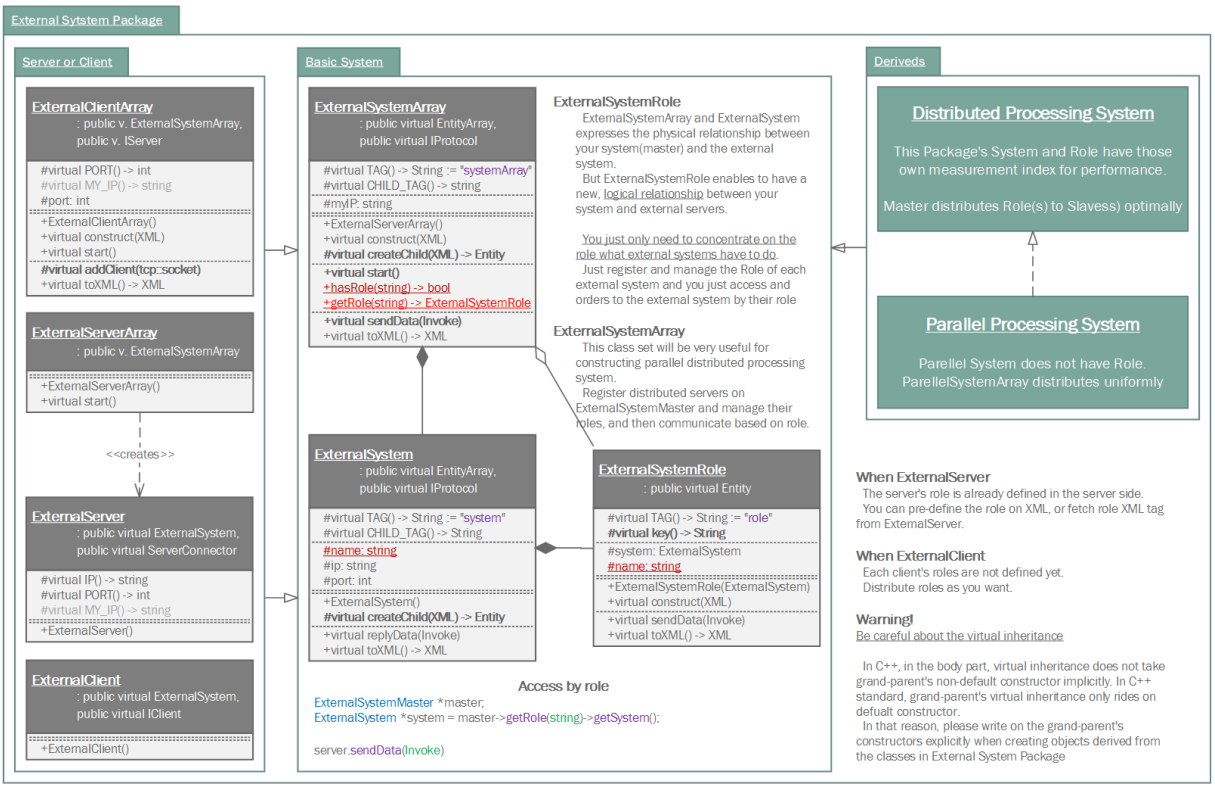
SlaveSystem, literally, means a slave system belongs to a maste system.

The SlaveSystem class is used in opposite side system of master::DistributedSystem and master::ParallelSystem and reports elapsed time of each commmand (by Invoke message) for estimation of its performance.

[Inherited]

ExternalSystem is a boundary class interacting with an external system by network communication. Also, External↩System is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystemRole.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an ExternalSystem. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.27.2 Member Function Documentation

#### 6.27.2.1 virtual void replyData ( std::shared_ptr< Invoke > ) [override], [virtual]

Handling replied message from an external system.

If there's a related ExternalSystemRole, shifts responsibility to the ExternalSystemRole.

**Parameters**

| | |
|---|---|
| *invoke* | Replied Invoke message |

Reimplemented from ExternalSystem.

#### 6.27.2.2 virtual auto TAG ( ) const -> std::string [override], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Reimplemented from ExternalSystem.

The documentation for this class was generated from the following file:

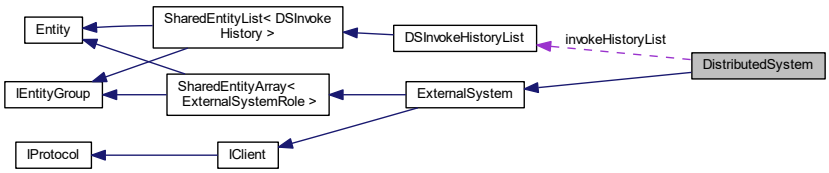
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedSlaveSystemMediator.hpp

## 6.28 DistributedSystem Class Reference

A network driver for a distributed system.

```
#include <DistributedSystem.hpp>
```

Collaboration diagram for DistributedSystem:




### Public Member Functions

- DistributedSystem ()

*Default Constructor.*

- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*

- virtual void sendData (std::shared_ptr< Invoke >) override

  *Sends message to a related system.*

- virtual void replyData (std::shared_ptr< Invoke >) override

  *Handling replied message from an external system.*

- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the EntityGroup.*

### Protected Attributes

- size_t inProgress

  *A number of processes running on the distributed system.*

- size_t processed

  *A number of processed have runned.*

- double avgElapsedTime

  *Average of elapsed time.*

- double performance

  *A performance index.*

- DSRoleHistoryList * roleHistoryList

  *A list of history log for role allocations.*

- DSInvokeHistoryList * invokeHistoryList

  *A list of history log for reported Invoke messages.*

### Additional Inherited Members

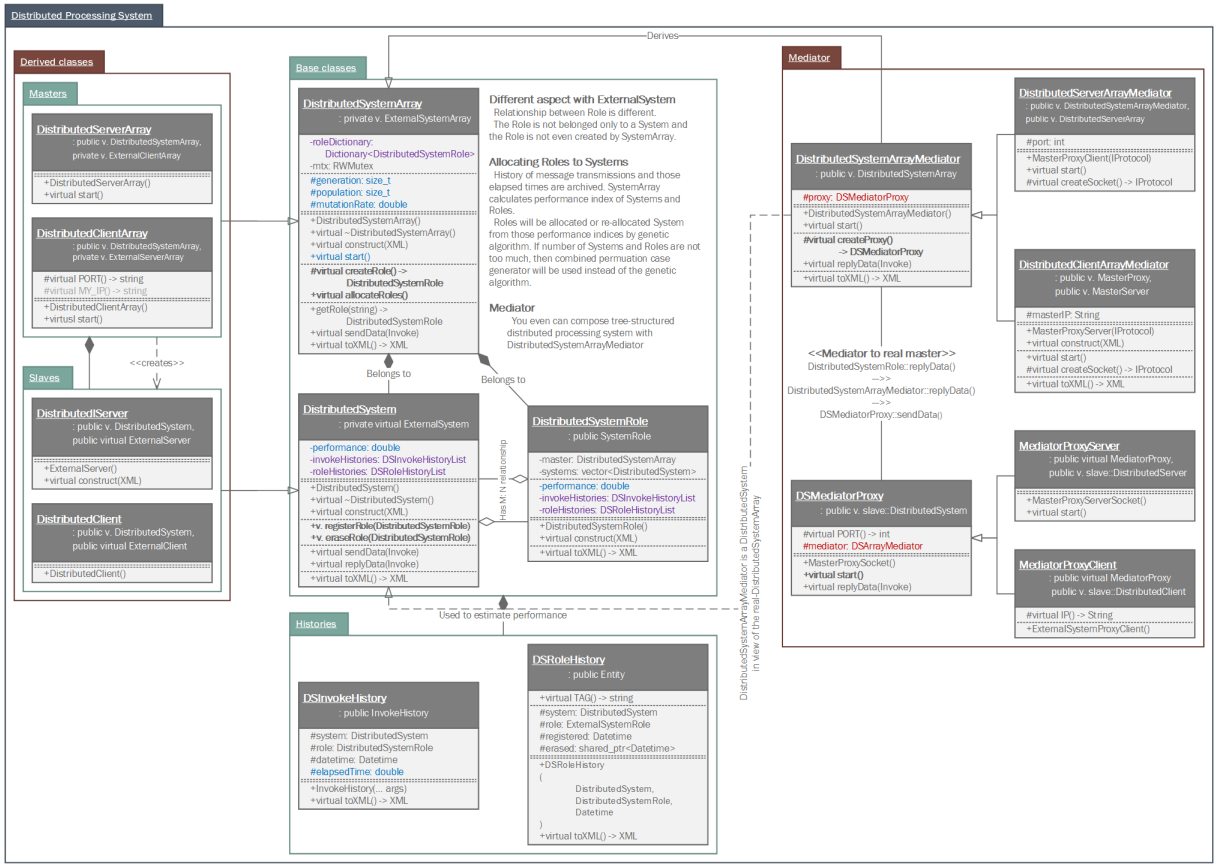
### 6.28.1 Detailed Description

A network driver for a distributed system.

DistributedSystem class is an ExternalSystem having role as DistributedSystemRole objects with performance index and history log allocation of DistributedSystemRole objects and have requsted Invoke message to related external system.

The greatest difference between DistributedSystem and ExternalSystem is, unlike the ExternalSystem class which having is ExternalSystemRole objects exclusively, DistributedSystem does not monopoly a DistributedSystemRole. The DistributedSystemRole can allocatedto multiple DistributedSystem.

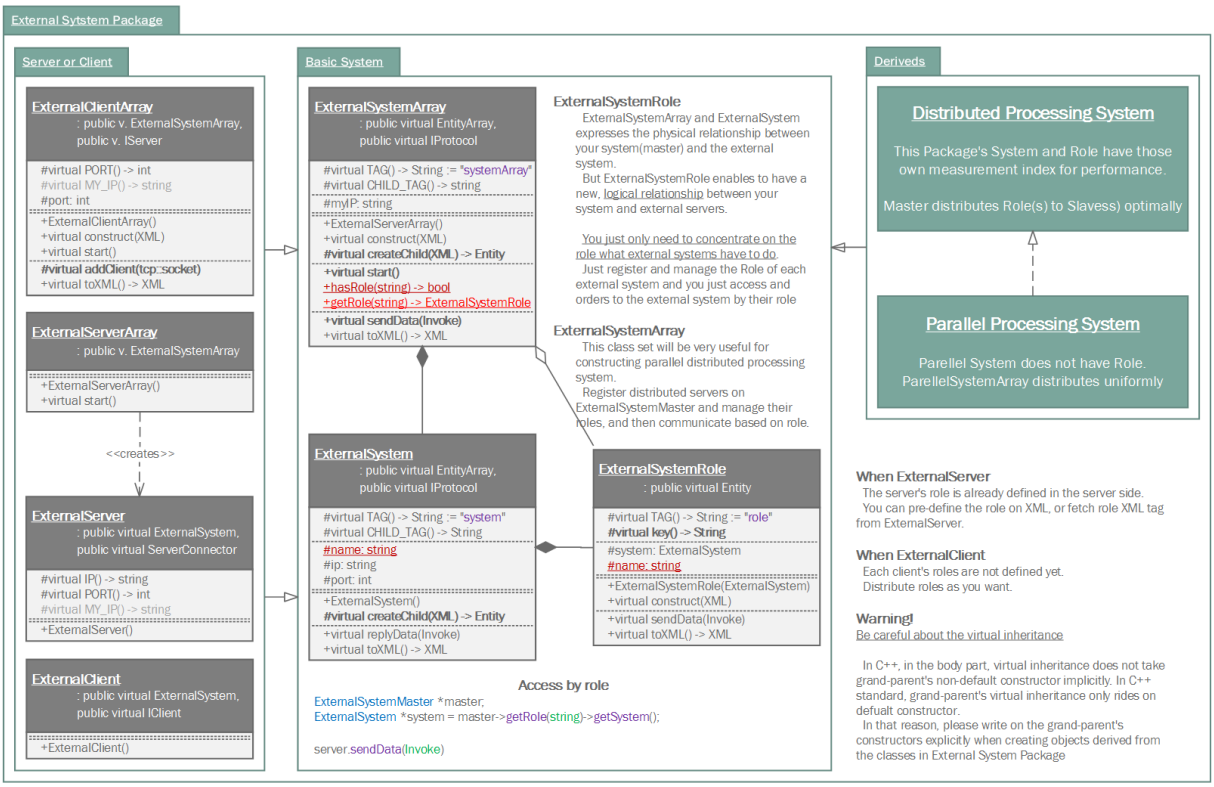
DistributedSystem and DistributedSystemRole classes have performance index and history log archiving what they've requested to the related distributed system. Allocating DistributedSystemRole objects to DistributedSyste will be determined those performance index and history log for optimize distribution of elasped time about each Invoke message processing.




**[Inherited]**

ExternalSystem is a boundary class interacting with an external system by network communication. Also, External↩System is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystemRole.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩ SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an ExternalSystem. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

## 6.28.2 Member Function Documentation

### 6.28.2.1 virtual void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from ExternalSystem.

Reimplemented in DistributedServer.

#### 6.28.2.2 virtual void sendData ( std::shared_ptr< Invoke > ) [override], [virtual]

Sends message to a related system.

**Parameters**

| | |
|---|---|
| *invoke* | Invoke message to send |

Reimplemented from IClient.

#### 6.28.2.3 virtual void replyData ( std::shared_ptr< Invoke > ) [override], [virtual]

Handling replied message from an external system.

If there's a related ExternalSystemRole, shifts responsibility to the ExternalSystemRole.

**Parameters**

| | |
|---|---|
| *invoke* | Replied Invoke message |

Reimplemented from ExternalSystem.

#### 6.28.2.4 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from ExternalSystem.

Reimplemented in DistributedServer.

### 6.28.3 Member Data Documentation

#### 6.28.3.1 size_t inProgress [protected]

A number of processes running on the distributed system.

Adds one count when sendData() is called and minus one count if a DSInvokeHistory, which means reported Invoke history, was reported by replyData().

If an DistributedSystemRole is allocated to multiple DistributedSystem objects, which DistributedSystem will be used is determined by the *process size* and performance index of the ExternalSystemRole.

#### 6.28.3.2 double avgElapsedTime [protected]

Average of elapsed time.

Average elapsed time of handling Invoke message (request) in frame work of tbe related distributed system. Not in frame work of distributed system's driver, DistributeDSystem.

The ultimate optimization target of distributed processing system is to minimizing standard deviation of the average elapsed time of the DistributedSystem.

#### 6.28.3.3 double performance [protected]

A performance index.

A performance index z is calculated by normalization calculating reverse number of whole distributed system's average elapsed times and its z value between the normal distribution.

- X = (

  If a distributed system has no history of handling Invoke message, then set the performance index to 0 as default. The performance index will be re-calcuated whenever re-allocation of roles is done (DistributedSystem::allocateRoles()).

  The documentation for this class was generated from the following file:

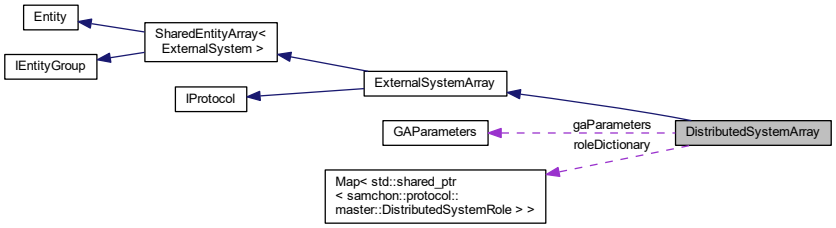
  - D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedSystem.hpp

## 6.29 DistributedSystemArray Class Reference

An array of distributed system drivers.

```
#include <DistributedSystemArray.hpp>
```

Collaboration diagram for DistributedSystemArray:




## Public Member Functions

- DistributedSystemArray ()

  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*
- virtual void start () override

  *Start interaction.*
- virtual void allocateRoles ()

  *Allocate roles to each distributed processing system.*
- auto getRole (const std::string &) const -> std::shared_ptr< DistributedSystemRole >

  *Get a role.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the EntityGroup.*

## Protected Member Functions

- virtual auto createRole (std::shared_ptr< library::XML >) -> DistributedSystemRole *=0

  *Factory method of a DistributedSystemRole.*

## Protected Attributes

- Dictionary< std::shared_ptr< DistributedSystemRole > > roleDictionary

  *A dictionary of role objects.*
- struct library::GAParameters gaParameters

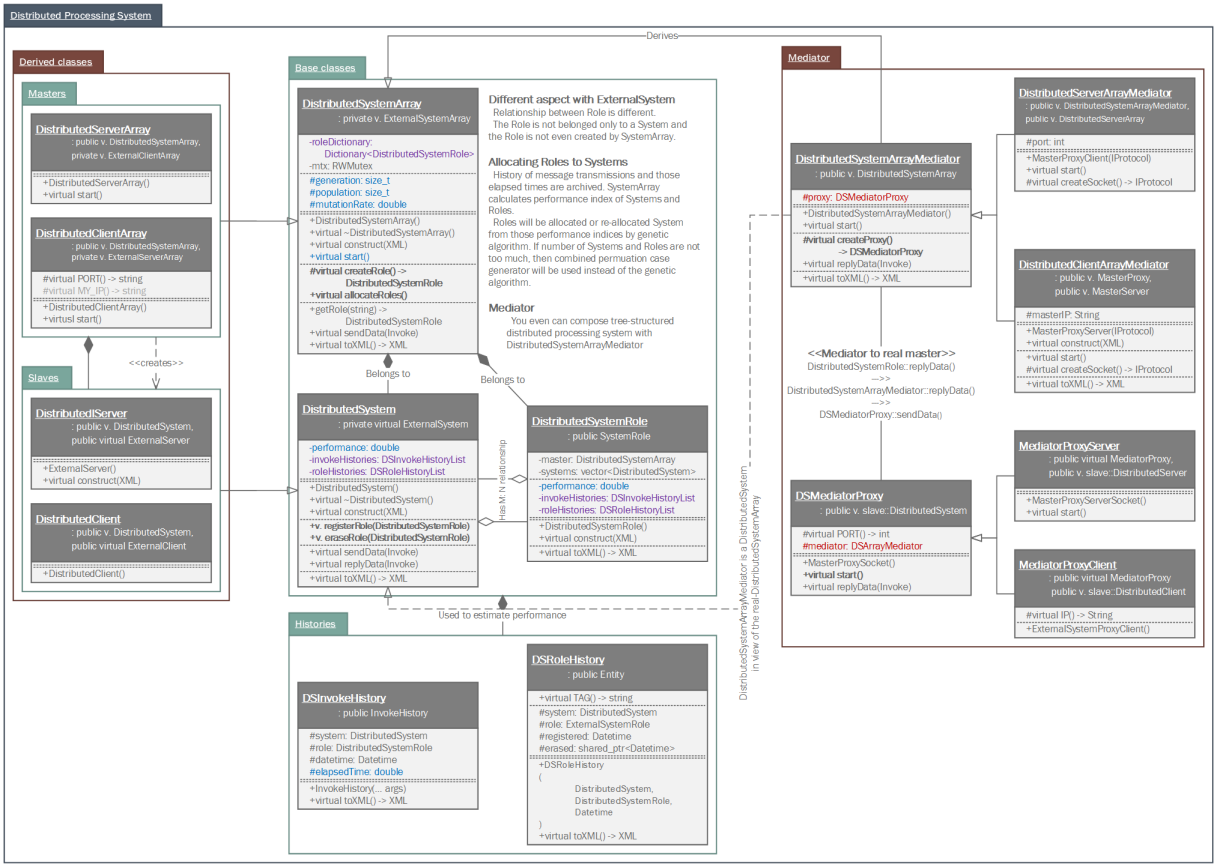
  *A structure of parameters for genetic algorithm.*

### 6.29.1 Detailed Description

An array of distributed system drivers.

DistributedSystemArray class is an ExternalSystemArray and an abstract class containing and managing distributed system drivers within framework of master. The DistributedSystemArray class allocates DistributedSystemRole objects to DistributedSystem objects for optimization.

Unlike the ExternalSystemRole class which is dependent on an ExternalSystem, DistributedSystemRole is not dependent on a DistributedSystem and even can be allocated to multiple DistributedSystem objects. Allocation of DistributedSystemRole(s) to DistributedSystem(s) is determined by estimation of performance index pursuing best distribution. If number of DistributedSystem and DistributedSystemRole objects is not a lot, optimize by combined permuation algorithm. Else the objects are a lot, the allocation will be optimized by genetic algorithm.



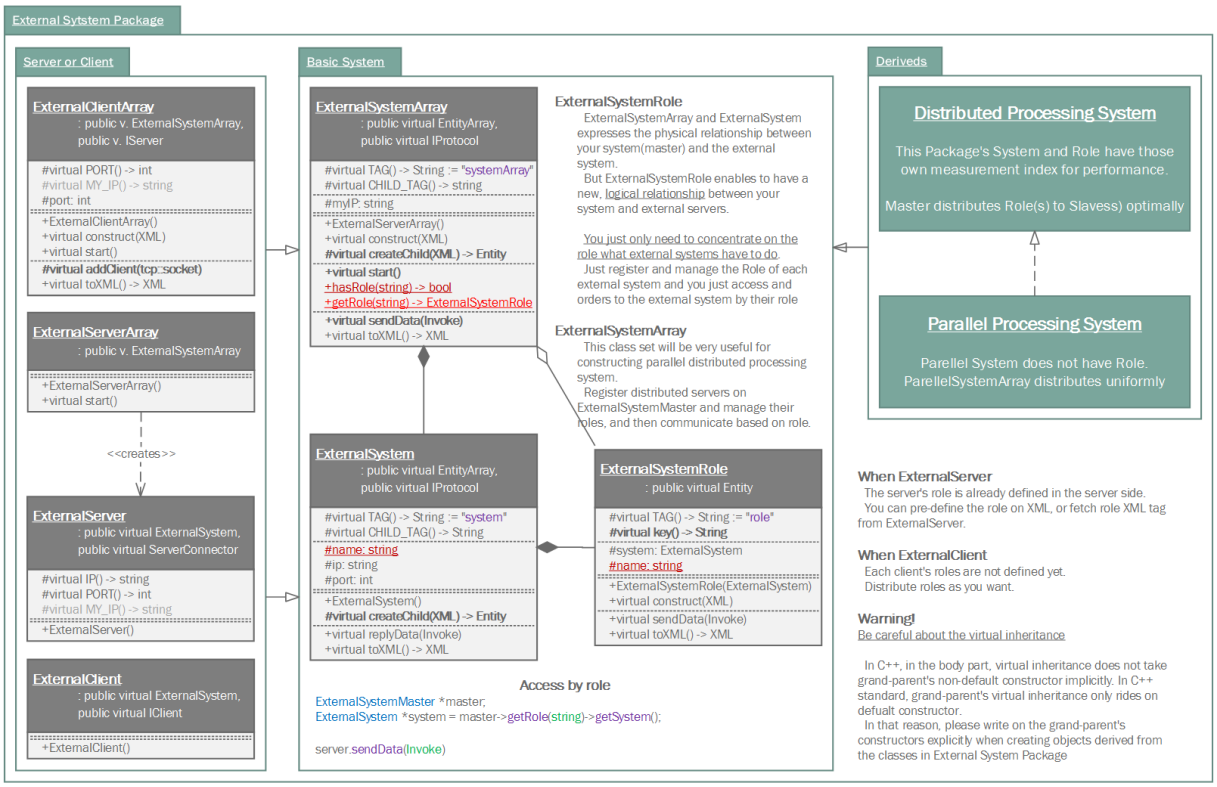

**[Inherited]**

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




**See also**

samchon::protocol

**Author**

Jeongho Nam

## 6.29.2 Member Function Documentation

### 6.29.2.1 virtual void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from EntityGroup< _Container, _ETy, _Ty >.

Reimplemented in DistributedSystemArrayMediator, DistributedClientArrayMediator, and DistributedClient↩Array.

#### 6.29.2.2 virtual auto createRole ( std::shared_ptr< library::XML > ) -> DistributedSystemRole * [protected], [pure virtual]

Factory method of a DistributedSystemRole.

**Parameters**

| | |
|---|---|
| *An* | XML object represents the role. |

**Returns**

A new DistributedSystemRole.

#### 6.29.2.3 virtual void start ( ) [override], [virtual]

Start interaction.

An abstract method starting interaction with external systems.

If external systems are servers, starts connection to them, else clients, opens a server and accepts the external systems. You can addict your own procudures of starting drivers, but if you directly override method of abstract ExternalSystemArray, be careful about virtual inheritance.

- DistributedClientArray::start() calls DistributedSystemArray::start() and ExternalClientArray:start()

Implements ExternalSystemArray.

Reimplemented in DistributedSystemArrayMediator, DistributedClientArrayMediator, DistributedClientArray, DistributedServerArrayMediator, and DistributedServerArray.

#### 6.29.2.4 virtual void allocateRoles ( ) [virtual]

Allocate roles to each distributed processing system.

Allocates DistributedSystemRole objects to Distributedsystem objects. The allocation will be done when:

- New distributed system (client) has connected.
- Ordinary distributed system is disconnected.
- Deviation of elapsed time of whole DistributedSystem overs limited value.

#### 6.29.2.5 auto getRole ( const std::string & ) const -> std::shared_ptr< DistributedSystemRole >

Get a role.

**Parameters**

| | |
|---|---|
| *name* | An identifier of an DistributedSystemRole |

**Returns**

A shared pointer of specialized role

#### 6.29.2.6 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from EntityGroup< _Container, _ETy, _Ty >.

Reimplemented in DistributedSystemArrayMediator, DistributedClientArrayMediator, and DistributedClient↩Array.

The documentation for this class was generated from the following file:

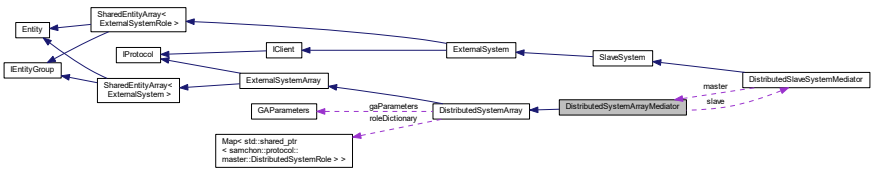
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedSystemArray.hpp

## 6.30 DistributedSystemArrayMediator Class Reference

A mediator of distributed system between master and slaves.

```
#include <DistributedSystemArrayMediator.hpp>
```

Collaboration diagram for DistributedSystemArrayMediator:



### Public Member Functions

- DistributedSystemArrayMediator ()

  *Default Constructor.*

- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*

- virtual void start () override

  *Start interaction.*

- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the EntityGroup.*

### Protected Member Functions

- virtual auto createSlave () const -> DistributedSlaveSystemMediator *=0

  *Factory method of slave system for mediation.*

### Protected Attributes

- DistributedSlaveSystemMediator * slave

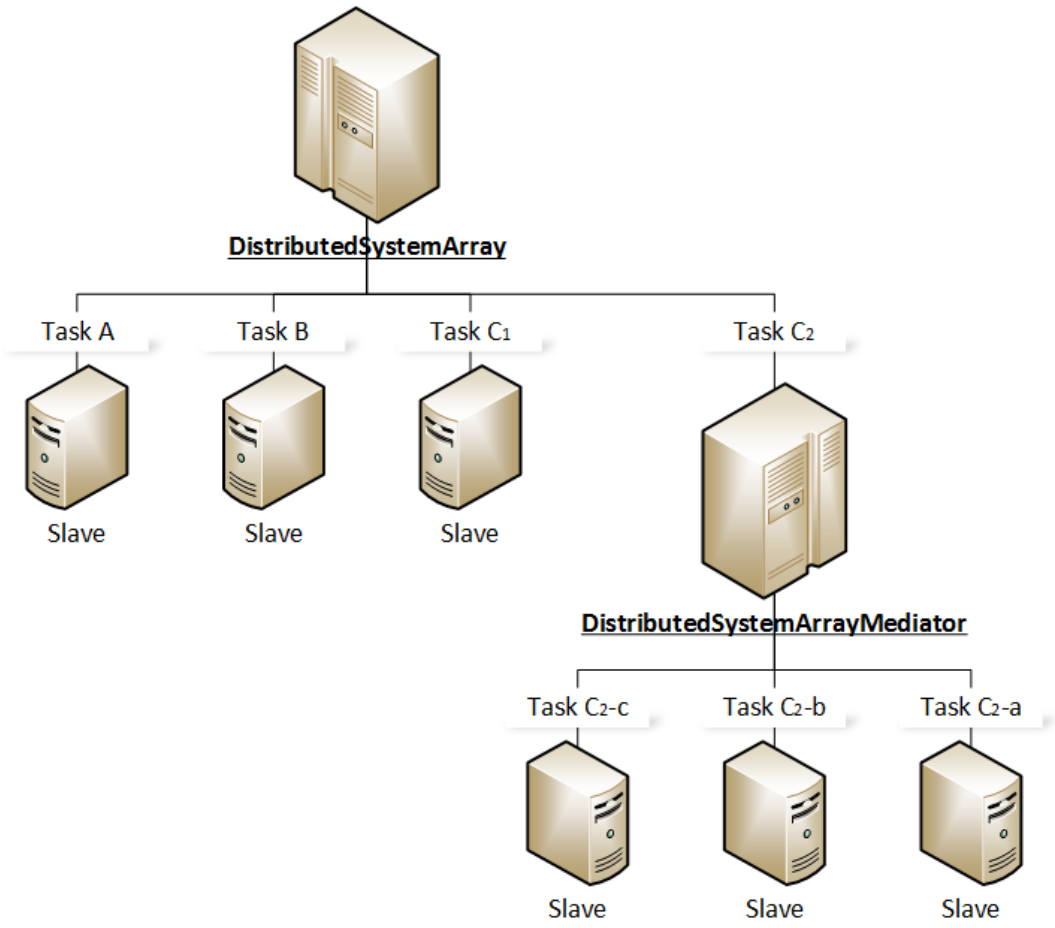
  *A slave system for mediation.*

## 6.30.1 Detailed Description

A mediator of distributed system between master and slaves.

DistributedSystemArrayMediator class is used to realizing a mediator system of tree-structured distributed processing system. DistributedSystemArrayMediator intermediates between origin-master(DistributedSystemArray) and its slaves(slave::DistributedSystem).

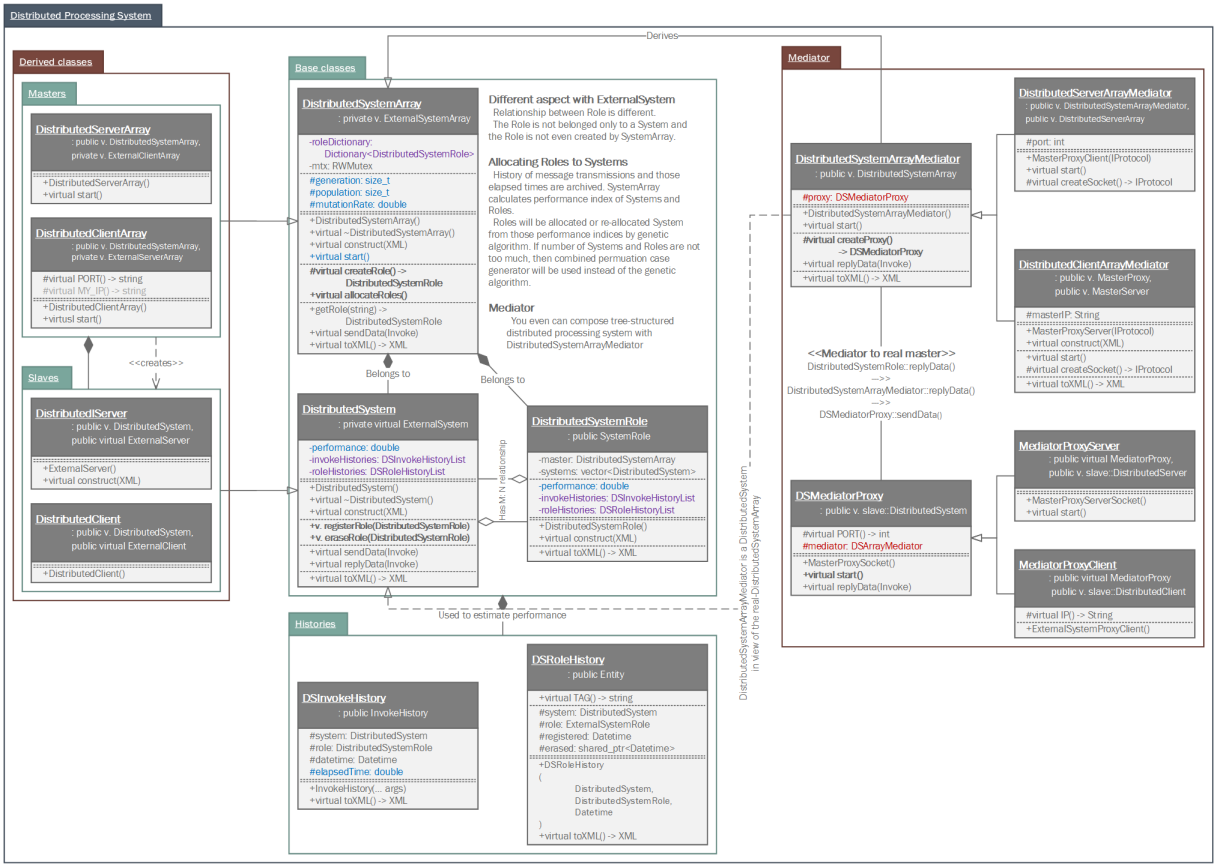
DistributedSystemArrayMediator is a master(DistributedSystemArray) within the framework of slaves systems (slave::DistributedSystem objects) and also can be a slave system (slave::DistributedSystem) within framework of its master(DistributedSystemArray) by having DistributedSlaveSystemMediator.




**[Inherited]**

DistributedSystemArray class is an ExternalSystemArray and an abstract class containing and managing distributed system drivers within framework of master. The DistributedSystemArray class allocates DistributedSystemRole objects to DistributedSystem objects for optimization.

Unlike the ExternalSystemRole class which is dependent on an ExternalSystem, DistributedSystemRole is not dependent on a DistributedSystem and even can be allocated to multiple DistributedSystem objects. Allocation of DistributedSystemRole(s) to DistributedSystem(s) is determined by estimation of performance index pursuing best distribution. If number of DistributedSystem and DistributedSystemRole objects is not a lot, optimize by combined permuation algorithm. Else the objects are a lot, the allocation will be optimized by genetic algorithm.



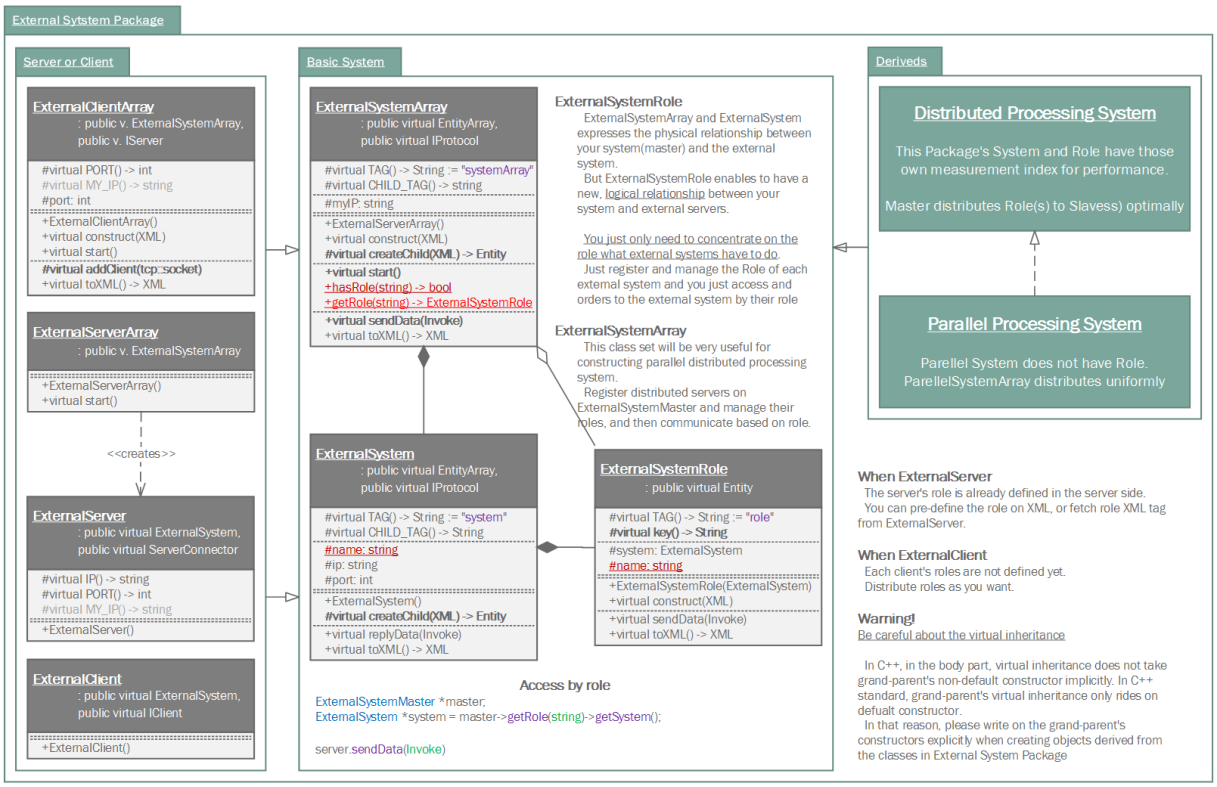

**[Inherited]**

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




**See also**

samchon::protocol

**Author**

Jeongho Nam

## 6.30.2 Member Function Documentation

### 6.30.2.1 virtual void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from DistributedSystemArray.

Reimplemented in DistributedClientArrayMediator.

#### 6.30.2.2 virtual auto createSlave ( ) const -> DistributedSlaveSystemMediator * [protected], [pure virtual]

Factory method of slave system for mediation.

**Exceptions**

| | |
|---|---|
| *invalid_parameter* | If DistributedServerArrayMediator, slave must be a type of DistributedSlave↩ ServerMediator |

#### 6.30.2.3 virtual void start ( ) [override], [virtual]

Start interaction.

An abstract method starting interaction with external systems.

If external systems are servers, starts connection to them, else clients, opens a server and accepts the external systems. You can addict your own procudures of starting drivers, but if you directly override method of abstract ExternalSystemArray, be careful about virtual inheritance.

- DistributedClientArray::start() calls DistributedSystemArray::start() and ExternalClientArray:start()

Reimplemented from DistributedSystemArray.

Reimplemented in DistributedClientArrayMediator, and DistributedServerArrayMediator.

#### 6.30.2.4 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from DistributedSystemArray.

Reimplemented in DistributedClientArrayMediator.

The documentation for this class was generated from the following file:

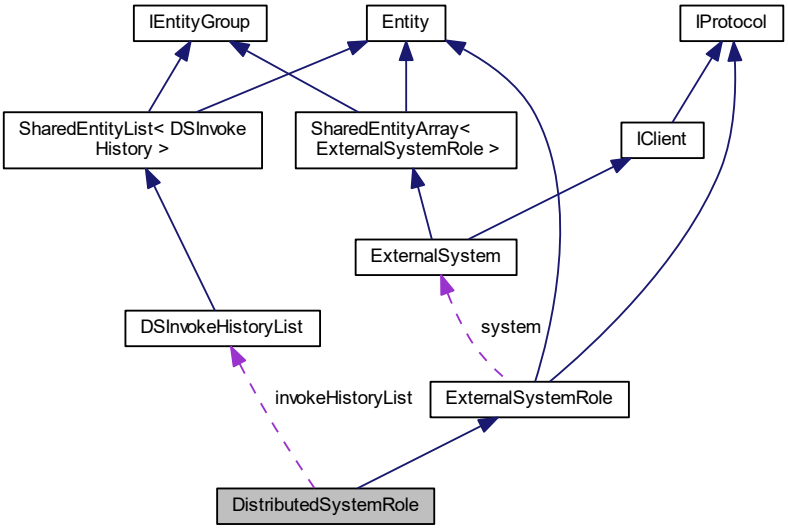
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedSystemArray↩ Mediator.hpp

## 6.31 DistributedSystemRole Class Reference

A role of distributed processing system.

`#include <DistributedSystemRole.hpp>`

Collaboration diagram for DistributedSystemRole:




### Public Member Functions

- DistributedSystemRole ()

  *Default Constructor.*
- auto getSystem () const -> ExternalSystem *=delete

  *Get an external system -> depreciated.*
- auto getPerformance () const -> double

  *Get performance.*
- auto getAllocationHistoryList () const -> DSRoleHistoryList *

  *Get allocation histories.*
- auto getInvokeHistoryList () const -> DSInvokeHistoryList *

  *Get invoke histories.*
- virtual void sendData (std::shared_ptr< Invoke >) override

  *Send a message.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the Entity.*

### Protected Attributes

- std::set< DistributedSystem * > allocatedSystems

  *Allocated systems of about the role, at now.*
- double performance

  *A required performance index.*
- DSRoleHistoryList * allocationHistoryList

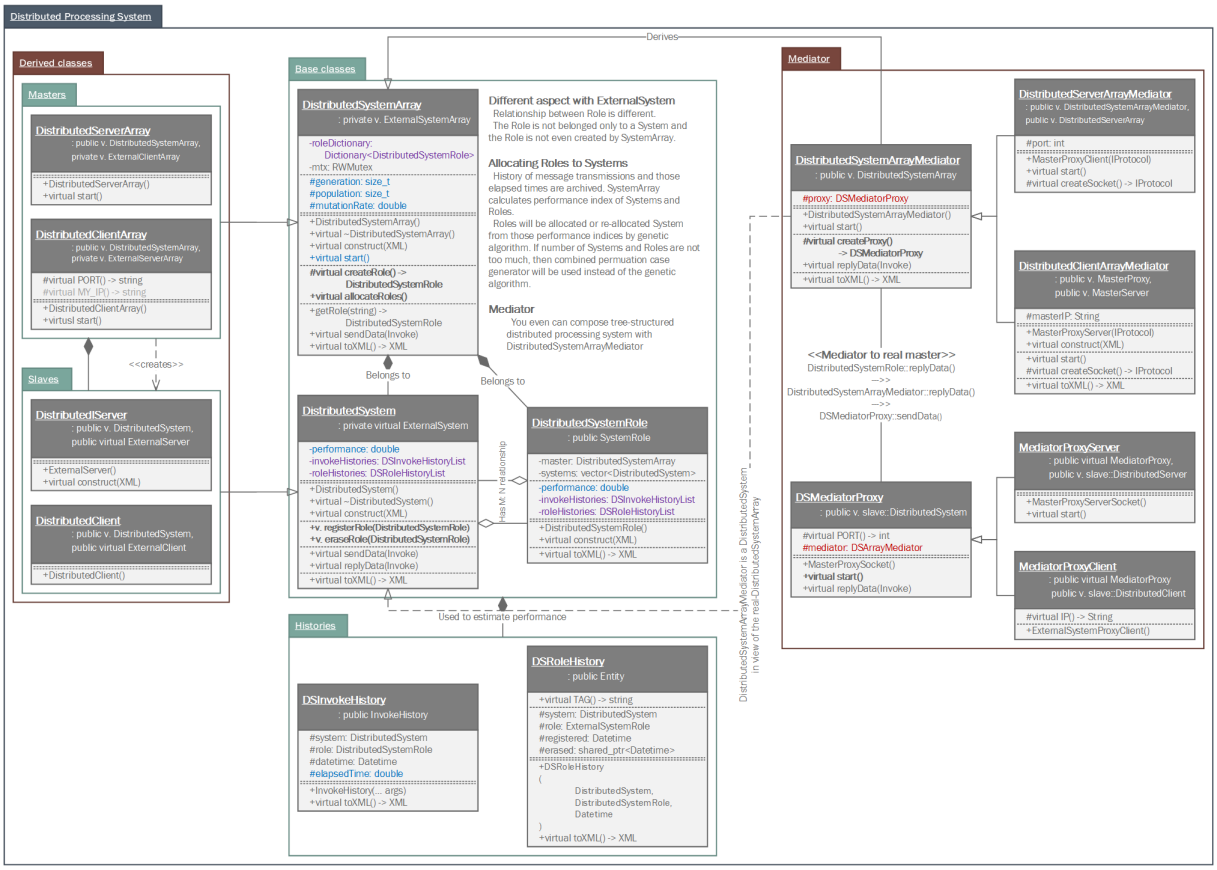
  *A history log for archiving role allocation to a system.*
- DSInvokeHistoryList * invokeHistoryList

  *A history log for archiving elapsed time for each process.*

## 6.31.1 Detailed Description

A role of distributed processing system.

DistributedSystemRole is an ExternalSystemRole allocates for distributed processing system(s). Unlike the ExternalSystemRole, DistributedSystemRole can belonged to multiple DistributedSystem(s).

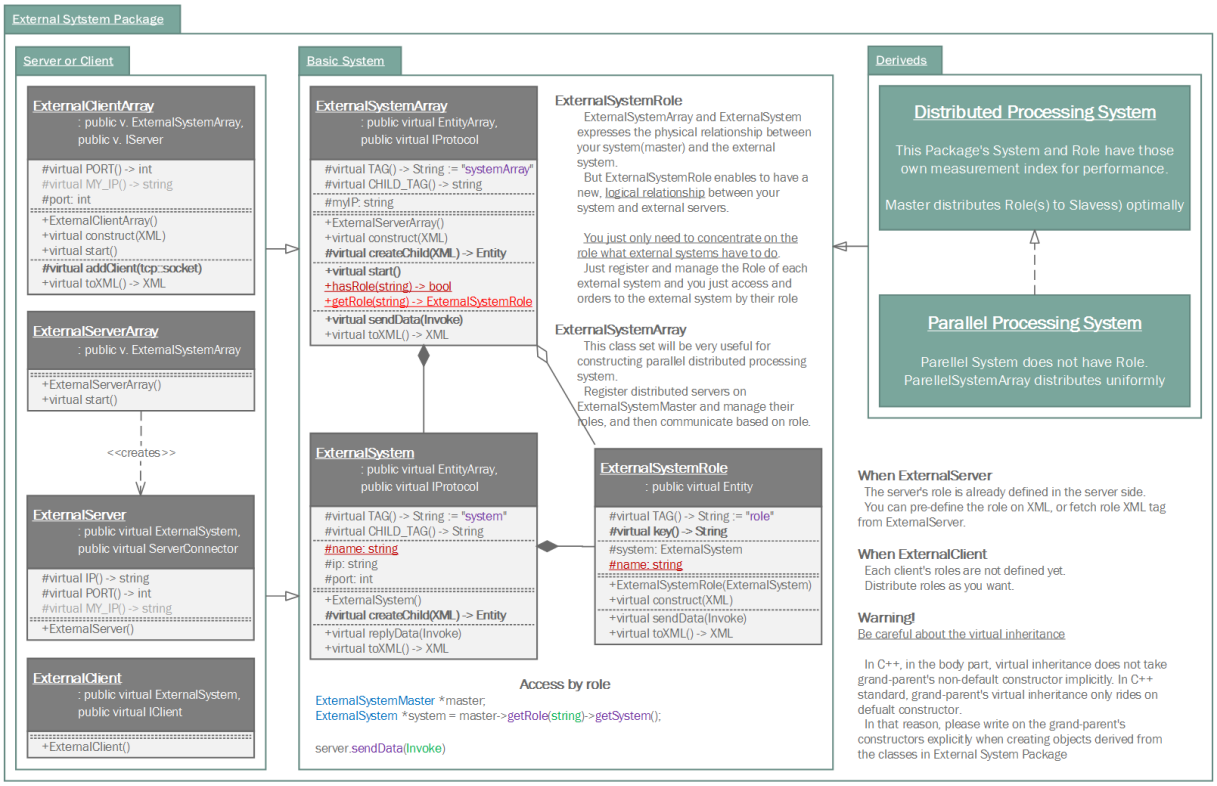



[Inherited]

ExternalSystemRole is a 'control' class groupping methods, handling Invoke messages interacting with an external system that the ExternalSystemRole is belonged to, by a subject or unit of a module.

ExternalSystemRole can be a "logical proxy" for an ExternalSystem which is containing the ExternalSystem↩ Role. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystem↩ Role acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.




**See also**

samchon::protocol

**Author**

Jeongho Nam

## 6.31.2 Member Function Documentation

### 6.31.2.1 auto getSystem ( ) const -> ExternalSystem *=delete [delete]

Get an external system -> depreciated.

Unlike ExternalSysemRole, DistributedSystemRole can be belonged to multiple DistributedSystem(s). By that reason, the getSystem(), a getter of a single ExternalSystem is depreciated.

### 6.31.2.2 virtual void sendData ( std::shared_ptr< Invoke > ) [override], [virtual]

Send a message.

Sends Invoke message to a network system or shifts the responsibility to related chain.

**Parameters**

| | |
|---|---|
| *invoke* | An Invoke message to send to a network system |

Reimplemented from ExternalSystemRole.

### 6.31.2.3 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from ExternalSystemRole.

The documentation for this class was generated from the following file:

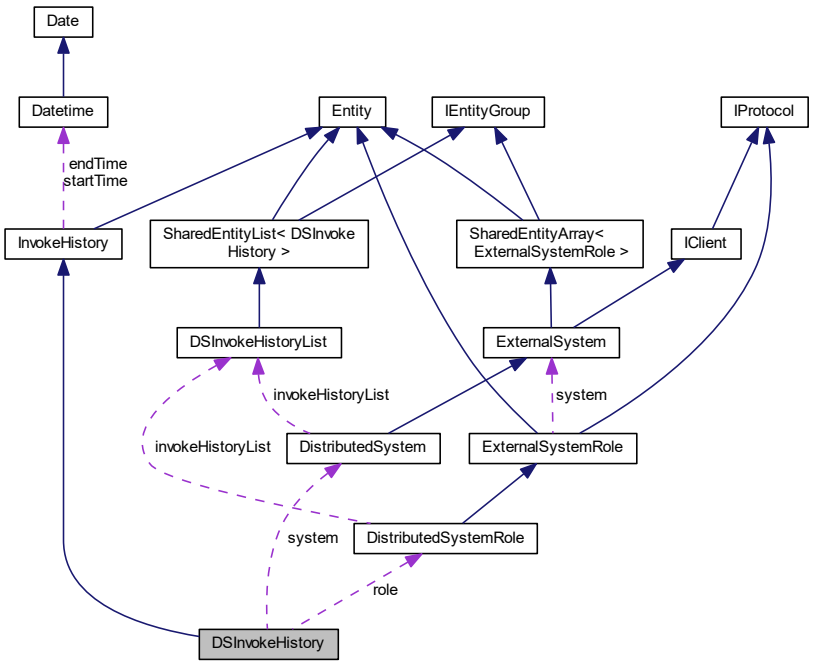
– D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DistributedSystemRole.hpp

## 6.32 DSInvokeHistory Class Reference

A reported history of an Invoke message.

```
#include <DSInvokeHistory.hpp>
```

Collaboration diagram for DSInvokeHistory:



### Public Member Functions

- DSInvokeHistory (DistributedSystem *, DistributedSystemRole *)

  *Construct from a system and role.*

- auto getSystem () const -> DistributedSystem *

  *Get source system.*

- auto getRole () const -> DistributedSystemRole *

  *Gets source role.*

### Protected Attributes

- DistributedSystem * system

  *Source system.*

- DistributedSystemRole * role

  *Source role.*

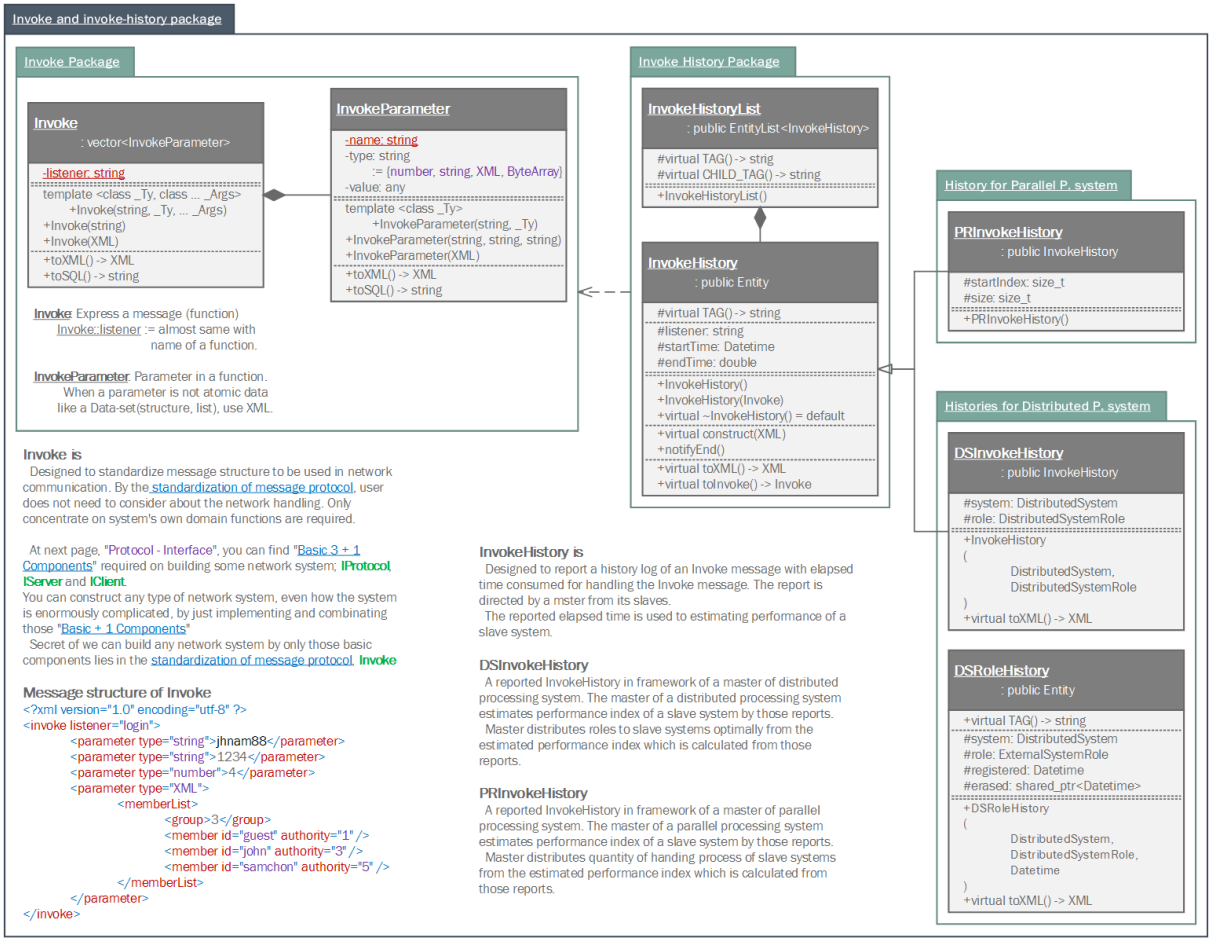
## 6.32.1 Detailed Description

A reported history of an Invoke message.

**[Inherited]**

InvokeHistory is a class for reporting history log of an Invoke message with elapsed time from a slave to its master.

With the elapsed time, consumed time for a process of handling the Invoke message, InvokeHistory is reported to the master. The master utilizies the elapsed time to estimating performances of each slave system. With the estimated performan index, master retrives the optimal solution of distributing processes.




### See also

samchon::protocol
samchon::protocol::master
samchon::protocol::slave

### Author

Jeongho Nam

## 6.32.2 Constructor & Destructor Documentation

### 6.32.2.1 DSInvokeHistory ( DistributedSystem * *system*, DistributedSystemRole * *role* )

Construct from a system and role.

**Parameters**

| | |
|---|---|
| *system* | a source system |
| *role* | a source role |

The documentation for this class was generated from the following files:

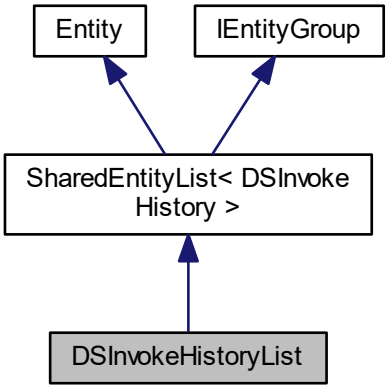
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DSInvokeHistory.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DSInvokeHistory.cpp

# 6.33 DSInvokeHistoryList Class Reference

A list of DSInvokeHistory.

```
#include <DSInvokeHistoryList.hpp>
```

Collaboration diagram for DSInvokeHistoryList:




### Public Member Functions

- DSInvokeHistoryList ()
  *Default Constructor.*

### Protected Member Functions

- virtual auto createChild (std::shared_ptr< library::XML >) -> DSInvokeHistory *override
  *Factory method of a child Entity.*

## 6.33.1 Detailed Description

A list of DSInvokeHistory.

**Author**

Jeongho Nam

## 6.33.2 Member Function Documentation

### 6.33.2.1 virtual auto createChild ( std::shared_ptr< library::XML > ) -> DSInvokeHistory *override [override], [protected], [virtual]

Factory method of a child Entity.

EntityGroup::createChild() is a factory method creating a new child Entity which is belonged to the EntityGroup. This method is called by EntityGroup::construct(). The children construction methods Entity::construct() will be called by abstract method of the EntityGroup::construct().

**Returns**

A new child Entity belongs to EntityGroup.

Implements EntityGroup< _Container, _ETy, _Ty >.

The documentation for this class was generated from the following file:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/DSInvokeHistoryList.hpp

## 6.34 Entity Class Reference

An entity, a standard data class.

```
#include <Entity.hpp>
```

### Public Member Functions

- virtual auto TAG () const -> std::string=0

  *A tag name when represented by XML.*

- Entity ()

  *Default Constructor.*

- virtual void construct (std::shared_ptr< library::XML >)=0

  *Construct data of the Entity from an XML object.*

- virtual auto key () const -> std::string

  *Get a key that can identify the Entity uniquely.*

- virtual auto toXML () const -> std::shared_ptr< library::XML >

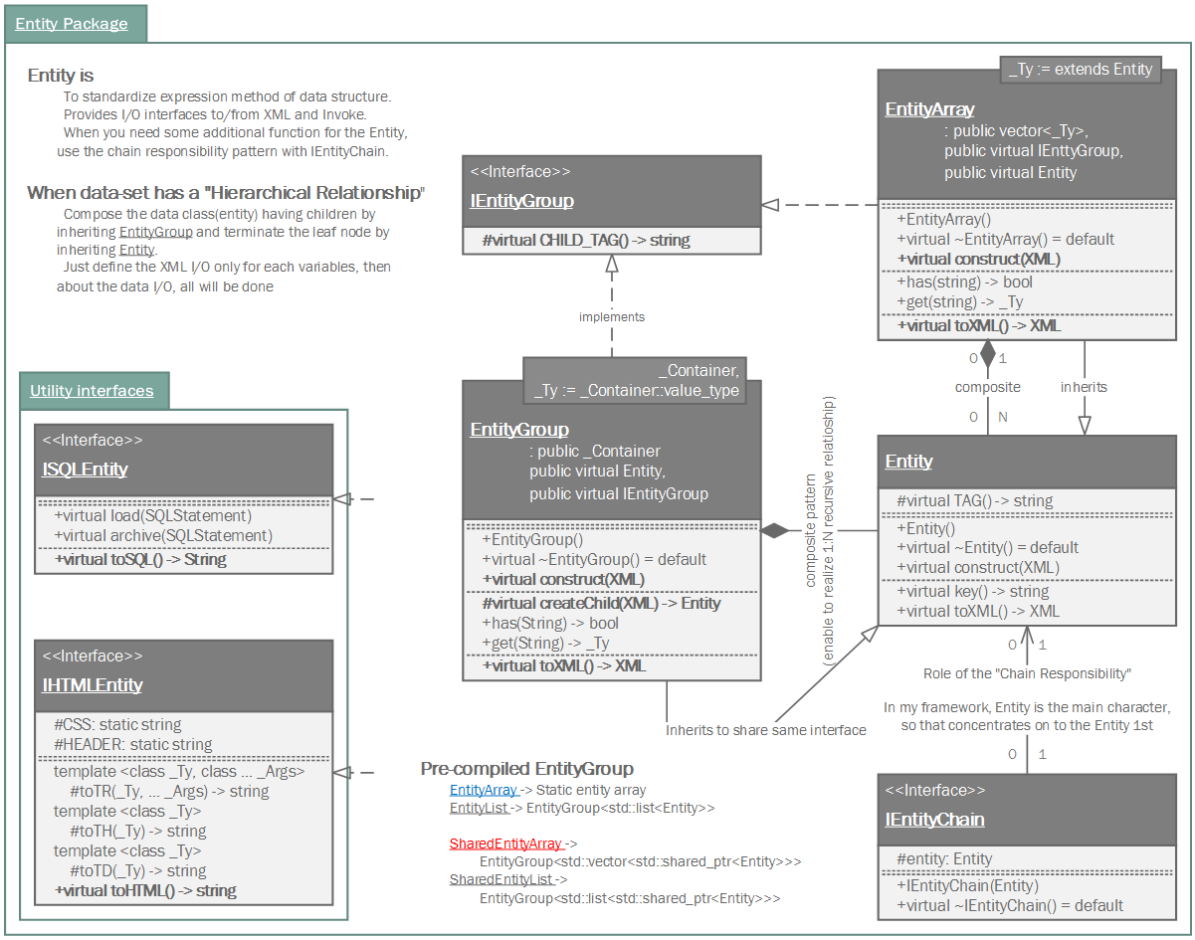
  *Get an XML object represents the Entity.*

### 6.34.1 Detailed Description

An entity, a standard data class.

Entity is a class for standardization of expression method using on network I/O by XML. If Invoke is a standard message protocol of Samchon Framework which must be kept, Entity is a recommended semi-protocol of message for expressing a data class. Following the semi-protocol Entity is not imposed but encouraged.

As we could get advantages from standardization of message for network I/O with Invoke, we can get additional advantage from standardizing expression method of data class with Entity. We do not need to know a part of network communication. Thus, with the Entity, we can only concentrate on entity's own logics and relationships between another entities. Entity does not need to how network communications are being done.




## Example source

```
#include <iostream>

#include <samchon/protocol/Entity.hpp>
#include <samchon/protocol/IHTMLEntity.hpp>
#include <samchon/protocol/SharedEntityArray.hpp>

#include <samchon/library/XML.hpp>

#ifdef _WIN64
#   ifdef _DEBUG
#       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "x64/Release/SamchonFramework.lib")
#   endif
#else
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

using namespace std;
using namespace samchon::library;
using namespace samchon::protocol;

class Member
    : public Entity, public virtual IHTMLEntity
{
protected:
    typedef Entity super;

    string id;
    string name;
    int age;
    int grade;

public:
    /* ----------------------------------------------------------------------
        CONSTRUCTORS
```

```
    ------------------------------------------------------------------- */
    Member()
        : super(), IHTMLEntity()
    {
    };
    Member(const string &id, const string &name, int age, int grade)
        : super(), IHTMLEntity()
    {
        this->id = id;
        this->name = name;
        this->age = age;
        this->grade = grade;
    };
    virtual ~Member() = default;

    virtual void construct(shared_ptr<XML> xml) override
    {
        this->id = xml->getProperty("id");
        this->name = xml->getProperty("name");
        this->age = xml->getProperty<int>("age");
        this->grade = xml->getProperty<int>("grade");
    };

    /* ------------------------------------------------------------------
        GETTERSs
    ------------------------------------------------------------------- */
    virtual auto key() const -> std::string override
    {
        return this->id;
    };

    /* ------------------------------------------------------------------
        XML EXPORTERS
    ------------------------------------------------------------------- */
    virtual auto TAG() const -> string override
    {
        return "member";
    };
    virtual auto toXML() const -> shared_ptr<XML>
    {
        shared_ptr<XML> &xml = super::toXML();
        xml->setProperty("id", id);
        xml->setProperty("name", name);
        xml->setProperty("age", age);
        xml->setProperty("grade", grade);

        return move(xml);
    };
    virtual auto toHTML() const -> string
    {
        return toTR(id, name, age, grade);
    };
};

class MemberArray
    : public SharedEntityArray<Member>,
    public virtual IHTMLEntity
{
protected:
    typedef SharedEntityArray<Member> super;

    string application;
    int department;
    Member *chief;

public:
    /* ------------------------------------------------------------------
        CONSTRUCTORS
    ------------------------------------------------------------------- */
    MemberArray()
        : super(), IHTMLEntity()
    {
        this->chief = nullptr;
    };
    virtual ~MemberArray() = default;

    // You don't need to consider children(Member) objects
    // Just concentrate on constructing MemberArray's own member variables
    virtual void construct(shared_ptr<XML> xml) override
    {
        super::construct(xml);

        this->application = xml->getProperty("application");
        this->department = xml->getProperty<int>("department");

        if(xml->hasProperty("chief") == true && this->has( xml->getProperty("chief") ) == true)
            this->chief = this->get( xml->getProperty("cheif") ).get();
```

```
    };

protected:
    //FACTORY METHOD FOR MEMBER
    virtual auto createChild(shared_ptr<XML> = nullptr) -> Member* override
    {
        return new Member();
    };

    /* ---------------------------------------------------------------------
        XML EXPORTERS
    --------------------------------------------------------------------- */
public:
    virtual auto TAG() const -> string override
    {
        return "memberArray";
    };
    virtual auto CHILD_TAG() const -> string override
    {
        return "member";
    };

    // You don't need to consider children(Member) objects
    // Just concentrate on expressing MemberArray's own member variables
    virtual auto toXML() const -> shared_ptr<XML>
    {
        shared_ptr<XML> &xml = super::toXML();
        xml->setProperty("application", application);
        xml->setProperty("department", department);

        if(chief != nullptr)
            xml->setProperty("cheif", chief->key());

        return move(xml);
    };
    virtual auto toHTML() const -> string
    {
        string html = "<table>\n";
        html += toTH("ID", "Name", "Age", "Grade") + "\n";

        for (size_t i = 0; i < 2; i++)
            html += at(i)->toHTML() + "\n";

        html += "</table>";
        return move(html);
    };
};

void main()
{
    string str = string("") +
        "<memberArray application='framework' department='7' cheif='samchon'>\n" +
        "   <member id='samchon' name='Jeongho Nam' age='27' grade='5' />" +
        "   <member id='submaster' name='No Name' age='100' grade='4' />" +
        "   <member id='john' name='John Doe' age='33' grade='2' />" +
        "   <member id='bad_man' name='Bad Man' age='44' grade='-1' />" +
        "   <member id='guest' name='Guest' age='0' grade='0' />" +
        "</memberArray>";
    shared_ptr<XML> xml(new XML(str));

    MemberArray memberArray;
    memberArray.construct(xml);

    memberArray.emplace_back(new Member("freshman", "A fresh man", 20, 2));
    memberArray.emplace_back(new Member("senior", "A senior", 70, 2));

    cout << memberArray.toXML()->toString() << endl << endl;
    cout << memberArray.toHTML() << endl;
    system("pause");
}
```

**Result of the example**

```
D:\OneDrive\Project\Samchon\framework\cpp\Debug\entity.exe
<memberArray application="framework" department="7">
        <member age="27" grade="5" id="samchon" name="Jeongho" />
        <member age="100" grade="4" id="submaster" name="No" />
        <member age="33" grade="2" id="john" name="John" />
        <member age="44" grade="-1" id="bad_man" name="Bad" />
        <member age="0" grade="0" id="guest" name="Guest" />
        <member age="20" grade="2" id="freshman" name="A fresh man" />
        <member age="70" grade="2" id="senior" name="A senior" />
</memberArray>

<table>
        <th>
                <td>ID</td>
                <td>Name</td>
                <td>Age</td>
                <td>Grade</td>
        </th>
        <tr>
                <td>samchon</td>
                <td>Jeongho</td>
                <td>27</td>
                <td>5</td>
        </tr>
        <tr>
                <td>submaster</td>
                <td>No</td>
                <td>100</td>
                <td>4</td>
        </tr>
</table>
Press any key to continue . . .
```

**Note**

I say repeatedly. Expression method of Entity is recommended, but not imposed. It's a semi protocol for network I/O but not a essential protocol must be kept. The expression method of Entity, using on network I/O, is expressed by XML string.

If your own network system has a critical performance issue on communication data class, it would be better to using binary communication (with ByteArray or boost::serialization). Don't worry about the problem! Invoke also provides methods for binary data (ByteArray).

**See also**

protocol

**Author**

Jeongho Nam

### 6.34.2 Member Function Documentation

#### 6.34.2.1 virtual auto TAG ( ) const -> std::string [pure virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implemented in InvokeParameter, InvokeHistory, Invoke, NTCriteria, ExternalSystemArray, ExternalSystem, ExternalSystemRole, NTParameter, NTParameterDetermined, SystemRole, DistributedSlaveSystemMediator, ParallelSlaveSystemMediator, ChatRoom, NTSide, InvokeHistoryArray, NTParameterArray, ChatMessage, and FTInstance.

#### 6.34.2.2 void construct ( std::shared_ptr< library::XML > ) [pure virtual]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Implemented in InvokeParameter, DistributedSystem, NTCriteria, NTFile, InvokeHistory, EntityGroup< _Container, _ETy, _Ty >, EntityGroup< _Container, std::unique_ptr< Entity > >, EntityGroup< _Container, std::shared_ptr< Entity > >, EntityGroup< _Container, Entity * >, EntityList< _Ty >, ExternalSystem, ExternalSystemRole, ParallelSystem, EntityArray< _Ty >, Invoke, DistributedSystemArray, ChatMessage, INTExplore, NTParameterDetermined, PRInvokeHistory, DistributedSystemArrayMediator, ParallelSystemArrayMediator, NTParameter, SystemRole, NTSide, ExternalClientArray, ExternalServer, DistributedClientArrayMediator, ParallelClientArrayMediator, DistributedClientArray, ParallelServer, and DistributedServer.

#### 6.34.2.3 auto key ( ) const -> std::string [virtual]

Get a key that can identify the Entity uniquely.

If identifier of the Entity is not atomic value, returns a string represents the composite identifier. If identifier of the Entity is not string, converts the identifier to string and returns the string.

**Returns**

An identifier

Reimplemented in InvokeParameter, InvokeHistory, ExternalSystem, ExternalSystemRole, FTInstance, NTParameter, NTParameterDetermined, and SystemRole.

#### 6.34.2.4 auto toXML ( ) const -> std::shared_ptr<library::XML> [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented in InvokeParameter, EntityGroup< _Container, _ETy, _Ty >, EntityGroup< _Container, std::unique_ptr< Entity > >, EntityGroup< _Container, std::shared_ptr< Entity > >, EntityGroup< _Container, Entity * >, InvokeHistory, Invoke, DistributedSystem, NTCriteria, NTFile, ExternalSystem, ExternalSystemRole, DistributedSystemArray, EntityList< _Ty >, DistributedSystemRole, EntityArray< _Ty >, ParallelSystem, ChatRoom, FTInstance, INTExplore, NTParameter, NTParameterDetermined, PRInvokeHistory, ChatMessage, DistributedSystemArrayMediator, ParallelSystemArrayMediator, SystemRole, ExternalClientArray, ExternalServer, FTFolder, NTSide, FTFile, DistributedClientArrayMediator, ParallelClientArrayMediator, DistributedClientArray, ParallelServer, and DistributedServer.

The documentation for this class was generated from the following files:

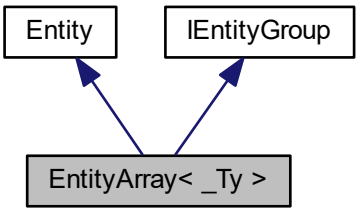
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/Entity.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/Entity.cpp

## 6.35 EntityArray< _Ty > Class Template Reference

An Entity and a static array containing Entity objects.

```
#include <EntityArray.hpp>
```

Collaboration diagram for EntityArray< _Ty >:




### Public Member Functions

- EntityArray ()
  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML > xml) override
  *Construct data of the Entity from an XML object.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override
  *Get an XML object represents the EntityArray.*

### Additional Inherited Members

### 6.35.1 Detailed Description

**template<typename _Ty>class samchon::protocol::EntityArray< _Ty >**

An Entity and a static array containing Entity objects.

**Template Parameters**

| | |
|---|---|
| *_Ty* | A type of children Entity. Must be a class derived from an Entity. |

EntityArray is a static array containing children objects derived from an Entity class.

The EntityArray has advantages of performance like fast iteration or fast access because the EntityArray is serialized. However, as EntityArray is serialized, allocated memory space for each child is fixed and cannot contain derived a entity class from the child entity type.

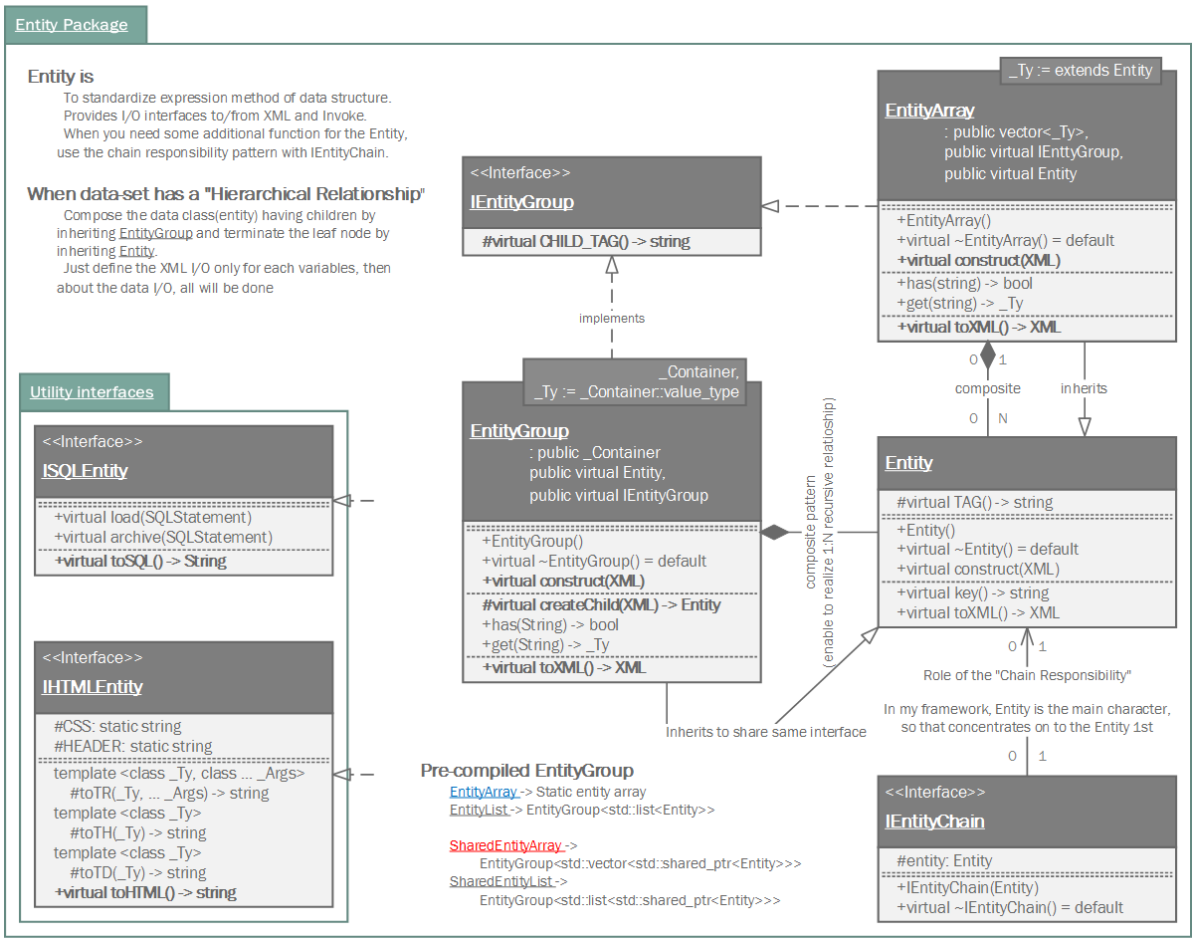
- EntityArray<Animal> is specified
- Dog is extended from the Animal
- EntityArray<Animal> cannot contain Dog. You can try insertion of the Dog class into the EntityArray, but only memory size of Animal is allocated, so that derived member variables and methods are all truncated.

Thus, it's suitable for when fast accessment and iteration like an entity class containing mathmatical or statistical data and methods which doesn't seemed to be inherited.

**[Inherited]**

Entity is a class for standardization of expression method using on network I/O by XML. If Invoke is a standard message protocol of Samchon Framework which must be kept, Entity is a recommended semi-protocol of message for expressing a data class. Following the semi-protocol Entity is not imposed but encouraged.

As we could get advantages from standardization of message for network I/O with Invoke, we can get additional advantage from standardizing expression method of data class with Entity. We do not need to know a part of network communication. Thus, with the Entity, we can only concentrate on entity's own logics and relationships between another entities. Entity does not need to how network communications are being done.



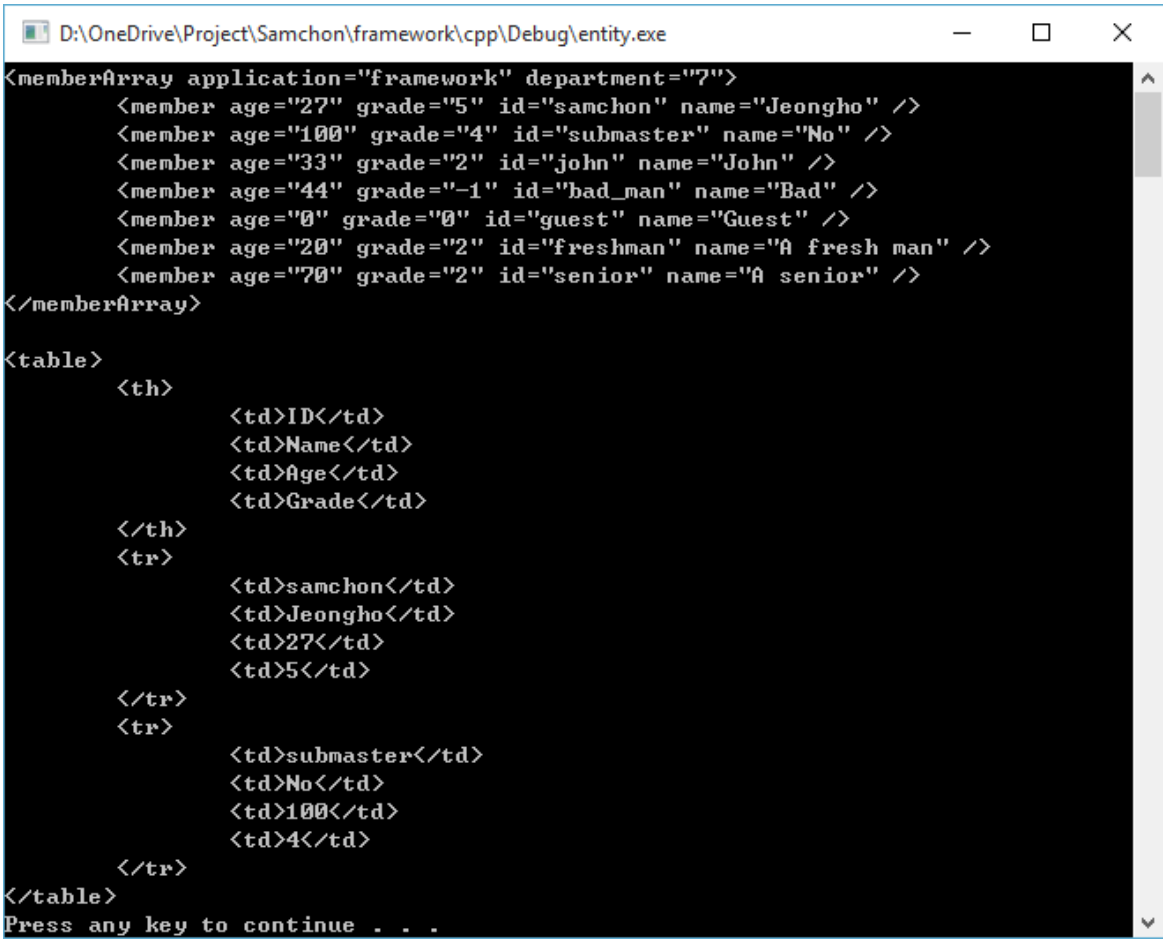
### Example source

```
#include <iostream>

#include <samchon/protocol/Entity.hpp>
#include <samchon/protocol/IHTMLEntity.hpp>
#include <samchon/protocol/SharedEntityArray.hpp>

#include <samchon/library/XML.hpp>

#ifdef _WIN64
#   ifdef _DEBUG
#       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "x64/Release/SamchonFramework.lib")
#   endif
#else
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

using namespace std;
using namespace samchon::library;
using namespace samchon::protocol;

class Member
    : public Entity, public virtual IHTMLEntity
{
protected:
    typedef Entity super;

    string id;
    string name;
    int age;
    int grade;

public:
    /* ----------------------------------------------------------------------
        CONSTRUCTORS
    ---------------------------------------------------------------------- */
    Member()
        : super(), IHTMLEntity()
    {
    };
    Member(const string &id, const string &name, int age, int grade)
        : super(), IHTMLEntity()
    {
        this->id = id;
        this->name = name;
        this->age = age;
        this->grade = grade;
    };
    virtual ~Member() = default;

    virtual void construct(shared_ptr<XML> xml) override
    {
        this->id = xml->getProperty("id");
        this->name = xml->getProperty("name");
        this->age = xml->getProperty<int>("age");
        this->grade = xml->getProperty<int>("grade");
    };

    /* ----------------------------------------------------------------------
        GETTERSs
    ---------------------------------------------------------------------- */
    virtual auto key() const -> std::string override
    {
        return this->id;
    };

    /* ----------------------------------------------------------------------
        XML EXPORTERS
    ---------------------------------------------------------------------- */
    virtual auto TAG() const -> string override
    {
        return "member";
    };
    virtual auto toXML() const -> shared_ptr<XML>
    {
        shared_ptr<XML> &xml = super::toXML();
        xml->setProperty("id", id);
        xml->setProperty("name", name);
        xml->setProperty("age", age);
        xml->setProperty("grade", grade);
```

```
        return move(xml);
    };
    virtual auto toHTML() const -> string
    {
        return toTR(id, name, age, grade);
    };
};

class MemberArray
    : public SharedEntityArray<Member>,
    public virtual IHTMLEntity
{
protected:
    typedef SharedEntityArray<Member> super;

    string application;
    int department;
    Member *chief;

public:
    /* ----------------------------------------------------------------------
        CONSTRUCTORS
    ---------------------------------------------------------------------- */
    MemberArray()
        : super(), IHTMLEntity()
    {
        this->chief = nullptr;
    };
    virtual ~MemberArray() = default;

    // You don't need to consider children(Member) objects
    // Just concentrate on constructing MemberArray's own member variables
    virtual void construct(shared_ptr<XML> xml) override
    {
        super::construct(xml);

        this->application = xml->getProperty("application");
        this->department = xml->getProperty<int>("department");

        if(xml->hasProperty("chief") == true && this->has( xml->getProperty("chief") ) == true)
            this->chief = this->get( xml->getProperty("cheif") ).get();
    };

protected:
    //FACTORY METHOD FOR MEMBER
    virtual auto createChild(shared_ptr<XML> = nullptr) -> Member* override
    {
        return new Member();
    };

    /* ----------------------------------------------------------------------
        XML EXPORTERS
    ---------------------------------------------------------------------- */
public:
    virtual auto TAG() const -> string override
    {
        return "memberArray";
    };
    virtual auto CHILD_TAG() const -> string override
    {
        return "member";
    };

    // You don't need to consider children(Member) objects
    // Just concentrate on expressing MemberArray's own member variables
    virtual auto toXML() const -> shared_ptr<XML>
    {
        shared_ptr<XML> &xml = super::toXML();
        xml->setProperty("application", application);
        xml->setProperty("department", department);

        if(chief != nullptr)
            xml->setProperty("cheif", chief->key());

        return move(xml);
    };
    virtual auto toHTML() const -> string
    {
        string html = "<table>\n";
        html += toTH("ID", "Name", "Age", "Grade") + "\n";

        for (size_t i = 0; i < 2; i++)
            html += at(i)->toHTML() + "\n";

        html += "</table>";
        return move(html);
```

```
    };
};

void main()
{
    string str = string("") +
        "<memberArray application='framework' department='7' cheif='samchon'>\n" +
        "   <member id='samchon' name='Jeongho Nam' age='27' grade='5' />" +
        "   <member id='submaster' name='No Name' age='100' grade='4' />" +
        "   <member id='john' name='John Doe' age='33' grade='2' />" +
        "   <member id='bad_man' name='Bad Man' age='44' grade='-1' />" +
        "   <member id='guest' name='Guest' age='0' grade='0' />" +
        "</memberArray>";
    shared_ptr<XML> xml(new XML(str));

    MemberArray memberArray;
    memberArray.construct(xml);

    memberArray.emplace_back(new Member("freshman", "A fresh man", 20, 2));
    memberArray.emplace_back(new Member("senior", "A senior", 70, 2));

    cout << memberArray.toXML()->toString() << endl << endl;
    cout << memberArray.toHTML() << endl;
    system("pause");
}
```

**Result of the example**




**Note**

I say repeatedly. Expression method of Entity is recommended, but not imposed. It's a semi protocol for network I/O but not a essential protocol must be kept. The expression method of Entity, using on network I/O, is expressed by XML string.

If your own network system has a critical performance issue on communication data class, it would be better to using binary communication (with ByteArray or boost::serialization). Don't worry about the problem! Invoke also provides methods for binary data (ByteArray).

**See also**

protocol

**Author**

Jeongho Nam

**Warning**

If a data structure has recursive and hierarchical relationship, never use the EntityArray. EntityArray's memory allocation is static. The recursive relationship causes infinite memory allocation. It must generates stack overflow.

Use EntityGroup instead.

- class NTCriteria : public EntityArray<NTCriteria> causes a stack overflow.
- class NTCriteria : public SharedEntityArray<NTCriteria> doesn't cause the stack overflow.

### 6.35.2 Member Function Documentation

#### 6.35.2.1 virtual void construct ( std::shared_ptr< library::XML > *xml* ) [inline], [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityArray's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityArray::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityArray::toXML().

Constructs only data of EntityArray's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Implements Entity.

#### 6.35.2.2 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [inline], [override], [virtual]

Get an XML object represents the EntityArray.

Archives the EntityArray's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityArray::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityArray::toXML().

Archives only data of EntityArray's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

The documentation for this class was generated from the following file:

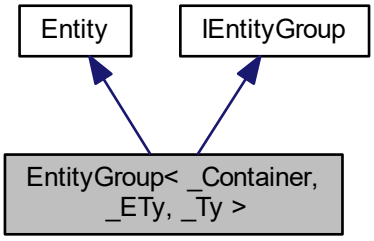
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/EntityArray.hpp

## 6.36 EntityGroup< _Container, _ETy, _Ty > Class Template Reference

An Entity and a container of children Entity objects.

`#include <EntityGroup.hpp>`

Collaboration diagram for EntityGroup< _Container, _ETy, _Ty >:




### Public Member Functions

- EntityGroup ()
  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML > xml)
  *Construct data of the Entity from an XML object.*
- auto has (const std::string &key) const -> bool
  *Indicates whether a container has an object having the specified identifier.*

- auto get (const std::string &key) -> value_type &

  *Access the element by specified identifier(key).*

- auto get (const std::string &key) const -> const value_type &

  *Access the const element by specified identifier(key).*

- virtual auto toXML () const -> std::shared_ptr< library::XML >

  *Get an XML object represents the EntityGroup.*

### Protected Member Functions

- virtual auto createChild (std::shared_ptr< library::XML >) -> entity_type *=0

  *Factory method of a child Entity.*

## 6.36.1 Detailed Description

**template<typename _Container, typename _ETy = Entity, typename _Ty = _Container::value_type>class samchon::protocol::EntityGroup< _Container, _ETy, _Ty >**

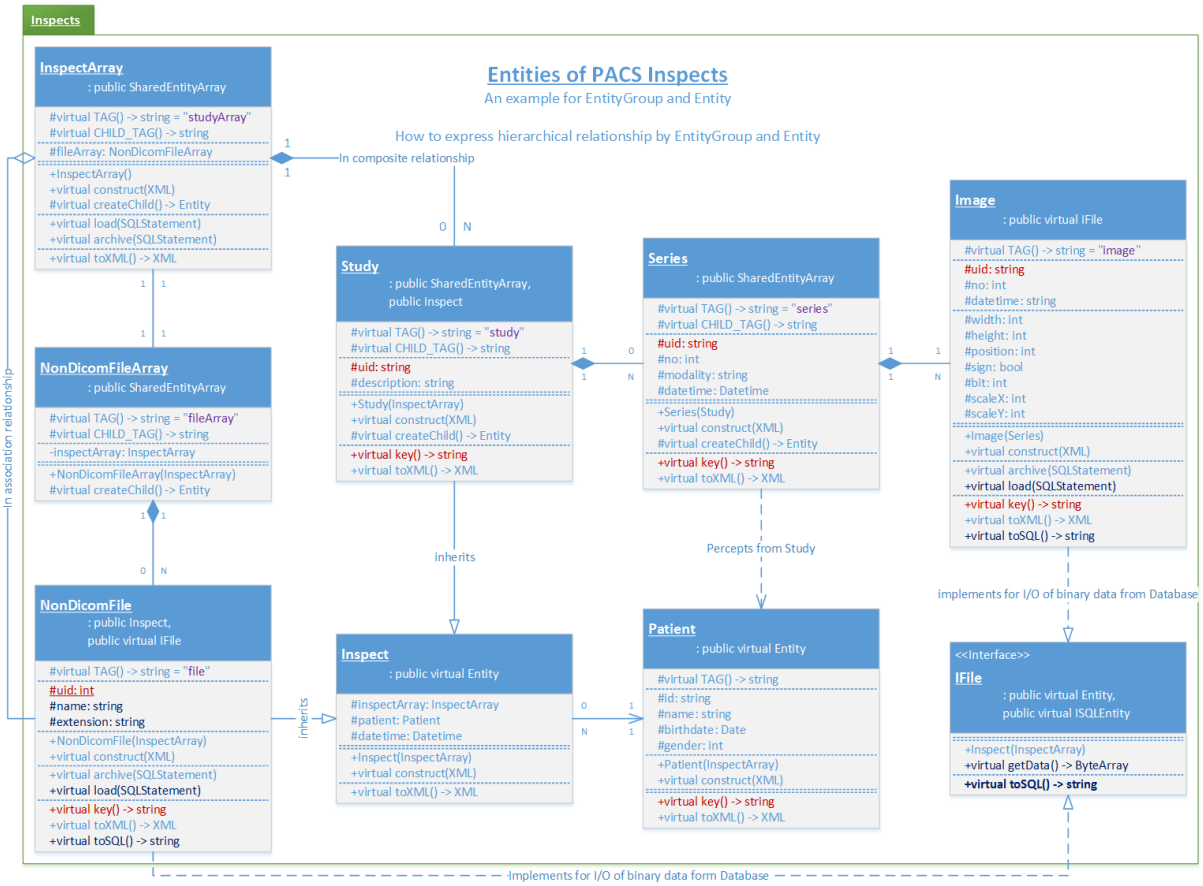
An Entity and a container of children Entity objects.

**Template Parameters**

| | |
|---|---|
| *_Container* | A type of container containing children entity objects. |
| *_Ety* | A type of children entity. It must be a class derived from an Entity class, or Entity class itself. |
| *_Ty* | A type of children element of _Container. Using default template parameter is recommended. |

EntityGroup is a template class for containinig children Entity objects, and also another type of an Entity, too. You can realize hierarchical relationship. Although some entities have complicated hierarchical relationship, you can deduct a optimal solution easily with EntityGroup and Entity.

If an entity has some subordinate entities of same type, they are in "Composite relationship". Make the entity to be EmntityGroup and subordinate entities to be children of the entity. When those relationships are continued, continue to create classes dervied from EntityGroup. When those relationshiop meets a terminal node, then make the terminal node to be an Entity.




EntityGroup is an Entity, and a container of children Entity objects at the same time. If children type, of a class derived from an EntityGroup, is itself, you can realize hierarchical and recursive relationship. The relationship is called as "Composite pattern".

- FTFolder extends FTInstance and SharedEntityArray<FTInstance>
- NTCriteria extends SharedEntityArray<NTCriteria>

**Note**

As a freelancer developer and architect I am, I even design DB I/O to follow the format representing Entity and EntityGroup by XML. Below T-SQL script also follows the standard format of expressing Entity with XML by procedure and "FOR XML AUTO" statement.

```
SET
  ANSI_NULLS,
  QUOTED_IDENTIFIER,
  CONCAT_NULL_YIELDS_NULL,
  ANSI_WARNINGS,
  ANSI_PADDING
ON;

USE OraQ;
IF OBJECT_ID('v_studyStatus') IS NOT NULL           DROP VIEW v_studyStatus;
IF OBJECT_ID('v_nonDicomFileStatus') IS NOT NULL    DROP VIEW v_nonDicomFileStatus;
IF OBJECT_ID('v_candidateStudy') IS NOT NULL        DROP VIEW v_candidateStudy;
IF OBJECT_ID('v_candidateFile') IS NOT NULL         DROP VIEW v_candidateFile;
IF OBJECT_ID('goCandidateInspectList') IS NOT NULL  DROP PROCEDURE goCandidateInspectList;
GO

CREATE VIEW v_studyStatus
AS
    WITH cte AS
    (
        SELECT S.studyUID uid, S.type type, ROW_NUMBER() OVER (PARTITION BY S.studyUID ORDER BY H.datetime
    DESC) no
```

```
        FROM History.history H, History.study S
        WHERE
            H.uid = S.uid AND type <> 1
    )
    SELECT
        A.uid,
        CASE WHEN B.type IS NULL THEN
            A.type
            ELSE 1
        END status
    FROM
    (
        SELECT uid, type
        FROM cte
        WHERE no = 1
    ) A LEFT OUTER JOIN
    (
        SELECT studyUID uid, 1 type
        FROM History.study
        GROUP BY studyUID
        HAVING MAX(type) = 1
    ) B ON A.uid = B.uid
GO
CREATE VIEW v_nonDicomFileStatus
AS
    WITH cte AS
    (
        SELECT
            F.fileUID uid, F.type type,
            ROW_NUMBER() OVER (PARTITION BY F.fileUID ORDER BY H.datetime DESC) no
        FROM History.history H, History.nonDicomFile F
        WHERE
            H.uid = F.uid AND type <> 1
    )
    SELECT
        A.uid,
        CASE WHEN B.type IS NULL THEN
            A.type
            ELSE 1
        END status
    FROM
    (
        SELECT uid, type
        FROM cte
        WHERE no = 1
    ) A LEFT OUTER JOIN
    (
        SELECT fileUID uid, 1 type
        FROM History.nonDicomFile
        GROUP BY fileUID
        HAVING MAX(type) = 1
    ) B ON A.uid = B.uid
GO
CREATE VIEW v_candidateStudy
AS
    SELECT DISTINCT
        P.id patientID,
            P.name patientName, P.gender patientGender,
            CAST(P.birthdate AS DATE) patientBirthdate,
        S.uid,
            S.description,
            CONVERT(VARCHAR, CAST(S.datetime AS DATETIME), 120) AS datetime,
            H.status
    FROM
        Hospital.patient P, Inspect.media M, Inspect.mediaStudyPair A,
        Inspect.study S, v_studyStatus H
    WHERE
        P.id = M.patientID AND M.uid = A.mediaUID AND A.studyUID = S.uid AND
        S.uid = H.uid
GO
CREATE VIEW v_candidateFile
AS
    SELECT DISTINCT
        P.id patientID,
            P.name patientName, P.gender patientGender,
            CAST(P.birthdate AS DATE) patientBirthdate,
        M.uid mediaUID,
            F.uid, F.name, F.extension,
             CONVERT(VARCHAR, CAST(F.datetime AS DATETIME), 120) AS datetime,
             H.status
     FROM
         Hospital.patient P, Inspect.media M,
         Inspect.nonDicomFile F, v_nonDicomFileStatus H
     WHERE
         P.id = M.patientID AND M.uid = F.mediaUID AND F.uid = H.uid
GO

```

```
CREATE PROCEDURE goCandidateInspectList
AS
    DECLARE @xml XML =
    (
        SELECT *
        FROM
        (
            SELECT N'candidate' service
        ) inspect
        FOR XML AUTO
    )
    DECLARE @studyList XML =
    (
        SELECT study.*, series.*, image.*
        FROM
            v_candidateStudy study
                LEFT OUTER JOIN Inspect.series series
                    ON study.uid = series.studyUID
                LEFT OUTER JOIN Inspect.image image
                    ON series.uid = image.seriesUID
        FOR XML AUTO, ROOT(N'studyList')
    )
    DECLARE @fileList XML =
    (
        SELECT * FROM v_candidateFile
        FOR XML RAW(N'file'), ROOT(N'fileList')
    )

    IF(@studyList IS NOT NULL)  SET @xml.modify('insert sql:variable("@studyList") into (/inspect)[1]')
    IF(@fileList IS NOT NULL)   SET @xml.modify('insert sql:variable("@fileList") into (/inspect)[1]')

    SELECT @xml;
GO
```

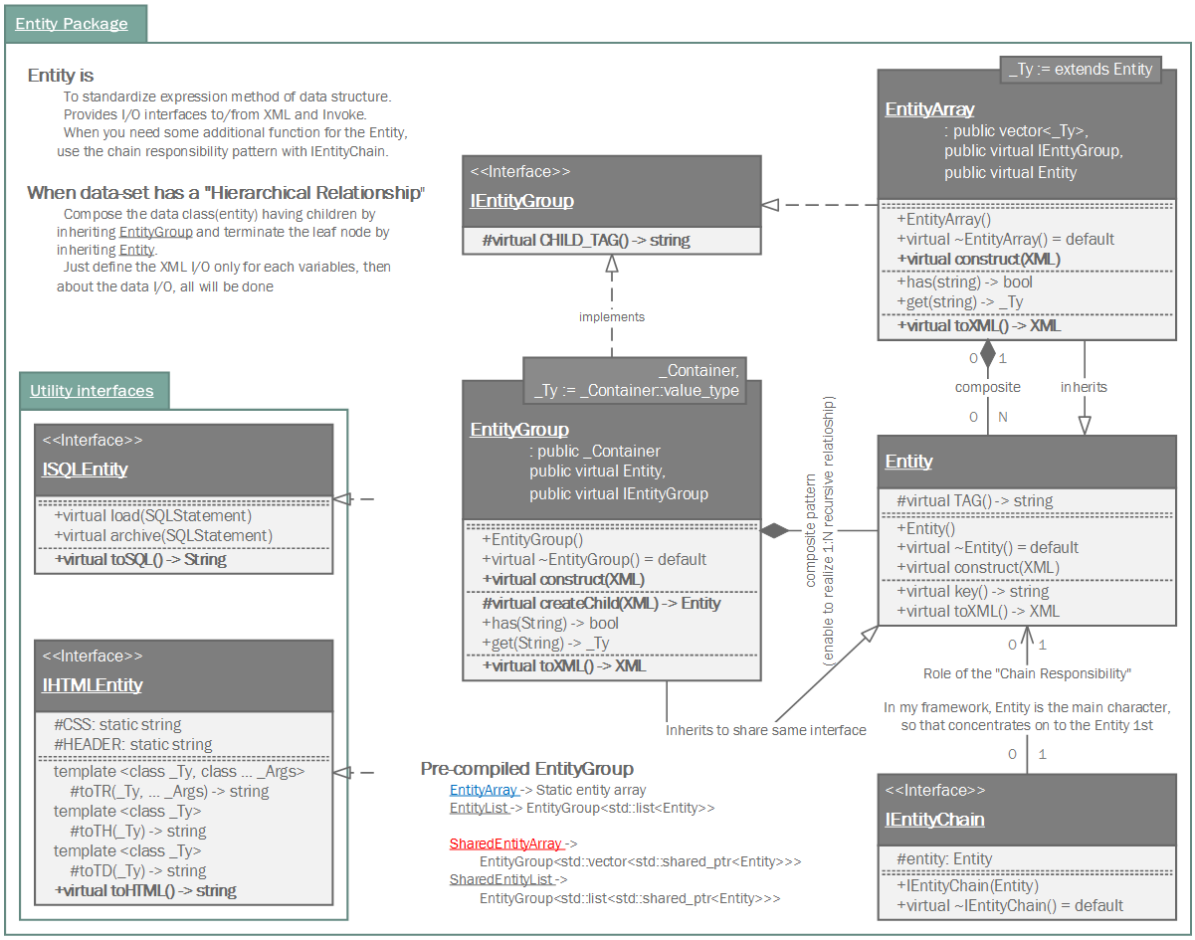
**Warning**

EntityGroup contains children entity elements as type of pointer. Because children entity objects are not serialized and referenced by pointer, its iteration and accessment is not fast. If it needs higher performance, then use EntityArray (static array for children entity) instead.

**[Inherited]**

Entity is a class for standardization of expression method using on network I/O by XML. If Invoke is a standard message protocol of Samchon Framework which must be kept, Entity is a recommended semi-protocol of message for expressing a data class. Following the semi-protocol Entity is not imposed but encouraged.

As we could get advantages from standardization of message for network I/O with Invoke, we can get additional advantage from standardizing expression method of data class with Entity. We do not need to know a part of network communication. Thus, with the Entity, we can only concentrate on entity's own logics and relationships between another entities. Entity does not need to how network communications are being done.




## Example source

```
#include <iostream>

#include <samchon/protocol/Entity.hpp>
#include <samchon/protocol/IHTMLEntity.hpp>
#include <samchon/protocol/SharedEntityArray.hpp>

#include <samchon/library/XML.hpp>

#ifdef _WIN64
#   ifdef _DEBUG
#       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "x64/Release/SamchonFramework.lib")
#   endif
#else
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

using namespace std;
using namespace samchon::library;
using namespace samchon::protocol;

class Member
    : public Entity, public virtual IHTMLEntity
{
protected:
    typedef Entity super;

    string id;
    string name;
    int age;
    int grade;

public:
    /* ----------------------------------------------------------------------
        CONSTRUCTORS
```

```
    ------------------------------------------------------------------- */
    Member()
        : super(), IHTMLEntity()
    {
    };
    Member(const string &id, const string &name, int age, int grade)
        : super(), IHTMLEntity()
    {
        this->id = id;
        this->name = name;
        this->age = age;
        this->grade = grade;
    };
    virtual ~Member() = default;

    virtual void construct(shared_ptr<XML> xml) override
    {
        this->id = xml->getProperty("id");
        this->name = xml->getProperty("name");
        this->age = xml->getProperty<int>("age");
        this->grade = xml->getProperty<int>("grade");
    };

    /* ------------------------------------------------------------------
        GETTERSs
    ------------------------------------------------------------------- */
    virtual auto key() const -> std::string override
    {
        return this->id;
    };

    /* ------------------------------------------------------------------
        XML EXPORTERS
    ------------------------------------------------------------------- */
    virtual auto TAG() const -> string override
    {
        return "member";
    };
    virtual auto toXML() const -> shared_ptr<XML>
    {
        shared_ptr<XML> &xml = super::toXML();
        xml->setProperty("id", id);
        xml->setProperty("name", name);
        xml->setProperty("age", age);
        xml->setProperty("grade", grade);

        return move(xml);
    };
    virtual auto toHTML() const -> string
    {
        return toTR(id, name, age, grade);
    };
};

class MemberArray
    : public SharedEntityArray<Member>,
    public virtual IHTMLEntity
{
protected:
    typedef SharedEntityArray<Member> super;

    string application;
    int department;
    Member *chief;

public:
    /* ------------------------------------------------------------------
        CONSTRUCTORS
    ------------------------------------------------------------------- */
    MemberArray()
        : super(), IHTMLEntity()
    {
        this->chief = nullptr;
    };
    virtual ~MemberArray() = default;

    // You don't need to consider children(Member) objects
    // Just concentrate on constructing MemberArray's own member variables
    virtual void construct(shared_ptr<XML> xml) override
    {
        super::construct(xml);

        this->application = xml->getProperty("application");
        this->department = xml->getProperty<int>("department");

        if(xml->hasProperty("chief") == true && this->has( xml->getProperty("chief") ) == true)
            this->chief = this->get( xml->getProperty("cheif") ).get();
```

```
    };

protected:
    //FACTORY METHOD FOR MEMBER
    virtual auto createChild(shared_ptr<XML> = nullptr) -> Member* override
    {
        return new Member();
    };

    /* ------------------------------------------------------------------
        XML EXPORTERS
    ------------------------------------------------------------------ */
public:
    virtual auto TAG() const -> string override
    {
        return "memberArray";
    };
    virtual auto CHILD_TAG() const -> string override
    {
        return "member";
    };

    // You don't need to consider children(Member) objects
    // Just concentrate on expressing MemberArray's own member variables
    virtual auto toXML() const -> shared_ptr<XML>
    {
        shared_ptr<XML> &xml = super::toXML();
        xml->setProperty("application", application);
        xml->setProperty("department", department);

        if(chief != nullptr)
            xml->setProperty("cheif", chief->key());

        return move(xml);
    };
    virtual auto toHTML() const -> string
    {
        string html = "<table>\n";
        html += toTH("ID", "Name", "Age", "Grade") + "\n";

        for (size_t i = 0; i < 2; i++)
            html += at(i)->toHTML() + "\n";

        html += "</table>";
        return move(html);
    };
};

void main()
{
    string str = string("") +
        "<memberArray application='framework' department='7' cheif='samchon'>\n" +
        "   <member id='samchon' name='Jeongho Nam' age='27' grade='5' />" +
        "   <member id='submaster' name='No Name' age='100' grade='4' />" +
        "   <member id='john' name='John Doe' age='33' grade='2' />" +
        "   <member id='bad_man' name='Bad Man' age='44' grade='-1' />" +
        "   <member id='guest' name='Guest' age='0' grade='0' />" +
        "</memberArray>";
    shared_ptr<XML> xml(new XML(str));

    MemberArray memberArray;
    memberArray.construct(xml);

    memberArray.emplace_back(new Member("freshman", "A fresh man", 20, 2));
    memberArray.emplace_back(new Member("senior", "A senior", 70, 2));

    cout << memberArray.toXML()->toString() << endl << endl;
    cout << memberArray.toHTML() << endl;
    system("pause");
}
```

**Result of the example**

```
D:\OneDrive\Project\Samchon\framework\cpp\Debug\entity.exe
<memberArray application="framework" department="7">
        <member age="27" grade="5" id="samchon" name="Jeongho" />
        <member age="100" grade="4" id="submaster" name="No" />
        <member age="33" grade="2" id="john" name="John" />
        <member age="44" grade="-1" id="bad_man" name="Bad" />
        <member age="0" grade="0" id="guest" name="Guest" />
        <member age="20" grade="2" id="freshman" name="A fresh man" />
        <member age="70" grade="2" id="senior" name="A senior" />
</memberArray>

<table>
        <th>
                <td>ID</td>
                <td>Name</td>
                <td>Age</td>
                <td>Grade</td>
        </th>
        <tr>
                <td>samchon</td>
                <td>Jeongho</td>
                <td>27</td>
                <td>5</td>
        </tr>
        <tr>
                <td>submaster</td>
                <td>No</td>
                <td>100</td>
                <td>4</td>
        </tr>
</table>
Press any key to continue . . .
```

**Note**

I say repeatedly. Expression method of Entity is recommended, but not imposed. It's a semi protocol for network I/O but not a essential protocol must be kept. The expression method of Entity, using on network I/O, is expressed by XML string.

If your own network system has a critical performance issue on communication data class, it would be better to using binary communication (with ByteArray or boost::serialization). Don't worry about the problem! Invoke also provides methods for binary data (ByteArray).

**See also**

protocol

**Author**

Jeongho Nam

### 6.36.2 Member Function Documentation

#### 6.36.2.1 virtual void construct ( std::shared_ptr< library::XML > *xml* ) [inline], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Implements Entity.

Reimplemented in DistributedSystem, NTCriteria, ExternalSystem, ParallelSystem, Invoke, DistributedSystemArray, DistributedSystemArrayMediator, ParallelSystemArrayMediator, NTParameter, ExternalClientArray, ExternalServer, DistributedClientArrayMediator, ParallelClientArrayMediator, DistributedClientArray, ParallelServer, and DistributedServer.

#### 6.36.2.2 virtual auto createChild ( std::shared_ptr< library::XML > ) -> entity_type * [protected], [pure virtual]

Factory method of a child Entity.

EntityGroup::createChild() is a factory method creating a new child Entity which is belonged to the EntityGroup. This method is called by EntityGroup::construct(). The children construction methods Entity::construct() will be called by abstract method of the EntityGroup::construct().

**Returns**

A new child Entity belongs to EntityGroup.

Implemented in NTCriteria, Invoke, NTParameter, NTParameterArray, DSInvokeHistoryList, PRInvokeHistoryArray, and InvokeHistoryArray.

#### 6.36.2.3 auto has ( const std::string & *key* ) const -> bool [inline]

Indicates whether a container has an object having the specified identifier.

**Parameters**

| | |
|---|---|
| *key* | An identifier of an Entity |

**Returns**

If there's the object then true, otherwise false

#### 6.36.2.4 auto get ( const std::string & *key* ) -> value_type& [inline]

Access the element by specified identifier(key).

**Parameters**

| | |
|---|---|
| *key* | the identifier of the element wants to access |

**Returns**

The element having the key, or throw exception if there is none.

#### 6.36.2.5 auto get ( const std::string & *key* ) const -> const value_type& [inline]

Access the const element by specified identifier(key).

**Parameters**

| | |
|---|---|
| *key* | the identifier of the element wants to access |

**Returns**

The const element having the key, or throw exception if there is none.

#### 6.36.2.6 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [inline], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

Reimplemented in Invoke, DistributedSystem, NTCriteria, ExternalSystem, DistributedSystemArray, ParallelSystem, NTParameter, DistributedSystemArrayMediator, ParallelSystemArrayMediator, External↩ ClientArray, ExternalServer, FTFolder, DistributedClientArrayMediator, ParallelClientArrayMediator, DistributedClientArray, ParallelServer, and DistributedServer.

The documentation for this class was generated from the following file:

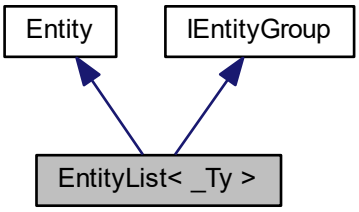
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/EntityGroup.hpp

## 6.37 EntityList< _Ty > Class Template Reference

An Entity and a static list containing Entity objects.

```
#include <EntityList.hpp>
```

Collaboration diagram for EntityList< _Ty >:




### Public Member Functions

- EntityList ()
  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML > xml) override
  *Construct data of the Entity from an XML object.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override
  *Get an XML object represents the EntityList.*

### Additional Inherited Members

### 6.37.1 Detailed Description

**template<typename _Ty>class samchon::protocol::EntityList< _Ty >**

An Entity and a static list containing Entity objects.

**Template Parameters**

| | |
|---|---|
| *_Ty* | A type of children Entity. Must be a class derived from an Entity. |

EntityList is a static array containing children objects derived from an Entity class.

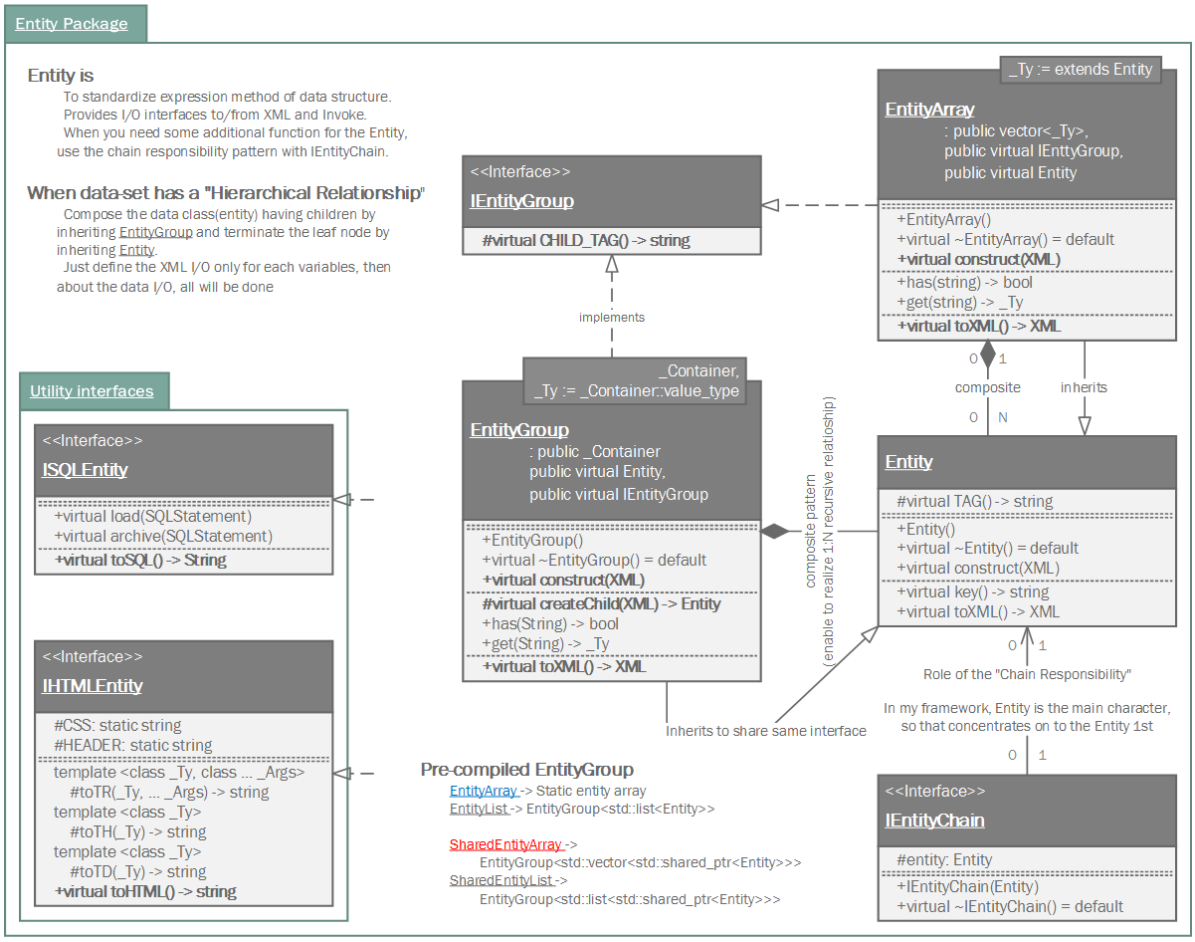
EntityList, its allocated memory space for each child is fixed and cannot contain derived a entity class from the child entity type. It has advantages on performance by direct accessment and static memory allocation for child, however, its increasement of performance is not eminent.

- EntityList<Animal> is specified
- Dog is extended from the Animal
- EntityList<Animal> cannot contain Dog. You can try insertion of the Dog class into the EntityList, but only memory size of Animal is allocated, so that derived member variables and methods are all truncated.

**[Inherited]**

Entity is a class for standardization of expression method using on network I/O by XML. If Invoke is a standard message protocol of Samchon Framework which must be kept, Entity is a recommended semi-protocol of message for expressing a data class. Following the semi-protocol Entity is not imposed but encouraged.

As we could get advantages from standardization of message for network I/O with Invoke, we can get additional advantage from standardizing expression method of data class with Entity. We do not need to know a part of network communication. Thus, with the Entity, we can only concentrate on entity's own logics and relationships between another entities. Entity does not need to how network communications are being done.




## Example source

```
#include <iostream>

#include <samchon/protocol/Entity.hpp>
#include <samchon/protocol/IHTMLEntity.hpp>
#include <samchon/protocol/SharedEntityArray.hpp>

#include <samchon/library/XML.hpp>

#ifdef _WIN64
#   ifdef _DEBUG
#       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "x64/Release/SamchonFramework.lib")
#   endif
#else
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

using namespace std;
using namespace samchon::library;
using namespace samchon::protocol;

class Member
    : public Entity, public virtual IHTMLEntity
{
protected:
    typedef Entity super;

    string id;
    string name;
    int age;
    int grade;

public:
    /* ----------------------------------------------------------------------
```

```
        CONSTRUCTORS
    ------------------------------------------------------------------- */
    Member()
        : super(), IHTMLEntity()
    {
    };
    Member(const string &id, const string &name, int age, int grade)
        : super(), IHTMLEntity()
    {
        this->id = id;
        this->name = name;
        this->age = age;
        this->grade = grade;
    };
    virtual ~Member() = default;

    virtual void construct(shared_ptr<XML> xml) override
    {
        this->id = xml->getProperty("id");
        this->name = xml->getProperty("name");
        this->age = xml->getProperty<int>("age");
        this->grade = xml->getProperty<int>("grade");
    };

    /* -------------------------------------------------------------------
        GETTERSs
    ------------------------------------------------------------------- */
    virtual auto key() const -> std::string override
    {
        return this->id;
    };

    /* -------------------------------------------------------------------
        XML EXPORTERS
    ------------------------------------------------------------------- */
    virtual auto TAG() const -> string override
    {
        return "member";
    };
    virtual auto toXML() const -> shared_ptr<XML>
    {
        shared_ptr<XML> &xml = super::toXML();
        xml->setProperty("id", id);
        xml->setProperty("name", name);
        xml->setProperty("age", age);
        xml->setProperty("grade", grade);

        return move(xml);
    };
    virtual auto toHTML() const -> string
    {
        return toTR(id, name, age, grade);
    };
};

class MemberArray
    : public SharedEntityArray<Member>,
    public virtual IHTMLEntity
{
protected:
    typedef SharedEntityArray<Member> super;

    string application;
    int department;
    Member *chief;

public:
    /* -------------------------------------------------------------------
        CONSTRUCTORS
    ------------------------------------------------------------------- */
    MemberArray()
        : super(), IHTMLEntity()
    {
        this->chief = nullptr;
    };
    virtual ~MemberArray() = default;

    // You don't need to consider children(Member) objects
    // Just concentrate on constructing MemberArray's own member variables
    virtual void construct(shared_ptr<XML> xml) override
    {
        super::construct(xml);

        this->application = xml->getProperty("application");
        this->department = xml->getProperty<int>("department");

        if(xml->hasProperty("chief") == true && this->has( xml->getProperty("chief") ) == true)
```

```
            this->chief = this->get( xml->getProperty("cheif") ).get();
    };

protected:
    //FACTORY METHOD FOR MEMBER
    virtual auto createChild(shared_ptr<XML> = nullptr) -> Member* override
    {
        return new Member();
    };

    /* ------------------------------------------------------------------
        XML EXPORTERS
    ------------------------------------------------------------------ */
public:
    virtual auto TAG() const -> string override
    {
        return "memberArray";
    };
    virtual auto CHILD_TAG() const -> string override
    {
        return "member";
    };

    // You don't need to consider children(Member) objects
    // Just concentrate on expressing MemberArray's own member variables
    virtual auto toXML() const -> shared_ptr<XML>
    {
        shared_ptr<XML> &xml = super::toXML();
        xml->setProperty("application", application);
        xml->setProperty("department", department);

        if(chief != nullptr)
            xml->setProperty("cheif", chief->key());

        return move(xml);
    };
    virtual auto toHTML() const -> string
    {
        string html = "<table>\n";
        html += toTH("ID", "Name", "Age", "Grade") + "\n";

        for (size_t i = 0; i < 2; i++)
            html += at(i)->toHTML() + "\n";

        html += "</table>";
        return move(html);
    };
};

void main()
{
    string str = string("") +
        "<memberArray application='framework' department='7' cheif='samchon'>\n" +
        "   <member id='samchon' name='Jeongho Nam' age='27' grade='5' />" +
        "   <member id='submaster' name='No Name' age='100' grade='4' />" +
        "   <member id='john' name='John Doe' age='33' grade='2' />" +
        "   <member id='bad_man' name='Bad Man' age='44' grade='-1' />" +
        "   <member id='guest' name='Guest' age='0' grade='0' />" +
        "</memberArray>";
    shared_ptr<XML> xml(new XML(str));

    MemberArray memberArray;
    memberArray.construct(xml);

    memberArray.emplace_back(new Member("freshman", "A fresh man", 20, 2));
    memberArray.emplace_back(new Member("senior", "A senior", 70, 2));

    cout << memberArray.toXML()->toString() << endl << endl;
    cout << memberArray.toHTML() << endl;
    system("pause");
}
```

**Result of the example**

```
D:\OneDrive\Project\Samchon\framework\cpp\Debug\entity.exe
<memberArray application="framework" department="7">
        <member age="27" grade="5" id="samchon" name="Jeongho" />
        <member age="100" grade="4" id="submaster" name="No" />
        <member age="33" grade="2" id="john" name="John" />
        <member age="44" grade="-1" id="bad_man" name="Bad" />
        <member age="0" grade="0" id="guest" name="Guest" />
        <member age="20" grade="2" id="freshman" name="A fresh man" />
        <member age="70" grade="2" id="senior" name="A senior" />
</memberArray>

<table>
        <th>
                <td>ID</td>
                <td>Name</td>
                <td>Age</td>
                <td>Grade</td>
        </th>
        <tr>
                <td>samchon</td>
                <td>Jeongho</td>
                <td>27</td>
                <td>5</td>
        </tr>
        <tr>
                <td>submaster</td>
                <td>No</td>
                <td>100</td>
                <td>4</td>
        </tr>
</table>
Press any key to continue . . .
```

**Note**

I say repeatedly. Expression method of Entity is recommended, but not imposed. It's a semi protocol for network I/O but not a essential protocol must be kept. The expression method of Entity, using on network I/O, is expressed by XML string.

If your own network system has a critical performance issue on communication data class, it would be better to using binary communication (with ByteArray or boost::serialization). Don't worry about the problem! Invoke also provides methods for binary data (ByteArray).

**See also**

protocol

**Author**

Jeongho Nam

**Warning**

If a data structure has recursive and hierarchical relationship, never use the EntityList. EntityList's memory allocation is static. The recursive relationship causes infinite memory allocation. It must generates stack overflow.

Use EntityGroup instead.

- class NTCriteria : public EntityList<NTCriteria> causes a stack overflow.
- class NTCriteria : public SharedEntityList<NTCriteria> doesn't cause the stack overflow.

**Warning**

Unlike EntityArray containing children serialized, EntityList's static memory allocation and accessment for a child, its advantage doesn't seemed to have eminent advantage on performance. As there's not meaningful advantage but has only disadvantage that cannot containing derived objects, I'm planning to depreciate the EntityList in next generation.

Use SharedEntityList instead will be better I think.

### 6.37.2 Member Function Documentation

#### 6.37.2.1 virtual void construct ( std::shared_ptr< library::XML > *xml* ) [inline], [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityList's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityList::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityList::toXML().

Constructs only data of EntityList's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Implements Entity.

#### 6.37.2.2 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [inline], [override], [virtual]

Get an XML object represents the EntityList.

Archives the EntityList's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityList::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityList::toXML().

Archives only data of EntityList's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

The documentation for this class was generated from the following file:

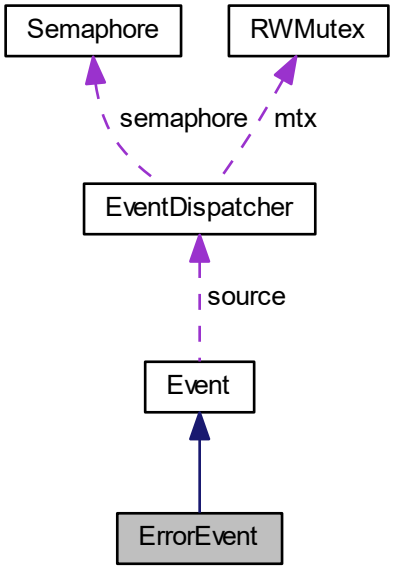
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/EntityList.hpp

## 6.38 ErrorEvent Class Reference

Event representing an error.

`#include <ErrorEvent.hpp>`

Collaboration diagram for ErrorEvent:




### Public Member Functions

- ErrorEvent (EventDispatcher *, const std::string &)

  *Construct from source and error-id.*
- auto getMessage () const -> std::string

  *Get error-id.*

### Protected Attributes

– std::string message

*Error message.*

## 6.38.1 Detailed Description

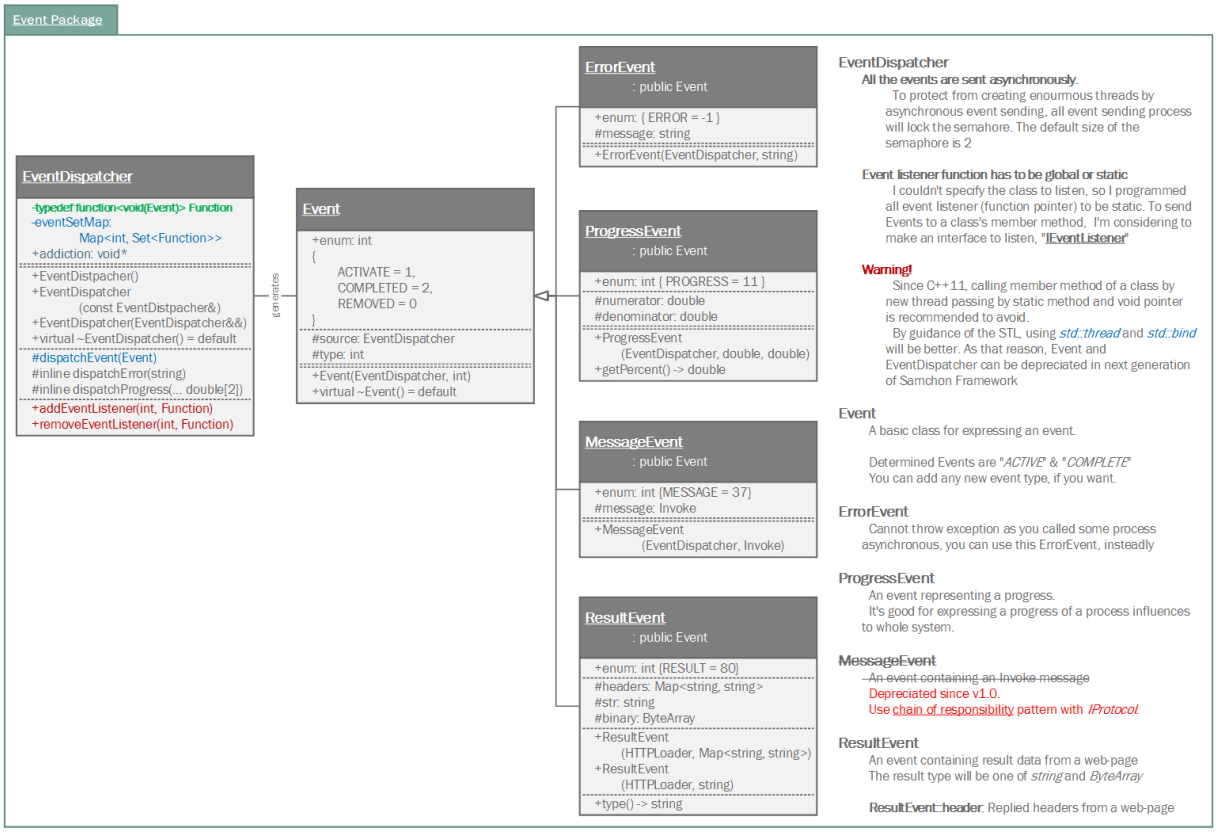
Event representing an error.

**[Inherited]**

The Event class is used as the base class for the creation of Event objects, which are passed as parameters to event listeners when an event occurs.

The properties of the Event class carry basic information about an event, such as the event's type or source (who made the event) of the event.

For many events, such as the events represented by the Event class constants, this basic information is sufficient. Other events, however, may require more detailed information.




### Example source

```
#include <iostream>
#include <thread>
#include <chrono>

#include <samchon/library/EventDispatcher.hpp>
#include <samchon/library/Event.hpp>
#include <samchon/library/ProgressEvent.hpp>

#ifdef _WIN64
#   ifdef _DEBUG
#       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "x64/Release/SamchonFramework.lib")
```

```
#   endif
#else
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

using namespace std;
using namespace samchon::library;

class Process
    : public EventDispatcher
{
public:
    Process()
    {

    };

    void run()
    {
        dispatchEvent(shared_ptr<Event>(new Event(this, Event::ACTIVATE)));

        for (size_t i = 0; i < 100; i++)
        {
            this_thread::sleep_for(chrono::seconds(1));
            dispatchEvent(shared_ptr<Event>(new ProgressEvent(this, i + 1, 100)));
        }

        dispatchEvent(shared_ptr<Event>(new Event(this, Event::COMPLETE)));
    };
};

void handleActivate(shared_ptr<Event> event)
{
    cout << "Activated" << endl;
}
void handleComplete(shared_ptr<Event> event)
{
    cout << "Completed" << endl;
}
void handleProgress(shared_ptr<Event> event)
{
    cout << dynamic_pointer_cast<ProgressEvent>(event)->getPercent() * 100.0 << "%" << endl;
}

void main()
{
    Process process;

    process.addEventListener(Event::ACTIVATE, handleActivate);
    process.addEventListener(Event::COMPLETE, handleComplete);
    process.addEventListener(ProgressEvent::PROGRESS, handleProgress);

    process.run();
    system("pause");
}
```

### Note

Event is a candidate to be depreciated.

Since C++11, calling member method of a class by a new thread passing by static method and using void pointer are recommeded to avoid. As the reason, using *std::thread* and *std::bind will* be better.

- std::thread: http://www.cplusplus.com/reference/thread/thread/
- std::bind: http://www.cplusplus.com/reference/functional/bind/

### See also

samchon::library

### Author

Jeongho Nam

### 6.38.2 Constructor & Destructor Documentation

#### 6.38.2.1 ErrorEvent ( EventDispatcher *, const std::string & )

Construct from source and error-id.

The event object owns its source and type

**Parameters**

| | |
|---|---|
| *source* | Source of the event; who made the event |
| *id* | An error-id |

The documentation for this class was generated from the following files:

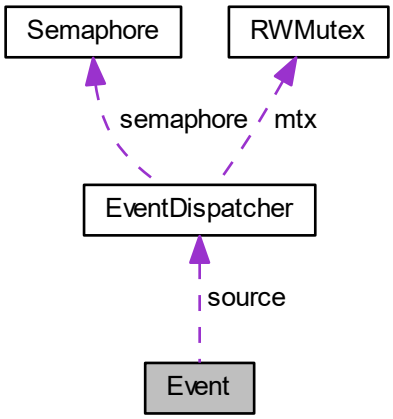
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/ErrorEvent.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/ErrorEvent.cpp

## 6.39 Event Class Reference

Represent an event running on background.

`#include <Event.hpp>`

Collaboration diagram for Event:




### Public Member Functions

- Event (EventDispatcher *, int)

  *Construct from source and type.*
- auto getSource () const -> EventDispatcher *

  *Get source of the Event.*
- auto getType () const -> int

  *Get type of the Event.*

### Protected Attributes

- EventDispatcher * source

  *Source of the event.*
- int type

  *Type of the event.*

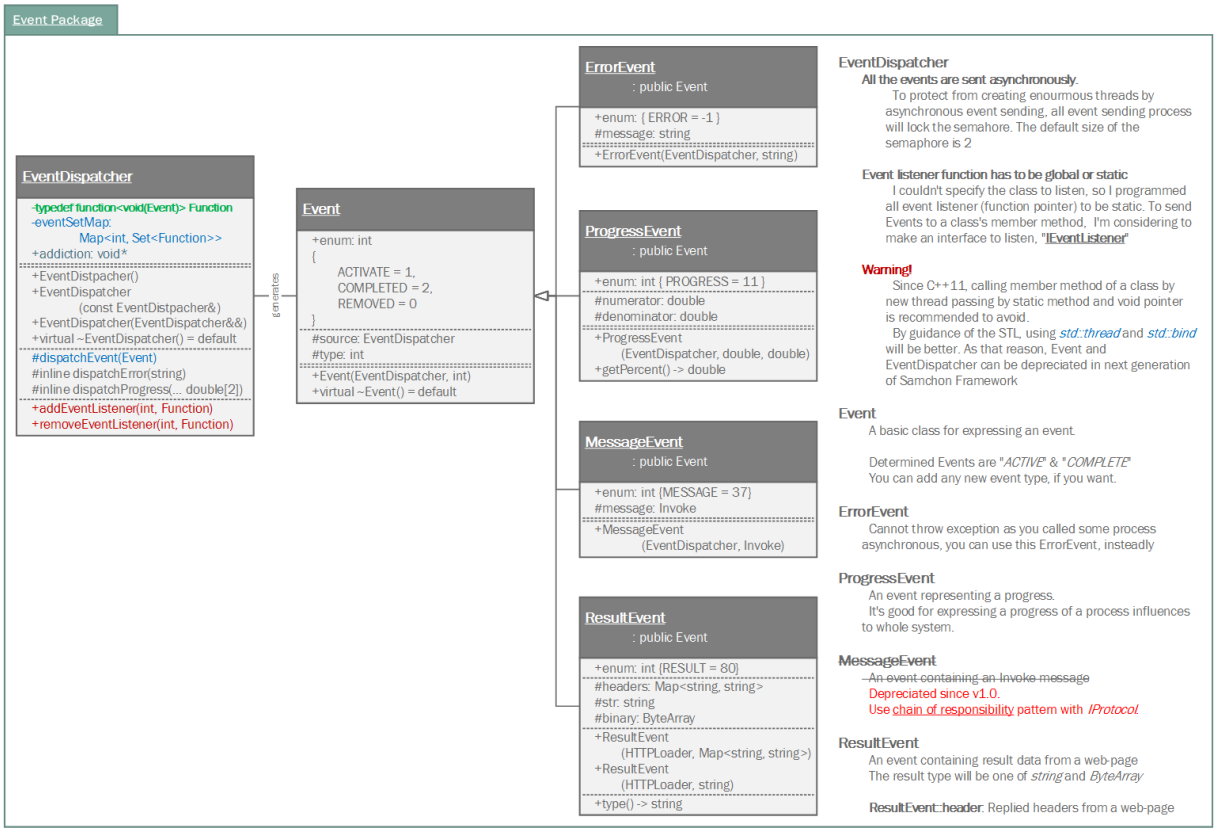
## 6.39.1 Detailed Description

Represent an event running on background.

The Event class is used as the base class for the creation of Event objects, which are passed as parameters to event listeners when an event occurs.

The properties of the Event class carry basic information about an event, such as the event's type or source (who made the event) of the event.

For many events, such as the events represented by the Event class constants, this basic information is sufficient. Other events, however, may require more detailed information.




### Example source

```
1 #include <iostream>
2 #include <thread>
3 #include <chrono>
4
5 #include <samchon/library/EventDispatcher.hpp>
6 #include <samchon/library/Event.hpp>
7 #include <samchon/library/ProgressEvent.hpp>
8
9 #ifdef _WIN64
10 #   ifdef _DEBUG
11 #       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
12 #   else
13 #       pragma comment(lib, "x64/Release/SamchonFramework.lib")
14 #   endif
15 #else
16 #   ifdef _DEBUG
```

```
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

using namespace std;
using namespace samchon::library;

class Process
    : public EventDispatcher
{
public:
    Process()
    {

    };

    void run()
    {
        dispatchEvent(shared_ptr<Event>(new Event(this, Event::ACTIVATE)));

        for (size_t i = 0; i < 100; i++)
        {
            this_thread::sleep_for(chrono::seconds(1));
            dispatchEvent(shared_ptr<Event>(new ProgressEvent(this, i + 1, 100)));
        }

        dispatchEvent(shared_ptr<Event>(new Event(this, Event::COMPLETE)));
    };
};

void handleActivate(shared_ptr<Event> event)
{
    cout << "Activated" << endl;
}
void handleComplete(shared_ptr<Event> event)
{
    cout << "Completed" << endl;
}
void handleProgress(shared_ptr<Event> event)
{
    cout << dynamic_pointer_cast<ProgressEvent>(event)->getPercent() * 100.0 << "%" << endl;
}

void main()
{
    Process process;

    process.addEventListener(Event::ACTIVATE, handleActivate);
    process.addEventListener(Event::COMPLETE, handleComplete);
    process.addEventListener(ProgressEvent::PROGRESS, handleProgress);

    process.run();
    system("pause");
}
```

#### Note

Event is a candidate to be depreciated.

Since C++11, calling member method of a class by a new thread passing by static method and using void pointer are recommeded to avoid. As the reason, using *std::thread* and *std::bind will* be better.

- std::thread: http://www.cplusplus.com/reference/thread/thread/
- std::bind: http://www.cplusplus.com/reference/functional/bind/

#### See also

samchon::library

#### Author

Jeongho Nam

### 6.39.2 Constructor & Destructor Documentation

#### 6.39.2.1 Event ( EventDispatcher * *source*, int *type* )

Construct from source and type.

The event object owns its source and type

**Parameters**

| | |
|---|---|
| *source* | Source of the event; who made the event |
| *type* | Type of the event |

The documentation for this class was generated from the following files:

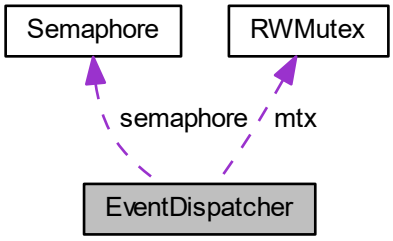
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Event.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Event.cpp

## 6.40 EventDispatcher Class Reference

Abstract class for dispatching Event.

`#include <EventDispatcher.hpp>`

Collaboration diagram for EventDispatcher:




### Public Member Functions

- EventDispatcher ()
  *Default Constructor.*
- EventDispatcher (const EventDispatcher &eventDispatcher)
  *Copy Constructor.*
- EventDispatcher (EventDispatcher &&eventDispatcher)
  *Move Constructor.*
- void addEventListener (int, void(*listener)(std::shared_ptr< Event >))
  *Register an event listener.*
- void removeEventListener (int, void(*listener)(std::shared_ptr< Event >))
  *Remove a registered event listener.*

### Protected Member Functions

- auto dispatchEvent (std::shared_ptr< Event >) -> bool
  *Dispatches an event to all listeners.*
- auto dispatchProgressEvent (size_t x, size_t size) -> bool
  *Convenient method of dispatching a progress event.*

### Private Attributes

- std::map< int, std::set< void(*)(std::shared_ptr< Event >)> > eventSetMap

  *A container storing listeners.*
- RWMutex mtx

  *A rw_mutex for concurrency.*
- Semaphore semaphore

  *A semaphore for restricting thread size.*

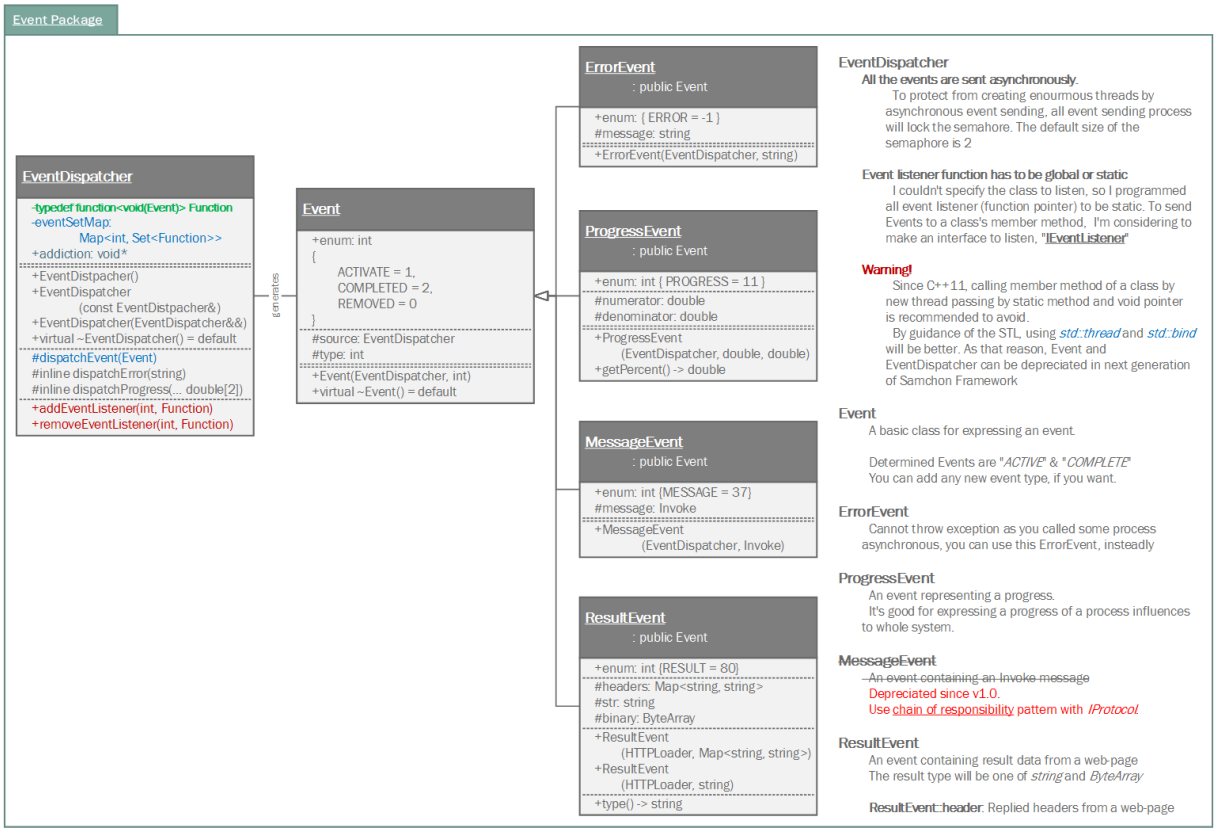
## 6.40.1 Detailed Description

Abstract class for dispatching Event.

EventDispatcher is the base class for all classes that dispatch events.

All the events are sent asynchronously. To avoid from creating tooo enourmouse threads dispatching events, all event sending processes will acuiqre a semaphore. The default permitted size of the semaphore is 2.

- Number of thread pools used to sending events is 2.




### Example source

```
1 #include <iostream>
2 #include <thread>
3 #include <chrono>
4
5 #include <samchon/library/EventDispatcher.hpp>
6 #include <samchon/library/Event.hpp>
7 #include <samchon/library/ProgressEvent.hpp>
8
9 #ifdef _WIN64
10 #   ifdef _DEBUG
11 #       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
12 #   else
13 #       pragma comment(lib, "x64/Release/SamchonFramework.lib")
14 #   endif
15 #else
```

```
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

using namespace std;
using namespace samchon::library;

class Process
    : public EventDispatcher
{
public:
    Process()
    {

    };

    void run()
    {
        dispatchEvent(shared_ptr<Event>(new Event(this, Event::ACTIVATE)));

        for (size_t i = 0; i < 100; i++)
        {
            this_thread::sleep_for(chrono::seconds(1));
            dispatchEvent(shared_ptr<Event>(new ProgressEvent(this, i + 1, 100)))
    ;
        }

        dispatchEvent(shared_ptr<Event>(new Event(this, Event::COMPLETE)));
    };
};

void handleActivate(shared_ptr<Event> event)
{
    cout << "Activated" << endl;
}
void handleComplete(shared_ptr<Event> event)
{
    cout << "Completed" << endl;
}
void handleProgress(shared_ptr<Event> event)
{
    cout << dynamic_pointer_cast<ProgressEvent>(event)->getPercent() * 100.0 << "%" << endl;
}

void main()
{
    Process process;

    process.addEventListener(Event::ACTIVATE, handleActivate);
    process.addEventListener(Event::COMPLETE, handleComplete);
    process.addEventListener(ProgressEvent::PROGRESS, handleProgress);

    process.run();
    system("pause");
}
```

#### Note

EventDispatcher is a candidate to be depreciated.

Since C++11, calling member method of a class by a new thread passing by static method and using void pointer are recommeded to avoid. As the reason, using *std::thread* and *std::bind* will be better.

- std::thread: `http://www.cplusplus.com/reference/thread/thread/`
- std::bind: `http://www.cplusplus.com/reference/functional/bind/`

#### See also

samchon::library

#### Author

Jeongho Nam

### 6.40.2 Constructor & Destructor Documentation

#### 6.40.2.1 EventDispatcher ( const EventDispatcher & *eventDispatcher* )

Copy Constructor.

Copying an EventDispatcher instance does not copy the event listeners attached to it. (If your newly created node needs an event listener, you must attach the listener after creating the node.)

**Parameters**

| | |
|---|---|
| *eventDispatcher* | The object to copy |

#### 6.40.2.2 EventDispatcher ( EventDispatcher && *eventDispatcher* )

Move Constructor.

**Parameters**

| | |
|---|---|
| *eventDispatcher* | The object to move |

### 6.40.3 Member Function Documentation

#### 6.40.3.1 void addEventListener ( int *type*, void(∗)(std::shared_ptr< Event >) *listener* )

Register an event listener.

Registers an event listener object with an EventDispatcher object so that the listener receives notification of an event.

**Warning**

> Copying an EventDispatcher instance does not copy the event listeners attached to it. (If your newly created node needs an event listener, you must attach the listener after creating the node.) However, if you move an EventDispatcher instance, the event listeners attached to it move along with it.
> If you no longer need an event listener, remove it by calling removeEventListener, or EventDispatcher already try to send events to the no longer needed listener and it can cause some confliction.

**Parameters**

| | |
|---|---|
| *type* | The type of event. |
| *listener* | The listener function processes the event. |

#### 6.40.3.2 void removeEventListener ( int *type*, void(∗)(std::shared_ptr< Event >) *listener* )

Remove a registered event listener.

Removes a listener from the EventDispatcher object. If there is no matching listener registered with the EventDispatcher object, a call to this method has no effect

**Parameters**

| | |
|---|---|
| *type* | The type of event. |
| *listener* | The listener function to remove. |

#### 6.40.3.3 auto dispatchEvent ( std::shared_ptr< Event > ) -> bool [protected]

Dispatches an event to all listeners.

Dispatches an event into the event flow in the background. The Event::source is the EventDispatcher object upon which the dispatchEvent.

**Parameters**

| | |
|---|---|
| *event* | The Event object that is dispatched into the event flow. |

**Returns**

Whether there's some listener to listen the event

#### 6.40.3.4 auto dispatchProgressEvent ( size_t *x*, size_t *size* ) -> bool [protected]

Convenient method of dispatching a progress event.

Dispatches a progress event into the event flow in the background The Event::source is the EventDispatcher object upon with the dispatchProgressEvent

**Parameters**

| | |
|---|---|
| *x* | The number of current progress |
| *size* | The number of total progress |

**Returns**

Whether there's some listener to listen the progress event

**See also**

ProgressEvent
EventDispatcher::dispatchEvent

The documentation for this class was generated from the following files:

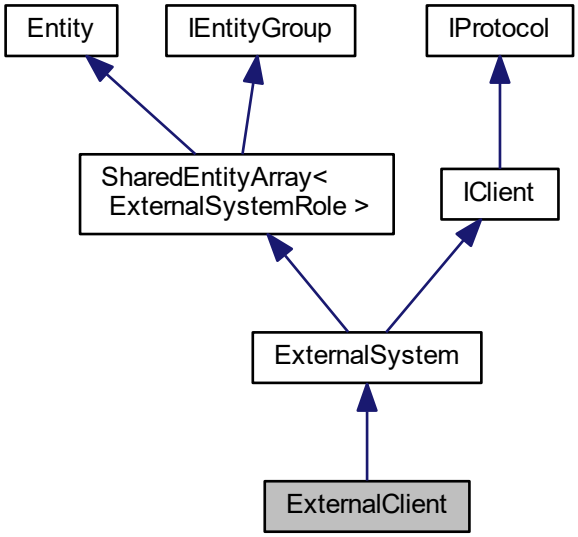
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/EventDispatcher.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/EventDispatcher.cpp

## 6.41 ExternalClient Class Reference

A network driver for an external client.

```
#include <ExternalClient.hpp>
```

Collaboration diagram for ExternalClient:




### Public Member Functions

– ExternalClient ()

*Default Constructor.*

### Additional Inherited Members

#### 6.41.1 Detailed Description

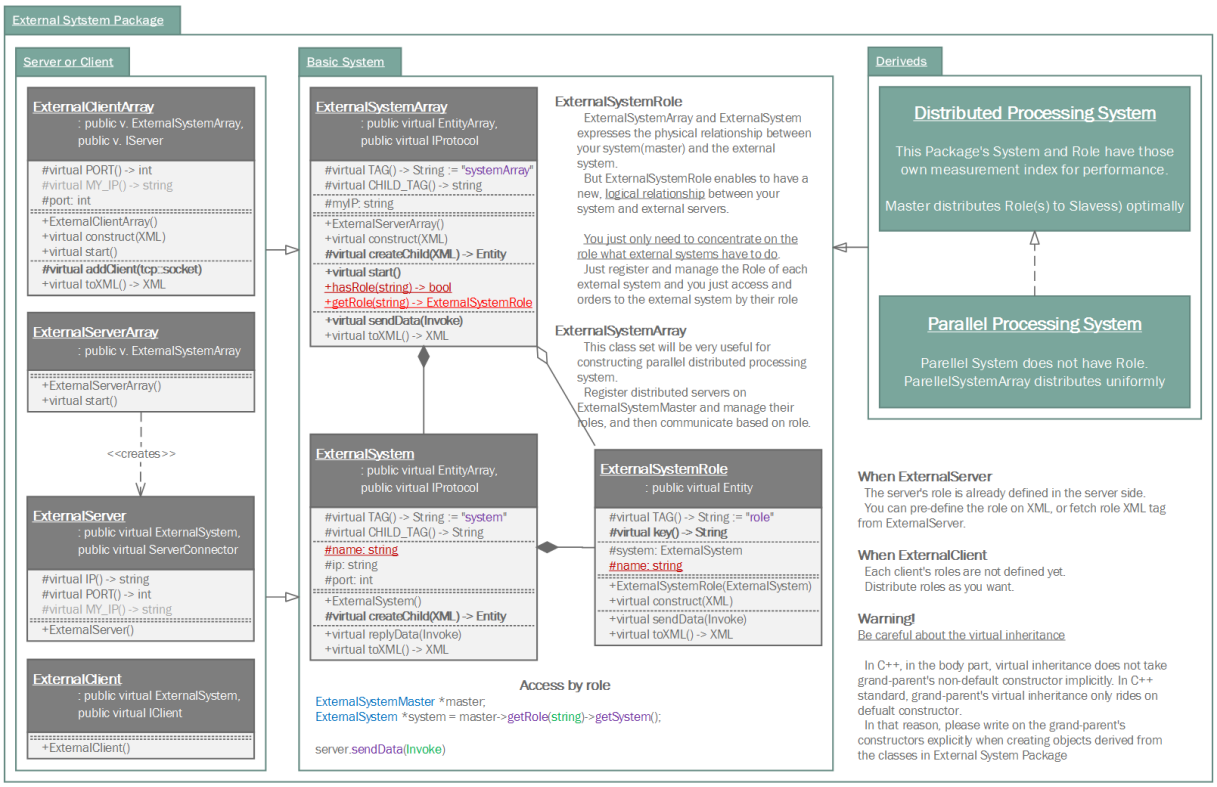
A network driver for an external client.

ExternalClient is an ExternalSystem specialized in client driver.

**[Inherited]**

ExternalSystem is a boundary class interacting with an external system by network communication. Also, ExternalSystem is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystem↩Role.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an External↩System. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

The documentation for this class was generated from the following files:

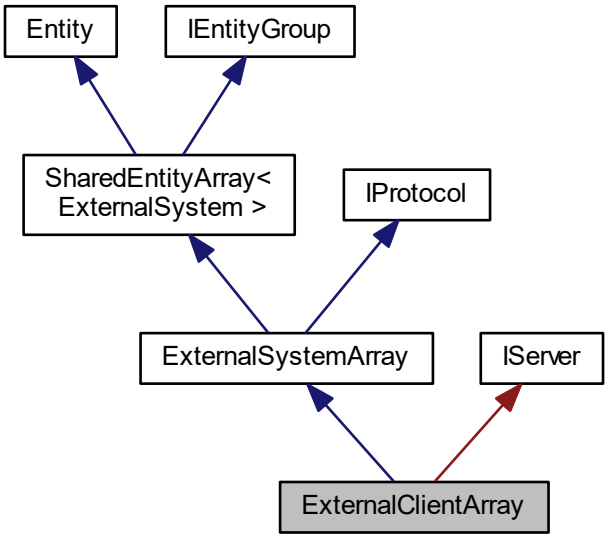
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalClient.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalClient.cpp

## 6.42 ExternalClientArray Class Reference

An array of ExternalClient(s)

```
#include <ExternalClientArray.hpp>
```

Collaboration diagram for ExternalClientArray:




## Public Member Functions

- ExternalClientArray ()

  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*
- virtual void start () override

  *Start interaction.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the EntityGroup.*

## Protected Member Functions

- virtual auto PORT () const -> int

  *Port number of the server.*
- virtual auto MY_IP () const -> std::string

  *(optional) Server's IP*
- virtual void addClient (Socket *) override

  *Handling connection of a physical client.*

## Protected Attributes

- std::string myIP

  *A custom ip address of my system to bind.*
- int port

  *A port number for accepting external clients.*

### Additional Inherited Members

### 6.42.1 Detailed Description

An array of ExternalClient(s)

ExternalClientArray is an ExternalSystemArray specialized in clients' driver.

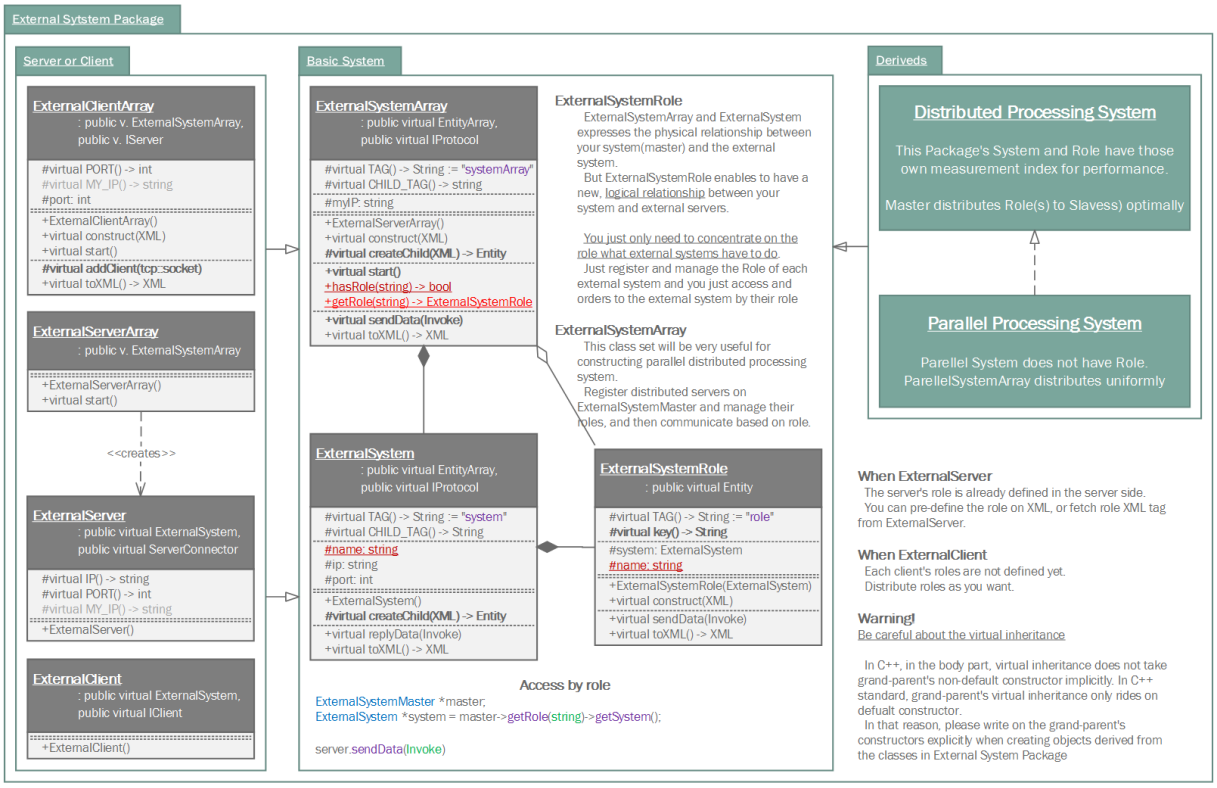
**[Inherited]**

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




### See also

samchon::protocol

### Author

Jeongho Nam

### 6.42.2 Member Function Documentation

#### 6.42.2.1 void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from EntityGroup< _Container, _ETy, _Ty >.

Reimplemented in DistributedClientArrayMediator, ParallelClientArrayMediator, and DistributedClientArray.

#### 6.42.2.2 void start ( ) [override], [virtual]

Start interaction.

An abstract method starting interaction with external systems.

If external systems are servers, starts connection to them, else clients, opens a server and accepts the external systems. You can addict your own procudures of starting drivers, but if you directly override method of abstract ExternalSystemArray, be careful about virtual inheritance.

- DistributedClientArray::start() calls DistributedSystemArray::start() and ExternalClientArray:start()

Implements ExternalSystemArray.

Reimplemented in DistributedClientArrayMediator, ParallelClientArrayMediator, and DistributedClientArray.

#### 6.42.2.3 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from EntityGroup< _Container, _ETy, _Ty >.

Reimplemented in DistributedClientArrayMediator, ParallelClientArrayMediator, and DistributedClientArray.

The documentation for this class was generated from the following files:

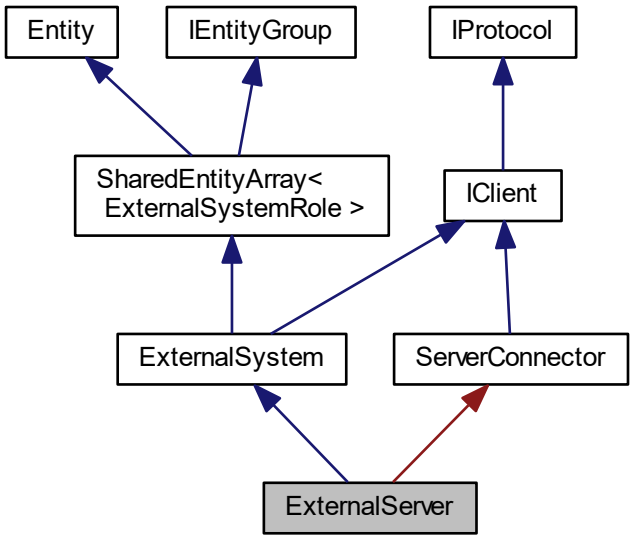
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalClientArray.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalClientArray.cpp

## 6.43 ExternalServer Class Reference

A network driver for an external server.

`#include <ExternalServer.hpp>`

Collaboration diagram for ExternalServer:




### Public Member Functions

- ExternalServer ()

  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*

- virtual void start () override
  *Start interaction.*
- virtual auto getIP () const -> std::string override
  *Destinatio IP.*
- virtual auto getPort () const -> int override
  *Destination port.*
- virtual auto getMyIP () const -> std::string override
  *(optional) My IP, if you want to bind*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override
  *Get an XML object represents the EntityGroup.*

### Protected Attributes

- std::string myIP
  *A custom ip address of my system to bind.*

### Additional Inherited Members

### 6.43.1 Detailed Description

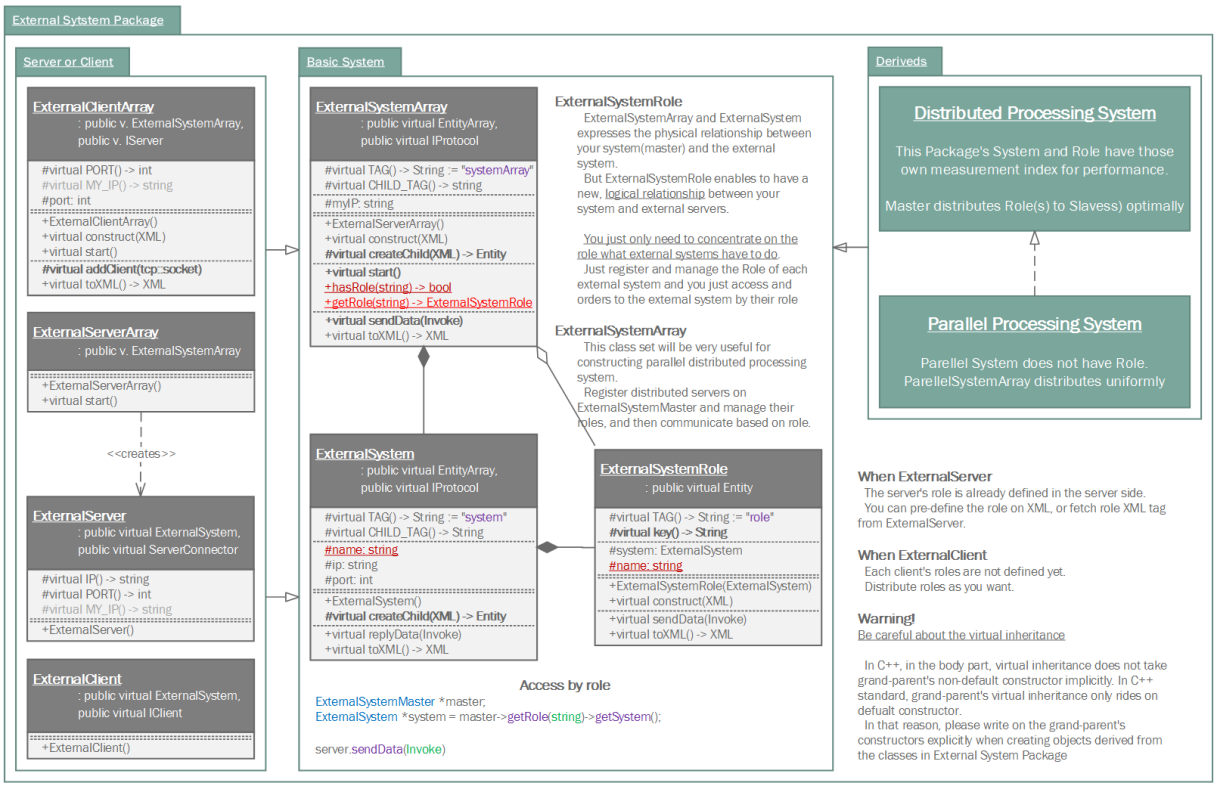
A network driver for an external server.

ExternalServer is an ExternalSystem specialized in server driver.

**[Inherited]**

ExternalSystem is a boundary class interacting with an external system by network communication. Also, ExternalSystem is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.



**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystemRole.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an ExternalSystem. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.43.2 Member Function Documentation

#### 6.43.2.1 void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from ExternalSystem.

Reimplemented in ParallelServer, and DistributedServer.

#### 6.43.2.2 void start ( ) [override], [virtual]

Start interaction.

An abstract method starting interaction with an external system.

If an external systems are a server, starts connection and listening Inovoke message, else clients, just starts listening only. You also can addict your own procudures of starting the driver, but if you directly override method of abstract ExternalSystem, be careful about virtual inheritance.

Implements ExternalSystem.

#### 6.43.2.3 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from ExternalSystem.

Reimplemented in ParallelServer, and DistributedServer.

The documentation for this class was generated from the following files:

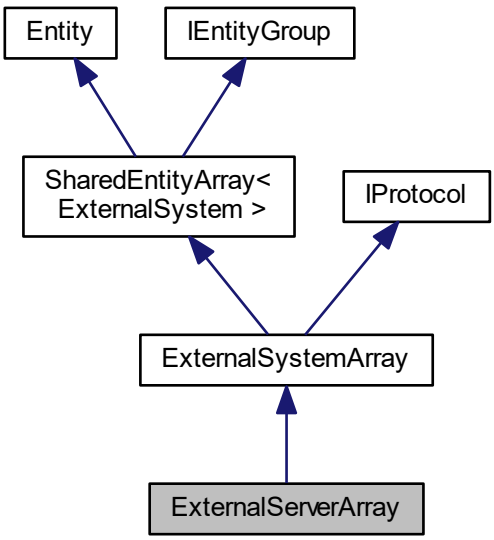
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalServer.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalServer.cpp

## 6.44 ExternalServerArray Class Reference

An array of ExternalServer(s)

```
#include <ExternalServerArray.hpp>
```

Collaboration diagram for ExternalServerArray:




### Public Member Functions

- virtual void start () override
  *Start interaction.*

### Additional Inherited Members

### 6.44.1 Detailed Description

An array of ExternalServer(s)

ExternalServerArray is an ExternalSystemArray specialized in servers' driver.

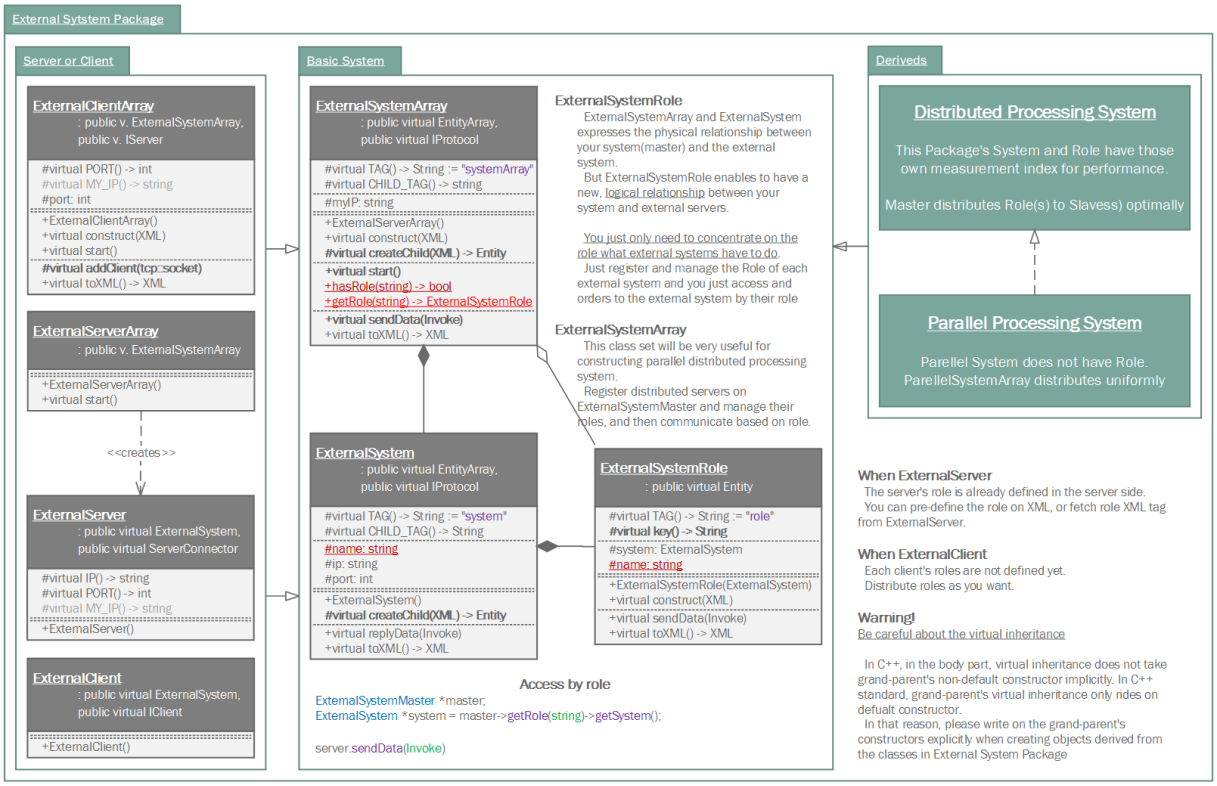
**[Inherited]**

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




### See also

samchon::protocol

### Author

Jeongho Nam

## 6.44.2 Member Function Documentation

### 6.44.2.1 void start ( ) [override], [virtual]

Start interaction.

An abstract method starting interaction with external systems.

If external systems are servers, starts connection to them, else clients, opens a server and accepts the external systems. You can addict your own procudures of starting drivers, but if you directly override method of abstract ExternalSystemArray, be careful about virtual inheritance.

- DistributedClientArray::start() calls DistributedSystemArray::start() and ExternalClientArray:start()

Implements ExternalSystemArray.

Reimplemented in DistributedServerArrayMediator, ParallelServerArrayMediator, and DistributedServer↩ Array.

The documentation for this class was generated from the following files:

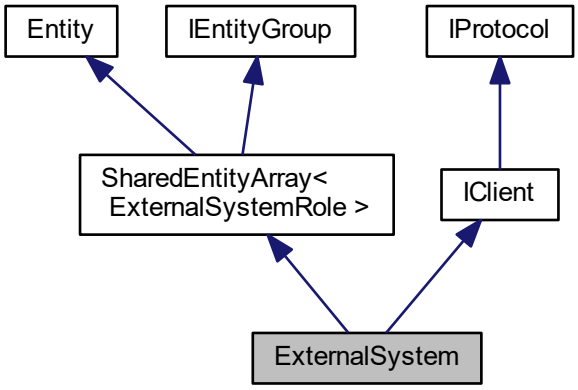
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalServerArray.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalServerArray.cpp

## 6.45 ExternalSystem Class Reference

A network driver for an external system.

`#include <ExternalSystem.hpp>`

Collaboration diagram for ExternalSystem:




### Public Member Functions

- ExternalSystem ()

  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*
- virtual void start ()=0

  *Start interaction.*
- virtual auto key () const -> std::string override

  *Get a key that can identify the Entity uniquely.*
- virtual void replyData (std::shared_ptr< Invoke >) override

  *Handling replied message from an external system.*
- virtual auto TAG () const -> std::string override

  *A tag name when represented by XML.*
- virtual auto CHILD_TAG () const -> std::string override

  *A tag name of children.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the EntityGroup.*

### Protected Attributes

- std::string name

  *A name can identify an external system.*
- std::string ip

  *An ip address of an external system.*
- int port

  *A port number of an external system.*

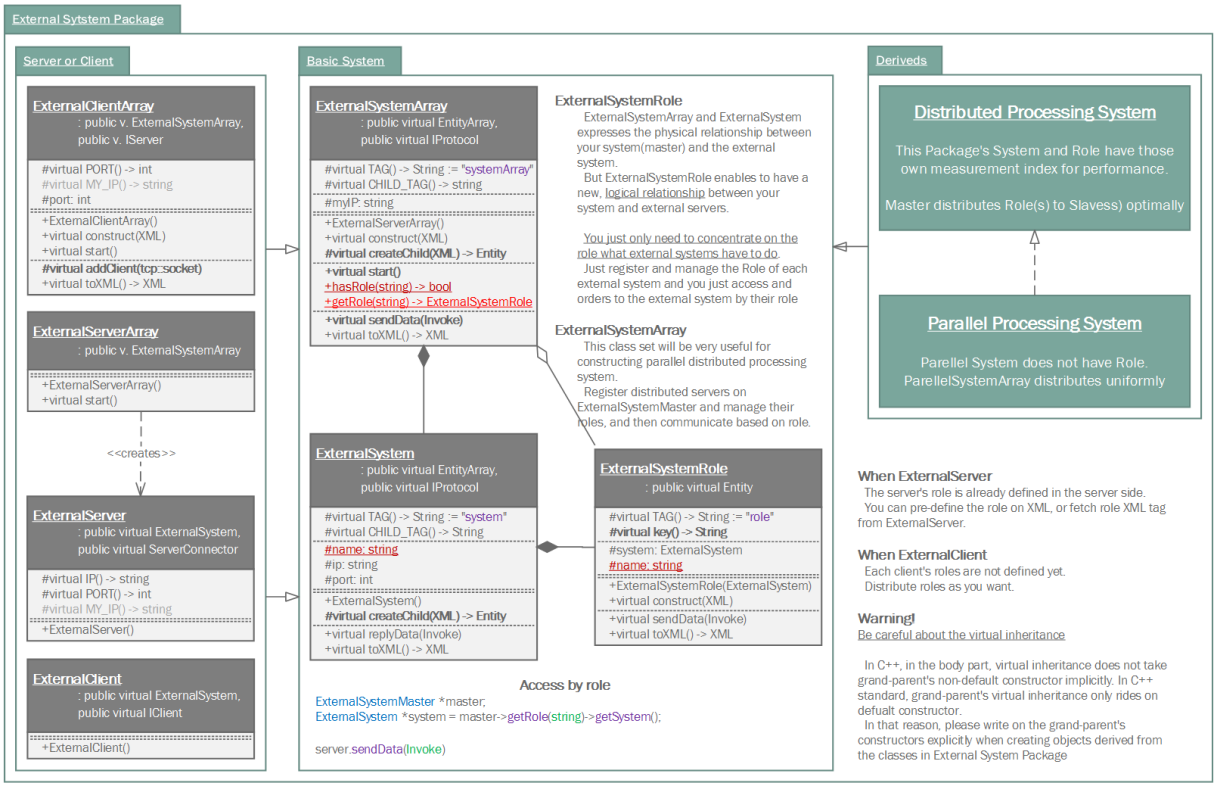
## Additional Inherited Members

### 6.45.1 Detailed Description

A network driver for an external system.

ExternalSystem is a boundary class interacting with an external system by network communication. Also, ExternalSystem is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




#### Note

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystem↩ Role.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩ SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an External↩ System. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

#### See also

samchon::protocol

#### Author

Jeongho Nam

### 6.45.2 Member Function Documentation

#### 6.45.2.1 void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from EntityGroup< _Container, _ETy, _Ty >.

Reimplemented in DistributedSystem, ParallelSystem, ExternalServer, ParallelServer, and DistributedServer.

#### 6.45.2.2 virtual void start ( ) [pure virtual]

Start interaction.

An abstract method starting interaction with an external system.

If an external systems are a server, starts connection and listening Inovoke message, else clients, just starts listening only. You also can addict your own procudures of starting the driver, but if you directly override method of abstract ExternalSystem, be careful about virtual inheritance.

Implemented in ExternalServer.

#### 6.45.2.3 auto key ( ) const -> std::string [override], [virtual]

Get a key that can identify the Entity uniquely.

If identifier of the Entity is not atomic value, returns a string represents the composite identifier. If identifier of the Entity is not string, converts the identifier to string and returns the string.

**Returns**

An identifier

Reimplemented from Entity.

#### 6.45.2.4 void replyData ( std::shared_ptr< Invoke > ) [override], [virtual]

Handling replied message from an external system.

If there's a related ExternalSystemRole, shifts responsibility to the ExternalSystemRole.

**Parameters**

| | |
|---|---|
| *invoke* | Replied Invoke message |

Reimplemented from IProtocol.

Reimplemented in DistributedSystem, DistributedSlaveSystemMediator, and ParallelSlaveSystemMediator.

#### 6.45.2.5 auto TAG ( ) const -> std::string [override], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

Reimplemented in DistributedSlaveSystemMediator, and ParallelSlaveSystemMediator.

#### 6.45.2.6 auto CHILD_TAG ( ) const -> std::string [override], [virtual]

A tag name of children.

< TAG>
<CHILD_TAG />
<CHILD_TAG />
</TAG>

Implements IEntityGroup.

#### 6.45.2.7 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from EntityGroup< _Container, _ETy, _Ty >.

Reimplemented in DistributedSystem, ParallelSystem, ExternalServer, ParallelServer, and DistributedServer.

### 6.45.3 Member Data Documentation

#### 6.45.3.1 std::string name [protected]

A name can identify an external system.

The name must be unique in ExternalSystemArray.

The documentation for this class was generated from the following files:

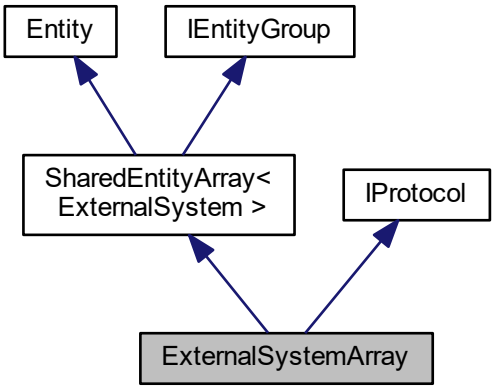
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalSystem.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalSystem.cpp

## 6.46 ExternalSystemArray Class Reference

An array of ExternalSystem(s).

`#include <ExternalSystemArray.hpp>`

Collaboration diagram for ExternalSystemArray:




### Public Member Functions

- ExternalSystemArray ()
  *Default Constructor.*
- virtual void start ()=0
  *Start interaction.*
- auto hasRole (const std::string &) const -> bool
  *Test whether has a role.*
- auto getRole (const std::string &) const -> std::shared_ptr< ExternalSystemRole >
  *Get a role.*
- virtual void sendData (std::shared_ptr< Invoke >) override
  *Sends an Invoke message to related ExternalSystem(s).*
- virtual void replyData (std::shared_ptr< Invoke >) override
  *Handle replied Invoke message.*
- virtual auto TAG () const -> std::string override
  *A tag name when represented by XML.*
- virtual auto CHILD_TAG () const -> std::string override
  *A tag name of children.*

## Additional Inherited Members

### 6.46.1 Detailed Description

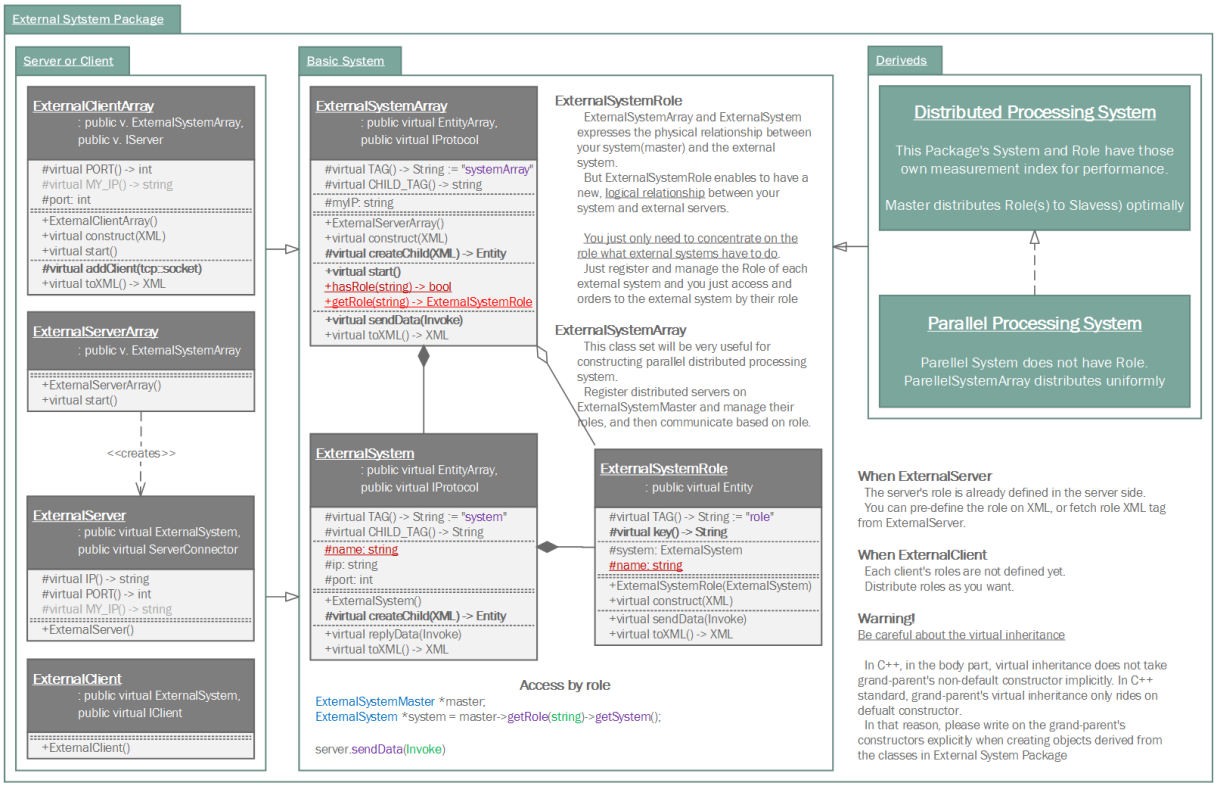
An array of ExternalSystem(s).

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.46.2 Member Function Documentation

#### 6.46.2.1 virtual void start ( ) [pure virtual]

Start interaction.

An abstract method starting interaction with external systems.

If external systems are servers, starts connection to them, else clients, opens a server and accepts the external systems. You can addict your own procudures of starting drivers, but if you directly override method of abstract ExternalSystemArray, be careful about virtual inheritance.

- DistributedClientArray::start() calls DistributedSystemArray::start() and ExternalClientArray:start()

Implemented in DistributedSystemArray, DistributedSystemArrayMediator, ParallelSystemArrayMediator, ExternalClientArray, DistributedClientArrayMediator, ParallelClientArrayMediator, DistributedClientArray, DistributedServerArrayMediator, ParallelServerArrayMediator, DistributedServerArray, and ExternalServer↩Array.

#### 6.46.2.2 auto hasRole ( const std::string & *name* ) const -> bool

Test whether has a role.

**Parameters**

| | |
|---|---|
| *name* | Name of an ExternalSystemRole |

**Returns**

Whether has or not

#### 6.46.2.3 auto getRole ( const std::string & *name* ) const -> std::shared_ptr<ExternalSystemRole>

Get a role.

**Parameters**

| | |
|---|---|
| *name* | Name of an ExternalSystemRole |

**Returns**

A shared pointer of specialized role

#### 6.46.2.4 void sendData ( std::shared_ptr< Invoke > ) [override], [virtual]

Sends an Invoke message to related ExternalSystem(s).

If listener of the Invoke message is registered on some ExternalSystemRole(s), sends the Invoke message to related ExternalSystem(s) (containing the ExternalSystemRole(s)). If cannot find any ExternalSystemRole, sends the Invoke message to all ExternalSystem(s) belongs to the ExternalSystemArray.

**Parameters**

| | |
|---|---|
| *invoke* | Invoke message to send |

Reimplemented from IProtocol.

#### 6.46.2.5 void replyData ( std::shared_ptr< Invoke > ) [override], [virtual]

Handle replied Invoke message.

Nothing is defined in the ExternalSystemArray::replyData(). It's only for avoid the method to have a status "not overriden, abstract".

**Parameters**

| | |
|---|---|
| *invoke* | Invoke message to send |

Reimplemented from IProtocol.

#### 6.46.2.6 auto TAG ( ) const -> std::string [override], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

#### 6.46.2.7 auto CHILD_TAG ( ) const -> std::string [override], [virtual]

A tag name of children.

< TAG>
<CHILD_TAG />
<CHILD_TAG />
</TAG>

Implements IEntityGroup.

The documentation for this class was generated from the following files:

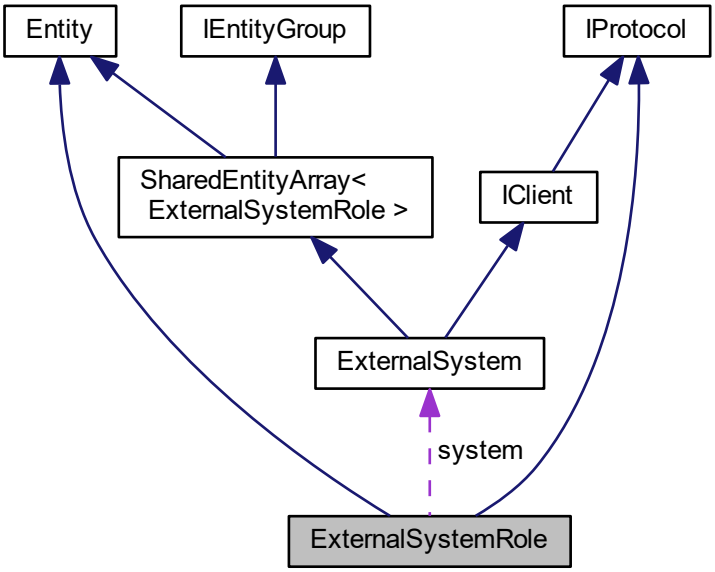
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalSystemArray.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalSystemArray.cpp

## 6.47 ExternalSystemRole Class Reference

A role belongs to an external system.

```
#include <ExternalSystemRole.hpp>
```

Collaboration diagram for ExternalSystemRole:




## Public Member Functions

- ExternalSystemRole (ExternalSystem ∗)
  *Construct from external system driver.*
- virtual void construct (std::shared_ptr< library::XML >) override
  *Construct data of the Entity from an XML object.*
- auto getSystem () const -> ExternalSystem ∗
  *Get an external system driver.*
- virtual auto key () const -> std::string override
  *Get a key that can identify the Entity uniquely.*
- auto hasSendListener (const std::string &) const -> bool
  *Test whether has a listener for send in the role.*
- auto hasReplyListener (const std::string &) const -> bool
  *Test whether has a listener for reply in the role.*
- virtual void sendData (std::shared_ptr< Invoke >) override
  *Send a message.*
- virtual auto TAG () const -> std::string override
  *A tag name when represented by XML.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override
  *Get an XML object represents the Entity.*

## Protected Attributes

- std::string name
  *A name representing the role.*
- std::set< std::string > replyListeners
  *Listeners to reply in the role.*
- std::set< std::string > sendListeners
  *Listeners to send in the role.*

### Private Attributes

– ExternalSystem * system

*A driver of external system containing the ExternalSystemRole.*

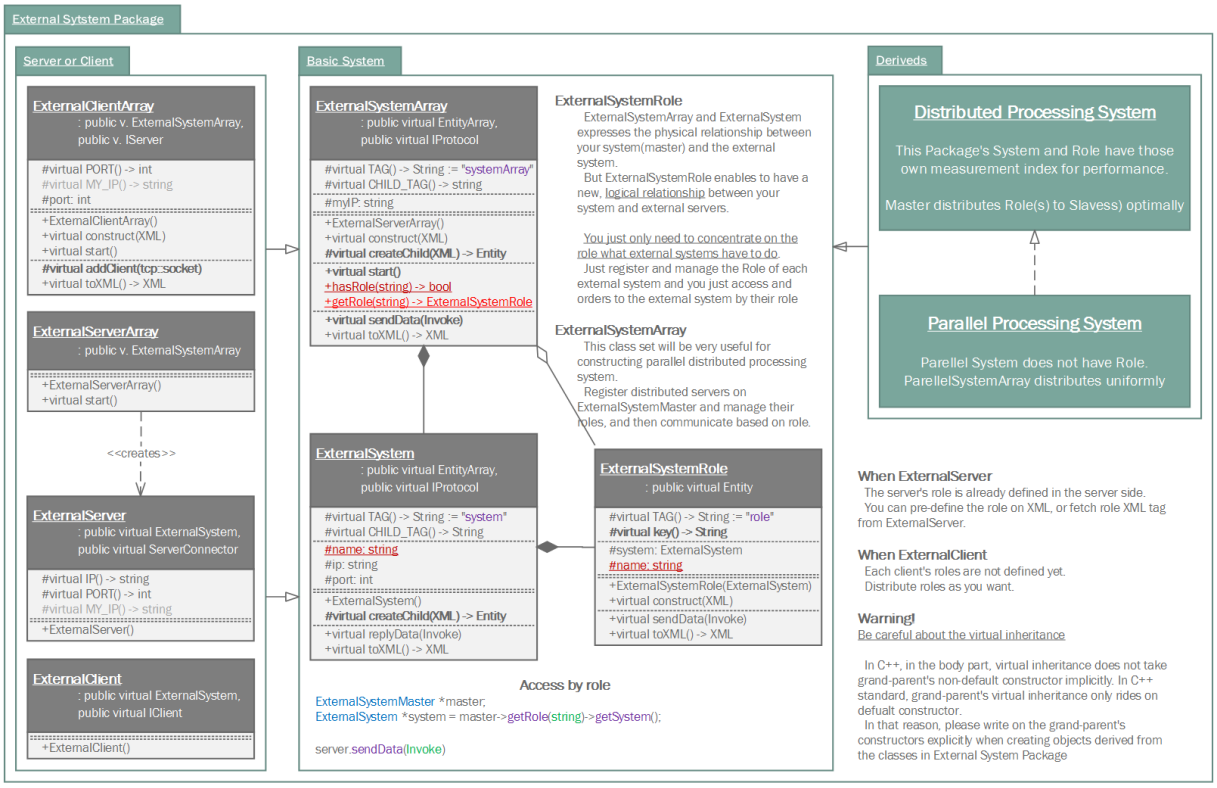
## 6.47.1 Detailed Description

A role belongs to an external system.

ExternalSystemRole is a 'control' class groupping methods, handling Invoke messages interacting with an external system that the ExternalSystemRole is belonged to, by a subject or unit of a module.

ExternalSystemRole can be a "logical proxy" for an ExternalSystem which is containing the ExternalSystem↩ Role. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystem↩ Role acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.




### See also

samchon::protocol

### Author

Jeongho Nam

## 6.47.2 Constructor & Destructor Documentation

### 6.47.2.1 ExternalSystemRole ( ExternalSystem * *system* )

Construct from external system driver.

**Parameters**

| | |
|---|---|
| *system* | A driver of external system the ExternalSystemRole is belonged to. |

### 6.47.3 Member Function Documentation

#### 6.47.3.1 void construct ( std::shared_ptr< library::XML > ) [override], [virtual]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Implements Entity.

#### 6.47.3.2 auto key ( ) const -> std::string [override], [virtual]

Get a key that can identify the Entity uniquely.

If identifier of the Entity is not atomic value, returns a string represents the composite identifier. If identifier of the Entity is not string, converts the identifier to string and returns the string.

**Returns**

An identifier

Reimplemented from Entity.

#### 6.47.3.3 void sendData ( std::shared_ptr< Invoke > ) [override], [virtual]

Send a message.

Sends Invoke message to a network system or shifts the responsibility to related chain.

**Parameters**

| | |
|---|---|
| *invoke* | An Invoke message to send to a network system |

Reimplemented from IProtocol.

Reimplemented in DistributedSystemRole.

#### 6.47.3.4 auto TAG ( ) const -> std::string [override], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

#### 6.47.3.5 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

Reimplemented in DistributedSystemRole.

The documentation for this class was generated from the following files:

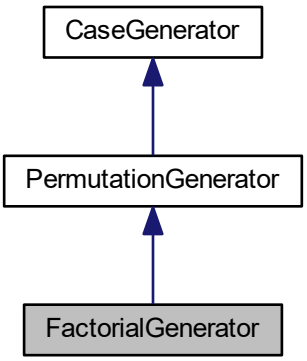
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalSystemRole.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ExternalSystemRole.cpp

## 6.48 FactorialGenerator Class Reference

Factorical case generator.

`#include <FactorialGenerator.hpp>`

Collaboration diagram for FactorialGenerator:




### Public Member Functions

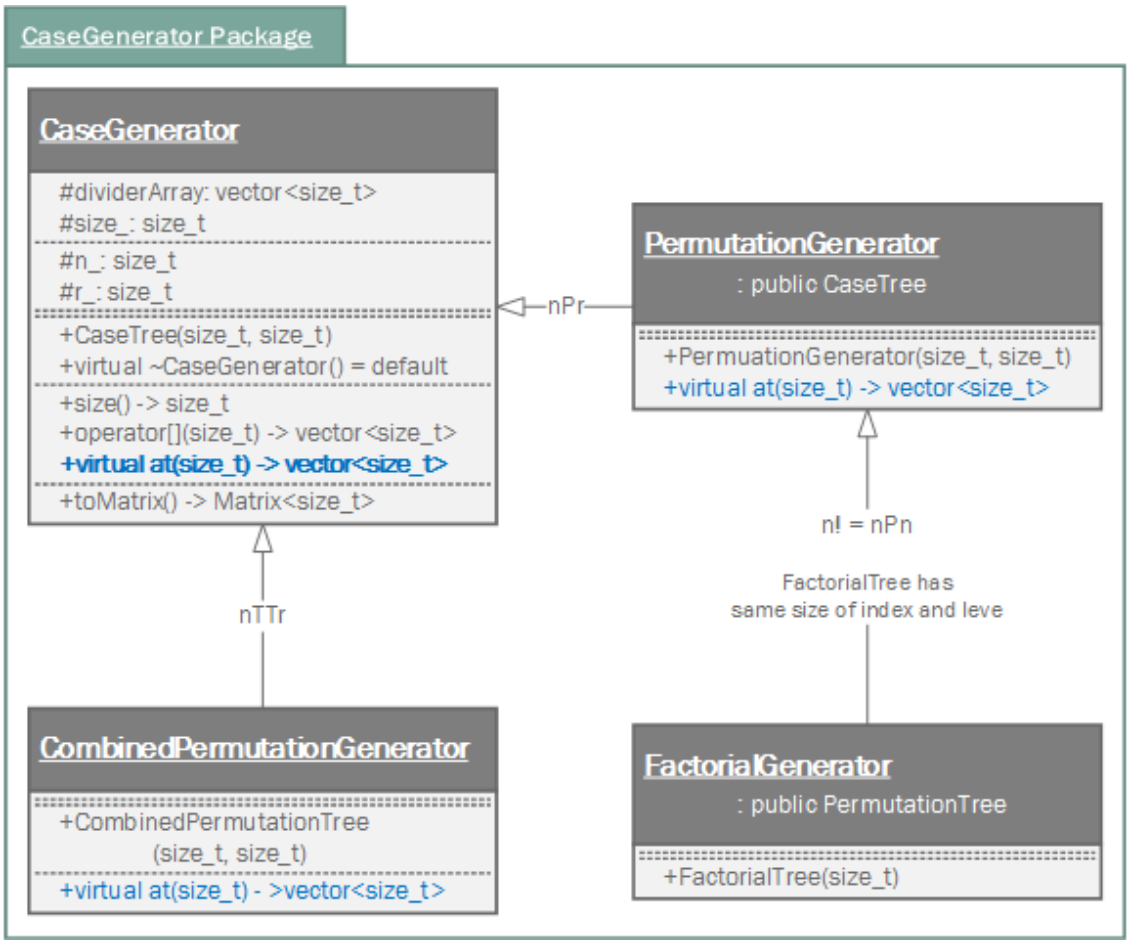
- FactorialGenerator (size_t size)
  *Construct from size N.*

### Additional Inherited Members

### 6.48.1 Detailed Description

Factorical case generator.

n! = nPn




**See also**

samchon::library

**Author**

Jeongho Nam

### 6.48.2 Constructor & Destructor Documentation

#### 6.48.2.1 FactorialGenerator ( size_t *size* )

Construct from size N.

**Parameters**

| | |
|---|---|
| *n* | Size of elements of each case to be arranged. |

The documentation for this class was generated from the following files:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/FactorialGenerator.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/FactorialGenerator.cpp

## 6.49 FlashPolicyServer Class Reference

A flash policy server.

```
#include <FlashPolicyServer.hpp>
```

### Public Member Functions

- FlashPolicyServer ()
  *Default constructor.*
- FlashPolicyServer (std::shared_ptr< library::XML >)
  *Construct from custom policy.*
- void openServer ()
  *Open server.*

### Protected Attributes

- std::shared_ptr< library::XML > policy
  *cross-domain-policy*

### Private Member Functions

- void accept (Socket *)
  *Accept client.*

## 6.49.1 Detailed Description

A flash policy server.

FlashPolicyServer is a policy server replying cross-domain-policy to flash clients.

**Author**

Jeongho Nam

## 6.49.2 Constructor & Destructor Documentation

### 6.49.2.1 FlashPolicyServer ( )

Default constructor.

The cross-domain-policy is to accept all, any client.

### 6.49.2.2 FlashPolicyServer ( std::shared_ptr< library::XML > )

Construct from custom policy.

**Parameters**

| | |
|---|---|
| *policy* | Custom cross-domain-policy to adjust |

## 6.49.3 Member Function Documentation

### 6.49.3.1 void accept ( Socket * ) [private]

Accept client.

Accepts flash client and replies cross-domain-policy

The documentation for this class was generated from the following files:

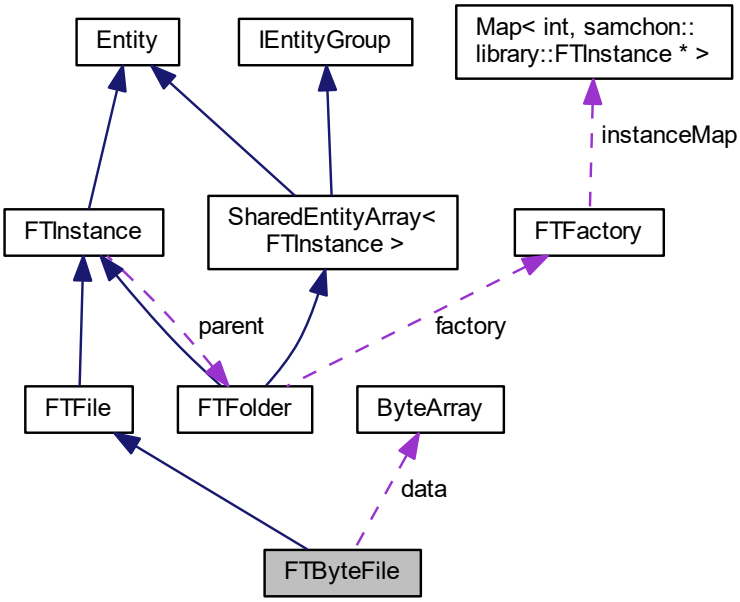
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/FlashPolicyServer.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/FlashPolicyServer.cpp

## 6.50 FTByteFile Class Reference

A binary file.

`#include <FTByteFile.hpp>`

Collaboration diagram for FTByteFile:




### Public Member Functions

- FTByteFile (FTFolder *)

  *Construct from parent folder.*
- auto getData () -> ByteArray

  *Get binaray data of the file.*

### Protected Attributes

- ByteArray data

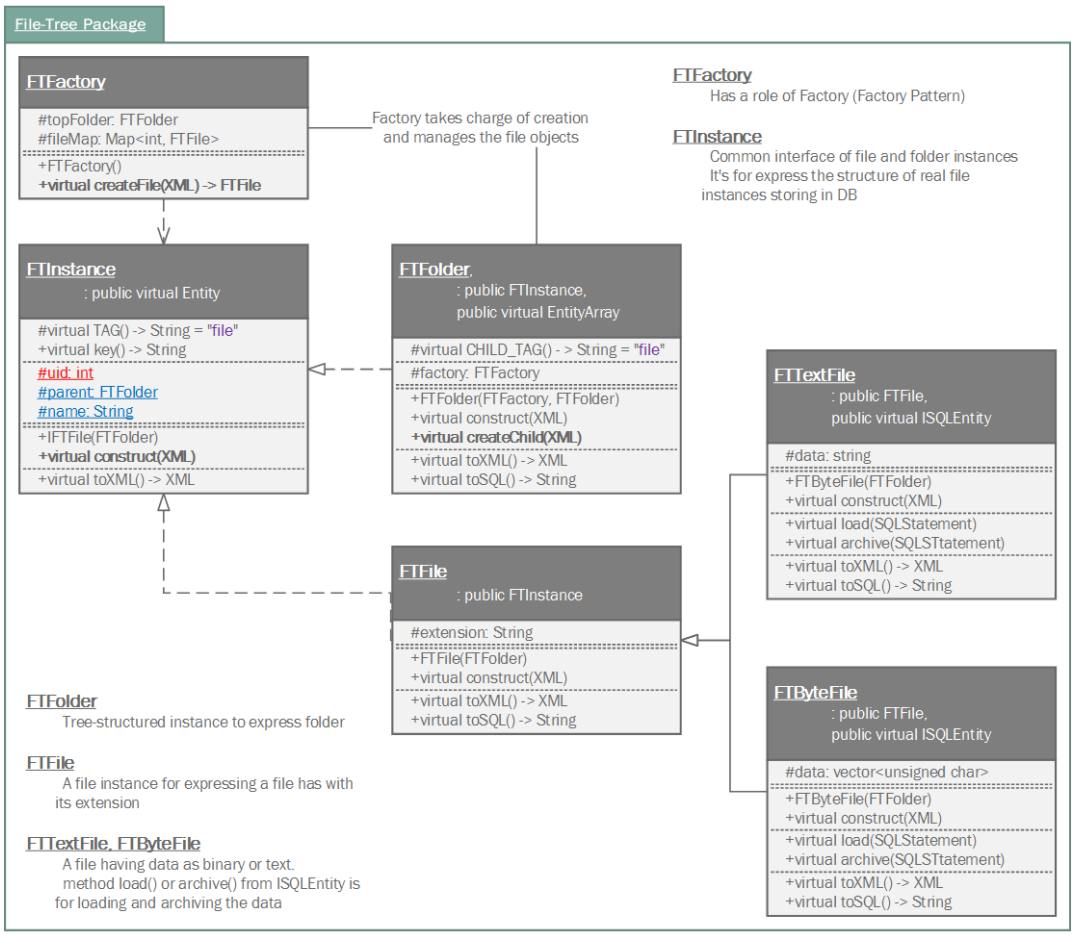
  *Binary data of the file.*

### Additional Inherited Members

### 6.50.1 Detailed Description

A binary file.

A file having data as binary.




**See also**

samchon::library

**Author**

Jeongho Nam

### 6.50.2 Constructor & Destructor Documentation

#### 6.50.2.1 FTByteFile ( FTFolder * )

Construct from parent folder.

**Parameters**

| | |
|---|---|
| *folder* | Belonged folder |

The documentation for this class was generated from the following file:

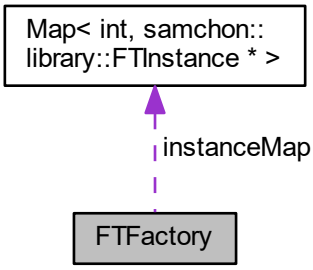
– D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/FTByteFile.hpp

## 6.51 FTFactory Class Reference

A Factory and manager for file-tree.

```
#include <FTFactory.hpp>
```

Collaboration diagram for FTFactory:




### Public Member Functions

- FTFactory ()

  *Default Constructor.*
- virtual auto createFile (FTFolder ∗, std::shared_ptr< XML >) -> FTFile ∗=0

  *Factory method of a file.*
- void registerInstance (FTInstance ∗)

  *Register file instance to map.*

### Protected Attributes

- int application

  *An application id.*
- int category

  *A categori id.*
- std::string member

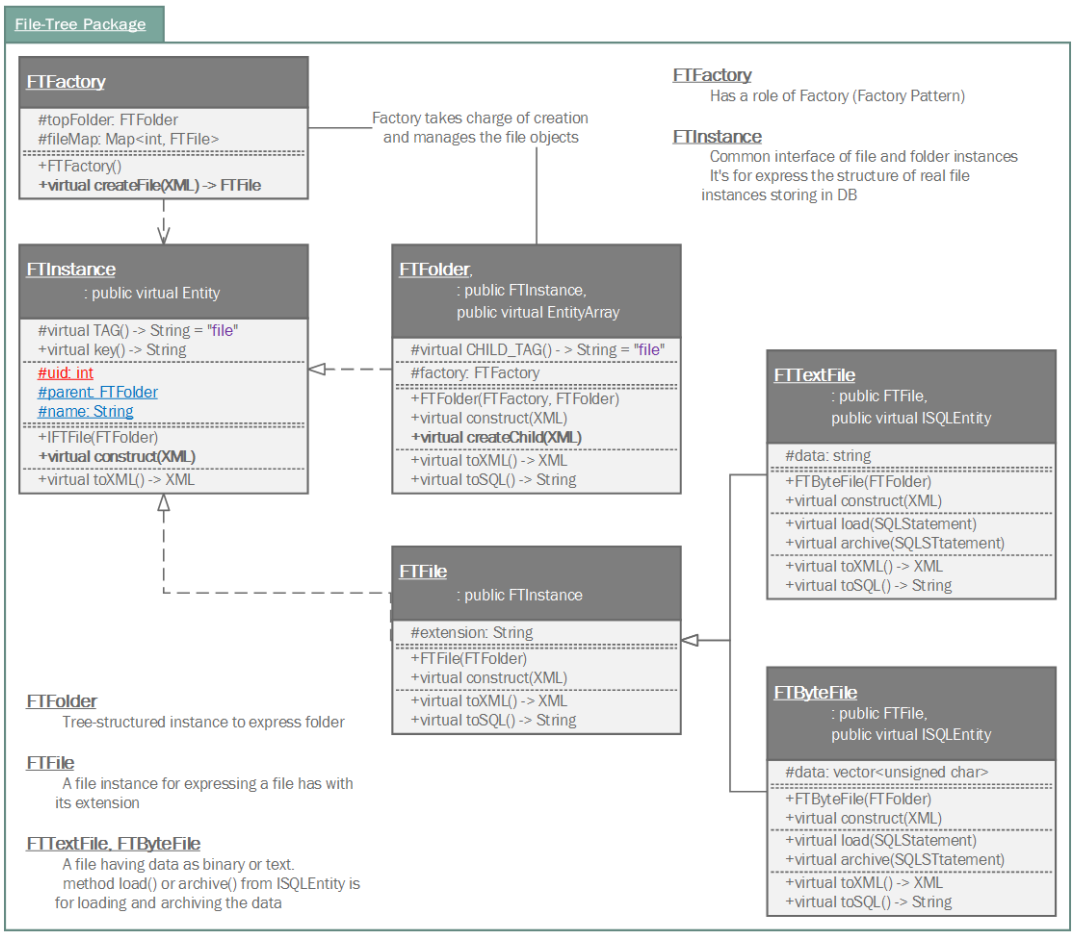
  *Account id of a member.*
- Map< int, FTInstance ∗ > instanceMap

  *Map of files.*

## 6.51.1 Detailed Description

A Factory and manager for file-tree.

FTFactory is a class taking a role of creating FTFile instances and managing them by having their direct pointers. FTFactory also has a role of archiving and loading from DB.




**See also**

samchon::library

**Author**

Jeongho Nam

### 6.51.2 Member Data Documentation

#### 6.51.2.1 int application [protected]

An application id.

An enumeration code of an application that managed FTInstance(s) are belonged to.

#### 6.51.2.2 int category [protected]

A categori id.

An enumeration code of a category that managed FTInstance(s) are belonged to.

#### 6.51.2.3 Map<int, FTInstance*> instanceMap [protected]

Map of files.

- key: uid
- value: pointer of file

The documentation for this class was generated from the following files:

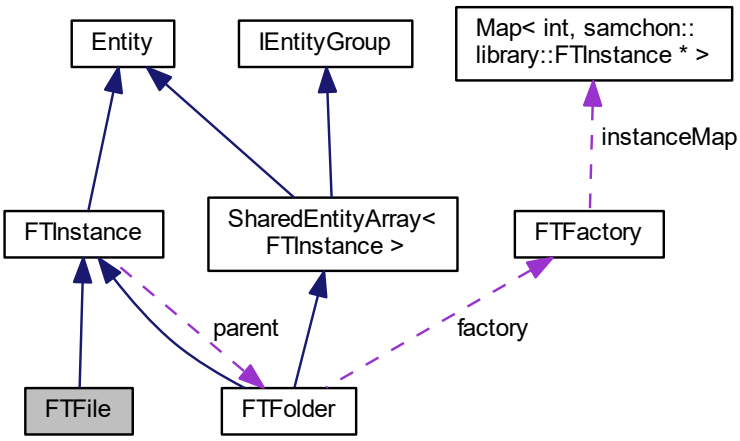
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/FTFactory.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/FTFactory.cpp

## 6.52 FTFile Class Reference

A file.

`#include <FTFile.hpp>`

Collaboration diagram for FTFile:




### Public Member Functions

- FTFile (FTFolder *)

  *Construct from parent folder.*
- auto getExtension () const -> std::string

  *Get extension.*
- virtual auto toXML () const -> std::shared_ptr< library::XML >

  *Get an XML object represents the Entity.*

### Protected Attributes

- std::string extension

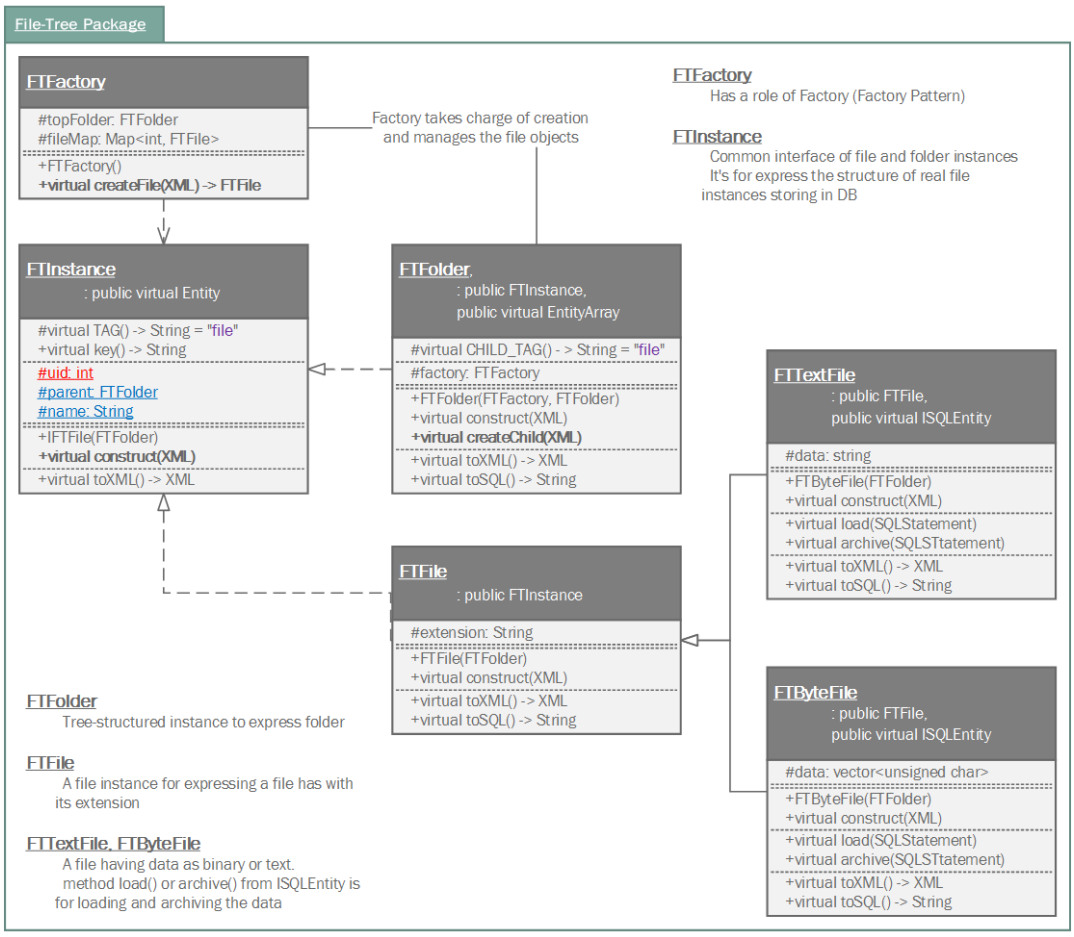
  *An extension of a file.*

### Additional Inherited Members

### 6.52.1 Detailed Description

A file.

An abstract class represents a file instance with extension.




**See also**

samchon::library

**Author**

Jeongho Nam

## 6.52.2 Constructor & Destructor Documentation

### 6.52.2.1 FTFile ( FTFolder * *parent* )

Construct from parent folder.

**Parameters**

| | |
|---|---|
| *folder* | Belonged folder |

## 6.52.3 Member Function Documentation

### 6.52.3.1 auto toXML ( ) const -> std::shared_ptr<library::XML> [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from FTInstance.

Reimplemented in NTFile.

### 6.52.4 Member Data Documentation

#### 6.52.4.1 std::string extension [protected]

An extension of a file.

FTFile's identifier is composited by name and extension.

The documentation for this class was generated from the following files:

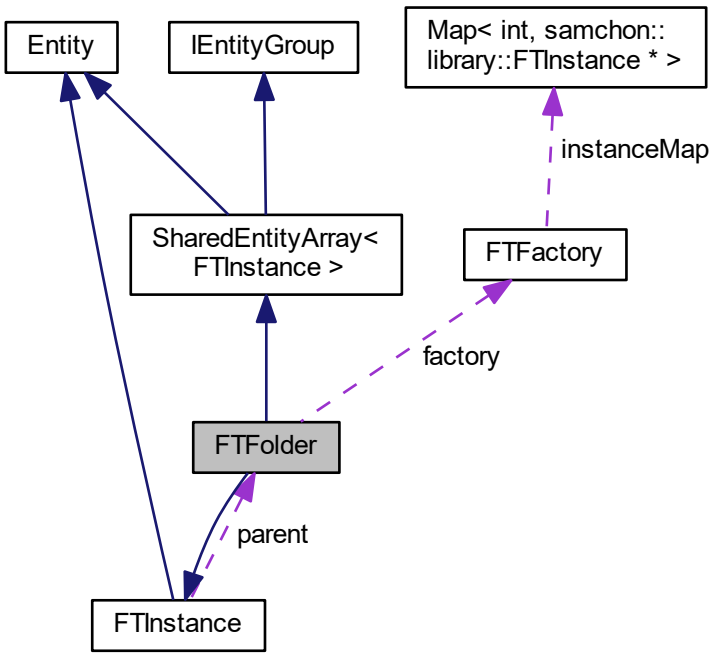
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/FTFile.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/FTFile.cpp

## 6.53 FTFolder Class Reference

A folder.

```
#include <FTFolder.hpp>
```

Collaboration diagram for FTFolder:




### Public Member Functions

- FTFolder (FTFactory ∗, FTFolder ∗)

  *Construct from factory and parent folder.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the Entity.*

### Protected Member Functions

- virtual auto CHILD_TAG () const -> std::string override

  *A tag name of children.*

### Protected Attributes

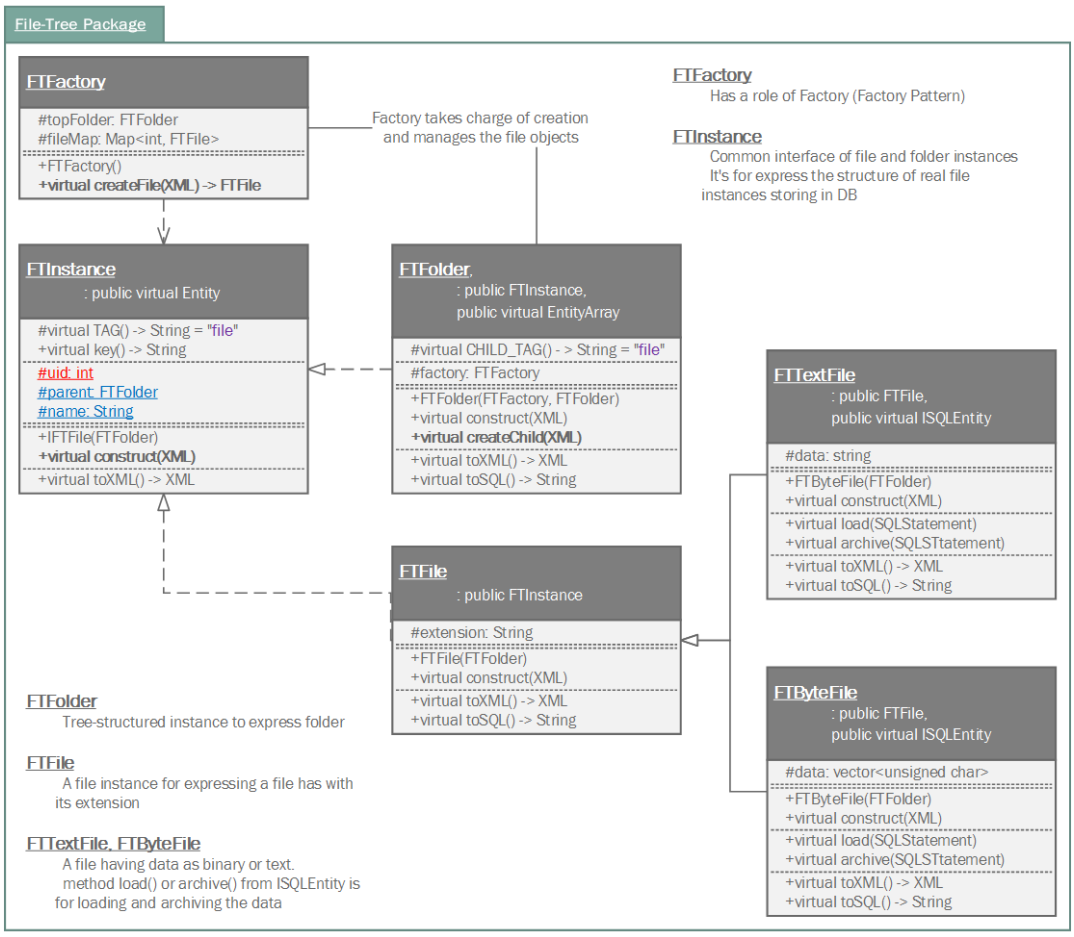
- FTFactory ∗ factory

  *Factory instance for creating sub files.*

### 6.53.1 Detailed Description

A folder.

A folder object has recursive and hierarchical relationship.




**See also**

samchon::library

**Author**

Jeongho Nam

## 6.53.2 Constructor & Destructor Documentation

### 6.53.2.1 FTFolder ( FTFactory * *factory*, FTFolder * *parent* )

Construct from factory and parent folder.

**Parameters**

| | |
|---|---|
| *factory* | Factory instance |
| *parent* | Parent folder that this folder is belonged to |

## 6.53.3 Member Function Documentation

### 6.53.3.1 auto CHILD_TAG ( ) const -> std::string [override], [protected], [virtual]

A tag name of children.

< TAG>
<CHILD_TAG />
<CHILD_TAG />
</TAG>

Implements IEntityGroup.

#### 6.53.3.2 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from FTInstance.

The documentation for this class was generated from the following files:

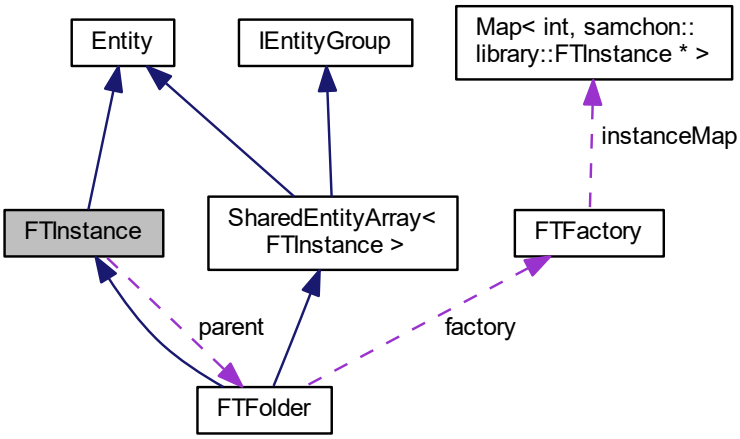
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/FTFolder.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/FTFolder.cpp

## 6.54 FTInstance Class Reference

An interface of file-tree.

`#include <FTInstance.hpp>`

Collaboration diagram for FTInstance:



### Public Member Functions

- FTInstance (FTFolder *)

  *Construct from parent folder.*
- virtual auto key () const -> std::string

  *Get a key that can identify the Entity uniquely.*
- auto getUID () const -> int

  *Get uid.*
- auto getParent () const -> FTFolder *

  *Get parent folder.*
- auto getName () const -> std::string

  *Get name.*
- auto getComment () const -> std::string

  *Get comment.*
- virtual auto toXML () const -> std::shared_ptr< library::XML >

  *Get an XML object represents the Entity.*

### Protected Member Functions

- virtual auto TAG () const -> std::string

  *A tag name when represented by XML.*

### Protected Attributes

- FTFolder * parent

  *Parent folder containing the instance.*
- int uid

  *Key, an unique id of file.*
- std::string name

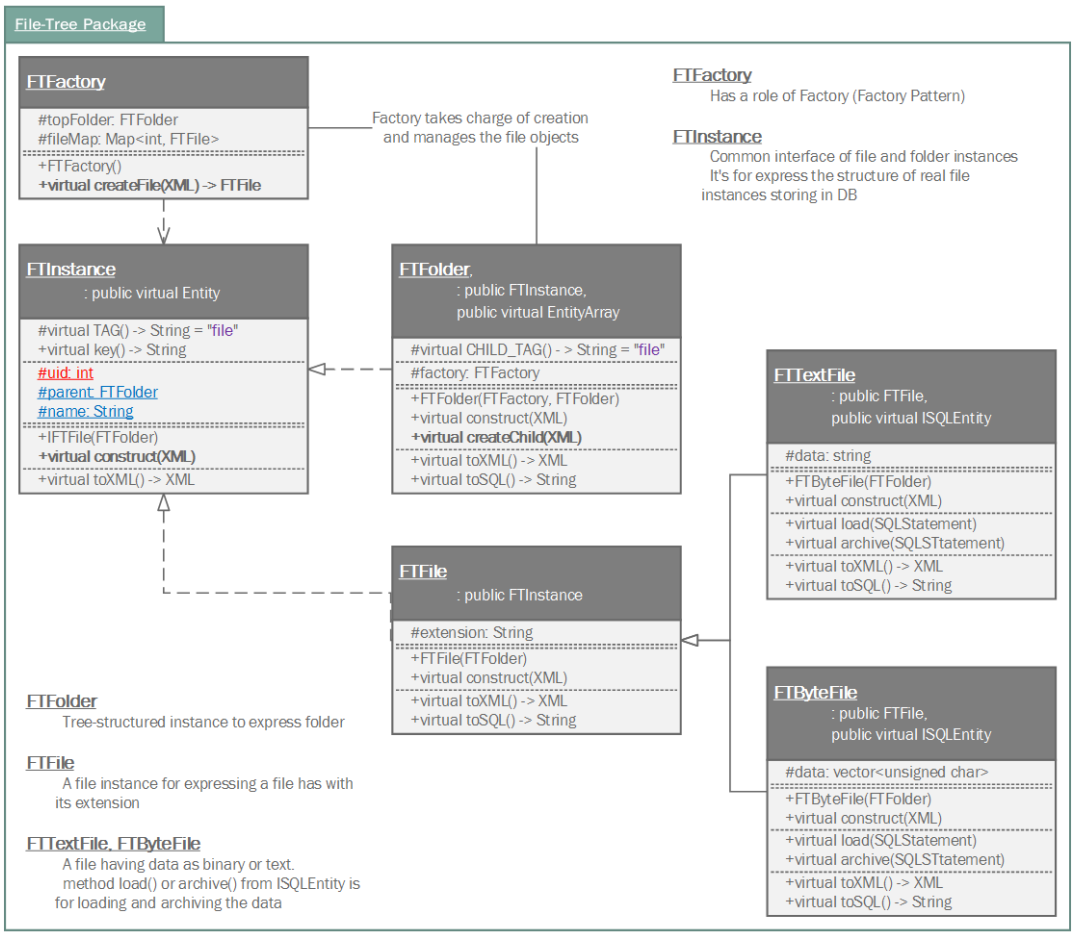
  *Name of the file.*
- std::string comment

  *Comment of the file.*

## 6.54.1 Detailed Description

An interface of file-tree.

An abstract class for folder and file instances.




**See also**

samchon::library

**Author**

Jeongho Nam

## 6.54.2 Constructor & Destructor Documentation

### 6.54.2.1 FTInstance ( FTFolder * *parent* )

Construct from parent folder.

**Parameters**

| | |
|---|---|
| *parent* | Parent folder that this instance is belonged to |

## 6.54.3 Member Function Documentation

### 6.54.3.1 auto TAG ( ) const -> std::string [protected], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

#### 6.54.3.2 auto key ( ) const -> std::string [virtual]

Get a key that can identify the Entity uniquely.

If identifier of the Entity is not atomic value, returns a string represents the composite identifier. If identifier of the Entity is not string, converts the identifier to string and returns the string.

**Returns**

An identifier

Reimplemented from Entity.

#### 6.54.3.3 auto toXML ( ) const -> std::shared_ptr<library::XML> [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

Reimplemented in NTFile, FTFolder, and FTFile.

The documentation for this class was generated from the following files:

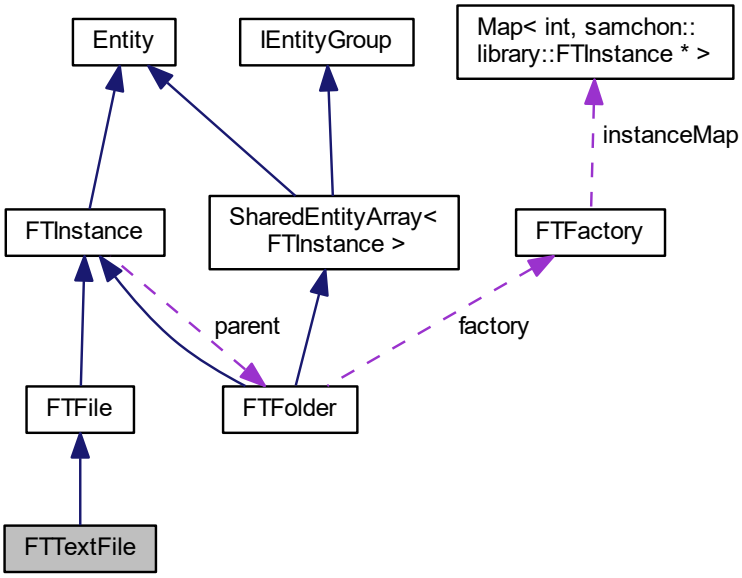
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/FTInstance.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/FTInstance.cpp

## 6.55 FTTextFile Class Reference

A text file.

```
#include <FTTextFile.hpp>
```

Collaboration diagram for FTTextFile:




### Public Member Functions

- FTTextFile (FTFolder *)

  *Construct from parent folder.*
- auto getData () const -> std::string

  *Get string content.*

### Protected Attributes

- std::string data

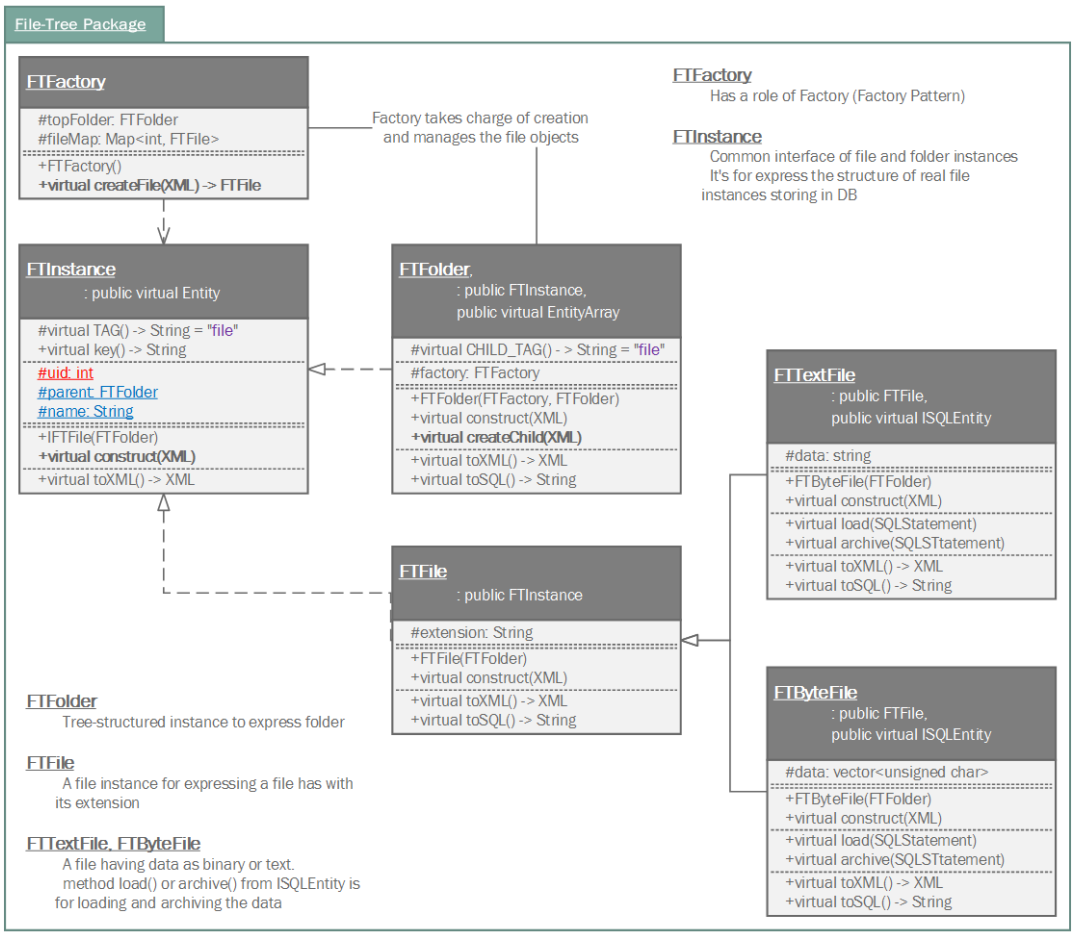
  *Text recorded in the file.*

### Additional Inherited Members

### 6.55.1 Detailed Description

A text file.

A file having data as text.




**See also**

samchon::library

**Author**

Jeongho Nam

### 6.55.2 Constructor & Destructor Documentation

#### 6.55.2.1 FTTextFile ( FTFolder * )

Construct from parent folder.

**Parameters**

| | |
|---|---|
| *folder* | Belonged folder |

The documentation for this class was generated from the following file:

– D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/FTTextFile.hpp

## 6.56 GAParameters Struct Reference

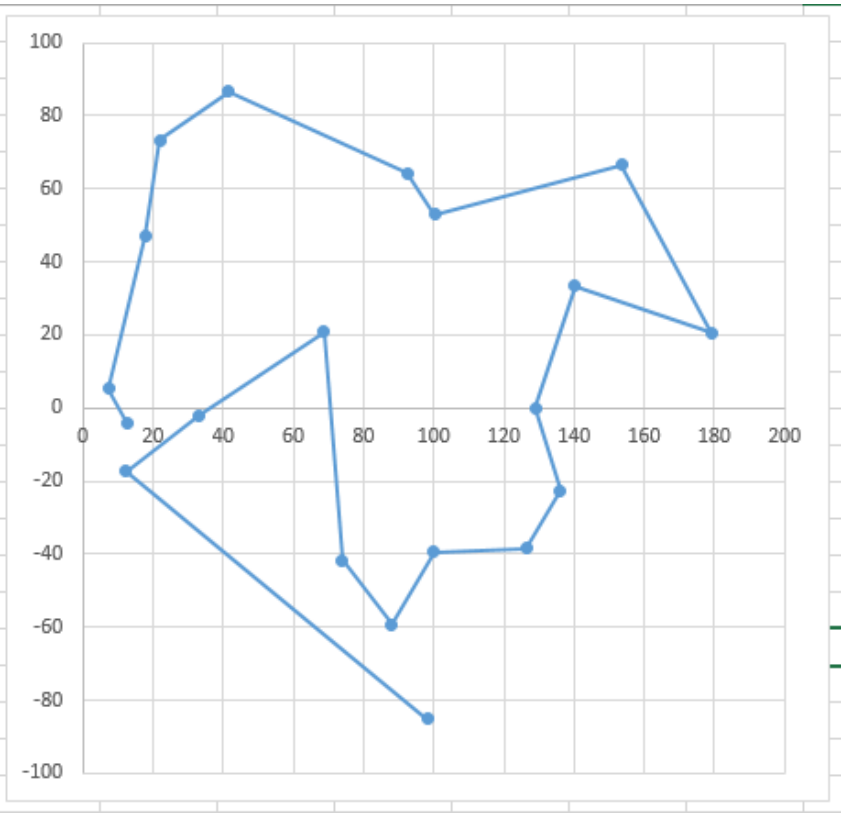
Parameters for Genetic-Algorithm.

`#include <Scheduler.hpp>`

### 6.56.1 Detailed Description

Parameters for Genetic-Algorithm.

| Distance: 64,896.70 km | | |
|---|---|---|
| uid | longitude | latitude |
| 18 | 12.5233 | -3.95529 |
| 15 | 7.23275 | 5.18342 |
| 7 | 17.7528 | 46.8665 |
| 2 | 22.0434 | 73.4133 |
| 20 | 41.6615 | 86.5372 |
| 13 | 92.427 | 64.3369 |
| 1 | 100.345 | 53.1067 |
| 9 | 153.521 | 66.5119 |
| 3 | 179.118 | 20.5073 |
| 10 | 140.113 | 33.3537 |
| 17 | 128.885 | 0.054607 |
| 4 | 136.012 | -22.4915 |
| 6 | 126.352 | -38.5031 |
| 16 | 99.9775 | -39.3696 |
| 11 | 87.8859 | -59.3663 |
| 14 | 73.8477 | -41.5867 |
| 5 | 68.6563 | 20.8528 |
| 12 | 33.2162 | -1.92823 |
| 8 | 12.1839 | -17.3552 |
| 19 | 98.0967 | -85.195 |




**See also**

samchon::library::GeneticAlgorithm

**Author**

Jeongho Nam

The documentation for this struct was generated from the following file:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/tsp/Scheduler.hpp

## 6.57 GAParameters Struct Reference

A structure containing parameters of genetic algorithm.

`#include <GAParameters.hpp>`

### Public Attributes

- size_t generation
  *A number of generation of evolution.*
- size_t population
  *A number of population in a generation.*
- size_t tournament
  *A number of tournament in a selection.*
- double mutationRate
  *Rate of mutate ocurrence.*

### 6.57.1 Detailed Description

A structure containing parameters of genetic algorithm.

The number and rate parameters in the structure affects success of evolution of genetic algorithm.

**See also**

library::GeneticAlgorithm
library::GAPopulation

**Author**

Jeongho Nam

### 6.57.2 Member Data Documentation

#### 6.57.2.1 double mutationRate

Rate of mutate ocurrence.

A mutation rate determines the percentage of occurence of mutation in a sequence list.

- Value from 0.0 to 1.0

**Note**

- When mutationRate is too high, it is hard to ancitipate studying on genetic algorithm.
- When mutationRate is too low and initial set of genes(GeneArray) is far away from optimal, the evolution tends to wandering outside of he optimal.

The documentation for this struct was generated from the following file:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/GAParameters.hpp

## 6.58 GAPopulation< GeneArray, Compare > Class Template Reference

A population of a generation in G.A.

```
#include <GAPopulation.hpp>
```

### Public Member Functions

- GAPopulation (std::shared_ptr< GeneArray > geneArray, size_t size)
  *Construct from a GeneArray and size of the population.*
- auto fitTest () const -> std::shared_ptr< GeneArray >
  *Test fitness of each GeneArray in the population.*

### Private Member Functions

- GAPopulation (size_t size)
  *Private Constructor with population.*

### Private Attributes

- std::vector< std::shared_ptr< GeneArray > > children
  *Genes representing the population.*

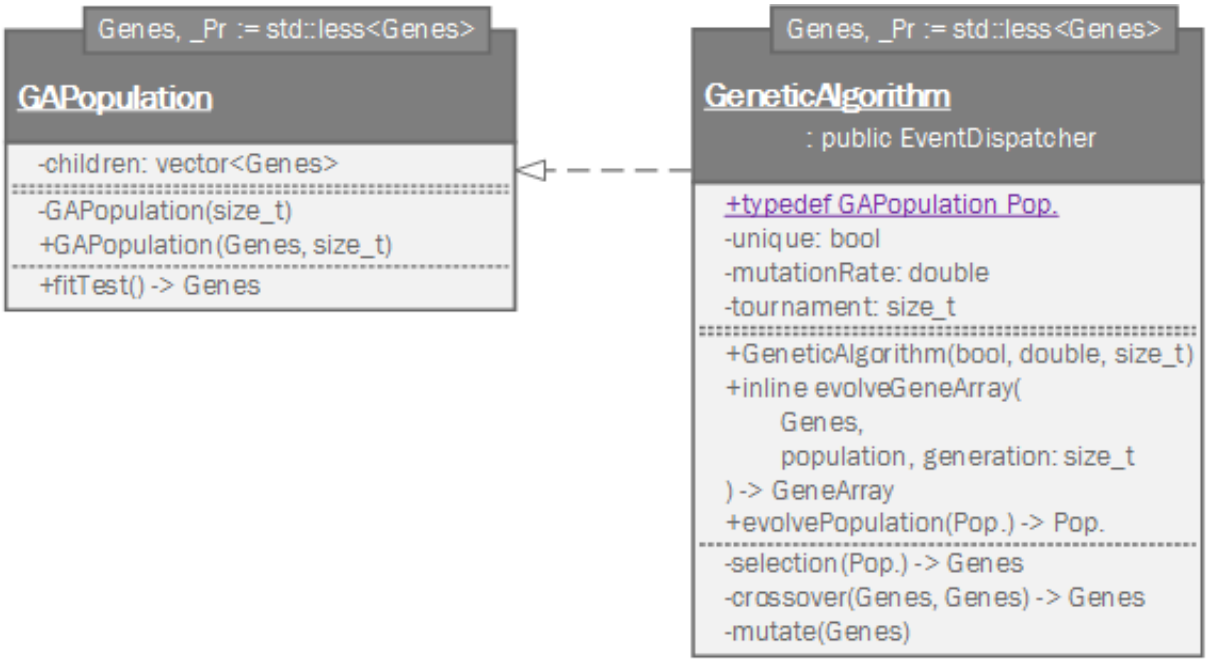
### 6.58.1 Detailed Description

**template<typename GeneArray, typename Compare = std::less<GeneArray>>class samchon::library::GAPopulation< GeneArray, Compare >**

A population of a generation in G.A.

GAPopulation is a class representing population of candidate genes(sequence listing) having an array of GeneArray as a member. GAPopulation also manages initial set of genes and handles fitting test direclty by the method *fitTest*.

The success of evolution of genetic alogirhtm is depend on the GAPopulation's initial set and fitting test. (GeneArray and Compare.)




**Template Parameters**

| | |
|---|---|
| *GeneArray* | |

An array(std::vector) containing genes as elments; sequnce listing

The GeneArray must be a type of *std::vector*.

**Template Parameters**

| | |
|---|---|
| *Compare* | A comparison class (or struct) returns whether left gene is more optimal.<br><br>Default template parameter of Compare is *std::less<GeneArray>*. It means to compare two std::vector (GeneArray must be a std::vector). Thus, you've to keep follwing rules.<br><br>If you don't want to follow the rules or want a custom comparison class, you have to realize a comparison class. The following code is an example realizing the comparison class.<br><br>`- GeneArray is inherited from <i>std::vector</i>`<br>`- GeneArray has custom <i>auto operator<(const GeneArray &) const -> bool</i>` |

```
template <typename _Ty>
struct MyCompare
{
auto operator()(const _Ty &newObj, const _Ty &prevObj) const -> bool;
};
```

**Warning**

Be careful for the mistakes of direction or position of Compare.

Most of logical errors failed to access optimal solution are occured by those mistakens.

**See also**

library::GeneticAlgorithm
samchon::library

**Author**

Jeonghoh Nam

### 6.58.2 Constructor & Destructor Documentation

#### 6.58.2.1 GAPopulation ( size_t *size* ) [inline],[private]

Private Constructor with population.

Private constructor of GAPopulation does not create children (candidate genes) but fills only *nullptr* repeatedly following the size.

The private constructor is only for and handled by GeneticAlgorithm.

**Parameters**

| | |
|---|---|
| *size* | Size of the population |

#### 6.58.2.2 GAPopulation ( std::shared_ptr< GeneArray > *geneArray*, size_t *size* ) [inline]

Construct from a GeneArray and size of the population.

Constructor with initial set of genes and size of the population.

The public constructor creates GeneArray(s) as population (size) having shuffled genes which are came from the initial set of genes (geneArray).

**Note**

The success of genetic algorithm is depend on the initial genes(geneArray).

**Parameters**

| | |
|---|---|
| *geneArray* | An initial sequence listing |
| *size* | The size of population to have as children |

### 6.58.3 Member Function Documentation

#### 6.58.3.1 auto fitTest ( ) const -> std::shared_ptr<GeneArray> [inline]

Test fitness of each GeneArray in the population.

**Returns**

The best GeneArray in the population

The documentation for this class was generated from the following file:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/GAPopulation.hpp

## 6.59 GeneticAlgorithm< GeneArray, Compare > Class Template Reference

A genetic algorithm class.

```
#include <GeneticAlgorithm.hpp>
```

### Public Member Functions

- GeneticAlgorithm (bool unique, double mutationRate=0.015, size_t tournament=10)

  *Construct from parameters of Genetic Algorithm.*
- auto evolveGeneArray (std::shared_ptr< GeneArray > geneArray, size_t population, size_t generation) const -> std::shared_ptr< GeneArray >

  *Evolve a GeneArray.*
- auto evolvePopulation (std::shared_ptr< MyPopulation > population) const -> std::shared_ptr< My↩Population >

  *Evolve population, a mass of GeneArray(es)*

### Private Member Functions

- auto selection (std::shared_ptr< MyPopulation > population) const -> std::shared_ptr< GeneArray >

  *Select the best GeneArray in population from tournament.*
- auto crossover (std::shared_ptr< GeneArray > &parent1, std::shared_ptr< GeneArray > &parent2) const -> std::shared_ptr< GeneArray >

  *Create a new GeneArray by crossing over two GeneArray(s)*
- void mutate (std::shared_ptr< GeneArray > geneArray) const

  *Cause a mutation on the GeneArray.*

### Private Attributes

- bool unique

  *Whether each element (Gene) is unique in their GeneArray.*
- double mutationRate

  *Rate of mutate ocurrence.*
- size_t tournament

  *Size of tournament in selection.*

### 6.59.1 Detailed Description

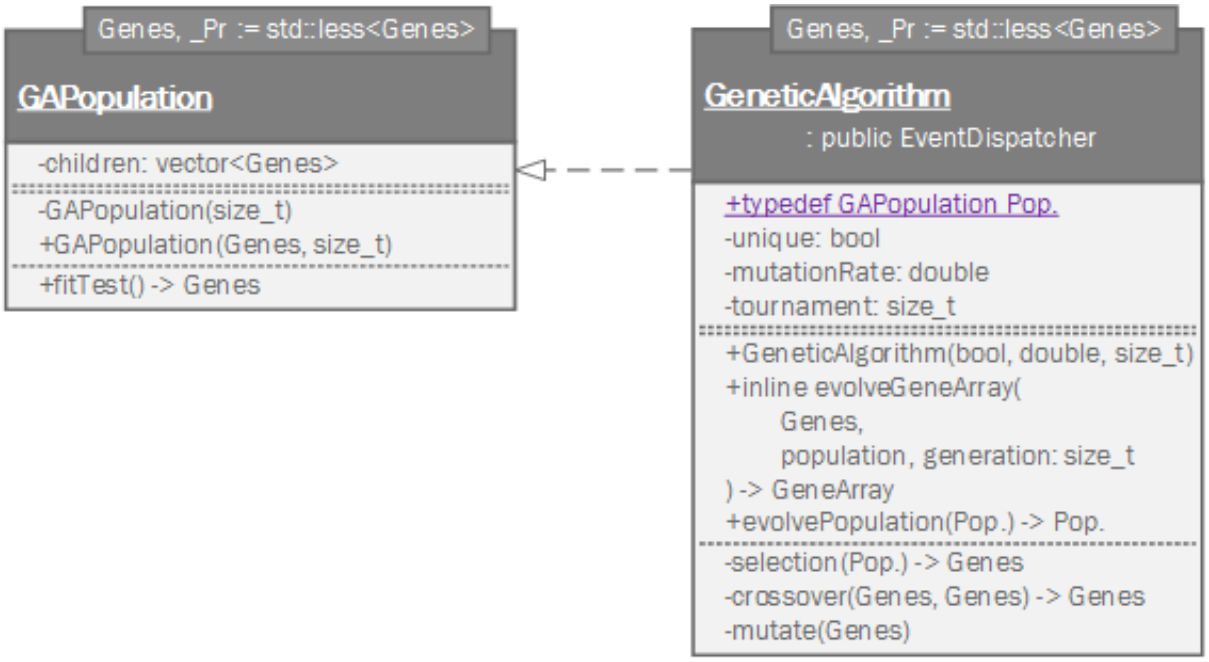
**template<typename GeneArray, typename Compare = std::less<GeneArray>>class samchon::library::Genetic↩Algorithm< GeneArray, Compare >**

A genetic algorithm class.

In the field of artificial intelligence, a genetic algorithm (GA) is a search heuristic that mimics the process of natural selection. This heuristic (also sometimes called a metaheuristic) is routinely used to generate useful solutions to optimization and search problems.

Genetic algorithms belong to the larger class of evolutionary algorithms (EA), which generate solutions to optimization problems using techniques inspired by natural evolution, such as inheritance, mutation, selection, and crossover.

- Referenced Wikipedia: https://en.wikipedia.org/wiki/Genetic_algorithm




**Template Parameters**

| | |
|---|---|
| *GeneArray* | An array(std::vector) containing genes as elments; sequnce listing.<br><br>The GeneArray must be a type of *std::vector*. |
| *Compare* | A comparison class (or struct) returns whether left gene is more optimal.<br><br>Default template parameter of Compare is *std::less<GeneArray>*. It means to compare two std::vector (GeneArray must be a std::vector). Thus, you've to keep follwing rules.<br><br>If you don't want to follow the rules or want a custom comparison class, you have to realize a comparison class. The following code is an example realizing the comparison class.<br><br>- GeneArray is inherited from std::vector<br>- GeneArray has custom auto operator<(const GeneArray &) const -> bool |

```
template <typename _Ty>
struct MyCompare
{
auto operator()(const _Ty &newObj, const _Ty &prevObj) const -> bool;
};
```

**Example source**

TSP - Traveling Salesman Problem

**examples/tsp/Scheduler.hpp**

```
1 #pragma once
2 #include <vector>
3 #include <memory>
4
5 namespace samchon
6 {
7     namespace example
8     {
9         namespace tsp
10         {
11             class Travel;
12
23             struct GAParameters
24             {
```

```
25                  double mutationRate;
26                  size_t tornament;
27
28                  size_t population;
29                  size_t generation;
30              };
31
38              class Scheduler
39              {
40              private:
44                  std::shared_ptr<Travel> travel;
45
49                  struct GAParameters gaParameters;
50
51              public:
55                  Scheduler(std::shared_ptr<Travel>, const struct GAParameters &);
56
64                  auto optimize() -> std::shared_ptr<Travel>;
65              };
66          };
67      };
68 };
```

### examples/tsp/Travel.hpp

```
1 #pragma once
2 #include <vector>
3 #include <string>
4
5 namespace samchon
6 {
7     namespace example
8     {
9         namespace tsp
10         {
11             class GeometryPoint;
12
24             class Travel
25                 : public std::vector<GeometryPoint*>
26             {
27             private:
28                 typedef std::vector<GeometryPoint*> super;
29
36                 double distance;
37
38             public:
39                 /* ----------------------------------------------------------
40                     CONSTRUCTORS
41                 ---------------------------------------------------------- */
45                 Travel();
46
55                 Travel(const Travel&);
56
60                 Travel(Travel&&);
61
62             private:
63                 /* ----------------------------------------------------------
64                     CALCULATORS
65                 ---------------------------------------------------------- */
69                 auto calcDistance() const -> double;
70
71             public:
79                 auto operator<(const Travel &) const -> bool;
80
81                 /* ----------------------------------------------------------
82                     EXPORTER
83                 ---------------------------------------------------------- */
96                 auto toString() const -> std::string;
97             };
98         };
99     };
100 };
```

### examples/tsp/GeometryPoint.hpp

```
1 #pragma once
2 #include <string>
3
4 namespace samchon
5 {
6     namespace example
7     {
8         namespace tsp
9         {
19             class GeometryPoint
20             {
```

```
            private:
                int uid;

                double longitude;

                double latitude;

            public:
                /* ------------------------------------------------------------
                    CONSTRUCTORS
                ------------------------------------------------------------ */
                GeometryPoint(int);

                GeometryPoint(int, double, double);

                /* ------------------------------------------------------------
                    CALCULATOR
                ------------------------------------------------------------ */
                auto calcDistance(const GeometryPoint &) const -> double;

                /* ------------------------------------------------------------
                    EXPORTER
                ------------------------------------------------------------ */
                auto toString() const -> std::string;
            };
        };
    };
};
```

### examples/tsp/main.cpp

```
#include <iostream>
#include <Windows.h>

#include "Scheduler.hpp"
#include "Travel.hpp"
#include "GeometryPoint.hpp"

using namespace std;
using namespace samchon::example::tsp;

#ifdef _WIN64
#   ifdef _DEBUG
#       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "x64/Release/SamchonFramework.lib")
#   endif
#else
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

void toClipboard(const string &);

void main()
{
    //GEOMETRY COORPORATES
    shared_ptr<Travel> travel(new Travel());
    for(int i = 0; i < 20; i++)
        travel->push_back(new GeometryPoint(i + 1));

    //OPTIMIZING
    struct GAParameters gaParameters = {.03, 50, 100, 300};

    Scheduler scheduler(travel, gaParameters);
    travel = scheduler.optimize();

    //PRINTING
    string &str = travel->toString();
    toClipboard(str);
    cout << str << endl;

    system("pause");
}

void toClipboard(const string &str)
{
    OpenClipboard(0);
    EmptyClipboard();
    HGLOBAL hg = GlobalAlloc(GMEM_MOVEABLE, str.size());

    if (!hg)
    {
        CloseClipboard();
```

```
        return;
    }
    memcpy(GlobalLock(hg), str.c_str(), str.size());

    GlobalUnlock(hg);
    SetClipboardData(CF_TEXT, hg);
    CloseClipboard();
    GlobalFree(hg);
}
```

### examples/tsp/Scheduler.cpp

```
#include "Scheduler.hpp"
#   include "Travel.hpp"

#include <samchon/library/GeneticAlgorithm.hpp>

using namespace std;
using namespace samchon::library;
using namespace samchon::example::tsp;

Scheduler::Scheduler(shared_ptr<Travel> travel, const GAParameters &gaParameteres)
{
    this->travel = travel;
    this->gaParameters = gaParameteres;
}
auto Scheduler::optimize() -> shared_ptr<Travel>
{
    GeneticAlgorithm<Travel> geneticAlgorithm
    (
        true,
        gaParameters.mutationRate,
        gaParameters.tornament
    );

    travel =
        geneticAlgorithm.evolveGeneArray
        (
            travel,
            gaParameters.population,
            gaParameters.generation
        );
    return travel;
}
```

### examples/tsp/Travel.cpp

```
#include "Travel.hpp"
#   include "GeometryPoint.hpp"

#include <samchon/library/StringUtil.hpp>

using namespace std;
using namespace samchon::library;
using namespace samchon::example::tsp;

/* ------------------------------------------------------------
    CONSTRUCTORS
------------------------------------------------------------ */
Travel::Travel()
    : super()
{
    distance = INT_MIN;
}
Travel::Travel(const Travel &travel)
    : super(travel)
{
    distance = INT_MIN;
}
Travel::Travel(Travel &&travel)
    : super(move(travel))
{
    distance = travel.distance;
}

/* ------------------------------------------------------------
    CALCULATORS
------------------------------------------------------------ */
auto Travel::calcDistance() const -> double
{
    if(this->distance != INT_MIN)
        return this->distance;

    double distance = 0.0;
    for(size_t i = 1; i < size(); i++)
        distance += at(i-1)->calcDistance(*at(i));
```

```

    ((Travel*)this)->distance = distance;
    return distance;
}
auto Travel::operator<(const Travel &travel) const -> bool
{
    return this->calcDistance() < travel.calcDistance();
}

/* ------------------------------------------------------------
    EXPORTER
------------------------------------------------------------ */
auto Travel::toString() const -> string
{
    string str =
        "Distance: " + StringUtil::numberFormat(calcDistance()) + " km\n" +
        "uid    longitude   latitude\n";

    for(size_t i = 0; i < size(); i++)
        str += at(i)->toString() + "\n";

    return move(str);
}
```

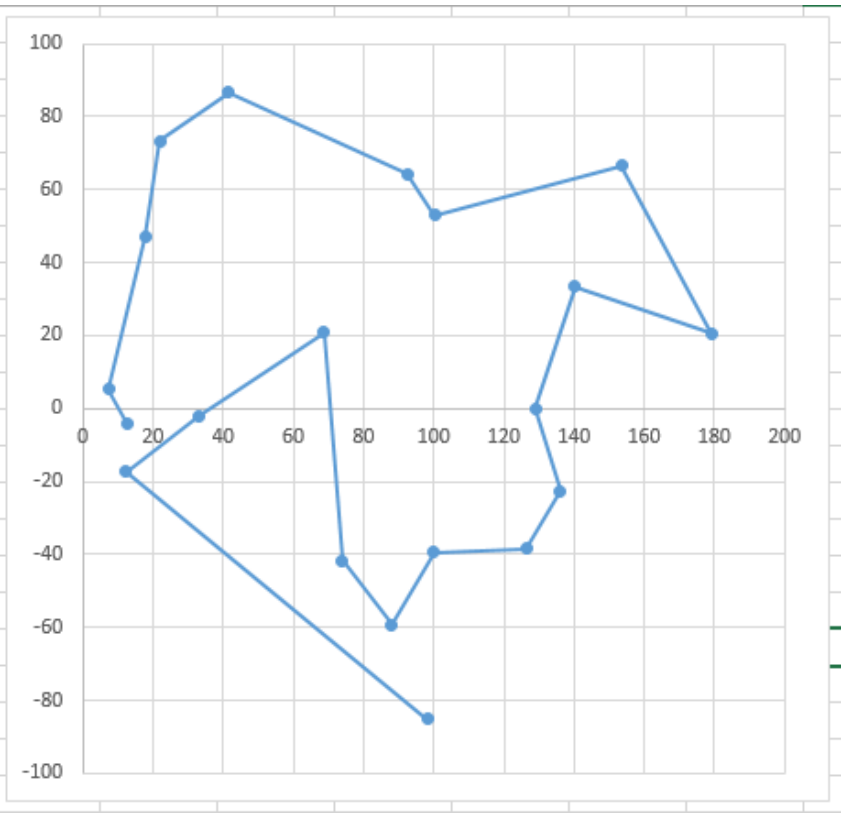
### examples/tsp/GeometryPoint.cpp

```
#include "GeometryPoint.hpp"

#include <random>
#include <cmath>
#include <samchon/library/Math.hpp>
#include <samchon/library/StringUtil.hpp>

using namespace std;
using namespace samchon::library;
using namespace samchon::example::tsp;

/* ------------------------------------------------------------
    CONSTRUCTORS
------------------------------------------------------------ */
GeometryPoint::GeometryPoint(int uid)
{
    this->uid = uid;
    this->longitude = Math::random() * 180.0;
    this->latitude = Math::random() * 180 - 90.0;
}
GeometryPoint::GeometryPoint(int uid, double longitude, double latitude)
{
    this->uid = uid;
    this->longitude = longitude;
    this->latitude = latitude;
}

/* ------------------------------------------------------------
    CALCULATOR
------------------------------------------------------------ */
auto GeometryPoint::calcDistance(const GeometryPoint &point) const -> double
{
    if (longitude == point.longitude && latitude == point.latitude)
        return 0.0;

    double latitude_radian1 = Math::degree_to_radian(this->latitude);
    double latitude_radian2 = Math::degree_to_radian(point.latitude);
    double theta = this->longitude - point.longitude;

    double val =
        sin(latitude_radian1) * sin(latitude_radian2)
        + cos(latitude_radian1) * cos(latitude_radian2) * cos(
    Math::degree_to_radian(theta));

    val = acos(val);
    val = Math::radian_to_degree(val);
    val = val * 60 * 1.1515;
    val = val * 1.609344;

    return val;
}

/* ------------------------------------------------------------
    EXPORTER
------------------------------------------------------------ */
auto GeometryPoint::toString() const -> string
{
    return StringUtil::substitute
        (
            "{1}\t{2}\t{3}",
            uid, longitude, latitude
```

```
        );
}
```

**Result of the example**

| Distance: 64,896.70 km | | |
|---|---|---|
| uid | longitude | latitude |
| 18 | 12.5233 | -3.95529 |
| 15 | 7.23275 | 5.18342 |
| 7 | 17.7528 | 46.8665 |
| 2 | 22.0434 | 73.4133 |
| 20 | 41.6615 | 86.5372 |
| 13 | 92.427 | 64.3369 |
| 1 | 100.345 | 53.1067 |
| 9 | 153.521 | 66.5119 |
| 3 | 179.118 | 20.5073 |
| 10 | 140.113 | 33.3537 |
| 17 | 128.885 | 0.054607 |
| 4 | 136.012 | -22.4915 |
| 6 | 126.352 | -38.5031 |
| 16 | 99.9775 | -39.3696 |
| 11 | 87.8859 | -59.3663 |
| 14 | 73.8477 | -41.5867 |
| 5 | 68.6563 | 20.8528 |
| 12 | 33.2162 | -1.92823 |
| 8 | 12.1839 | -17.3552 |
| 19 | 98.0967 | -85.195 |




**Warning**

Be careful for the mistakes of direction or position of Compare.

Most of logical errors failed to access optimal solution are occured by those mistakens.

**See also**

library::GAPopulation
samchon::library

**Author**

Jeongho Nam

### 6.59.2 Constructor & Destructor Documentation

#### 6.59.2.1 GeneticAlgorithm ( bool *unique*, double *mutationRate* = `0.015`, size_t *tournament* = `10` ) `[inline]`

Construct from parameters of Genetic Algorithm.

**Parameters**

| | |
|---|---|
| *unique* | Whether each Gene is unique in their GeneArray |
| *mutationRate* | Rate of mutation |
| *tournament* | Size of tournament in selection |
| *elitism* | Whether to keep the elitest GeneArray |

### 6.59.3 Member Function Documentation

#### 6.59.3.1 auto evolveGeneArray ( std::shared_ptr< GeneArray > *geneArray,* size_t *population,* size_t *generation* ) const -> std::shared_ptr<GeneArray> [inline]

Evolve a GeneArray.

Convinient method accessing to evolvePopulation().

**Parameters**

| | |
|---|---|
| *geneArray* | An initial set of genes; sequence listing |
| *population* | Size of population in a generation |
| *generation* | Size of generation in evolution |

**Returns**

A evolved GeneArray optimally

#### 6.59.3.2 auto evolvePopulation ( std::shared_ptr< **MyPopulation** > *population* ) const -> std::shared_ptr<**MyPopulation**> [inline]

Evolve population, a mass of GeneArray(es)

**Parameters**

| | |
|---|---|
| *population* | An initial population |

#### 6.59.3.3 auto selection ( std::shared_ptr< **MyPopulation** > *population* ) const -> std::shared_ptr<GeneArray> [inline],[private]

Select the best GeneArray in population from tournament.

Selection is the stage of a genetic algorithm in which individual genomes are chosen from a population for later breeding (using crossover operator). A generic selection procedure may be implemented as follows:

1. The fitness function is evaluated for each individual, providing fitness values, which are then normalized. Normalization means dividing the fitness value of each individual by the sum of all fitness values, so that the sum of all resulting fitness values equals 1.
2. The population is sorted by descending fitness values.
3. Accumulated normalized fitness values are computed (the accumulated fitness value of an individual is the sum of its own fitness value plus the fitness values of all the previous individuals). The accumulated fitness of the last individual should be 1 (otherwise something went wrong in the normalization step).
4. A random number R between 0 and 1 is chosen.
5. The selected individual is the first one whose accumulated normalized value is greater than R.

– Referenced Wekipedia: https://en.wikipedia.org/wiki/Selection_(genetic_algorithm)

**Parameters**

| | |
|---|---|
| *population* | The target of tournament |

**Returns**

The best genes derived by the tournament

#### 6.59.3.4 auto crossover ( std::shared_ptr< GeneArray > & *parent1*, std::shared_ptr< GeneArray > & *parent2* ) const -> std::shared_ptr<GeneArray> [inline],[private]

Create a new GeneArray by crossing over two GeneArray(s)

crossover is a genetic operator used to vary the programming of a chromosome or chromosomes from one generation to the next. It is analogous to reproduction and biological crossover, upon which genetic algorithms are based.

Cross over is a process of taking more than one parent solutions and producing a child solution from them. There are methods for selection of the chromosomes.

- Referenced Wikipedia: https://en.wikipedia.org/wiki/Crossover_(genetic_algorithm)

**Parameters**

| | |
|---|---|
| *parent1* | A parent sequence listing |
| *parent2* | A parent sequence listing |

#### 6.59.3.5 void mutate ( std::shared_ptr< GeneArray > *geneArray* ) const [inline],[private]

Cause a mutation on the GeneArray.

Mutation is a genetic operator used to maintain genetic diversity from one generation of a population of genetic algorithm chromosomes to the next. It is analogous to biological mutation.

Mutation alters one or more gene values in a chromosome from its initial state. In mutation, the solution may change entirely from the previous solution. Hence GA can come to better solution by using mutation.

Mutation occurs during evolution according to a user-definable mutation probability. This probability should be set low. If it is set too high, the search will turn into a primitive random search.

- Referenced Wikipedia: https://en.wikipedia.org/wiki/Mutation_(genetic_algorithm)

**Note**

Muttion is pursuing diversity. Mutation is useful for avoiding the following problem.

When initial set of genes(GeneArray) is far away from optimail, without mutation (only with selection and crossover), the genetic algorithm has a tend to wandering outside of the optimal.

Genes in the GeneArray will be swapped following percentage of the mutationRate.

**Parameters**

| | |
|---|---|
| *geneArray* | A container of genes to mutate |

**See also**

mutationRate;

### 6.59.4 Member Data Documentation

#### 6.59.4.1 double mutationRate [private]

Rate of mutate ocurrence.

The mutationRate determines the percentage of occurence of mutation in a GeneArray.

**Note**

- When mutationRate is too high, it is hard to ancitipate studying on genetic algorithm.
- When mutationRate is too low and initial set of genes(GeneArray) is far away from optimal, the evolution tends to wandering outside of he optimal.

The documentation for this class was generated from the following file:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/GeneticAlgorithm.hpp

## 6.60 GeometryPoint Class Reference

A geometry coordinates (point)

```
#include <GeometryPoint.hpp>
```

### Public Member Functions

- GeometryPoint (int)

  *Construct from uid.*
- GeometryPoint (int, double, double)

  *Construct from uid and geometry coordinates.*
- auto calcDistance (const GeometryPoint &) const -> double

  *Calculate distance between target Branch.*
- auto toString () const -> std::string

  *Convert the Branch to String.*

### Private Attributes

- int uid

  *An unique id for uniqueness.*
- double longitude

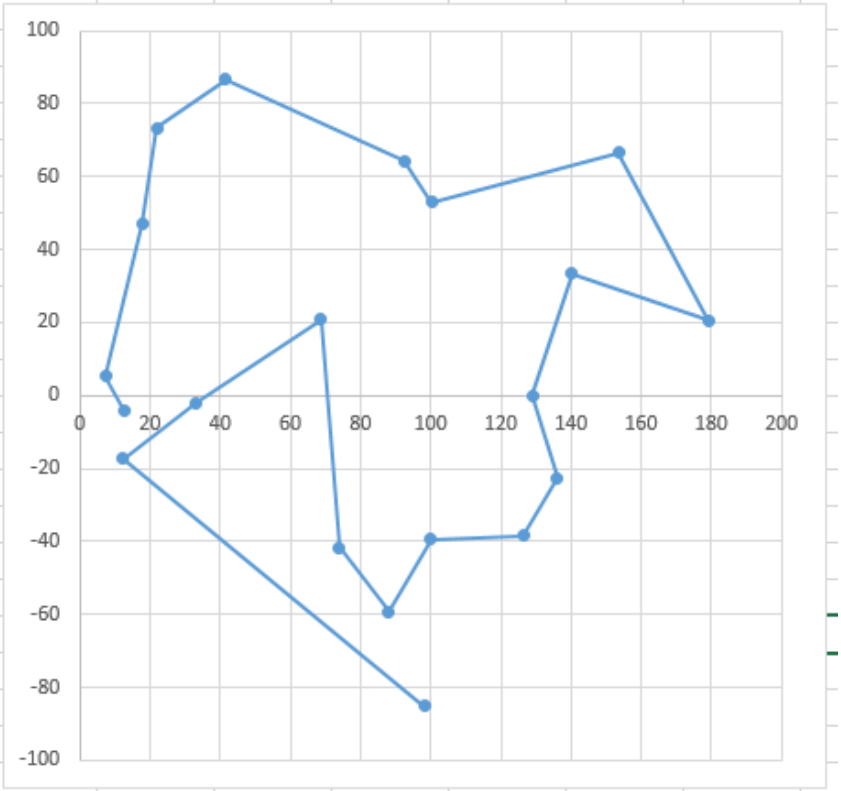
  *The longitude; coordinates X.*
- double latitude

  *The latitude, coordinates Y.*

### 6.60.1 Detailed Description

A geometry coordinates (point)

| Distance: 64,896.70 km | | |
|---|---|---|
| uid | longitude | latitude |
| 18 | 12.5233 | -3.95529 |
| 15 | 7.23275 | 5.18342 |
| 7 | 17.7528 | 46.8665 |
| 2 | 22.0434 | 73.4133 |
| 20 | 41.6615 | 86.5372 |
| 13 | 92.427 | 64.3369 |
| 1 | 100.345 | 53.1067 |
| 9 | 153.521 | 66.5119 |
| 3 | 179.118 | 20.5073 |
| 10 | 140.113 | 33.3537 |
| 17 | 128.885 | 0.054607 |
| 4 | 136.012 | -22.4915 |
| 6 | 126.352 | -38.5031 |
| 16 | 99.9775 | -39.3696 |
| 11 | 87.8859 | -59.3663 |
| 14 | 73.8477 | -41.5867 |
| 5 | 68.6563 | 20.8528 |
| 12 | 33.2162 | -1.92823 |
| 8 | 12.1839 | -17.3552 |
| 19 | 98.0967 | -85.195 |




**Author**

Jeongho Nam

### 6.60.2 Constructor & Destructor Documentation

#### 6.60.2.1 GeometryPoint ( int *uid* )

Construct from uid.

Geometry coordinates, longitude and latitude will have a random value between

- Longitude between 0 and 180.
- Latitude between -90 and 90.

#### 6.60.2.2 GeometryPoint ( int *uid*, double *longitude*, double *latitude* )

Construct from uid and geometry coordinates.

**Parameters**

| | |
|---|---|
| *longitude* | Longitude, a coordinate of the geometry point |
| *latitude* | Latitude, a coordinate of the geometry point |

### 6.60.3 Member Function Documentation

#### 6.60.3.1 auto calcDistance ( const GeometryPoint & *point* ) const -> double

Calculate distance between target Branch.

Referenced from http://thesunrises.tistory.com/958 (Geometry points to killometers)

**Parameters**

| | |
|---|---|
| *branch* | The target Branch to calculate |

#### 6.60.3.2 auto toString ( ) const -> std::string

Convert the Branch to String.

Have of form of tab and enter delimeters for Excel.

- `{$uid}  {$longitude}  {$latitude}`

**Returns**

A string represents the GeometryPoint

The documentation for this class was generated from the following files:

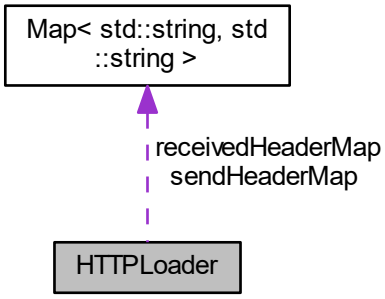
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/tsp/GeometryPoint.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/tsp/GeometryPoint.cpp

## 6.61 HTTPLoader Class Reference

A http, web-page loader.

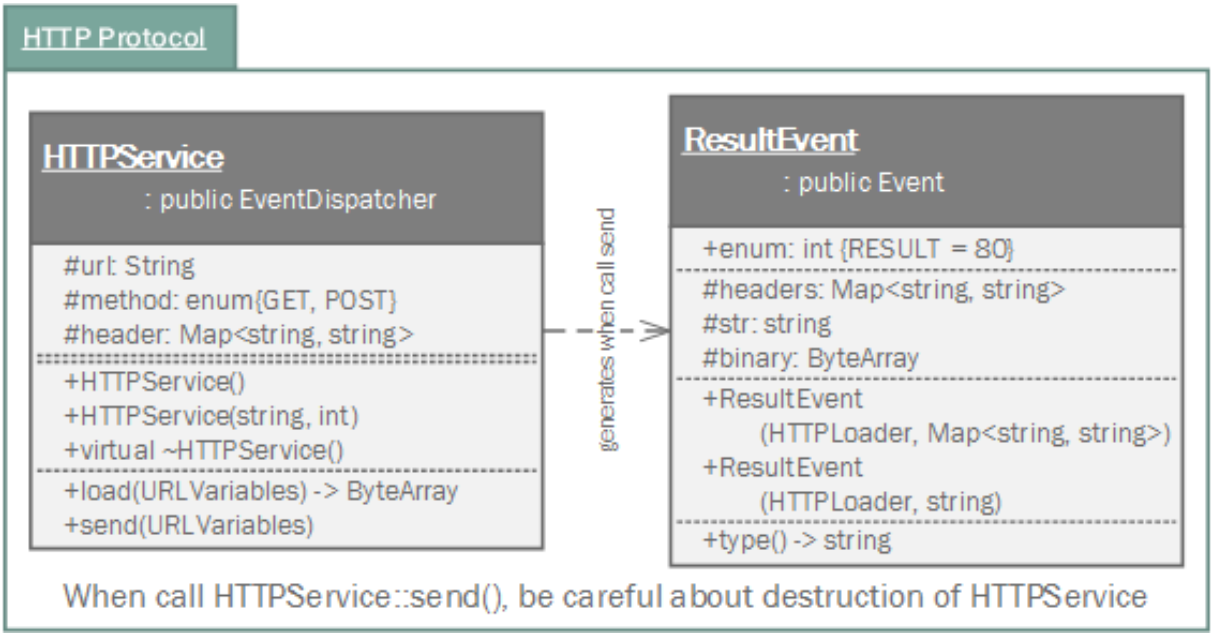
`#include <HTTPLoader.hpp>`

Collaboration diagram for HTTPLoader:




### 6.61.1 Detailed Description

A http, web-page loader.




**Note**

Depreciated

**See also**

samchon::library

**Author**

Jeongho Nam

The documentation for this class was generated from the following file:

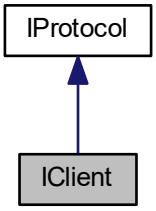
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/HTTPLoader.hpp

## 6.62 IClient Class Reference

An interface for a client.

`#include <IClient.hpp>`

Collaboration diagram for IClient:



### Public Member Functions

- IClient ()

  *Default Constructor.*
- virtual void listen ()

  *Listens message from a related system.*
- virtual void sendData (std::shared_ptr< Invoke >)

  *Sends message to a related system.*

### Protected Member Functions

- virtual auto BUFFER_SIZE () const -> size_t

  *Buffer size of network I/O.*
- virtual void _replyData (std::shared_ptr< Invoke >)

  *A method for pre-processing replied Invoke message.*

### Protected Attributes

- Socket * socket

  *Socket for network I/O.*
- std::mutex * sendMtx

  *A mutex for sending message.*

## 6.62.1 Detailed Description

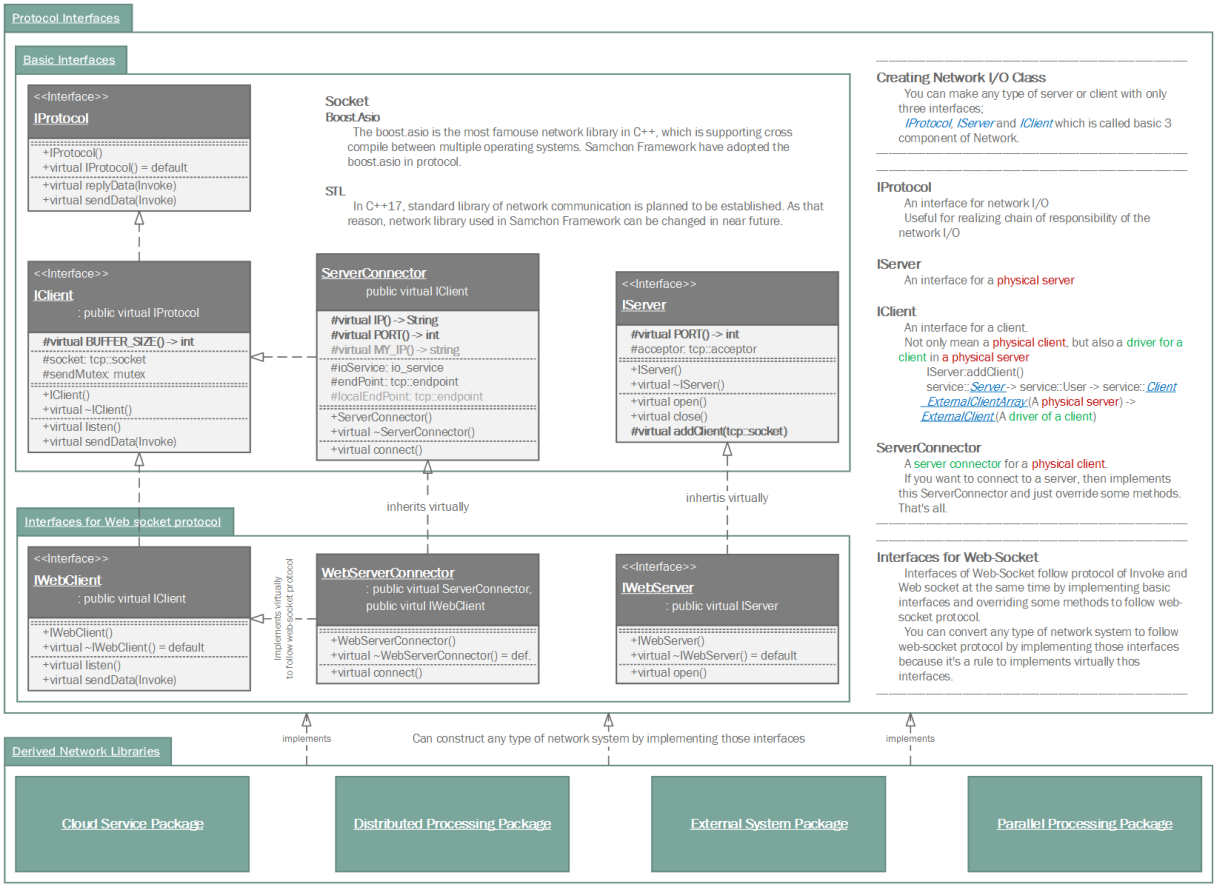
An interface for a client.

IClient is an interface not only for a physical client, but also a driver for a client in a physical server.

- IServer:addClient()
  - service::Server -> service::User -> service::Client
  - ExternalClientArray (A physical server) -> ExternalClient (A driver of a client)

IClient is one of the basic 3 + 1 components that can make any type of network system in Samchon Framework with IProtocol and IServer. Looking around classes in Samchon Framework, you can see all classes related with client are implemented from the IClient.

IClient takes a role of real network I/O. IClient sends data to otherside network system from IProtocol::send↩Data(). IClient also gets data from otherside network system, generates standard Invoke message from parsing the replied data and shift the Invoke message to IProtocol::replyData().




**Author**

Jeongho Nam

## 6.62.2 Member Function Documentation

### 6.62.2.1 void listen ( ) [virtual]

Listens message from a related system.

**Note**

It holds (monopolies) a thread.

Reimplemented in IWebClient.

### 6.62.2.2 void sendData ( std::shared_ptr< Invoke > ) [virtual]

Sends message to a related system.

**Parameters**

| | |
|---|---|
| *invoke* | Invoke message to send |

Reimplemented from IProtocol.

Reimplemented in DistributedSystem, Client, and IWebClient.

#### 6.62.2.3 void _replyData ( std::shared_ptr< Invoke > ) [protected],[virtual]

A method for pre-processing replied Invoke message.

You can realize a pre-processing about the replied Invoke message by overriding the IClient::_replyData().

Archiving a history log, filtering and truncating, let handling the message with a new thread, calculating performance by estimating elapsed time about the Invoke message, and so on. Anything you can define pre-processing works before IProtocol::replyData().

- Archive history log -> cloud service
- Estimating performance -> distributed and parallel processing system

**Parameters**

| | |
|---|---|
| *invoke* | An invoke message to be pre-processed and shifted to IProtocol::replyData(). |

Reimplemented in ParallelSystem, SlaveSystem, and ParallelSystem.

The documentation for this class was generated from the following files:

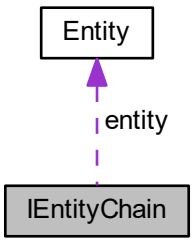
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IClient.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IClient.cpp

## 6.63 IEntityChain Class Reference

A chain of entity.

`#include <IEntityChain.hpp>`

Collaboration diagram for IEntityChain:




### Public Member Functions

- IEntityChain (Entity *)
  *Default Constructor.*

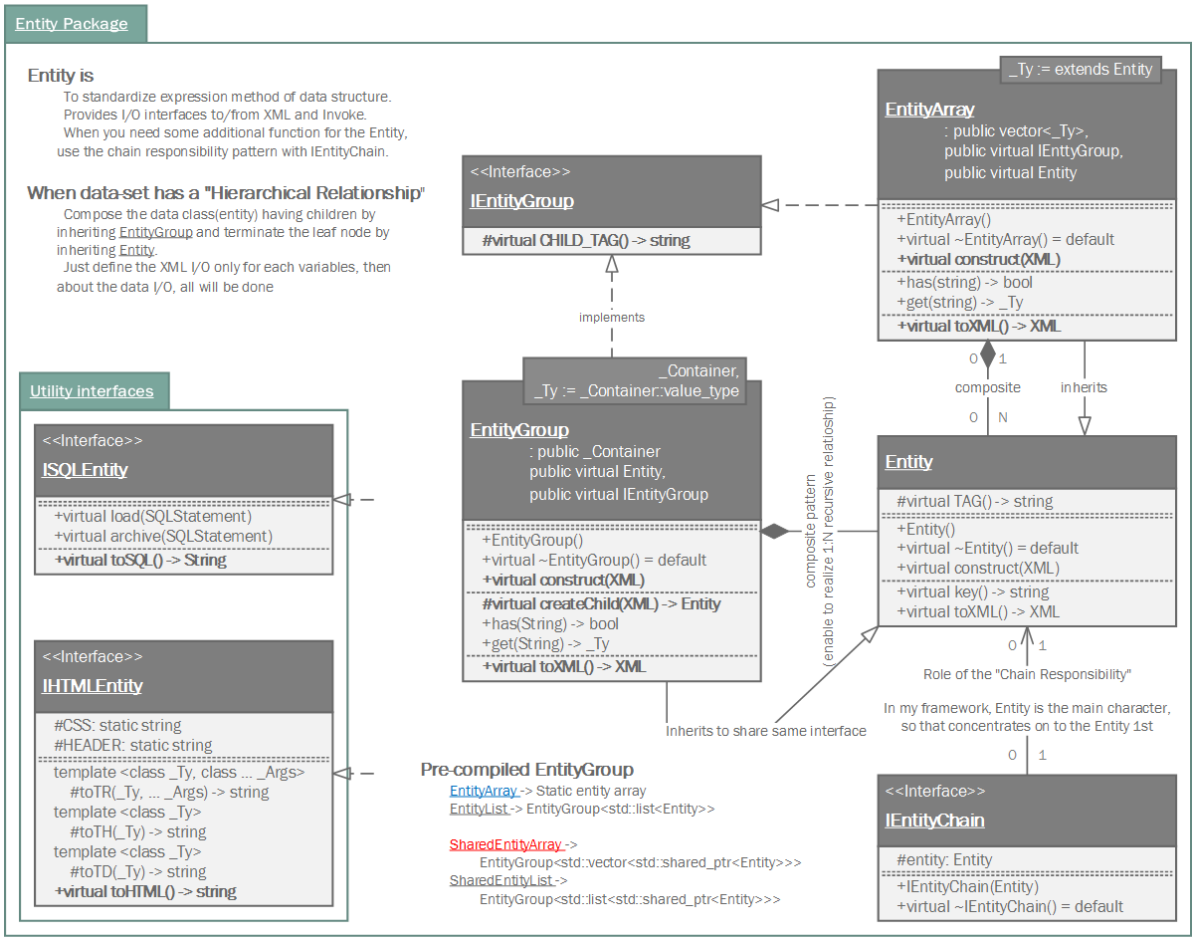
### Protected Attributes

- Entity * entity
  *An entity related with the chain.*

### 6.63.1 Detailed Description

A chain of entity.

IEntityChain is an interface takes role of control about an entity by chain of responsibliy pattern. It's suitable for a supplementary processes are required on an entity like calculation or historical regression about an entity.




**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.63.2 Constructor & Destructor Documentation

#### 6.63.2.1 IEntityChain ( Entity * *entity* )

Default Constructor.

**Parameters**

| | |
|---|---|
| *entity* | A related entity. |

The documentation for this class was generated from the following files:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IEntityChain.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IEntityChain.cpp

## 6.64 IEntityGroup Class Reference

An iternface for entity group.

`#include <IEntityGroup.hpp>`

### Public Member Functions

- IEntityGroup ()
  *Default Constructor.*

### Protected Member Functions

- virtual auto CHILD_TAG () const -> std::string=0
  *A tag name of children.*

### 6.64.1 Detailed Description

An iternface for entity group.

IEntityGroup is an interface for a container of entity. It does not have any special role or function. The IEntityGorup is only for discriminate an entity is single instance or gorup of entity.

- Group of entity is divided into EntityArray and EntityGroup.
  - Even they are template classes so that cannot be discriminated globally.
- dynamic_cast<IEntityGroup>(*some entity instance*)
  - If true then, it's not single entity instance, but group of entity.
  - False then, it's a single instance.

**Author**

Jeongho Nam

### 6.64.2 Member Function Documentation

#### 6.64.2.1 virtual auto CHILD_TAG ( ) const -> std::string [protected], [pure virtual]

A tag name of children.

< TAG>
<CHILD_TAG />
<CHILD_TAG />
</TAG>

Implemented in Invoke, NTCriteria, ExternalSystemArray, ExternalSystem, NTParameter, ChatRoomArray, InvokeHistoryArray, NTParameterArray, and FTFolder.

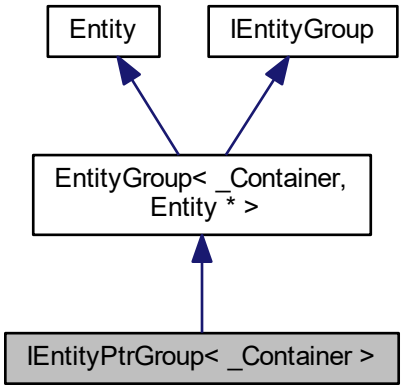
The documentation for this class was generated from the following files:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IEntityGroup.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IEntityGroup.cpp

## 6.65 IEntityPtrGroup< _Container > Class Template Reference

`#include <IEntityPtrGroup.hpp>`

Collaboration diagram for IEntityPtrGroup< _Container >:




### Additional Inherited Members

### 6.65.1 Detailed Description

**template<typename _Container>class samchon::protocol::IEntityPtrGroup< _Container >**

EntityPtrGroup is an EntityGroup having children Entity as their pointers.

The documentation for this class was generated from the following file:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IEntityPtrGroup.hpp

## 6.66 IHTMLEntity Class Reference

An interface supporting conversion to html.

`#include <IHTMLEntity.hpp>`

### Public Member Functions

- IHTMLEntity ()
  *Default Constructor.*
- virtual auto toHTML () const -> std::string=0
  *Get an html string represents the Entity.*

### Static Public Member Functions

- template<typename _Ty , typename... _Args>
  static auto toTH (const _Ty &val, const _Args &...args) -> std::string
  *Get a string represents a <th> tag.*

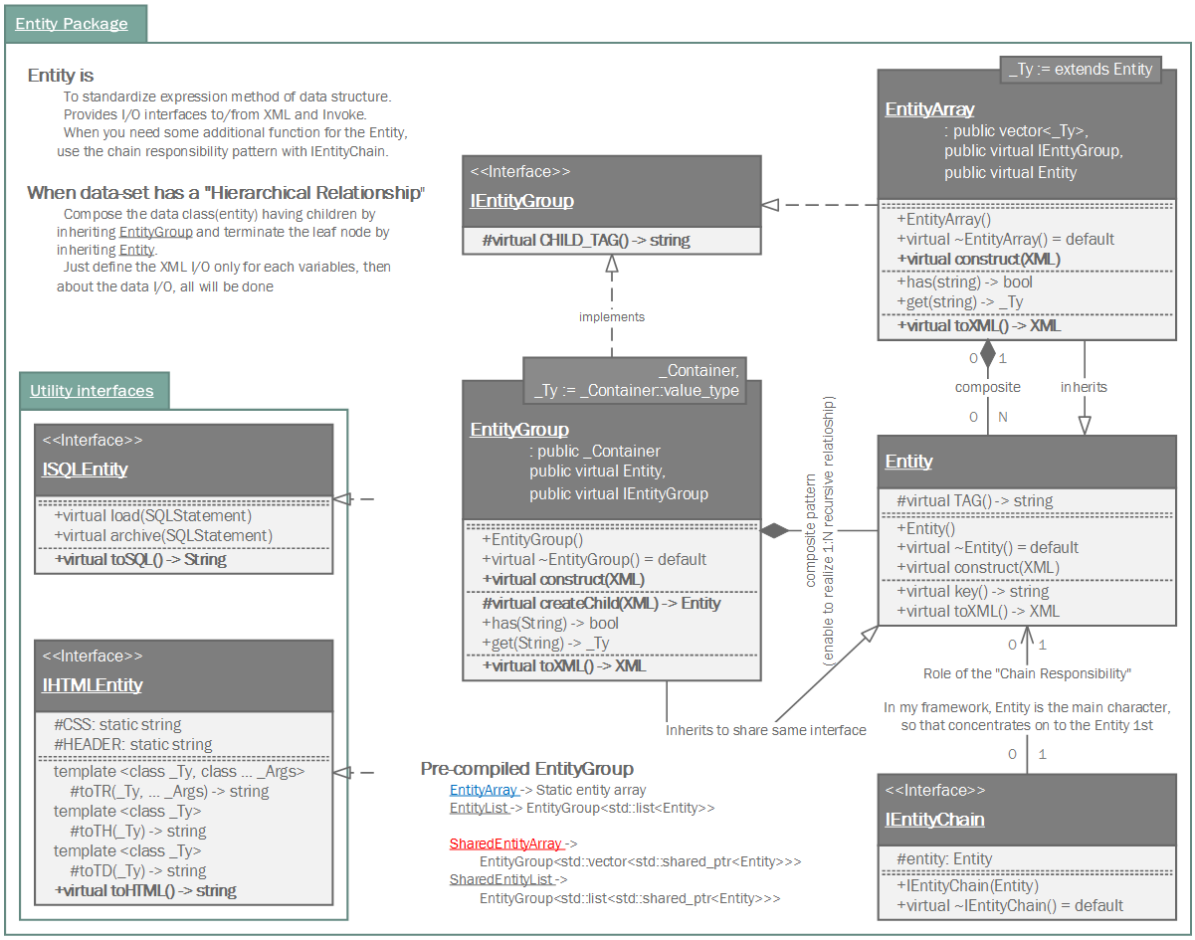
- template<typename _Ty , typename... _Args>
  static auto toTR (const _Ty &val, const _Args &...args) -> std::string
  *Get a string represents a <tr> tag.*

### 6.66.1 Detailed Description

An interface supporting conversion to html.

IHTMEntity is an interface supporting conversion method to html tags. The IHTMLEntity is used to documentation or printing data of the entity to web-screen; In C++, documentation is main reason to implementing the IHTMLEntity and in JS, printing on web-screen is main reason.

IHTMLEntity provides abstract method toHTML() and varadic template methods for constituting a table. I'm planning to support lots of utility methods for html tags but I've not exprienced developing the homepage or html service. If you're familiar with the html, please contribute to the IHTMLEntity interface.




**Example source**

```
#include <iostream>

#include <samchon/protocol/Entity.hpp>
#include <samchon/protocol/IHTMLEntity.hpp>
#include <samchon/protocol/SharedEntityArray.hpp>

#include <samchon/library/XML.hpp>

#ifdef _WIN64
#   ifdef _DEBUG
#       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "x64/Release/SamchonFramework.lib")
#   endif
#else
```

```
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

using namespace std;
using namespace samchon::library;
using namespace samchon::protocol;

class Member
    : public Entity, public virtual IHTMLEntity
{
protected:
    typedef Entity super;

    string id;
    string name;
    int age;
    int grade;

public:
    /* ----------------------------------------------------------------------
        CONSTRUCTORS
    ---------------------------------------------------------------------- */
    Member()
        : super(), IHTMLEntity()
    {
    };
    Member(const string &id, const string &name, int age, int grade)
        : super(), IHTMLEntity()
    {
        this->id = id;
        this->name = name;
        this->age = age;
        this->grade = grade;
    };
    virtual ~Member() = default;

    virtual void construct(shared_ptr<XML> xml) override
    {
        this->id = xml->getProperty("id");
        this->name = xml->getProperty("name");
        this->age = xml->getProperty<int>("age");
        this->grade = xml->getProperty<int>("grade");
    };

    /* ----------------------------------------------------------------------
        GETTERSs
    ---------------------------------------------------------------------- */
    virtual auto key() const -> std::string override
    {
        return this->id;
    };

    /* ----------------------------------------------------------------------
        XML EXPORTERS
    ---------------------------------------------------------------------- */
    virtual auto TAG() const -> string override
    {
        return "member";
    };
    virtual auto toXML() const -> shared_ptr<XML>
    {
        shared_ptr<XML> &xml = super::toXML();
        xml->setProperty("id", id);
        xml->setProperty("name", name);
        xml->setProperty("age", age);
        xml->setProperty("grade", grade);

        return move(xml);
    };
    virtual auto toHTML() const -> string
    {
        return toTR(id, name, age, grade);
    };
};

class MemberArray
    : public SharedEntityArray<Member>,
    public virtual IHTMLEntity
{
protected:
    typedef SharedEntityArray<Member> super;

    string application;
```

```
    int department;
    Member *chief;

public:
    /* ------------------------------------------------------------------
        CONSTRUCTORS
    ------------------------------------------------------------------ */
    MemberArray()
        : super(), IHTMLEntity()
    {
        this->chief = nullptr;
    };
    virtual ~MemberArray() = default;

    // You don't need to consider children(Member) objects
    // Just concentrate on constructing MemberArray's own member variables
    virtual void construct(shared_ptr<XML> xml) override
    {
        super::construct(xml);

        this->application = xml->getProperty("application");
        this->department = xml->getProperty<int>("department");

        if(xml->hasProperty("chief") == true && this->has( xml->getProperty("chief") ) == true)
            this->chief = this->get( xml->getProperty("cheif") ).get();
    };

protected:
    //FACTORY METHOD FOR MEMBER
    virtual auto createChild(shared_ptr<XML> = nullptr) -> Member* override
    {
        return new Member();
    };

    /* ------------------------------------------------------------------
        XML EXPORTERS
    ------------------------------------------------------------------ */
public:
    virtual auto TAG() const -> string override
    {
        return "memberArray";
    };
    virtual auto CHILD_TAG() const -> string override
    {
        return "member";
    };

    // You don't need to consider children(Member) objects
    // Just concentrate on expressing MemberArray's own member variables
    virtual auto toXML() const -> shared_ptr<XML>
    {
        shared_ptr<XML> &xml = super::toXML();
        xml->setProperty("application", application);
        xml->setProperty("department", department);

        if(chief != nullptr)
            xml->setProperty("cheif", chief->key());

        return move(xml);
    };
    virtual auto toHTML() const -> string
    {
        string html = "<table>\n";
        html += toTH("ID", "Name", "Age", "Grade") + "\n";

        for (size_t i = 0; i < 2; i++)
            html += at(i)->toHTML() + "\n";

        html += "</table>";
        return move(html);
    };
};

void main()
{
    string str = string("") +
        "<memberArray application='framework' department='7' cheif='samchon'>\n" +
        "   <member id='samchon' name='Jeongho Nam' age='27' grade='5' />" +
        "   <member id='submaster' name='No Name' age='100' grade='4' />" +
        "   <member id='john' name='John Doe' age='33' grade='2' />" +
        "   <member id='bad_man' name='Bad Man' age='44' grade='-1' />" +
        "   <member id='guest' name='Guest' age='0' grade='0' />" +
        "</memberArray>";
    shared_ptr<XML> xml(new XML(str));

    MemberArray memberArray;
    memberArray.construct(xml);
```

```
    memberArray.emplace_back(new Member("freshman", "A fresh man", 20, 2));
    memberArray.emplace_back(new Member("senior", "A senior", 70, 2));

    cout << memberArray.toXML()->toString() << endl << endl;
    cout << memberArray.toHTML() << endl;
    system("pause");
}
```

**Result of the example**

```
D:\OneDrive\Project\Samchon\framework\cpp\Debug\entity.exe
<memberArray application="framework" department="7">
        <member age="27" grade="5" id="samchon" name="Jeongho" />
        <member age="100" grade="4" id="submaster" name="No" />
        <member age="33" grade="2" id="john" name="John" />
        <member age="44" grade="-1" id="bad_man" name="Bad" />
        <member age="0" grade="0" id="guest" name="Guest" />
        <member age="20" grade="2" id="freshman" name="A fresh man" />
        <member age="70" grade="2" id="senior" name="A senior" />
</memberArray>

<table>
        <th>
                <td>ID</td>
                <td>Name</td>
                <td>Age</td>
                <td>Grade</td>
        </th>
        <tr>
                <td>samchon</td>
                <td>Jeongho</td>
                <td>27</td>
                <td>5</td>
        </tr>
        <tr>
                <td>submaster</td>
                <td>No</td>
                <td>100</td>
                <td>4</td>
        </tr>
</table>
Press any key to continue . . .
```

**Author**

Jeongho Nam

### 6.66.2 Member Function Documentation

#### 6.66.2.1 static auto toTH ( const _Ty & *val*, const _Args &... *args* ) -> std::string [inline], [static]

Get a string represents a <th> tag.

**Template Parameters**

| | |
|---|---|
| *_Ty* | Type of an argument to be contained with a <td> tag. |
| *_Args* | Left varadic template arguments' type |

Returns a string represents a title columns with <th> tag by varadic template method.

Supported parameters: that can converted to string

- number
  - (unsigned) short

    * (unsigned) long
    * (unsigned) long long
    * (unsigned) int
    * float
    * double
    * long double
  - string
    * std::string
    * WeakString

**Parameters**

| | |
|---|---|
| *val* | An element to be contained with <td> a tag. |
| *args* | Left argument to be contained with <td> tags. |

**Returns**

A string of <th> tag represents title columns.

#### 6.66.2.2 static auto toTR ( const _Ty & *val*, const _Args &... *args* ) -> std::string [inline], [static]

Get a string represents a <tr> tag.

**Template Parameters**

| | |
|---|---|
| *_Ty* | Type of an argument to be contained with a <tr> tag. |
| *_Args* | Left varadic template arguments' type |

Returns a string represents a data columns of a row with <tr> tag by varadic template method.

Supported parameters: that can converted to string

  - number
    * (unsigned) short
    * (unsigned) long
    * (unsigned) long long
    * (unsigned) int
    * float
    * double
    * long double
  - string
    * std::string
    * WeakString

**Parameters**

| | |
|---|---|
| *val* | An element to be contained with <tr> a tag. |
| *args* | Left argument to be contained with <tr> tags. |

**Returns**

A string of <th> tag represents data columns of a row.

#### 6.66.2.3 virtual auto toHTML ( ) const -> std::string [pure virtual]

Get an html string represents the Entity.

**Returns**

A string represents the Entity by html tags.

The documentation for this class was generated from the following files:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IHTMLEntity.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IHTMLEntity.cpp

## 6.67 IndexPair< _Ty > Class Template Reference

A pair of index and its value(_Ty)

```
#include <IndexPair.hpp>
```

### Public Member Functions

- auto getIndex () const -> size_t
  *Get index.*
- auto getValue () -> _Ty &
  *Get const value.*
- auto getValue () const -> const _Ty &
  *Get value.*

### 6.67.1 Detailed Description

**template<class _Ty>class samchon::IndexPair< _Ty >**

A pair of index and its value(_Ty)

IndexPair is a std::pair<size_t, _Ty> class.

IndexPair expresses index and value. It's useful for expressing finding literals, specified object, calculating mininum or maximum with its position.

**[Inherited]**

This class couples together a pair of values, which may be of different types (T1 and T2). The individual values can be accessed through its public members first and second.

Pairs are a particular case of tuple.

Referenced comments of std::pair

- http://www.cplusplus.com/reference/utility/pair/

**Author**

Jeongho Nam

### 6.67.2 Member Function Documentation

#### 6.67.2.1 auto getIndex ( ) const -> size_t [inline]

Get index.

**Returns**

Index of the pair

#### 6.67.2.2 auto getValue ( ) -> _Ty& [inline]

Get const value.

**Returns**

Reference of value of the pair

#### 6.67.2.3 auto getValue ( ) const -> const _Ty& [inline]

Get value.

**Returns**

Const reference of value of the pair

The documentation for this class was generated from the following file:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/IndexPair.hpp

## 6.68 Instance Class Reference

A physical instance.

`#include <Instance.hpp>`

### Public Member Functions

- Instance (const std::string &name, int price, int volume, int weight)

  *Construct from instance.*
- auto getName () const -> std::string

  *Get name.*
- auto getPrice () const -> int

  *Get price.*
- auto getVolume () const -> int

  *Get volume.*
- auto getWeight () const -> int

  *Get weight.*
- virtual auto toString () const -> std::string

  *Return a string represents the Instance.*

### Protected Attributes

- std::string name

  *Name represent the Instance.*
- int price

  *Price of an instance -> 1,000 won.*
- int volume

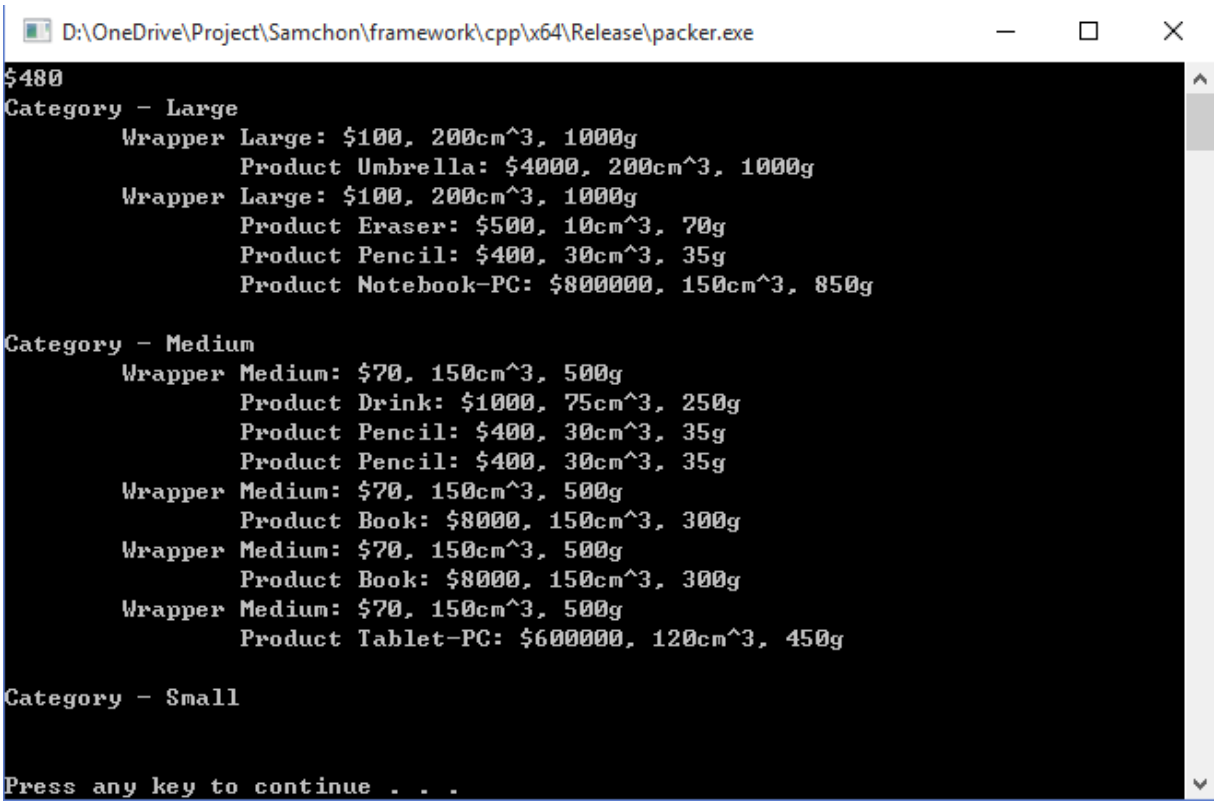
  *Volume of an instance -> 130 cm^3.*
- int weight

  *Weight of an instance -> 1,200 g.*

### 6.68.1 Detailed Description

A physical instance.

A physical instance having its own name, price, volume and weight.




**Author**

Jeongho Nam

### 6.68.2 Constructor & Destructor Documentation

#### 6.68.2.1 Instance ( const std::string & *name*, int *price*, int *volume*, int *weight* )

Construct from instance.

**Parameters**

| | |
|---|---|
| *name* | Name of the instance |
| *price* | Price of the instance |
| *volume* | Volume of the instance |
| *weight* | Weight of the instance |

The documentation for this class was generated from the following files:

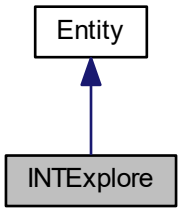
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/packer/Instance.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/packer/Instance.cpp

## 6.69 INTExplore Class Reference

An interface for exploration.

```
#include <INTExplore.hpp>
```

Collaboration diagram for INTExplore:




### Public Member Functions

- INTExplore ()

  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >)

  *Construct data of the Entity from an XML object.*
- auto getMinimum () const -> double

  *Get minimum.*
- auto getMaximum () const -> double

  *Get maximum.*
- auto getSection () const -> unsigned int

  *Get section.*
- auto getPrecision () const -> int

  *Get precision.*
- virtual auto toXML () const -> std::shared_ptr< library::XML >

  *Get an XML object represents the Entity.*

### Protected Attributes

- double minimum

  *Minimum value.*
- double maximum

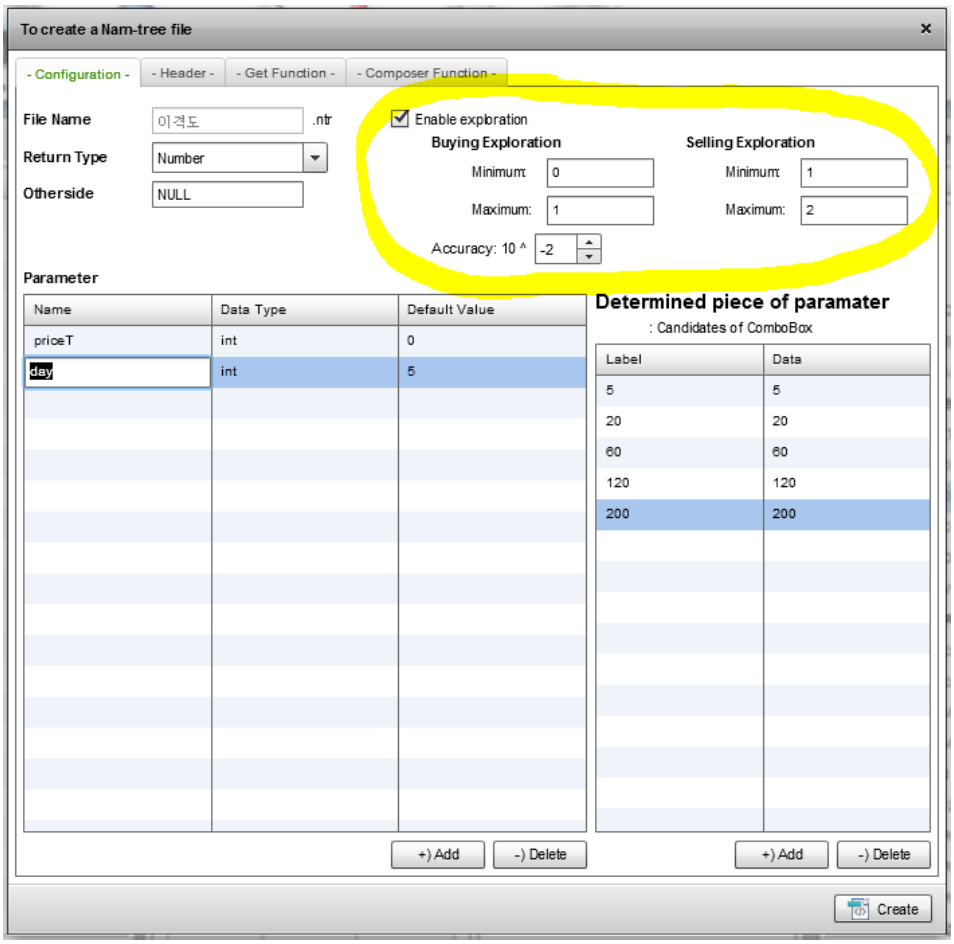
  *Maximum value.*
- unsigned int section

  *Section number of exploration.*
- int precision

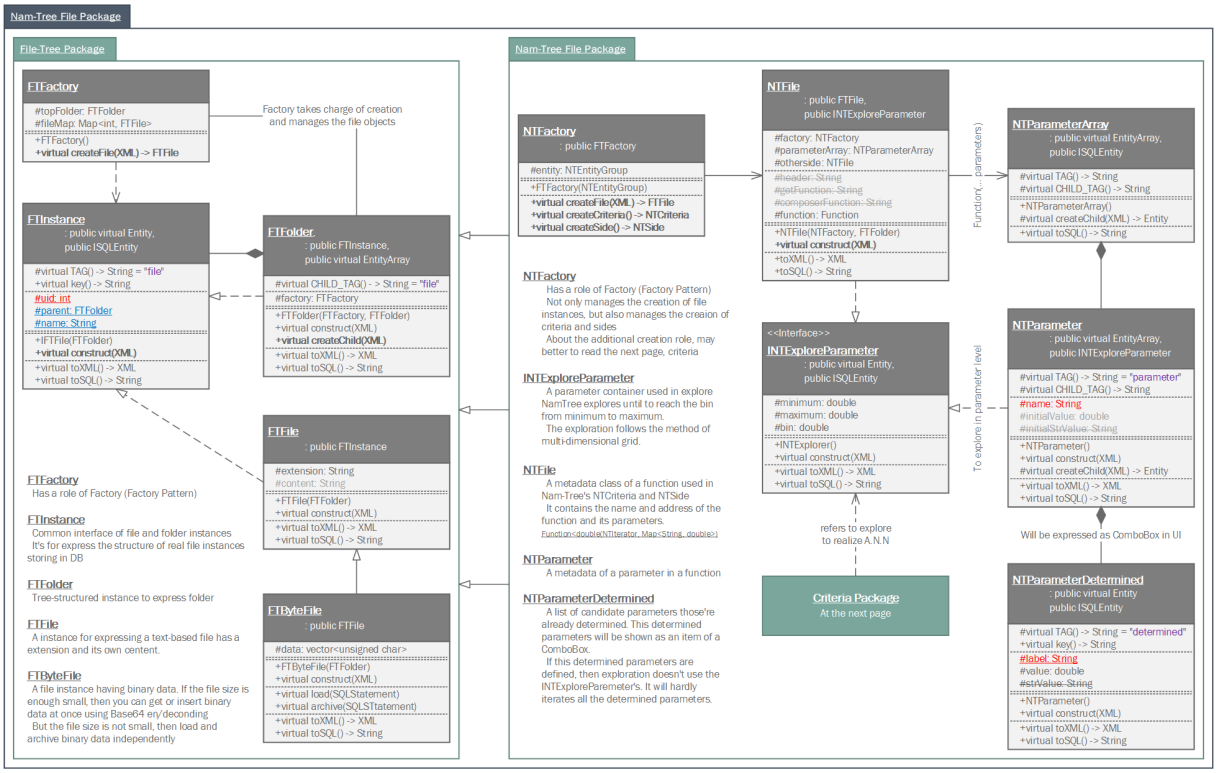
  *Target precision: $10^{precision}$*

## 6.69.1 Detailed Description

An interface for exploration.




INTExplore is an interface containing some parameters for grid optimization method.



**See also**

samchon::namtree

**Author**

Jeongho Nam

### 6.69.2 Member Function Documentation

#### 6.69.2.1 void construct ( std::shared_ptr< library::XML > ) [virtual]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Implements Entity.

Reimplemented in NTFile, and NTParameter.

#### 6.69.2.2 auto toXML ( ) const -> std::shared_ptr<library::XML> [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

Reimplemented in NTFile, and NTParameter.

The documentation for this class was generated from the following files:

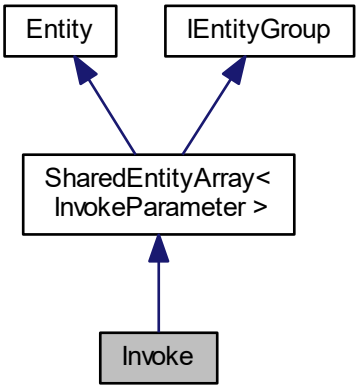
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/INTExplore.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/INTExplore.cpp

## 6.70 Invoke Class Reference

Standard message of network I/O.

`#include <Invoke.hpp>`

Collaboration diagram for Invoke:




### Public Member Functions

- Invoke ()

  *Default Constructor.*
- Invoke (const std::string &listener)

  *Construct from a listener.*
- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*
- template<typename _Ty , typename... _Args>
  Invoke (const std::string &listener, const _Ty &val, const _Args &...args)

  *Construct from arguments.*
- auto getListener () const -> std::string

  *Get listener.*
- void setListener (const std::string &)

  *Set listener.*
- virtual auto TAG () const -> std::string override

  *A tag name when represented by XML.*
- virtual auto CHILD_TAG () const -> std::string override

  *A tag name of children.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the EntityGroup.*
- auto toSQL () const -> std::string

  *Get a string of sql statement used to archive history log.*

### Protected Member Functions

- virtual auto createChild (std::shared_ptr< library::XML >) -> InvokeParameter *override

  *Factory method of a child Entity.*

### Protected Attributes

– std::string listener

*Represent who listens, often be a function name.*

## 6.70.1 Detailed Description

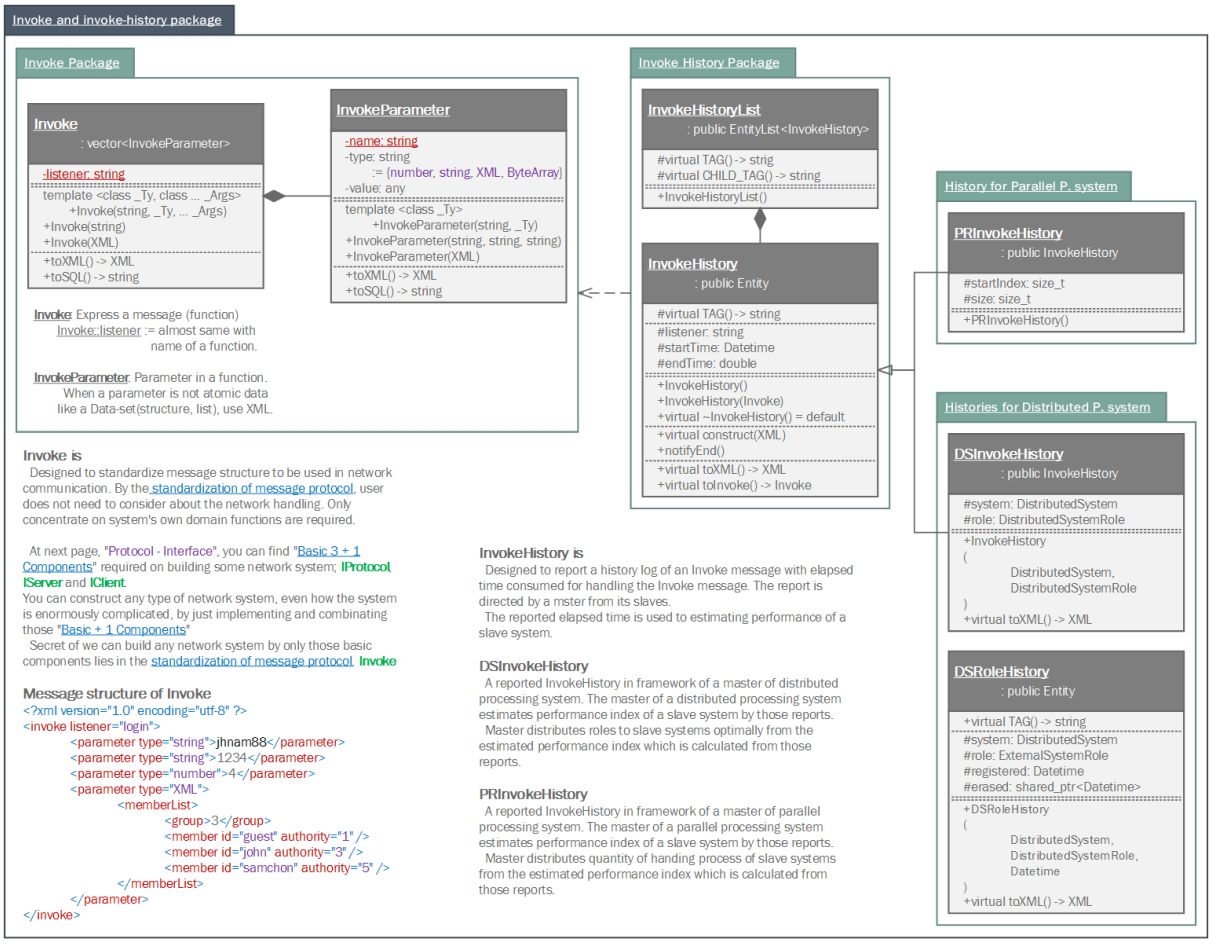
Standard message of network I/O.

Invoke is a class used in network I/O in protocol package of Samchon Framework.

The Invoke message has an XML structure like the result screen of provided example in below. We can enjoy lots of benefits by the normalized and standardized message structure used in network I/O.

The greatest advantage is that we can make any type of network system, even how the system is enourmously complicated. As network communication message is standardized, we only need to concentrate on logical relationships between network systems. We can handle each network system like a object (class) in OOD. And those relationships can be easily designed by using design pattern.

In Samchon Framework, you can make any type of network system with basic 3 + 1 componenets (IProtocol, IServer and IClient + ServerConnector), by implemens or inherits them, like designing classes of S/W architecture.




### Example source

```
#include <iostream>

#include <samchon/library/XML.hpp>
#include <samchon/protocol/Invoke.hpp>

using namespace std;
using namespace samchon;
```

```
using namespace samchon::library;
using namespace samchon::protocol;

#ifdef _WIN64
#   ifdef _DEBUG
#       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "x64/Release/SamchonFramework.lib")
#   endif
#else
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

void main()
{
    string str = string("") +
        "<memberList>\n" +
        "   <member id='jhnam88' pass='1231' />\n" +
        "   <member id='samchon' pass='1231'>Administrator</member>\n" +
        "   <group>3</group>\n" +
        "</memberList>";

    shared_ptr<XML> xml(new XML(str));
    shared_ptr<Invoke> invoke(new Invoke("login", "jhnam88", "1231", 4, xml));

    cout << "Invoke to XML: " << endl;
    cout << invoke->toXML()->toString() << endl << endl;

    cout << "------------------------------------------------------------" << endl;
    cout << "   Parameters" << endl;
    cout << "------------------------------------------------------------" << endl;
    cout << "1st param: " << invoke->at(0)->getValue<string>() << endl;
    cout << "2nd param: " << invoke->at(1)->getValue<string>() << endl;
    cout << "3rd param: " << invoke->at(2)->getValue<string>() << endl;
    cout << "4th param: " << endl << invoke->at(3)->getValue<shared_ptr<XML>>()->toString() << endl;

    system("pause");
}
```

**Result of the example**

```
D:\OneDrive\Project\Samchon\framework\cpp\Debug\invoke.exe
Invoke to XML:
<invoke listener="login">
        <parameter type="string">jhnam88</parameter>
        <parameter type="string">1231</parameter>
        <parameter type="number">4.000000</parameter>
        <parameter type="XML">
                <memberList>
                        <group>3</group>
                        <member id="jhnam88" pass="1231" />
                        <member id="samchon" pass="1231">Administrator</member>
                </memberList>
        </parameter>
</invoke>

------------------------------------------------------------
        Parameters
------------------------------------------------------------
1st param: jhnam88
2nd param: 1231
3rd param: 4
4th param:
<memberList>
        <group>3</group>
        <member id="jhnam88" pass="1231" />
        <member id="samchon" pass="1231">Administrator</member>
</memberList>
Press any key to continue . . .
```

**See also**

samchon::protocol
protocol::IProtocol

**Author**

Jeongho Nam

### 6.70.2 Constructor & Destructor Documentation

#### 6.70.2.1 Invoke ( const std::string & *listener* )

Construct from a listener.

**Parameters**

| | |
|---|---|
| *listener* | Represents who listens the Invoke message. Almost same with Function name |

#### 6.70.2.2 Invoke ( const std::string & *listener,* const _Ty & *val,* const _Args &... *args* ) [inline]

Construct from arguments.

**Template Parameters**

| | |
|---|---|
| *_Ty* | Type of an argument which represents a parameter |
| *_Args* | Left varadic template arguments' types |

Creates Invoke and InvokeParameter(s) at the same time by varadic template method.

By the varadic template constructor, you can't specify name of each InvokeParameter, but specify type and value of each InvokeParameter. If you try to record the Invoke to Database, the name of InvokeParameter will be *NULL*.

**Note**

By the varadic template constructor, name of InovkeParameter(s) will be omitted. Because of name, an identifier of an InvokeParameter, is omitted, you can't access to InvokeParameter by Invoke::has() or Invoke↩ ::get().

**Parameters**

| | |
|---|---|
| *listener* | A string represents who listens the Invoke message. Almost same with name of a function. |
| *val* | A value to be a parameter of Invoke |
| *args* | Left arguments to be parameters of Invoke |

### 6.70.3 Member Function Documentation

#### 6.70.3.1 void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from EntityGroup< _Container, _ETy, _Ty >.

#### 6.70.3.2 auto createChild ( std::shared_ptr< library::XML > ) -> InvokeParameter *override [override], [protected], [virtual]

Factory method of a child Entity.

EntityGroup::createChild() is a factory method creating a new child Entity which is belonged to the Entity↩ Group. This method is called by EntityGroup::construct(). The children construction methods Entity↩ ::construct() will be called by abstract method of the EntityGroup::construct().

**Returns**

A new child Entity belongs to EntityGroup.

Implements EntityGroup< _Container, _ETy, _Ty >.

#### 6.70.3.3 auto TAG ( ) const -> std::string [override], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

#### 6.70.3.4 auto CHILD_TAG ( ) const -> std::string [override], [virtual]

A tag name of children.

< TAG>
<CHILD_TAG />
<CHILD_TAG />
</TAG>

Implements IEntityGroup.

#### 6.70.3.5 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from EntityGroup< _Container, _ETy, _Ty >.

The documentation for this class was generated from the following files:

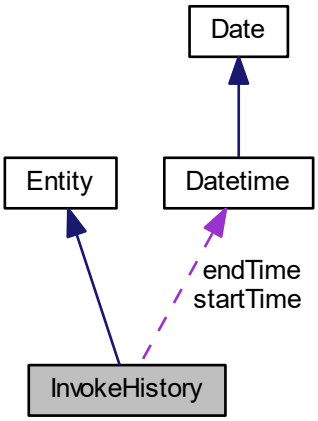
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/Invoke.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/Invoke.cpp

## 6.71 InvokeHistory Class Reference

A history of an Invoke message.

`#include <InvokeHistory.hpp>`

Collaboration diagram for InvokeHistory:




### Public Member Functions

- InvokeHistory ()
  *Default Constructor.*
- InvokeHistory (std::shared_ptr< Invoke >)
  *Construct from an Invoke message.*
- virtual void construct (std::shared_ptr< library::XML >) override
  *Construct data of the Entity from an XML object.*
- void notifyEnd ()
  *Notify end of the process.*
- virtual auto key () const -> std::string override
  *Get a key that can identify the Entity uniquely.*
- auto getUID () const -> size_t
  *Get uid.*
- auto getListener () const -> std::string
  *Get listener.*
- auto getStartTime () const -> library::Datetime
  *Get start time.*
- auto getEndTime () const -> library::Datetime
  *Get end time.*
- auto calcElapsedTime () const -> long long
  *Get elapsed time.*
- virtual auto TAG () const -> std::string override
  *A tag name when represented by XML.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override
  *Get an XML object represents the Entity.*
- auto toInvoke () const -> std::shared_ptr< Invoke >
  *Get an Invoke message.*

### Protected Attributes

- size_t uid

  *An identifier.*
- std::string listener

  *A listener of the Invoke message.*
- library::Datetime startTime

  *Start time of the history.*
- library::Datetime endTime

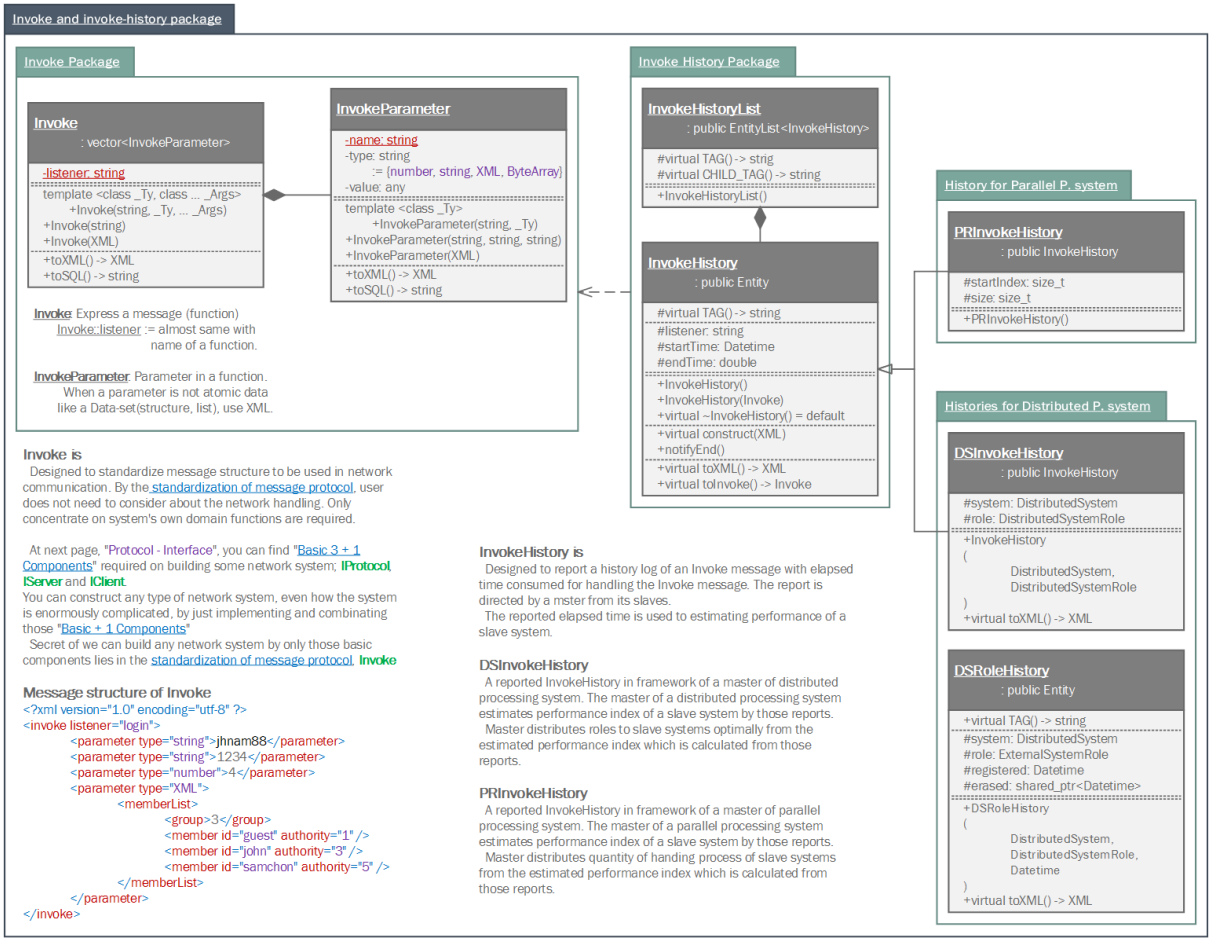
  *End time of the history.*

## 6.71.1 Detailed Description

A history of an Invoke message.

InvokeHistory is a class for reporting history log of an Invoke message with elapsed time from a slave to its master.

With the elapsed time, consumed time for a process of handling the Invoke message, InvokeHistory is reported to the master. The master utilizies the elapsed time to estimating performances of each slave system. With the estimated performan index, master retrives the optimal solution of distributing processes.




### See also

samchon::protocol
samchon::protocol::master
samchon::protocol::slave

**Author**

Jeongho Nam

### 6.71.2 Constructor & Destructor Documentation

#### 6.71.2.1 InvokeHistory ( std::shared_ptr< Invoke > )

Construct from an Invoke message.

InvokeHistory does not archive entire Invoke message, only archives its listener.

**Parameters**

| | |
|---|---|
| *invoke* | A message to archive its history log |

### 6.71.3 Member Function Documentation

#### 6.71.3.1 void construct ( std::shared_ptr< library::XML > ) [override], [virtual]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Implements Entity.

Reimplemented in PRInvokeHistory.

#### 6.71.3.2 void notifyEnd ( )

Notify end of the process.

Notifies end of a process handling the matched Invoke message to InvokeHistory.

InvokeHistory archives the end datetime and calculates elapsed time as nanoseconds.

#### 6.71.3.3 auto key ( ) const -> std::string [override], [virtual]

Get a key that can identify the Entity uniquely.

If identifier of the Entity is not atomic value, returns a string represents the composite identifier. If identifier of the Entity is not string, converts the identifier to string and returns the string.

**Returns**

An identifier

Reimplemented from Entity.

#### 6.71.3.4 auto calcElapsedTime ( ) const -> long long

Get elapsed time.

Calculates elapsed time frrom start, end time and Returns it.

The elapsed time will be reported to a master and the master will utilize the elapsed time to estimating performance of the slave system, the InvokeHistory is belonged to.

**Returns**

An elapsed time expressed as nano seconds.

#### 6.71.3.5 auto TAG ( ) const -> std::string [override], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

#### 6.71.3.6 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

Reimplemented in PRInvokeHistory.

#### 6.71.3.7 auto toInvoke ( ) const -> std::shared_ptr<Invoke>

Get an Invoke message.

Returns an Invoke message to report to a master that how much time was elapsed on a process handling the Invoke message. In master, those reports are used to estimate performance of each slave system.

**Returns**

An Invoke message to report master.

### 6.71.4 Member Data Documentation

#### 6.71.4.1 std::string listener [protected]

A listener of the Invoke message.

InvokeHistory does not archive entire data of an Invoke message. InvokeHistory only archives its listener. The first, formal reason is to save space, avoid wasting spaces.

The second, complicate reason is on an aspect of which systems are using the InvokeHistory class. InvokeHistory is designed to let slave reports to master elapsed time of a process used to handling the Invoke message. If you want to archive entire history log of Invoke messages, then the subject should be master, not the slave using InvokeHistory classes.

#### 6.71.4.2 library::Datetime startTime [protected]

Start time of the history.

Means start time of a process handling the Invoke message. The start time not only has ordinary arguments represented Datetime (year to seconds), but also has very precise values under seconds, which is expressed as nano seconds (10^-9).

The precise start time will be used to calculate elapsed time with end time.

#### 6.71.4.3 library::Datetime endTime [protected]

End time of the history.

Means end time of a process handling the Invoke message. The end time not only has ordinary arguments represented Datetime (year to seconds), but also has very precise values under seconds, which is expressed as nano seconds (10^-9).

The precise end time will be used to calculate elapsed time with start time.

The documentation for this class was generated from the following files:

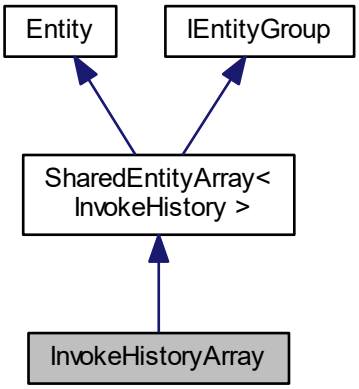
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/InvokeHistory.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/InvokeHistory.cpp

## 6.72 InvokeHistoryArray Class Reference

An array of InvokeHistory.

`#include <InvokeHistoryArray.hpp>`

Collaboration diagram for InvokeHistoryArray:




### Public Member Functions

- InvokeHistoryArray ()

  *Default Constructor.*
- virtual auto TAG () const -> std::string

  *A tag name when represented by XML.*
- virtual auto CHILD_TAG () const -> std::string

  *A tag name of children.*

### Protected Member Functions

- virtual auto createChild (std::shared_ptr< library::XML >) -> InvokeHistory *override
  *Factory method of a child Entity.*

## 6.72.1 Detailed Description

An array of InvokeHistory.

**Author**

Jeongho Nam

## 6.72.2 Member Function Documentation

### 6.72.2.1 auto createChild ( std::shared_ptr< library::XML > ) -> InvokeHistory *override [override], [protected], [virtual]

Factory method of a child Entity.

EntityGroup::createChild() is a factory method creating a new child Entity which is belonged to the EntityGroup. This method is called by EntityGroup::construct(). The children construction methods Entity::construct() will be called by abstract method of the EntityGroup::construct().

**Returns**

A new child Entity belongs to EntityGroup.

Implements EntityGroup< _Container, _ETy, _Ty >.

Reimplemented in PRInvokeHistoryArray.

### 6.72.2.2 auto TAG ( ) const -> std::string [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

### 6.72.2.3 auto CHILD_TAG ( ) const -> std::string [virtual]

A tag name of children.

< TAG>
<CHILD_TAG />
<CHILD_TAG />
</TAG>

Implements IEntityGroup.

The documentation for this class was generated from the following files:

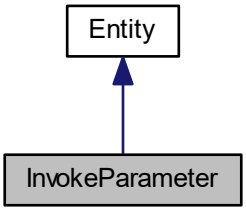
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/InvokeHistoryArray.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/InvokeHistoryArray.cpp

## 6.73 InvokeParameter Class Reference

A parameter of an Invoke.

`#include <InvokeParameter.hpp>`

Collaboration diagram for InvokeParameter:




### Public Member Functions

- InvokeParameter (const std::string &, const std::string &, const std::string &)
  *Construct from arguments.*
- template<typename _Ty >
  InvokeParameter (const std::string &name, const _Ty &val)
  *Construct with its name and a value.*
- InvokeParameter (const std::string &, std::string &&)
  *Construct from the name and a moved string.*
- InvokeParameter (const std::string &, ByteArray &&)
  *Construct from name and a moved ByteArray.*
- virtual auto key () const -> std::string override
  *Get a key that can identify the Entity uniquely.*
- auto getName () const -> std::string
  *Get name.*
- auto getType () const -> std::string
  *Get type.*
- template<typename _Ty >
  auto getValue () const -> _Ty
  *Get value.*
- auto getvalueAsXML () const -> std::shared_ptr< library::XML >
  *Get value as XML object.*
- template<typename _Ty >
  auto referValue () const -> const _Ty &
  *Reference value.*
- template<typename _Ty >
  auto moveValue () -> _Ty
  *Move value.*

### Protected Member Functions

- InvokeParameter ()
  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override
  *Construct data of the Entity from an XML object.*

- virtual auto TAG () const -> std::string override

  *A tag name when represented by XML.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the Entity.*
- auto toSQL () const -> std::string

  *Get a string of sql statement used to archive history log.*

### Protected Attributes

- std::string name

  *A name can represent the parameter.*
- std::string type

  *Type of the parameter.*
- std::string str

  *A string value if the type is "string" or "number".*
- std::shared_ptr< library::XML > xml

  *An XML object if the type is "XML".*
- std::unique_ptr< ByteArray > byteArray

  *A binary value if the type is "ByteArray".*

## 6.73.1 Detailed Description

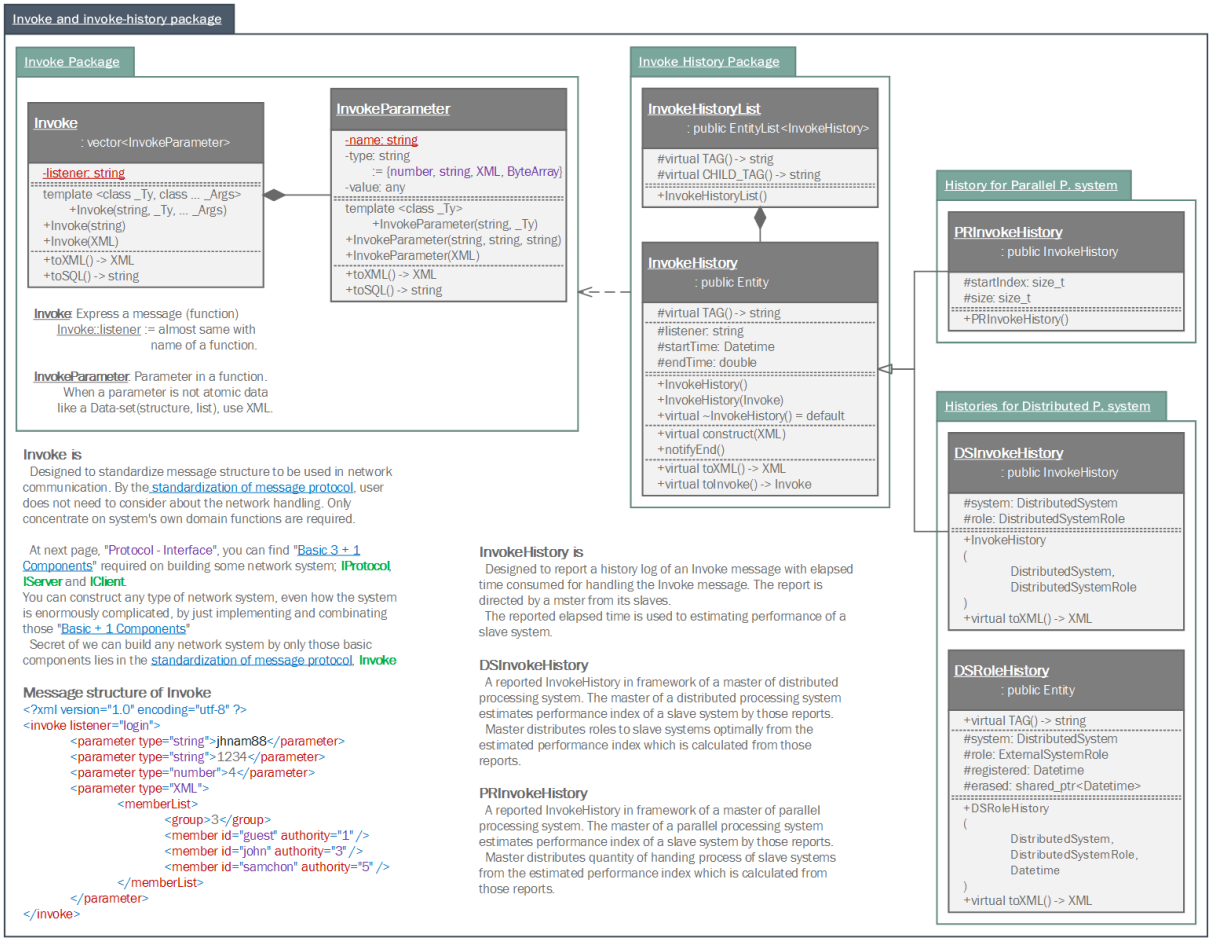
A parameter of an Invoke.

A parameter with its name, type and value in an Invoke message.

InvokeParameter supports 4 types pre-defined.

- number
- string
- XML
- ByteArray

You can specify InvokeParameter to have some type which is not one of the basic 4 types, but values of the custom type must be enable to expressed by one of those types; number, string, XML and ByteArray.




### Note

A member variable void∗ representing any type of value is depreciated.

Since C++11, method of void pointer (Declare a variable as void pointer whose type can not specified. And convert the pointer type to specified one for each case) is recommended to avoid.

As that reason, the *void value was a candidate to be depreciated or to be replaced to boost::any. And the void value* is really depreciated since version v1.0.

### See also

protocol::Invoke
samchon::protocol

### Author

Jeongho Nam

## 6.73.2 Constructor & Destructor Documentation

### 6.73.2.1 InvokeParameter ( const std::string & , const std::string & , const std::string & )

Construct from arguments.

Specifies all arguments of an InvokeParameter. You can specify a custom type, that is not one of number or string, but value of the type must be enable to expressed by a string.

If you want to express an object or container group, use XML instead; *Invoke::InvokeParameter(string, XML)*.

**Parameters**

| | |
|---|---|
| *name* | A name can represent the InvokeParameter |
| *type* | Type of value in the InvokeParameter |
| *value* | A value capsuled by a string |

#### 6.73.2.2 InvokeParameter ( const std::string & *name*, const _Ty & *val* ) [inline]

Construct with its name and a value.

Type of the InvokeParameter will be determined automatically.

Type supported in the template constructor:

- number
  - (unsigned) short
  - (unsigned) long
  - (unsigned) long long
  - (unsigned) int
  - float
  - double
  - long double
- string
  - std::string
  - WeakString
- XML
  - std::shared_ptr<library::XML>
  - Entity; protocol::Entity::toXML()
- ByteArray

**Template Parameters**

| | |
|---|---|
| *_Ty* | Type of value |

### 6.73.3 Member Function Documentation

#### 6.73.3.1 void construct ( std::shared_ptr< library::XML > ) [override], [protected], [virtual]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Implements Entity.

#### 6.73.3.2 auto key ( ) const -> std::string [override], [virtual]

Get a key that can identify the Entity uniquely.

If identifier of the Entity is not atomic value, returns a string represents the composite identifier. If identifier of the Entity is not string, converts the identifier to string and returns the string.

**Returns**

An identifier

Reimplemented from Entity.

#### 6.73.3.3 auto getValue ( ) const -> _Ty [inline]

Get value.

**Template Parameters**

| | |
|---|---|
| *_Ty* | Type of value to get |

#### 6.73.3.4 auto getvalueAsXML ( ) const -> std::shared_ptr<library::XML>

Get value as XML object.

Same with getValue< std::shared_ptr<library::XML> >();

#### 6.73.3.5 auto referValue ( ) const -> const _Ty &

Reference value.

**Template Parameters**

| | |
|---|---|
| *_Ty* | Type of value to reference |

#### 6.73.3.6 auto moveValue ( ) -> _Ty

Move value.

**Template Parameters**

| | |
|---|---|
| *_Ty* | Type of value to move |

#### 6.73.3.7 auto TAG ( ) const -> std::string [override], [protected], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

#### 6.73.3.8 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [protected], [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

### 6.73.4 Member Data Documentation

#### 6.73.4.1 std::string type [protected]

Type of the parameter.

List of pre-defined types

- number
- string
- XML
- ByteArray

The documentation for this class was generated from the following files:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/InvokeParameter.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/InvokeParameter.cpp

## 6.74 IOperator< _Ty > Class Template Reference

Interface for comparision operator.

```
#include <IOperator.hpp>
```

### Public Member Functions

- IOperator ()
  *Default Constructor.*
- virtual auto operator< (const IOperator &) const -> bool=0
  *Less.*
- virtual auto operator== (const IOperator &) const -> bool=0
  *Equal.*

### 6.74.1 Detailed Description

**template<typename _Ty>class samchon::library::IOperator< _Ty >**

Interface for comparision operator.

IOperator is a template class makes enalbe to realizing all compare operators by only overriding operator< and operator== methods.

- [!=] -> [NOT ==]
- [<=] -> [< OR ==]
- [>] -> [NOT < AND NOT ==]
- [>=] -> [NOT <]

Methods operator< and operator== are abstract. Overrides them.

**Note**

If you want to realize all comparison operators without inheritance and specifying clear type of parameter, you can use following macros instead.

- OPERATOR_METHODS_INLINE(_Ty)
- OPERATOR_METHODS_HEADER(_Ty)
- OPERATOR_METHODS_BODY(_Class, _Ty)

**See also**

samchon::library

**Author**

Jeongho Nam

### 6.74.2 Member Function Documentation

#### 6.74.2.1 virtual auto operator< ( const IOperator< _Ty > & ) const -> bool [pure virtual]

Less.

Overrides method less.

**Parameters**

| | |
|---|---|
| *obj* | The object to compare. |

**Returns**

The object is less than this.

#### 6.74.2.2 virtual auto operator== ( const IOperator< _Ty > & ) const -> bool [pure virtual]

Equal.

Overrides methods equal.

**Parameters**

| | |
|---|---|
| *obj* | The object to compare. |

**Returns**

The object is equal with this.

The documentation for this class was generated from the following file:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/IOperator.hpp

## 6.75 IProtocol Class Reference

An interface of Invoke message chain.

```
#include <IProtocol.hpp>
```

### Public Member Functions

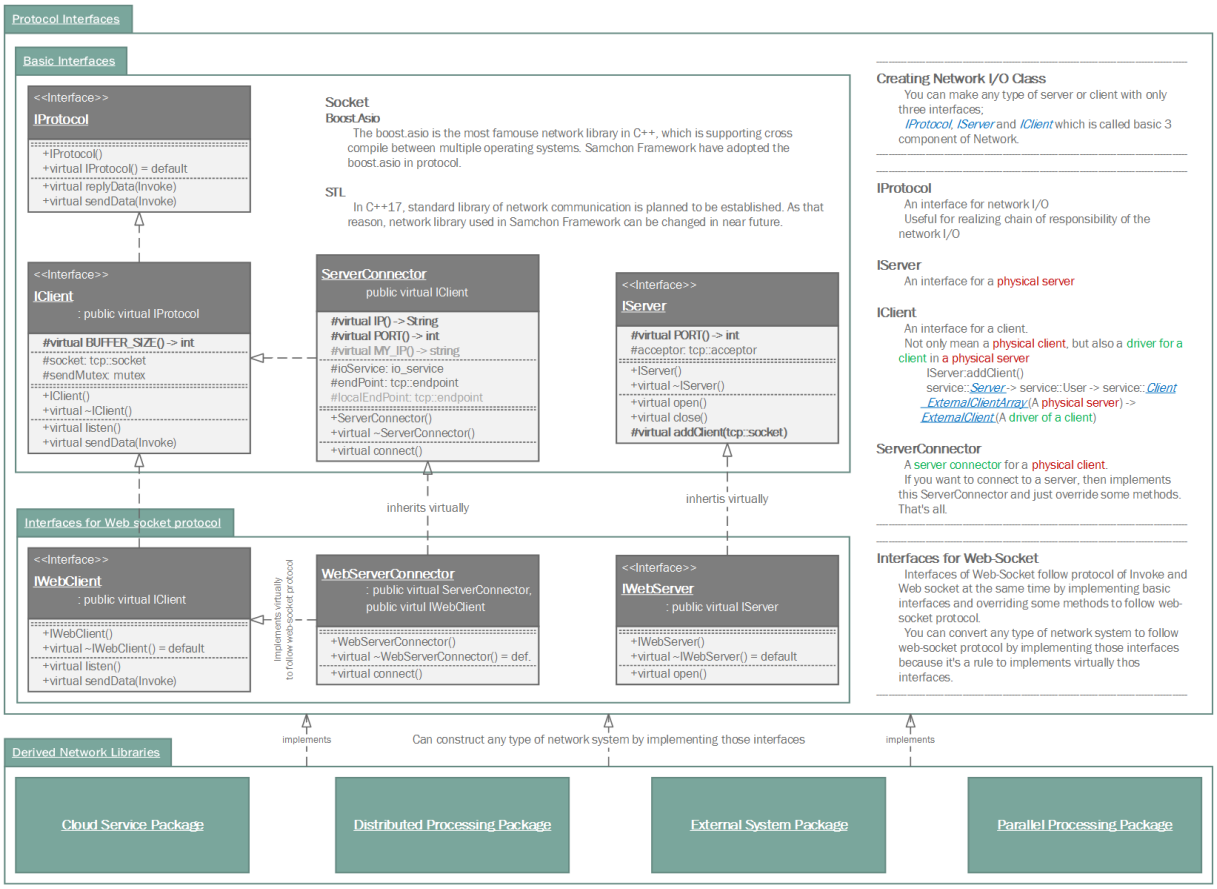
- IProtocol ()
  *Default Constructor.*
- virtual void replyData (std::shared_ptr< Invoke >)
  *Reply a message.*
- virtual void sendData (std::shared_ptr< Invoke >)
  *Send a message.*

### 6.75.1 Detailed Description

An interface of Invoke message chain.

IProtocol is an interface for Invoke message, which is standard message of network I/O in Samchon Framework, chain. The IProtocol interface is used to network drivers and some classes which are in a relationship of chain of responsibility with those network drivers.

IProtocol is one of the basic 3 + 1 components that can make any type of network system in Samchon Framework with IServer and IClient. Following the "chain of responsibility" pattern, looking around classes in Samchon Framework, you can see all related classes with network I/O are implemented from the IProtocol.




**Author**

Jeongho Nam

### 6.75.2 Member Function Documentation

#### 6.75.2.1 virtual void replyData ( std::shared_ptr< Invoke > ) [virtual]

Reply a message.

Handles a replied Invoke message or shifts the responsibility to related chain.

**Parameters**

| | |
|---|---|
| *invoke* | An Invoke message gotten from a network system |

Reimplemented in User, Client, DistributedSystem, ExternalSystemArray, ExternalSystem, DistributedSlaveSystemMediator, and ParallelSlaveSystemMediator.

#### 6.75.2.2 virtual void sendData ( std::shared_ptr< Invoke > ) [virtual]

Send a message.

Sends Invoke message to a network system or shifts the responsibility to related chain.

**Parameters**

| | |
|---|---|
| *invoke* | An Invoke message to send to a network system |

Reimplemented in User, DistributedSystem, Client, ExternalSystemRole, ExternalSystemArray, DistributedSystemRole, Service, IClient, and IWebClient.

The documentation for this class was generated from the following files:

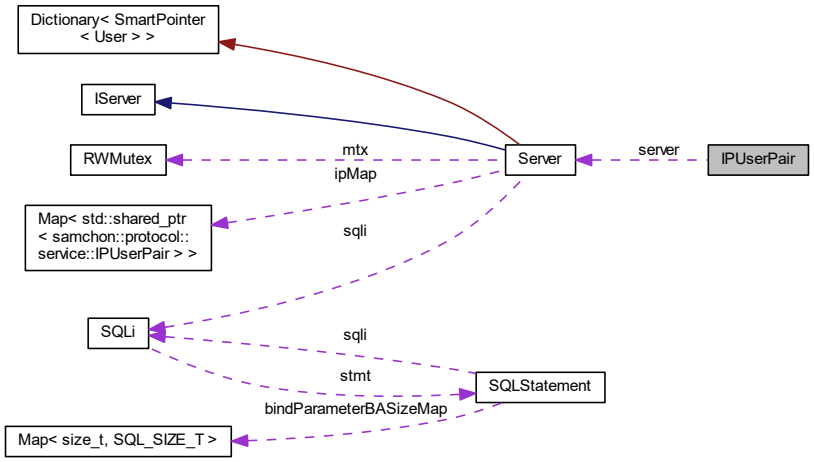
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IProtocol.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IProtocol.cpp

## 6.76 IPUserPair Class Reference

Relationship between IP address and User for issuing session.

`#include <IPUserPair.hpp>`

Collaboration diagram for IPUserPair:




### Private Member Functions

- IPUserPair (Server *server, const std::string &)

  *Construct from Server and IP address.*
- auto getSessionID (Socket *, size_t) -> std::string

  *Get a session ID.*
- auto issueSessionID (size_t) const -> std::string

  *Issue a session ID.*

### Private Attributes

- Server * server

  *The Server containing IP addresses and User(s)*
- std::string ip

*An IP address.*

– std::set< const User * > userSet

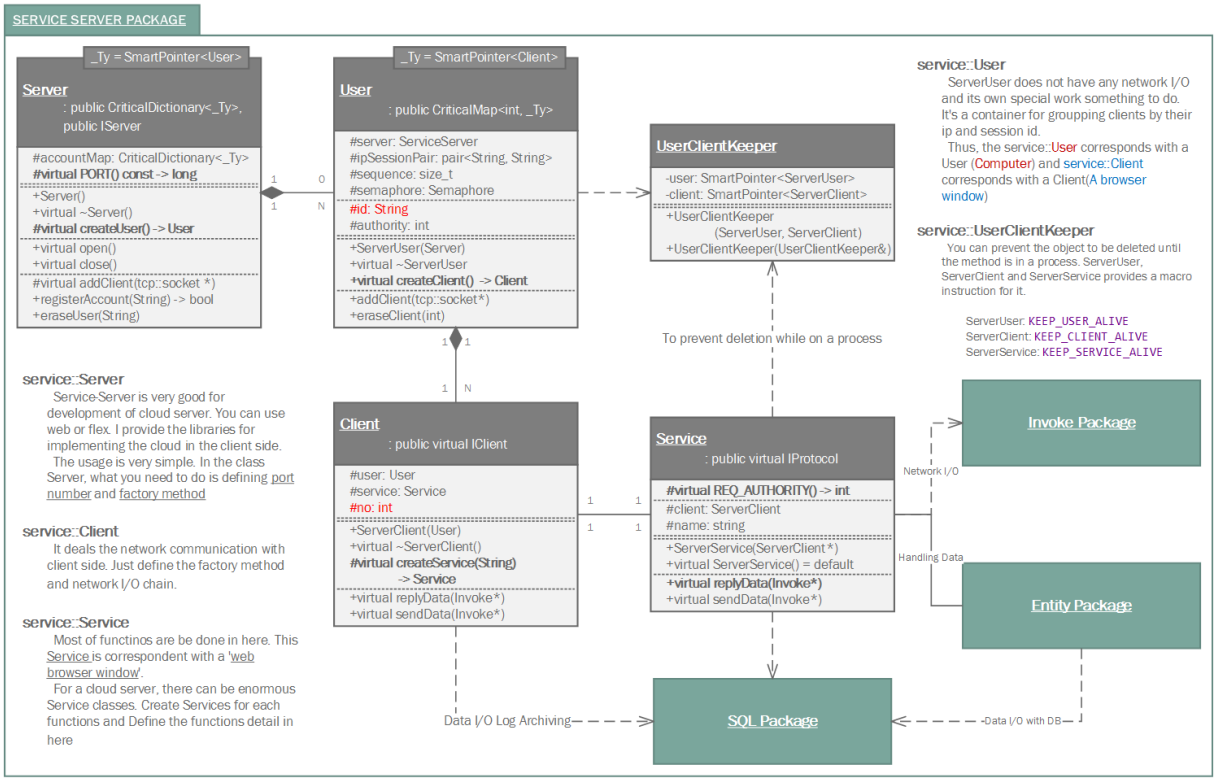
*User(s) belongs to the IP address.*

### 6.76.1 Detailed Description

Relationship between IP address and User for issuing session.

IPUserPair is a class representing 1:N relationship between IP address and User.

The key role of IPUserPair is to issuing session ID, that is published to User(s), within a critical section of an IP address.




#### Note

Samchon Framework is for Cloud Server basically, so I've adopted Session ID to discriminate unique User to follow standard. But I think there can be another good strategies something like a using MAC address instead of publishing Session-ID to discriminate uniqueness of User. It's okay to adapt those strategies and rebuild my framework's source to be suitable for those.

#### Warning

When changing the strategy, you've to careful about policy of each system or libraries.

Followings are something to consider when adjusting MAC address for uniqueness.

– In server side and view of socket, boost::asio or candidate network i/o libary of stl does not allow accessing otherside system's MAC address. But basic socket of window or linux are allowed.

– In client side and view of browser, IE allows to get MAC address by javascript with ActiveX, but other browsers do not allow.

**See also**

samchon::protocol
samchon::protocol::service

**Author**

Jeongho Nam

### 6.76.2 Member Function Documentation

#### 6.76.2.1 auto getSessionID ( Socket * *socket,* size_t *sequence* ) -> std::string [private]

Get a session ID.

Asks Whether client to have a session id stored in cookie.

If client has, get the session id from client, but if not, issues a new session ID and notify it(enrolled new session ID) to client. Additionally, if the session id was gotten from a client, inspect validate of the session ID.

Those tasks will hold a critical section of a global IP address

**Warning**

The session id must be unique

**Returns**

A new session ID that can ensure uniqueness

#### 6.76.2.2 auto issueSessionID ( size_t *sequence* ) const -> std::string [private]

Issue a session ID.

Issues a session ID when a target client haven't issued seesion ID yet

**Default organization of the Session ID**

- {$name}::{$port}::{$sequence}::{$linux_time}
  1. $name: Name of the Server; Server::NAME()
  2. $port: Port number of the Server; Server::PORT()
  3. $sequence: Sequence number of creation of User in Server
  4. $linux_time: Linux time of current time.
     If the object Server is re-constructed, $sequence can be duplicated. $linux_time is to avoid the duplication so that can ensure uniqueness on session id

The documentation for this class was generated from the following files:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/service/IPUserPair.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/service/IPUserPair.cpp

## 6.77 IServer Class Reference

An interface of a physical server.

```
#include <IServer.hpp>
```

### Public Member Functions

- IServer ()

  *Default Constructor.*
- virtual void open ()

  *Open the server.*
- virtual void close ()

  *Close the server.*

### Protected Member Functions

- virtual auto MY_IP () const -> std::string

  *(optional) Server's IP*
- virtual auto PORT () const -> int=NULL

  *Port number of the server.*
- virtual void addClient (Socket *)=0

  *Handling connection of a physical client.*

### Protected Attributes

- Acceptor * acceptor

  *An acceptor for clients.*

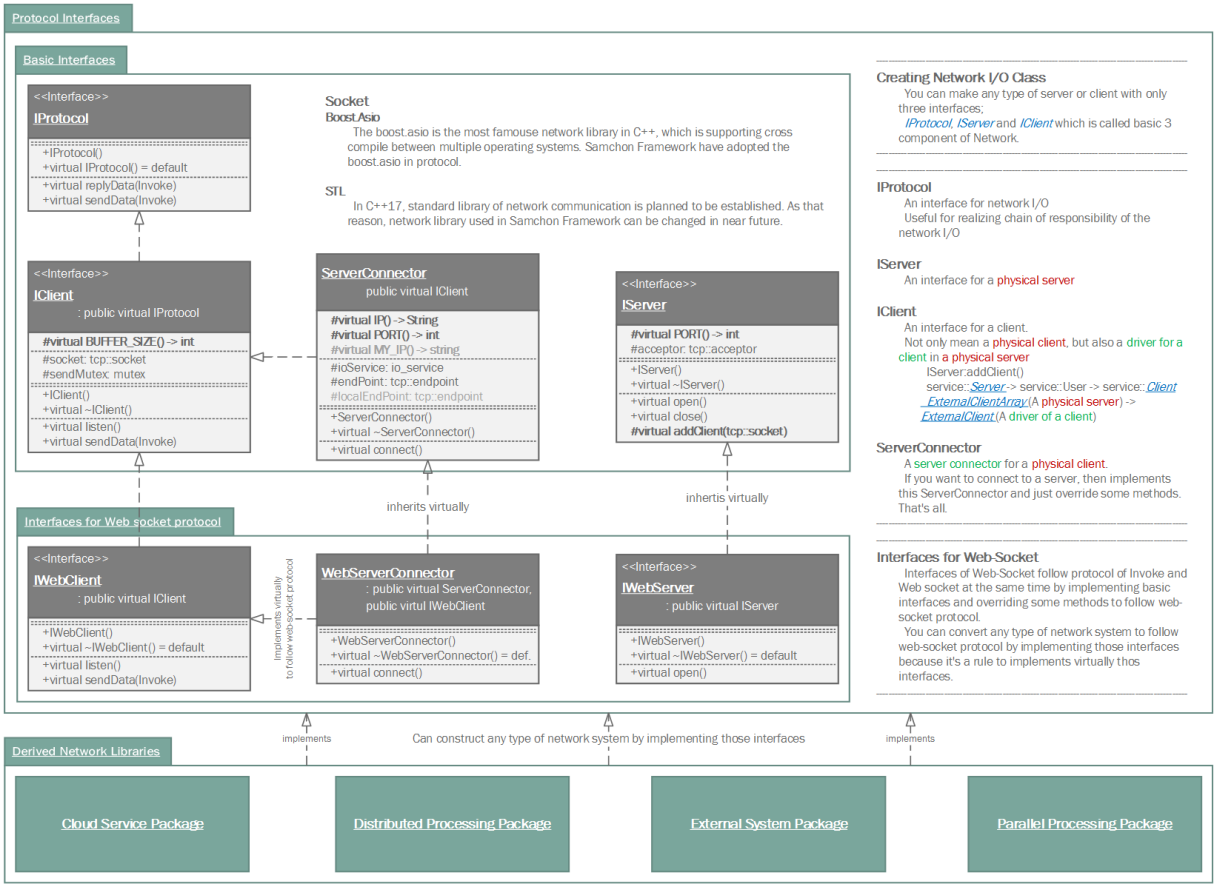
## 6.77.1 Detailed Description

An interface of a physical server.

IServer provides methods for opening a server.

IServer is one of the basic 3 + 1 components that can make any type of network system in Samchon Framework with IProtocol and IClient. Looking around classes in Samchon Framework, you can see all servers are implemented from the IServer.

When a client connects to the server, the abstract method IServer::addClient() is called with a new thread. If you want to accept only a client at a time, use OneToOneServer instead.




### Example source

A simple chat server running on console

**examples/console_chat_server/ChatServer.hpp**

```
1 #pragma once
2 #include <samchon/protocol/IServer.hpp>
3 #include <samchon/protocol/IProtocol.hpp>
4
5 #include <set>
6 #include <samchon/library/RWMutex.hpp>
7
8 namespace samchon
9 {
10     namespace example
11     {
21         namespace console_chat_server
22         {
23             class ChatClient;
24
30             class ChatServer
31                 : public protocol::IServer,
32                 public protocol::IProtocol
33             {
34             private:
35                 typedef protocol::IServer super;
36
40                 std::set<ChatClient*> clientSet;
41
45                 library::RWMutex rwMutex;
46
47             public:
51                 ChatServer();
52                 virtual ~ChatServer() = default;
53
57                 void eraseClient(ChatClient *client);
58
59             protected:
63                 virtual auto PORT() const -> int override
64                 {
65                     return 37749;
66                 };
```

```
67
71                  virtual void addClient(protocol::Socket *socket) override;
72
73              public:
80                  virtual void replyData(std::shared_ptr<protocol::Invoke>) override;
81
88                  virtual void sendData(std::shared_ptr<protocol::Invoke>) override;
89              };
90          };
91      };
92 };
```

### examples/console_chat_server/ChatServer.cpp

```
1 #include <samchon/examples/console_chat_server/ChatServer.hpp>
2 #include <samchon/examples/console_chat_server/ChatClient.hpp>
3
4 #include <thread>
5 #include <samchon/protocol/Invoke.hpp>
6
7 using namespace std;
8 using namespace samchon::library;
9 using namespace samchon::protocol;
10 using namespace samchon::example::console_chat_server;
11
12 ChatServer::ChatServer()
13     : super()
14 {
15 }
16 void ChatServer::addClient(Socket *socket)
17 {
18     ChatClient *client = new ChatClient(this, socket);
19
20     UniqueWriteLock uk(rwMutex);
21     clientSet.insert(client);
22
23     thread(&ChatClient::listen, client).detach();
24 }
25 void ChatServer::eraseClient(ChatClient *client)
26 {
27     UniqueWriteLock uk(rwMutex);
28     clientSet.erase(client);
29 }
30
31 void ChatServer::replyData(shared_ptr<Invoke> invoke)
32 {
33     sendData(invoke);
34 }
35 void ChatServer::sendData(shared_ptr<Invoke> invoke)
36 {
37     UniqueReadLock uk(rwMutex);
38
39     for(auto it = clientSet.begin(); it != clientSet.end(); it++)
40         (*it)->sendData(invoke);
41 }
```

### examples/console_chat_server/ChatClient.hpp

```
1 #pragma once
2 #include <samchon/protocol/IClient.hpp>
3
4 namespace samchon
5 {
6     namespace example
7     {
8         namespace console_chat_server
9         {
10             class ChatServer;
11
21             class ChatClient
22                 : public protocol::IClient
23             {
24             private:
25                 typedef protocol::IClient super;
26
30                 ChatServer *server;
31
32             public:
39                 ChatClient(ChatServer*, protocol::Socket*);
40
45                 virtual ~ChatClient();
46
51                 virtual void replyData(std::shared_ptr<protocol::Invoke>) override;
52             };
53         };
54     };
```

```
};
```

**examples/console_chat_server/ChatClient.cpp**

```
#include <samchon/examples/console_chat_server/ChatClient.hpp>
#include <samchon/examples/console_chat_server/ChatServer.hpp>

#include <samchon/protocol/Invoke.hpp>

using namespace std;
using namespace samchon::library;
using namespace samchon::protocol;
using namespace samchon::example::console_chat_server;

ChatClient::ChatClient(ChatServer *server, Socket *socket)
    : super()
{
    this->server = server;
    this->socket = socket;
}
ChatClient::~ChatClient()
{
    server->eraseClient(this);
}

void ChatClient::replyData(shared_ptr<Invoke> invoke)
{
    server->replyData(invoke);
}
```

**examples/console_chat_server/main.cpp**

```
#include <iostream>
#include <samchon/examples/console_chat_server/ChatServer.hpp>

#ifdef _WIN64
#   ifdef _DEBUG
#       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "x64/Release/SamchonFramework.lib")
#   endif
#else
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

using namespace samchon::example::console_chat_server;

void main()
{
    ChatServer chatServer;
    chatServer.open();

    system("pause");
}
```

**Author**

Jeongho Nam

### 6.77.2 Member Function Documentation

#### 6.77.2.1 void open ( ) [virtual]

Open the server.

**Note**

It holds (monopolies) a thread.

Reimplemented in IWebServer.

The documentation for this class was generated from the following files:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IServer.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IServer.cpp

## 6.78 ISQLEntity Class Reference

An interface supporting DB-I/O.

```
#include <ISQLEntity.hpp>
```

### Public Member Functions

- ISQLEntity ()

  *Default Constructor.*
- virtual void load (std::shared_ptr< library::SQLStatement > stmt)

  *Load data of entity from DB.*
- virtual void archive (std::shared_ptr< library::SQLStatement > stmt)

  *Archive data of entity to DB.*
- virtual auto toSQL () const -> std::string

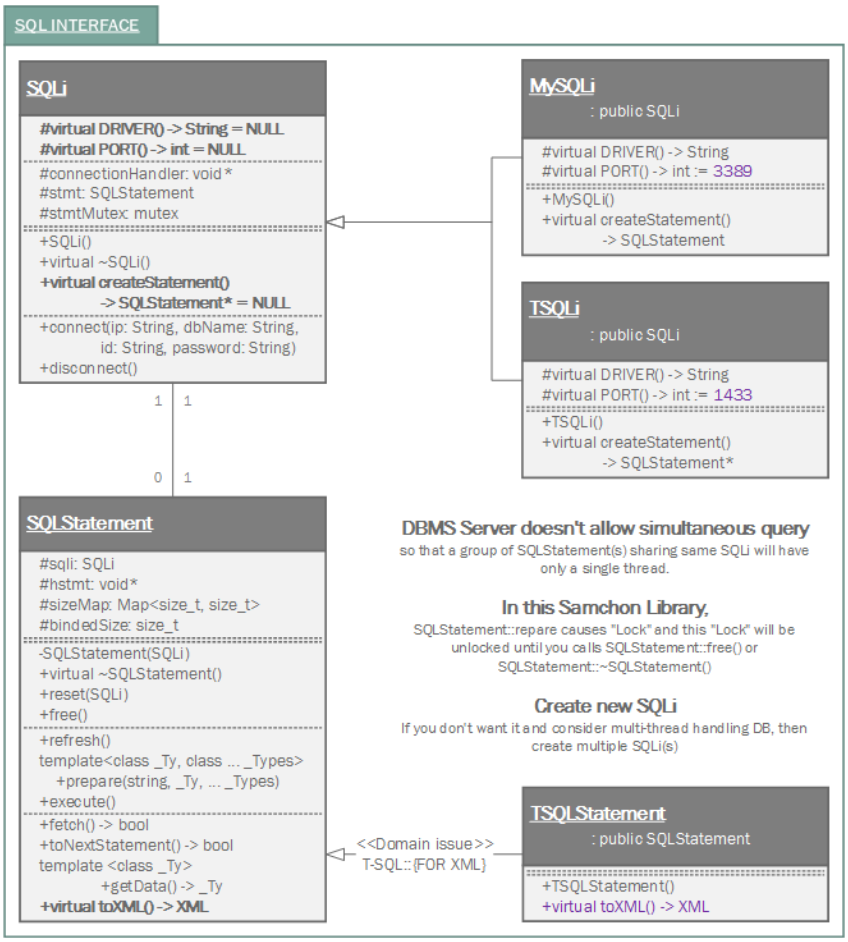
  *Get a sql-statement string represents the entity.*

### 6.78.1 Detailed Description

An interface supporting DB-I/O.

ISQLEntity is an interface for interacting with Database. By implementing load() and archive() methods, you can make an entity to interact with a Database.

If an entity implementing the ISQLEntity is a type of EntityGroup and its children also implemented the IS↩QLEntity, you can realize construction and archiving chain by each child entity to do their I/O procedures by their own.



**Author**

Jeongho Nam

### 6.78.2 Member Function Documentation

#### 6.78.2.1 void load ( std::shared_ptr< library::SQLStatement > *stmt* ) [virtual]

Load data of entity from DB.

Loads and constructs data of the entity from a SQLStatement.

If an entity implementing the ISQLEntity is a type of EntityGroup and its children also implemented the ISQLEntity, you can realize construction chain by each child entity fetches data of their own by themselves.

**Parameters**

| | |
|---|---|
| *stmt* | SQLStatement storing data of the Entity |

#### 6.78.2.2 void archive ( std::shared_ptr< library::SQLStatement > *stmt* ) [virtual]

Archive data of entity to DB.

Archives data of the entity to Database by a SQLStatement.

If an entity implementing the ISQLEntity is a type of EntityGroup and its children also implemented the ISQLEntity, you can realize archiving chain by each child entity archives data of their own by themselves.

**Parameters**

| | |
|---|---|
| *stmt* | SQLStatement would store data of the Entity |

#### 6.78.2.3 auto toSQL ( ) const -> std::string [virtual]

Get a sql-statement string represents the entity.

ISQLEntity::toSL() is an abstract method returns a sql-statement string.

However, if there's some parameter in a sql-statement string from the toString() method, it is categorized in dynamic sql. In that case, do not access table directly but indirect from sql-procedure. Indirecting procedure is good for performance and security.

**Returns**

SQL storing record(s) to temporary table of a Procedure

The documentation for this class was generated from the following files:

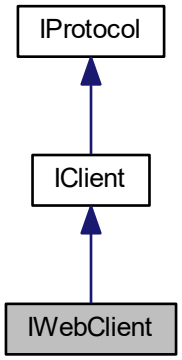
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ISQLEntity.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ISQLEntity.cpp

## 6.79 IWebClient Class Reference

An interface for a web-client.

```
#include <IWebClient.hpp>
```

Collaboration diagram for IWebClient:




### Public Member Functions

- IWebClient ()

  *Default Constructor.*
- virtual void listen () override

  *Listens message from a related system.*
- virtual void sendData (std::shared_ptr< Invoke >) override

  *Send Invoke message following web-socket protocol.*

### Additional Inherited Members

### 6.79.1 Detailed Description

An interface for a web-client.

IWebClient is a IClient following web-socket protocol.

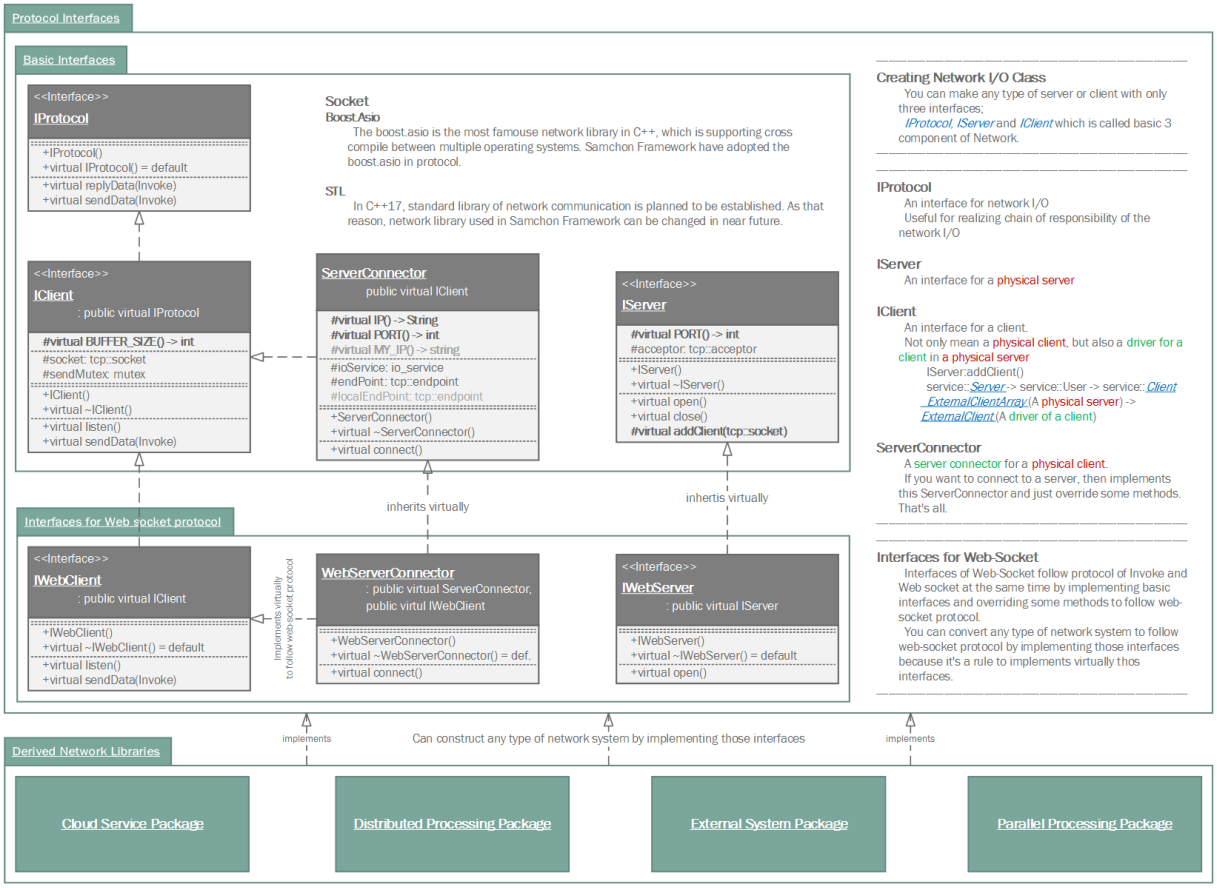
**[Inherited]**

IClient is an interface not only for a physical client, but also a driver for a client in a physical server.

- IServer:addClient()
  - service::Server -> service::User -> service::Client
  - ExternalClientArray (A physical server) -> ExternalClient (A driver of a client)

IClient is one of the basic 3 + 1 components that can make any type of network system in Samchon Framework with IProtocol and IServer. Looking around classes in Samchon Framework, you can see all classes related with client are implemented from the IClient.

IClient takes a role of real network I/O. IClient sends data to otherside network system from IProtocol::send↩Data(). IClient also gets data from otherside network system, generates standard Invoke message from parsing the replied data and shift the Invoke message to IProtocol::replyData().




**Author**

Jeongho Nam

## 6.79.2 Member Function Documentation

### 6.79.2.1 virtual void listen ( ) [override], [virtual]

Listens message from a related system.

**Note**

It holds (monopolies) a thread.

Reimplemented from IClient.

### 6.79.2.2 virtual void sendData ( std::shared_ptr< Invoke > ) [override], [virtual]

Send Invoke message following web-socket protocol.

**Parameters**

| | |
|---|---|
| *invoke* | Invoke message to send associated network system. |

Reimplemented from IClient.

The documentation for this class was generated from the following file:

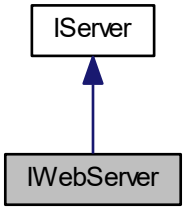
– D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IWebClient.hpp

## 6.80 IWebServer Class Reference

An interface for a physical server following web-socket.

```
#include <IWebServer.hpp>
```

Collaboration diagram for IWebServer:




### Public Member Functions

- IWebServer ()

  *Default Constructor.*
- virtual void open () override

  *Open the web-socket server.*

### Additional Inherited Members

### 6.80.1 Detailed Description

An interface for a physical server following web-socket.

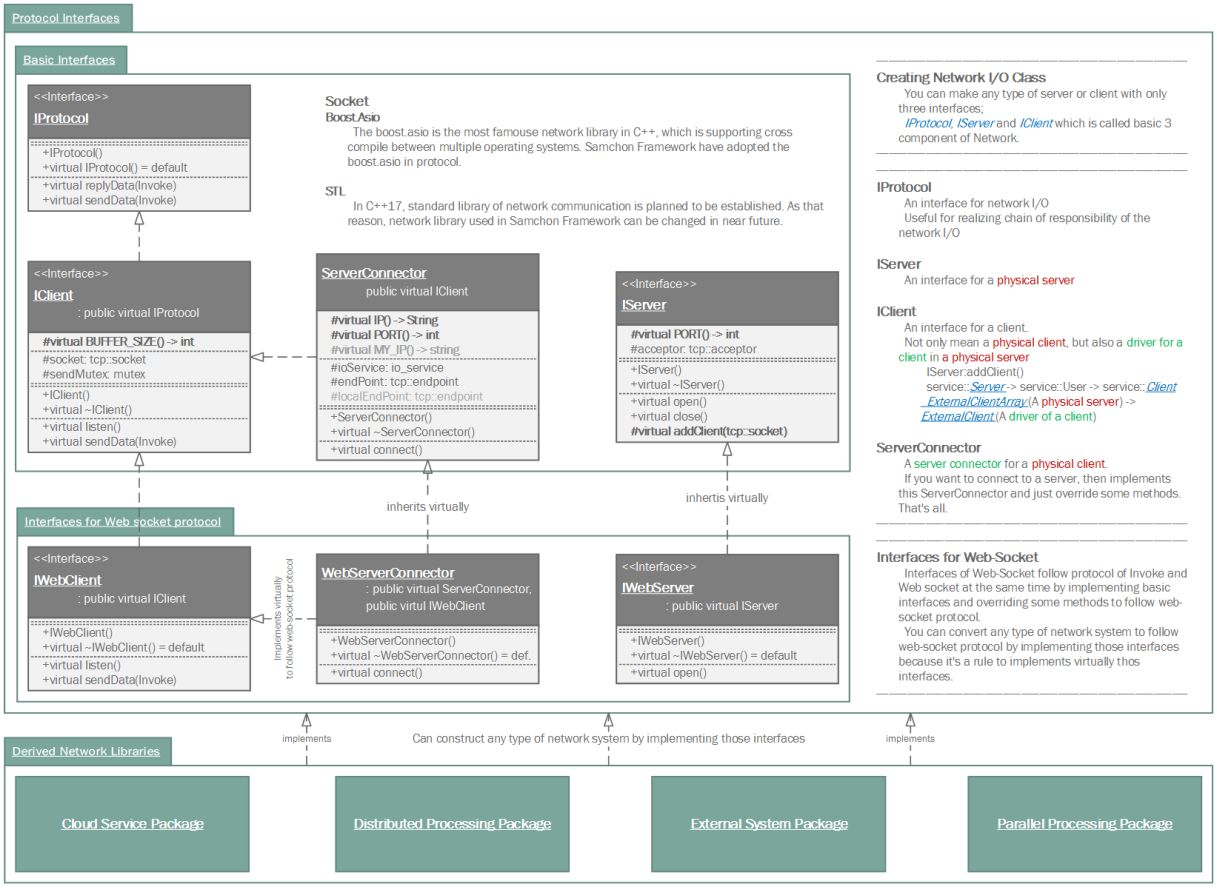
IWebServer is a IServer following web-socket protocol.

**[Inherited]**

IServer provides methods for opening a server.

IServer is one of the basic 3 + 1 components that can make any type of network system in Samchon Framework with IProtocol and IClient. Looking around classes in Samchon Framework, you can see all servers are implemented from the IServer.

When a client connects to the server, the abstract method IServer::addClient() is called with a new thread. If you want to accept only a client at a time, use OneToOneServer instead.




### Example source

A simple chat server running on console

**examples/console_chat_server/ChatServer.hpp**

```
1 #pragma once
2 #include <samchon/protocol/IServer.hpp>
3 #include <samchon/protocol/IProtocol.hpp>
4
5 #include <set>
6 #include <samchon/library/RWMutex.hpp>
7
8 namespace samchon
9 {
10     namespace example
11     {
21         namespace console_chat_server
22         {
23             class ChatClient;
24
30             class ChatServer
31                 : public protocol::IServer,
32                 public protocol::IProtocol
33             {
34             private:
35                 typedef protocol::IServer super;
36
40                 std::set<ChatClient*> clientSet;
41
45                 library::RWMutex rwMutex;
46
47             public:
51                 ChatServer();
52                 virtual ~ChatServer() = default;
53
57                 void eraseClient(ChatClient *client);
58
59             protected:
63                 virtual auto PORT() const -> int override
64                 {
65                     return 37749;
66                 };
```

```
67
71                  virtual void addClient(protocol::Socket *socket) override;
72
73              public:
80                  virtual void replyData(std::shared_ptr<protocol::Invoke>) override;
81
88                  virtual void sendData(std::shared_ptr<protocol::Invoke>) override;
89              };
90          };
91      };
92 };
```

### examples/console_chat_server/ChatServer.cpp

```
1 #include <samchon/examples/console_chat_server/ChatServer.hpp>
2 #include <samchon/examples/console_chat_server/ChatClient.hpp>
3
4 #include <thread>
5 #include <samchon/protocol/Invoke.hpp>
6
7 using namespace std;
8 using namespace samchon::library;
9 using namespace samchon::protocol;
10 using namespace samchon::example::console_chat_server;
11
12 ChatServer::ChatServer()
13     : super()
14 {
15 }
16 void ChatServer::addClient(Socket *socket)
17 {
18     ChatClient *client = new ChatClient(this, socket);
19
20     UniqueWriteLock uk(rwMutex);
21     clientSet.insert(client);
22
23     thread(&ChatClient::listen, client).detach();
24 }
25 void ChatServer::eraseClient(ChatClient *client)
26 {
27     UniqueWriteLock uk(rwMutex);
28     clientSet.erase(client);
29 }
30
31 void ChatServer::replyData(shared_ptr<Invoke> invoke)
32 {
33     sendData(invoke);
34 }
35 void ChatServer::sendData(shared_ptr<Invoke> invoke)
36 {
37     UniqueReadLock uk(rwMutex);
38
39     for(auto it = clientSet.begin(); it != clientSet.end(); it++)
40         (*it)->sendData(invoke);
41 }
```

### examples/console_chat_server/ChatClient.hpp

```
1 #pragma once
2 #include <samchon/protocol/IClient.hpp>
3
4 namespace samchon
5 {
6     namespace example
7     {
8         namespace console_chat_server
9         {
10             class ChatServer;
11
21             class ChatClient
22                 : public protocol::IClient
23             {
24             private:
25                 typedef protocol::IClient super;
26
30                 ChatServer *server;
31
32             public:
39                 ChatClient(ChatServer*, protocol::Socket*);
40
45                 virtual ~ChatClient();
46
51                 virtual void replyData(std::shared_ptr<protocol::Invoke>) override;
52             };
53         };
54     };
```

```
};
```

**examples/console_chat_server/ChatClient.cpp**

```
#include <samchon/examples/console_chat_server/ChatClient.hpp>
#include <samchon/examples/console_chat_server/ChatServer.hpp>

#include <samchon/protocol/Invoke.hpp>

using namespace std;
using namespace samchon::library;
using namespace samchon::protocol;
using namespace samchon::example::console_chat_server;

ChatClient::ChatClient(ChatServer *server, Socket *socket)
    : super()
{
    this->server = server;
    this->socket = socket;
}
ChatClient::~ChatClient()
{
    server->eraseClient(this);
}

void ChatClient::replyData(shared_ptr<Invoke> invoke)
{
    server->replyData(invoke);
}
```

**examples/console_chat_server/main.cpp**

```
#include <iostream>
#include <samchon/examples/console_chat_server/ChatServer.hpp>

#ifdef _WIN64
#   ifdef _DEBUG
#       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "x64/Release/SamchonFramework.lib")
#   endif
#else
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

using namespace samchon::example::console_chat_server;

void main()
{
    ChatServer chatServer;
    chatServer.open();

    system("pause");
}
```

**Author**

Jeongho Nam

### 6.80.2 Member Function Documentation

#### 6.80.2.1 virtual void open ( ) [override],[virtual]

Open the web-socket server.

Accepts clients and handshake with them following web-socket protocol.

**Note**

It monopolies a thread.

Reimplemented from IServer.

The documentation for this class was generated from the following file:

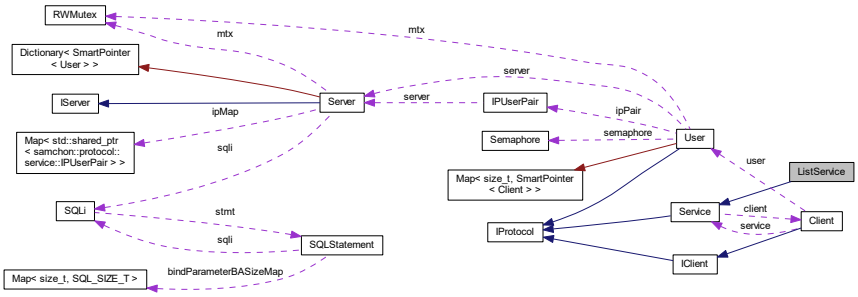
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/IWebServer.hpp

## 6.81 ListService Class Reference

A list service of chat rooms.

```
#include <ListService.hpp>
```

Collaboration diagram for ListService:




### Public Member Functions

- ListService (protocol::service::Client *)

  *Construct from a client.*

### Private Member Functions

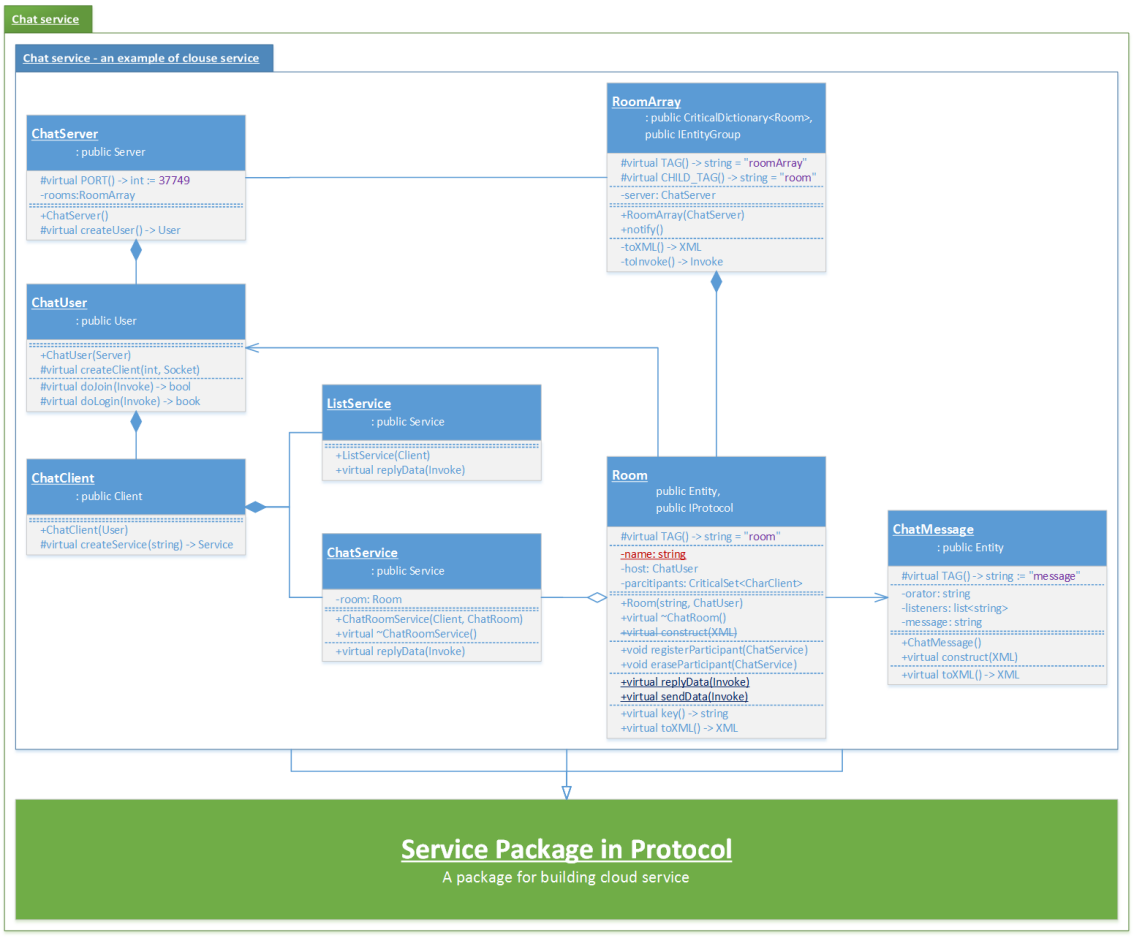
- void createRoom (const std::string &)

  *Create a chat room.*

### Additional Inherited Members

### 6.81.1 Detailed Description

A list service of chat rooms.




**Author**

Jeongho Nam

### 6.81.2 Member Function Documentation

#### 6.81.2.1 void createRoom ( const std::string & ) [private]

Create a chat room.

**Parameters**

| | |
|---|---|
| *name* | Name of the candidate room to create. |

The documentation for this class was generated from the following file:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/chat_service/ListService.hpp

## 6.82 Map< _Kty, _Ty, _Pr, _Alloc > Class Template Reference

Map.

```
#include <Map.hpp>
```

### Public Member Functions

- auto has (const _Kty &key) const -> bool

  *Whether have the item or not.*

- auto get (const _Kty &key) -> _Ty &
  *Get element.*
- void set (const _Kty &key, const _Ty &val)
  *Set element.*
- auto pop (const _Kty &key) -> _Ty
  *Pop item.*

### 6.82.1 Detailed Description

**template<typename _Kty, typename _Ty, typename _Pr = std::less<_Kty>, typename _Alloc = std::allocator<std::pair<const _Kty, _Ty>>>class samchon::Map< _Kty, _Ty, _Pr, _Alloc >**

Map.

Map is a std::map some methods are modified

- Addicted methods
  - has(find(key) != end()) method is addicted
  - at method is addicted
  - set method is addicted
  - pop method is addicted
- Modified methods
  - at was depreciated (get is different with at)

**[Inherited]**

Maps are associative containers that store elements formed by a combination of a key value and a mapped value, following a specific order.

In a map, the key values are generally used to sort and uniquely identify the elements, while the mapped values store the content associated to this key. The types of key and mapped value may differ, and are grouped together in member type value_type, which is a pair type combining both:

- typedef pair<const Key, T> value_type;

Internally, the elements in a map are always sorted by its key following a specific strict weak ordering criterion indicated by its internal comparison object (of type Compare).

map containers are generally slower than unordered_map containers to access individual elements by their key, but they allow the direct iteration on subsets based on their order.

Maps are typically implemented as binary search trees.

The mapped values in a map can be accessed directly by their corresponding key using the bracket operator ((operator[]).

Maps are typically implemented as binary search trees.

Referenced comments of std::map

- http://www.cplusplus.com/reference/map/map/

**Template Parameters**

| | |
|---|---|
| *_Kty* | |

Type of the keys. Each element in a map is uniquely identified by its key value.

Aliased as member type map::key_type.

**Template Parameters**

| | |
|---|---|
| *_Ty* | |

Type of the mapped value. Each element in a map stores some data as its mapped value.

Aliased as member type map::mapped_type.

**Template Parameters**

| | |
|---|---|
| *_Pr* | |

A binary predicate that takes two element keys as arguments and returns a bool. The expression comp(a,b), where comp is an object of this type and a and b are key values, shall return true if a is considered to go before b in the strict weak ordering the function defines.

The map object uses this expression to determine both the order the elements follow in the container and whether two element keys are equivalent (by comparing them reflexively: they are equivalent if !comp(a,b) && !comp(b,a)). No two elements in a map container can have equivalent keys.

This can be a function pointer or a function object. This defaults to std::less<T>, which returns the same as applying the less-than operator (a<b).

Aliased as member type map::key_compare.

**Template Parameters**

| | |
|---|---|
| *_Alloc* | |

Type of the allocator object used to define the storage allocation model. By default, the allocator class template is used, which defines the simplest memory allocation model and is value-independent.

Aliased as member type map::allocator_type.

**Author**

Jeongho Nam

### 6.82.2 Member Function Documentation

#### 6.82.2.1 auto has ( const _Kty & *key* ) const -> bool [inline]

Whether have the item or not.

Indicates whether a map has an item having the specified identifier.

**Parameters**

| | |
|---|---|
| *key* | Key value of the element whose mapped value is accessed. |

**Returns**

Whether the map has an item having the specified identifier

#### 6.82.2.2 auto get ( const _Kty & *key* ) -> _Ty& [inline]

Get element.

Returns a reference to the mapped value of the element identified with key

**Warning**

get is different with std::map's at. get does not create object but throws excention if the matched key doesn't exist.

**Parameters**

| | |
|---|---|
| *key* | Key value of the element whose mapped value is accessed. |

**Exceptions**

| | |
|---|---|
| *exception* | out of range |

**Returns**

A reference object of the mapped value (_Ty)

#### 6.82.2.3 void set ( const _Kty & *key*, const _Ty & *val* ) [inline]

Set element.

Set an item as the specified identifier.

If the identifier is already in map, change value of the identifier.
If not, then insert the object with the identifier.

**Parameters**

| | |
|---|---|
| *key* | Key value of the element whose mapped value is accessed. |
| *val* | Value, the item. |

#### 6.82.2.4 auto pop ( const _Kty & *key* ) -> _Ty [inline]

Pop item.

Removes an item having specified key and returns the removed element.

**Returns**

An item released by pop

The documentation for this class was generated from the following file:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/Map.hpp

## 6.83 Math Class Reference

Utility of Math.

```
#include <Math.hpp>
```

### Static Public Member Functions

- static auto random () -> double
  *Get a random value.*
- static auto degree_to_radian (double) -> double
  *Convert degree to radian.*
- static auto radian_to_degree (double) -> double
  *Convert radian to degree.*
- template<typename _Cont , typename _Ty = _Cont::value_type>
  static auto minimum (const _Cont &container) -> IndexPair< _Ty >
  *Calculate minimum value with its index.*
- template<typename _Cont , typename _Ty = _Cont::value_type>
  static auto maximum (const _Cont &container) -> IndexPair< _Ty >
  *Calculate maximum value with its index.*

- template<typename _Cont , typename _Ty = _Cont::value_type>
  static auto mean (const _Cont &container) -> double

  *Calculate average.*
- template<typename _Cont , typename _Ty = _Cont::value_type>
  static auto median (const _Cont &container) -> double

  *Get median value.*
- template<typename _Cont , typename _Ty = _Cont::value_type>
  static auto mode (const _Cont &container) -> _Ty

  *Find mode value.*
- template<typename _Cont , typename _Ty = _Cont::value_type>
  static auto stdev_p (const _Cont &container) -> double

  *Square root of a variance_p.*
- template<typename _Cont , typename _Ty = _Cont::value_type>
  static auto stdev_s (const _Cont &container) -> double

  *Square root of a variance_s.*
- template<typename _Cont , typename _Ty = _Cont::value_type>
  static auto variance_p (const _Cont &container) -> double

  *Calculate standard deviation for all population.*
- template<typename _Cont , typename _Ty = _Cont::value_type>
  static auto variance_s (const _Cont &container) -> double

  *Calculate variance for sample.*

### Static Public Attributes

- static const double E = exp(1.0)

  *Exponent.*
- static const double PI = 3.141592653589793

  *mber Pi*
- static const double LN2 = 1.0 / log2(E)

  *$log_e 2$*
- static const double LN10 = 1.0 / log10(E)

  *$log_e 10$*
- static const double LOG2E = log2(E)

  *$log_2 e$*
- static const double LOG10E = log10(E)

  *$log_{10} e$*
- static const double SQRT1_2 = sqrt(.5)

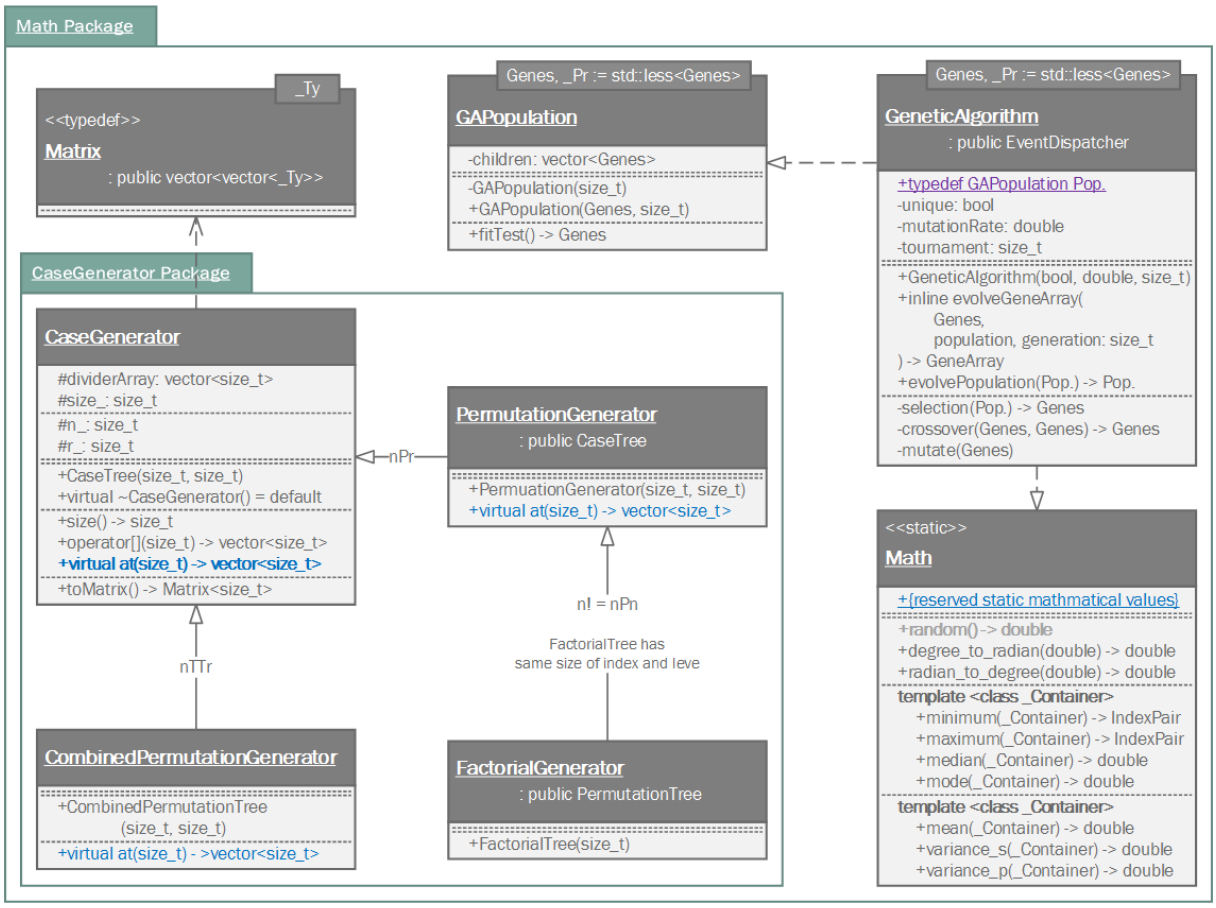
  *Squart root of 0.5.*
- static const double SQRT2 = sqrt(2.0)

  *Squart root of 2.*

## 6.83.1 Detailed Description

Utility of Math.

Provides some static values and mathmatical methods.




**See also**

samchon::library

**Author**

Jeongho Nam

## 6.83.2 Member Function Documentation

### 6.83.2.1 auto random ( ) -> double [static]

Get a random value.

Returns a random value following uniform distribution

**Returns**

The random value

### 6.83.2.2 static auto minimum ( const _Cont & *container* ) -> IndexPair<_Ty> [inline],[static]

Calculate minimum value with its index.

**Template Parameters**

| | |
|---|---|
| *_Cont* | Type of the container |
| *_Ty* | |

Value type of the container.

Do not modify the default template argument.

**Parameters**

| | |
|---|---|
| *container* | Container to find its minimum value |

**Returns**

Pair of minimum value and its index

#### 6.83.2.3 static auto maximum ( const _Cont & *container* ) -> IndexPair<_Ty> [inline],[static]

Calculate maximum value with its index.

**Template Parameters**

| | |
|---|---|
| *_Cont* | Type of the container |
| *_Ty* | |

Value type of the container.

Do not modify the default template argument.

**Parameters**

| | |
|---|---|
| *container* | Container to find its minimum value |

**Returns**

Pair of maximum value and its index

#### 6.83.2.4 static auto mean ( const _Cont & *container* ) -> double [inline],[static]

Calculate average.

**Template Parameters**

| | |
|---|---|
| *_Cont* | Type of the container |
| *_Ty* | |

Value type of the container.

Do not modify the default template argument.

**Parameters**

| | |
|---|---|
| *container* | Container to find its mean |

**Returns**

Average(mean) of the contaier

#### 6.83.2.5 static auto median ( const _Cont & *container* ) -> double [inline],[static]

Get median value.

**Template Parameters**

| | |
|---|---|
| *_Cont* | Type of the container |
| *_Ty* | |

Value type of the container.

Do not modify the default template argument.

**Parameters**

| | |
|---|---|
| *container* | Container to find its median |

**Returns**

Median value of the container

#### 6.83.2.6 static auto mode ( const _Cont & *container* ) -> _Ty [inline],[static]

Find mode value.

**Template Parameters**

| | |
|---|---|
| *_Cont* | Type of the container |
| *_Ty* | |

Value type of the container.

Do not modify the default template argument.

**Parameters**

| | |
|---|---|
| *container* | Container to find its mode |

**Returns**

Most appeared value in the container

#### 6.83.2.7 static auto stdev_p ( const _Cont & *container* ) -> double [inline],[static]

Square root of a variance_p.

$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

**Template Parameters**

| | |
|---|---|
| *_Cont* | Type of the container |
| *_Ty* | |

Value type of the container.

Do not modify the default template argument.

**Parameters**

| | |
|---|---|
| *container* | Container to find its standard deviation |

**Returns**

Standard deviation of the container

#### 6.83.2.8 static auto stdev_s ( const _Cont & *container* ) -> double [inline],[static]

Square root of a variance_s.

**Template Parameters**

| | |
|---|---|
| *_Cont* | Type of the container |
| *_Ty* | |

Value type of the container.

Do not modify the default template argument.

**Parameters**

| | |
|---|---|
| *container* | Container to find its variance |

**Returns**

Variance of the container

#### 6.83.2.9 static auto variance_p ( const _Cont & *container* ) -> double [inline], [static]

Calculate standard deviation for all population.

**Template Parameters**

| | |
|---|---|
| *_Cont* | Type of the container |
| *_Ty* | |

Value type of the container.

Do not modify the default template argument.

**Parameters**

| | |
|---|---|
| *container* | Container to find its standard deviation |

**Returns**

Standard deviation of the container

#### 6.83.2.10 static auto variance_s ( const _Cont & *container* ) -> double [inline], [static]

Calculate variance for sample.

**Template Parameters**

| | |
|---|---|
| *_Cont* | Type of the container |
| *_Ty* | |

Value type of the container.

Do not modify the default template argument.

**Parameters**

| | |
|---|---|
| *container* | Container to find its variance |

**Returns**

Variance of the container

### 6.83.3 Member Data Documentation

#### 6.83.3.1 const double E = exp(1.0) [static]

Exponent.

A mathematical constant for the base of natural logarithms, expressed as e. The approximate value of e is 2.71828182845905.

#### 6.83.3.2 const double PI = 3.141592653589793 [static]

mber Pi

A mathematical constant for the ratio of the circumference of a circle to its diameter, expressed as pi, with a value of 3.141592653589793.

#### 6.83.3.3 const double LN2 = 1.0 / log2(E) [static]

$\log_e 2$

A mathematical constant for the natural logarithm of 2, expressed as $\log_e 2$, with an approximate value of 0.6931471805599453.

#### 6.83.3.4 const double LN10 = 1.0 / log10(E) [static]

$\log_e 10$

A mathematical constant for the natural logarithm of 10, expressed as $\log_e 10$, with an approximate value of 2.302585092994046.

#### 6.83.3.5 const double LOG2E = log2(E) [static]

$\log_2 e$

A mathematical constant for the base-2 logarithm of the constant e, expressed as $\log_2 e$, with an approximate value of 1.442695040888963387.

#### 6.83.3.6 const double LOG10E = log10(E) [static]

$\log_{10} e$

A mathematical constant for the base-10 logarithm of the constant e (Math.E), expressed as $\log_{10} e$, with an approximate value of 0.4342944819032518. The Math.log() method computes the natural logarithm of a number. Multiply the result of Math.log() by Math.LOG10E to obtain the base-10 logarithm.

#### 6.83.3.7 const double SQRT1_2 = sqrt(.5) [static]

Squart root of 0.5.

A mathematical constant for the square root of one-half, with an approximate value of 0.7071067811865476.

#### 6.83.3.8 const double SQRT2 = sqrt(2.0) [static]

Squart root of 2.

A mathematical constant for the square root of 2, with an approximate value of 1.4142135623730951.

The documentation for this class was generated from the following files:

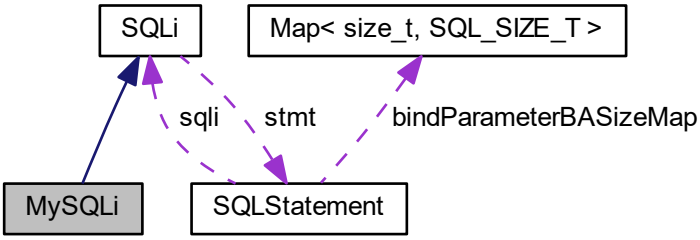
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Math.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Math.cpp

## 6.84 MySQLi Class Reference

A SQL interface for My-SQL.

```
#include <MySQLi.hpp>
```

Collaboration diagram for MySQLi:




### Public Member Functions

- MySQLi (int port=3306)

  *Construct from port.*

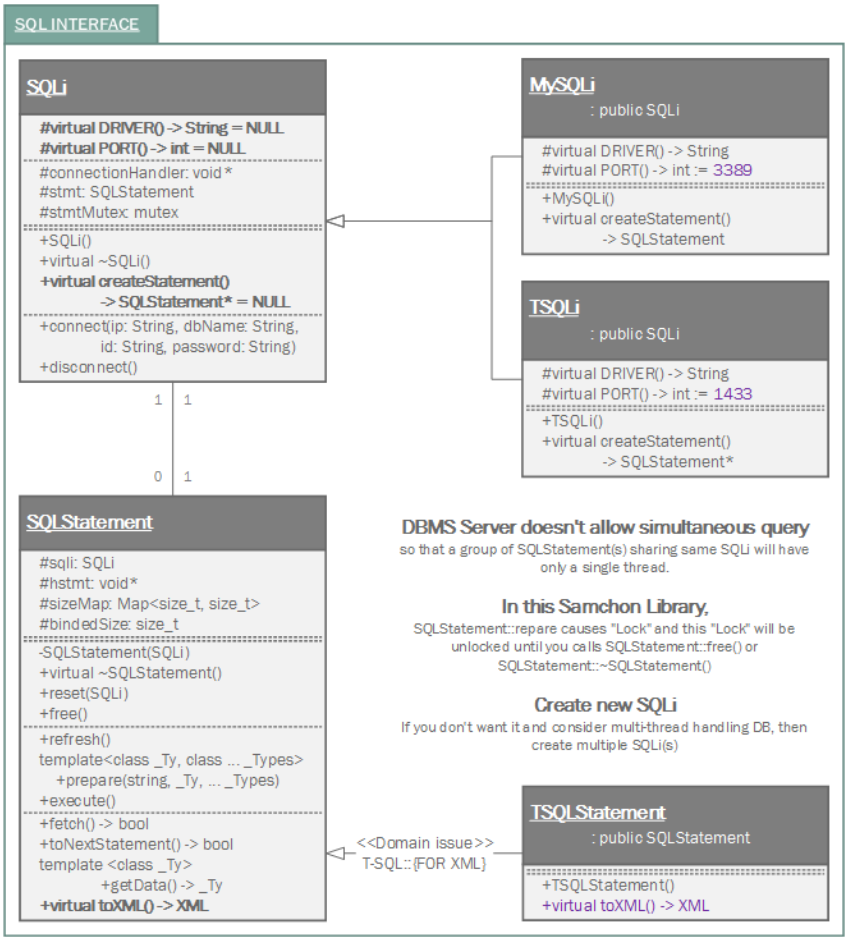
### Additional Inherited Members

### 6.84.1 Detailed Description

A SQL interface for My-SQL.

SQLi is an abstract class managing connection (session) with a specific database and manages SQL statements are executed and results are returned within the context of a connection.

The reason why SQLStatement(s) are managed by SQLi is because of a principle of DBMS, DBMS system doesn't allow simultaneous query from a session (connection). Only a query (process0) is allowed at a time. If you try to simultaneous query from a SQLi, ODBC throws error. To avoid the error, an execute of query from SQLStatement will lock a mutex of SQLi to ensure exclusiveness.




**Note**

To ensure the exclusiveness, you've to make SQLStatement from SQLi. Do not make SQLStatement by yourself. call SQLi::createSQLStatement() instead. Even you make a derived class from SQLStatement, don't make its constructor to have public accessor.

Becuase execution of a sql statement causes lock on mutex in SQLi, you've to destruct the SQLStatement or call SQLStatement::free() method(). If you don't, the mutex will not be unlocked, thus you can't do anything by the SQLi.

**See also**

samchon::library

**Author**

Jeongho Nam

### 6.84.2 Constructor & Destructor Documentation

#### 6.84.2.1 MySQLi ( int *port* = 3306 )

Construct from port.

**Parameters**

| | |
|---|---|
| *port* | Port number of My-SQL. default is 3306. |

The documentation for this class was generated from the following file:

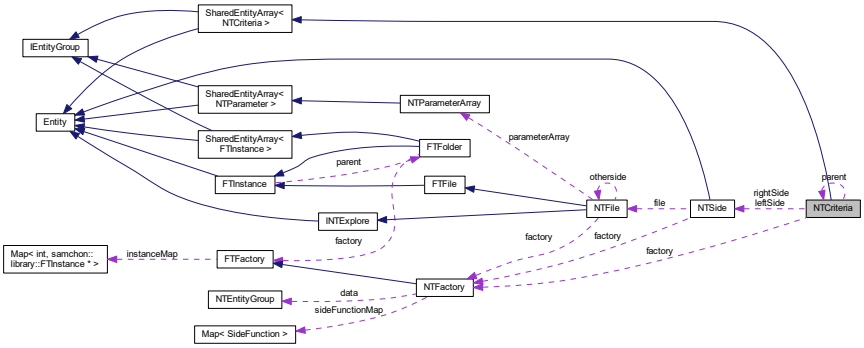
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/MySQLi.hpp

## 6.85 NTCriteria Class Reference

Criteria, a conditional expression with weight.

`#include <NTCriteria.hpp>`

Collaboration diagram for NTCriteria:




### Public Member Functions

- virtual void construct (std::shared_ptr< library::XML >) override
  *Construct data of the Entity from an XML object.*
- virtual auto TAG () const -> std::string override
  *A tag name when represented by XML.*
- virtual auto CHILD_TAG () const -> std::string override
  *A tag name of children.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override
  *Get an XML object represents the EntityGroup.*

### Protected Member Functions

- virtual auto createChild (std::shared_ptr< library::XML >) -> NTCriteria *override
  *Factory method of a child Entity.*

### 6.85.1 Detailed Description

Criteria, a conditional expression with weight.

NTCriteria is an object realizing ANN(Artificial Neural Network).

You can make the ANN model having weight and bias.

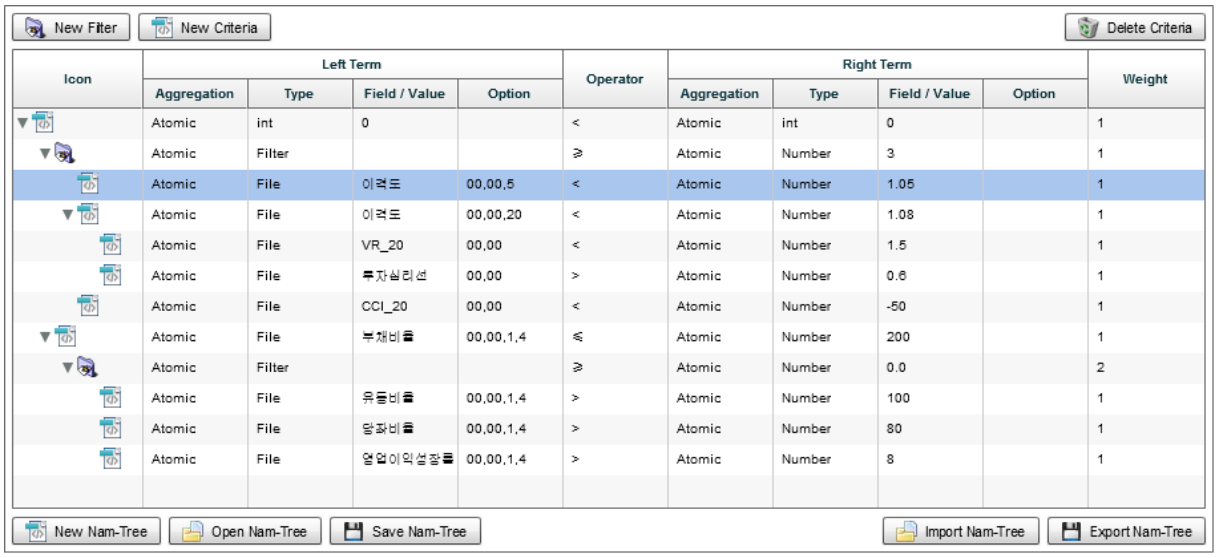
1. A conditional expression with weight
   F(x) = (NTSide < NTSide ? 1: 0) X weight
   NTCrietria is made up for conditional expression.
   - When the expression is true, returns 1 * weight

- When the expression is false, returns 0

2. Hierarchical relationship

   - In vertical relationship: multiply (X)
   - In horizontal relationship: plus (+)

With that rule, you can make enormous conditions. I can sure there's not any condition can'be be expressed by the model.




| Icon | Left Term | | | | Operator | Right Term | | | | Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| | Aggregation | Type | Field / Value | Option | | Aggregation | Type | Field / Value | Option | |
| | Atomic | int | 0 | | < | Atomic | int | 0 | | 1 |
| | Atomic | Filter | | | ≥ | Atomic | Number | 3 | | 1 |
| | Atomic | File | 이격도 | 00,00,5 | < | Atomic | Number | 1.05 | | 1 |
| | Atomic | File | 이격도 | 00,00,20 | < | Atomic | Number | 1.08 | | 1 |
| | Atomic | File | VR_20 | 00,00 | < | Atomic | Number | 1.5 | | 1 |
| | Atomic | File | 투자심리선 | 00,00 | > | Atomic | Number | 0.6 | | 1 |
| | Atomic | File | CCI_20 | 00,00 | < | Atomic | Number | -50 | | 1 |
| | Atomic | File | 부채비율 | 00,00,1,4 | ≤ | Atomic | Number | 200 | | 1 |
| | Atomic | Filter | | | ≥ | Atomic | Number | 0.0 | | 2 |
| | Atomic | File | 유동비율 | 00,00,1,4 | > | Atomic | Number | 100 | | 1 |
| | Atomic | File | 당좌비율 | 00,00,1,4 | > | Atomic | Number | 80 | | 1 |
| | Atomic | File | 영업이익성장률 | 00,00,1,4 | > | Atomic | Number | 8 | | 1 |

3. Making bias

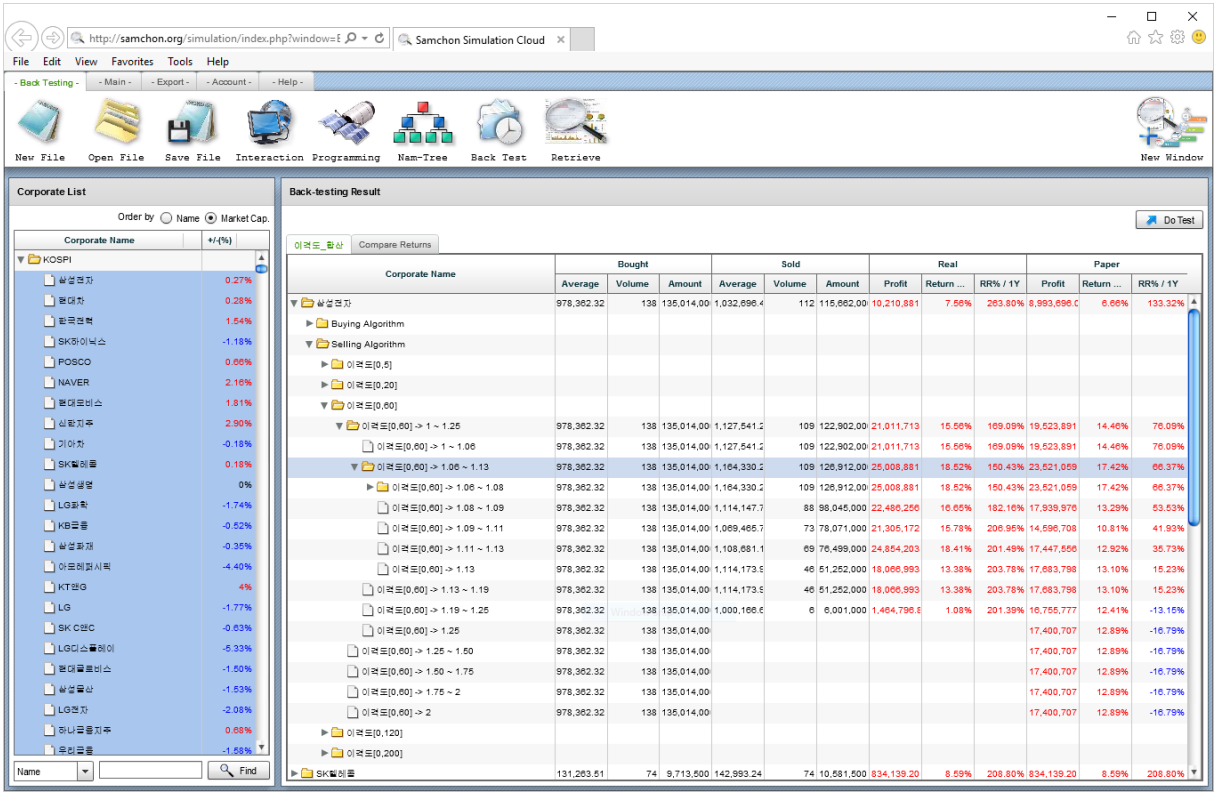
   Just make a NTCriteria returns only true.

   It's the bias returns only weight.

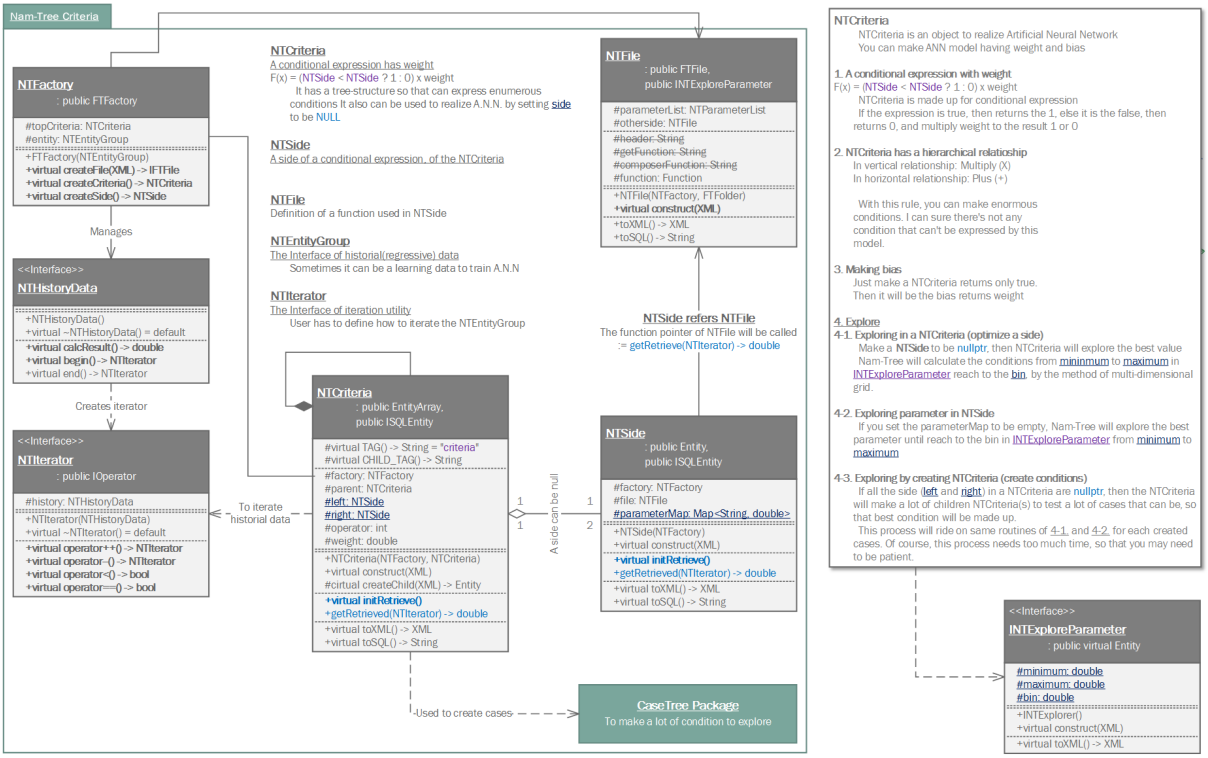
4. Explore

   (a) Exporing in a NTCriteria (optimize a side)
   Make a NTSide to be nullptr, then NTCriteria will explore the best value.
   Nam-Tree will calculate the condtions from minimum to maximum in INTExplore reach to the precision, by the method of multi-demensional grid.

   (b) Exploring parameter in NTSide
   If you set the parameterMNap to be empty, Nam-Tree will explore the best parameter until reach to the precision in INTExploreParameter from minimum to maximum.




(c) Exploring by creating NTCriteria
(Creates lots of hierarchical conditions and tests them)
If all the side (left and right) in a NTCriteria are nullptr, the NTCriteria will make a lot of children NTCriteria(s) to test lots of cases, so that derives the best condition set will be made up.
This process will ride on same routines of 4-1 and 4-2, for each created cases. Of course, this process needs too much time, so that you may need to be patient.



**See also**

samchon::namtree

**Author**

Jeongho Nam

### 6.85.2 Member Function Documentation

#### 6.85.2.1 void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Reimplemented from EntityGroup< _Container, _ETy, _Ty >.

#### 6.85.2.2 auto createChild ( std::shared_ptr< library::XML > ) -> NTCriteria *override [override], [protected], [virtual]

Factory method of a child Entity.

EntityGroup::createChild() is a factory method creating a new child Entity which is belonged to the Entity↩ Group. This method is called by EntityGroup::construct(). The children construction methods Entity↩ ::construct() will be called by abstract method of the EntityGroup::construct().

**Returns**

A new child Entity belongs to EntityGroup.

Implements EntityGroup< _Container, _ETy, _Ty >.

#### 6.85.2.3 auto TAG ( ) const -> std::string [override], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

#### 6.85.2.4 auto CHILD_TAG ( ) const -> std::string [override], [virtual]

A tag name of children.

< TAG>
<CHILD_TAG />
<CHILD_TAG />
</TAG>

Implements IEntityGroup.

#### 6.85.2.5 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Reimplemented from EntityGroup< _Container, _ETy, _Ty >.

The documentation for this class was generated from the following files:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTCriteria.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTCriteria.cpp

## 6.86 NTEntityGroup Class Reference

A historical, studying data.

```
#include <NTEntityGroup.hpp>
```

### Public Member Functions

- NTEntityGroup ()

  *Default Constructor.*
- virtual auto begin () const -> std::shared_ptr< NTIterator >=0

  *Return iterator to beginning.*
- virtual auto end () const -> std::shared_ptr< NTIterator >=0

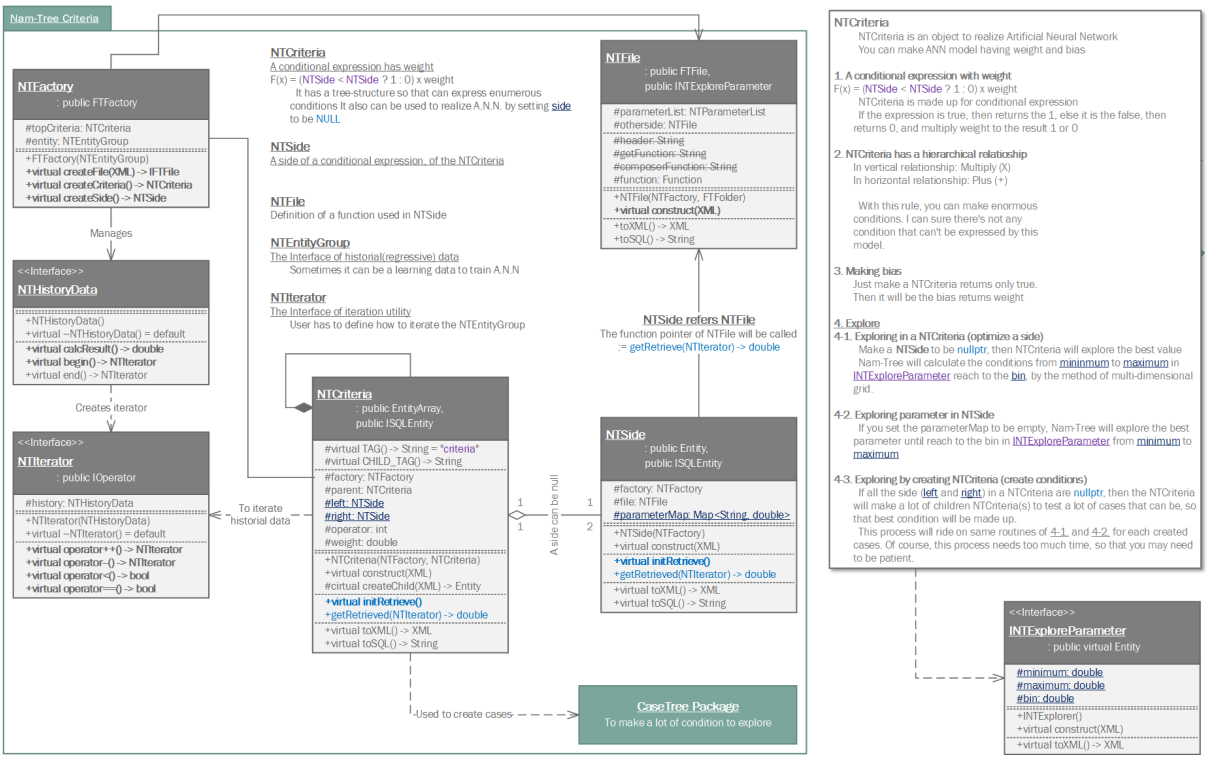
  *Return iterator to end.*

### 6.86.1 Detailed Description

A historical, studying data.

NTEntityGroup is an abstract class representing historical, regressive data

The NTEntitGroup is used to studying data evolving and training NTCriteria, representing Artificial neural network.




**See also**

samchon::namtree

**Author**

Jeongho Nam

## 6.86.2 Member Function Documentation

### 6.86.2.1 virtual auto begin ( ) const -> std::shared_ptr< NTIterator > [pure virtual]

Return iterator to beginning.

Returns an iterator referring the first element in the historical data container.

**Note**

If the container is empty, the returned iterator is same with end().

**Returns**

An iterator to the first element in the container.

The iterator containes the first element's pair; key and value.

### 6.86.2.2 virtual auto end ( ) const -> std::shared_ptr< NTIterator > [pure virtual]

Return iterator to end.

Returns an iterator referring to the past-the-end element in the historical data container.

The past-the-end element is the theoretical element that would follow the last element in the NTEntityGroup container. It does not point to any element, and thus shall not be dereferenced.

Because the ranges used by functions of the NTEntityGroup do not include the element reference by their closing iterator, this function is often used in combination with NTEntityGroup::begin() to specify a range including all the elements in the container.

**Note**

Returned iterator from NTEntityGroup::end() does not refer any element. Trying to accessing element by the iterator will cause throwing exception (out of range).

If the container is empty, this function returns the same as NTEntityGroup::begin().

The documentation for this class was generated from the following files:

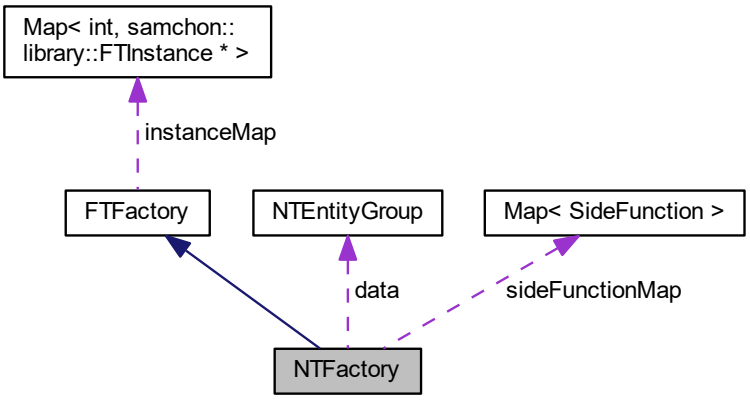
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTEntityGroup.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTEntityGroup.cpp

## 6.87 NTFactory Class Reference

A factory for Nam-Tree objects.

`#include <NTFactory.hpp>`

Collaboration diagram for NTFactory:




### Public Member Functions

- NTFactory (NTEntityGroup ∗)

  *Construct from historical(studying) data.*
- virtual auto createCriteria (NTCriteria ∗, std::shared_ptr< library::XML >) -> NTCriteria ∗

  *Factory method of a NTCriteria.*
- virtual auto createSide (std::shared_ptr< library::XML >) -> NTSide ∗

  *Factory method of a NTSide.*

### Protected Attributes

- NTEntityGroup ∗ data

  *A entity gorup containing historical data.*
- Dictionary< SideFunction > sideFunctionMap

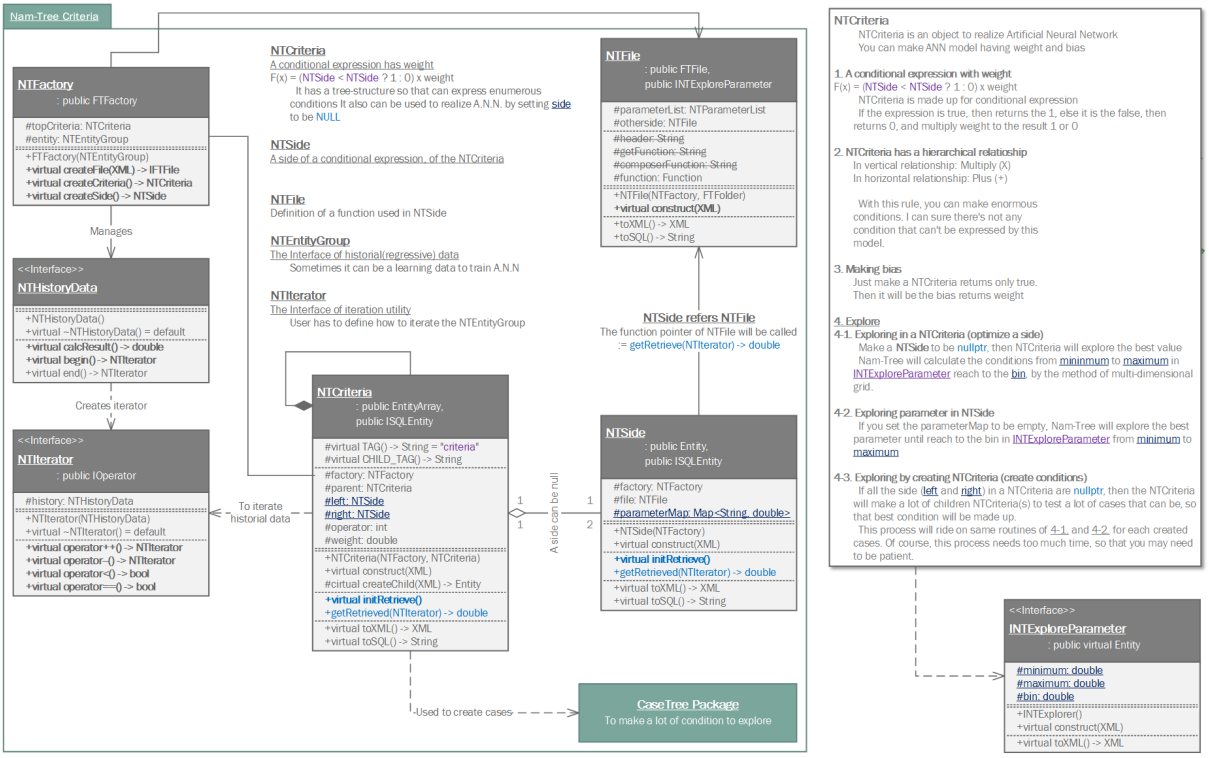
  *A dictionary of function pointers.*

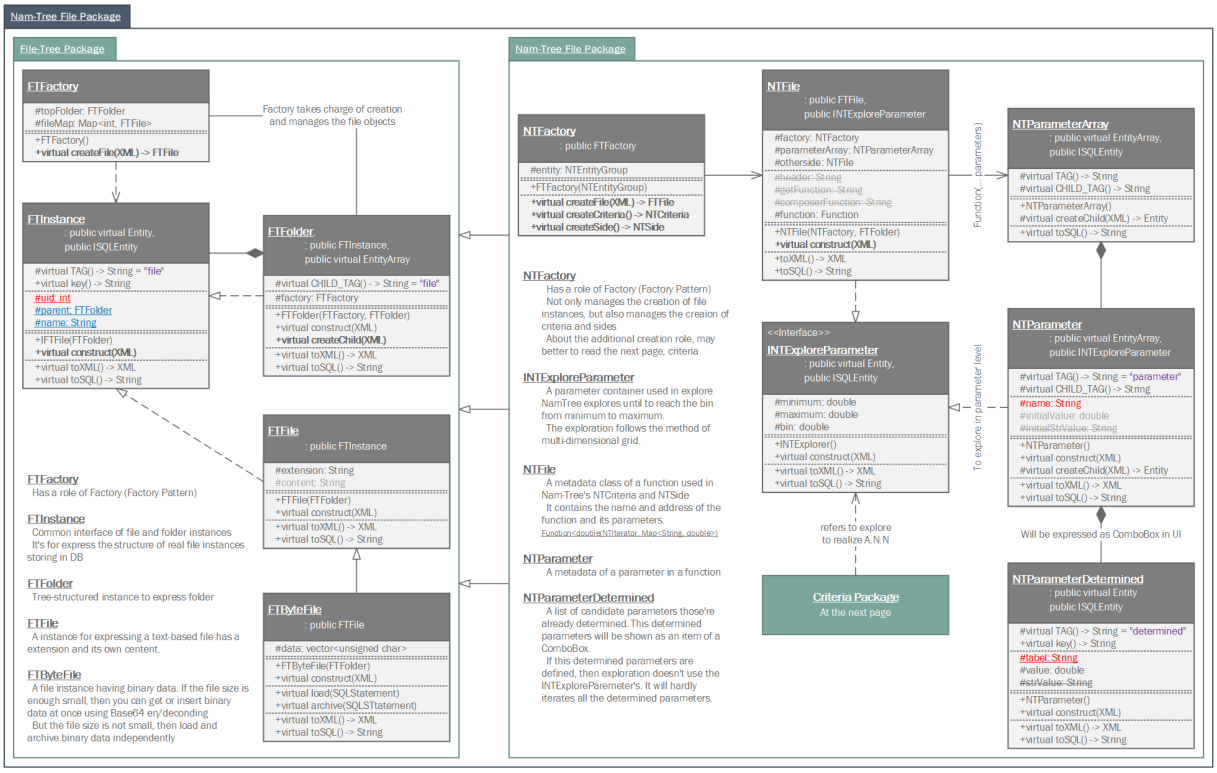
### 6.87.1 Detailed Description

A factory for Nam-Tree objects.

NTFactory class is a FTFactory and an abstract class creating and managing Nam-Tree objects. When overriding nam-tree module, do not override methods *createChild()* of file or criteria objects like NTFile, NT↩ Criteria and NTSide. Only overrides method of creation in the NTFactory.

- Creator method of history data is not in NTFactory. It must be done by hand of user.



**Note**

Previous version of the Samchon Framework, NTFile class had a function script on the NTFile and Nam-Tree module compiled the script like Nam-Tree moudle of Flex standalone that is keeping the compiling method.

However, modern Samchon Framework's C++ NTFile class doesn't have a function script and does not compile. I don't know a way to compile a script in lots of operating systems, so I dropped the compiling method. Until update, NTFactory has function pointers in a Dictionary and NTFile reference them. Users must put own methods into the Dictionary by their hands.

I will solve the problem sooon. Until next generation of Samchon Framework, put your own function pointers to a Dictionary in NTFactory by your hand please. Sorry for my unripe skill on programming.

**See also**

samchon::namtree

**Author**

Jeongho Nam

### 6.87.2 Constructor & Destructor Documentation

#### 6.87.2.1 NTFactory ( NTEntityGroup * *data* )

Construct from historical(studying) data.

**Parameters**

| | |
|---|---|
| *entity* | A group of history data. |

### 6.87.3 Member Function Documentation

#### 6.87.3.1 auto createCriteria ( NTCriteria *, std::shared_ptr< library::XML > ) -> NTCriteria* [virtual]

Factory method of a NTCriteria.

**Parameters**

| | |
|---|---|
| *parent* | A parent NTCriteria object xml An xml object for discriminating type. |

**Returns**

A NTCrteria object representing a logical conditional.

#### 6.87.3.2 auto createSide ( std::shared_ptr< library::XML > ) -> NTSide* [virtual]

Factory method of a NTSide.

**Parameters**

| | |
|---|---|
| *xml* | An xml oject for distriminating type. |

**Returns**

A NTSide object which means a side of a logical condition.

The documentation for this class was generated from the following files:

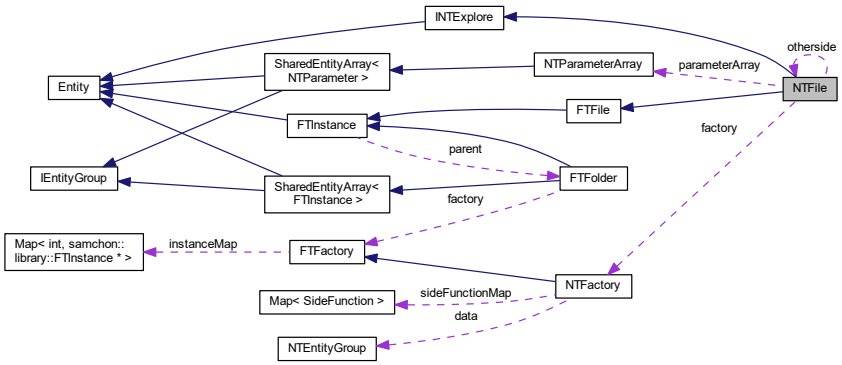
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTFactory.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTFactory.cpp

## 6.88 NTFile Class Reference

A file archiving metadata of a function.

`#include <NTFile.hpp>`

Collaboration diagram for NTFile:




### Public Member Functions

- NTFile (NTFactory ∗, library::FTFolder ∗)

  *Construct from factory and parent folder.*
- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*
- auto getParameterArray () const -> NTParameterArray ∗

  *Get metadata of parameters.*
- auto getOtherside () const -> NTFile ∗

  *Get otherside file.*
- auto getFunction () const -> SideFunction

  *Get function pointer.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the Entity.*

### Protected Attributes

- NTFactory ∗ factory

  *A factory and manager class for nam-tree.*
- NTParameterArray ∗ parameterArray

  *Metadata of parameters.*
- NTFile ∗ otherside

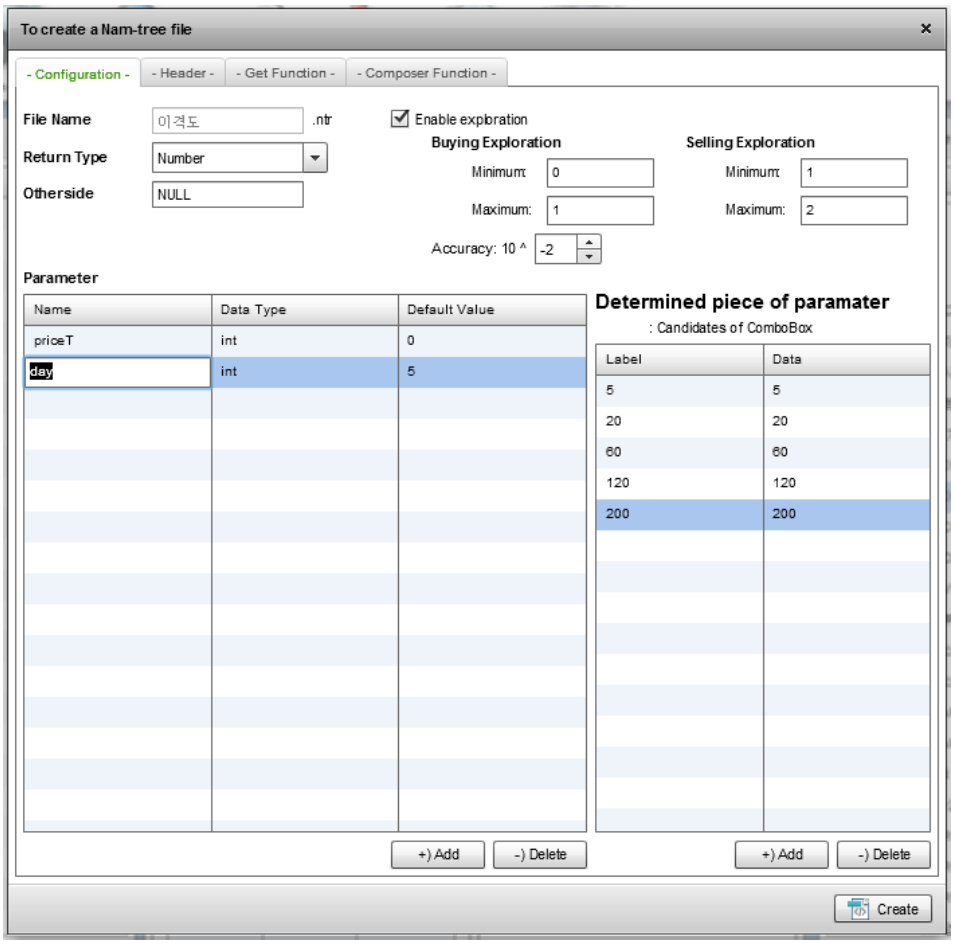
  *A file of otherside.*
- SideFunction function

  *A function pointer.*

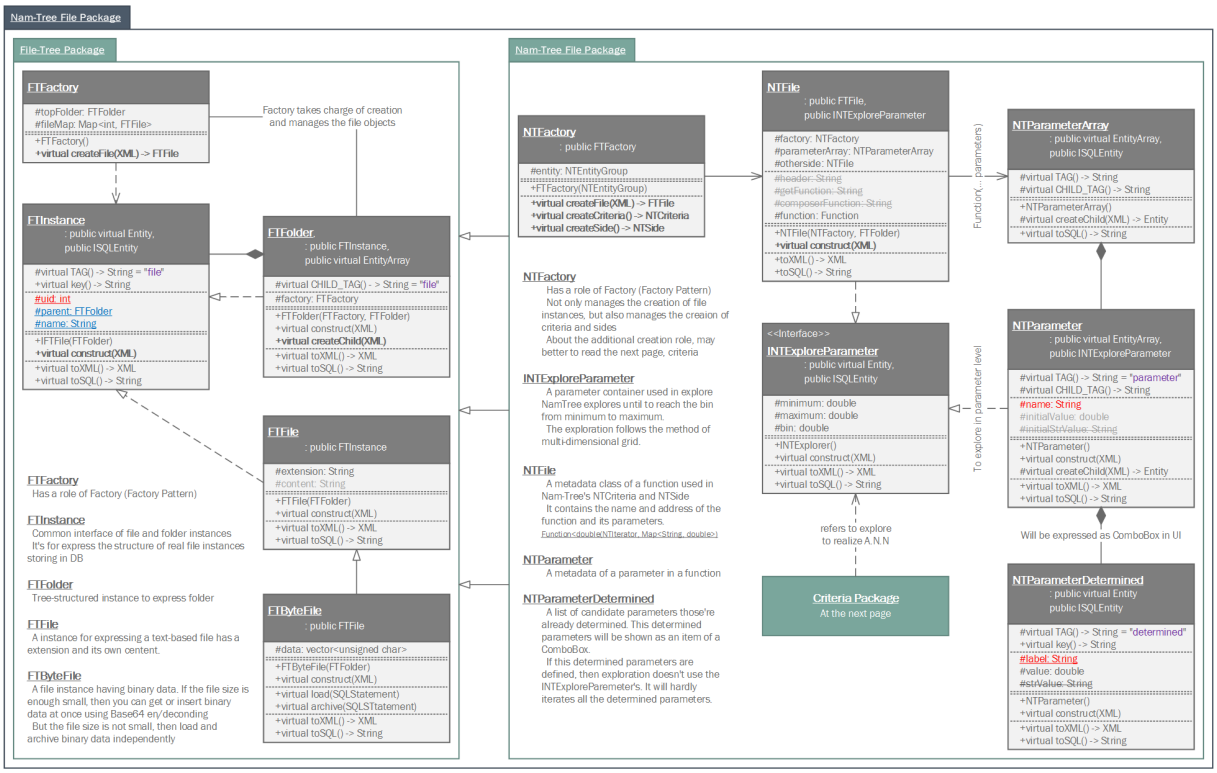
### Additional Inherited Members

### 6.88.1 Detailed Description

A file archiving metadata of a function.




NTFile class is a FTFile archiving meta of a function which is used by a NTSide class. It may better to understand what NTFile is, if you consider the NTFile as a header of a function. Name, metadata of parameters and function pointer is archived on the NTFile.




### Note

Previous version of the Samchon Framework, NTFile class had a function script on the NTFile and Nam-Tree module compiled the script like Nam-Tree moudle of Flex standalone that is keeping the compiling method.

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I will solve the problem sooon. Until next generation of Samchon Framework, put your own function pointers to a Dictionary in NTFactory by your hand please. Sorry for my unripe skill on programming.

### See also

samchon::namtree
namtree::NTSide

### Author

Jeongho Nam

## 6.88.2 Constructor & Destructor Documentation

### 6.88.2.1 NTFile ( NTFactory * *factory*, library::FTFolder * *parent* )

Construct from factory and parent folder.

**Parameters**

| | |
|---|---|
| *factory* | A factory class creating nam-tree objects. |

| | |
|---|---|
| *folder* | A parent folder of the NTFile. |

### 6.88.3 Member Function Documentation

#### 6.88.3.1 void construct ( std::shared_ptr< library::XML > ) [override], [virtual]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from INTExplore.

#### 6.88.3.2 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from FTFile.

### 6.88.4 Member Data Documentation

#### 6.88.4.1 NTFactory* factory [protected]

A factory and manager class for nam-tree.

NTFile references NTFactory to find otherside file and function pointer.

#### 6.88.4.2 NTFile* otherside [protected]

A file of otherside.

The variable otherside is a pair of file which is inserted to a criteria's opposite side.

When the otherside is specified and you determine the NTFile to be contained in a NTSide, the NTCriteria owning the NTSide will determine opposite side's NTSide to have the otherside NTFile forcibly.

**Note**

The determination will be automatic and unchangeble. Consider hardly when specifying an otherside.

The documentation for this class was generated from the following files:

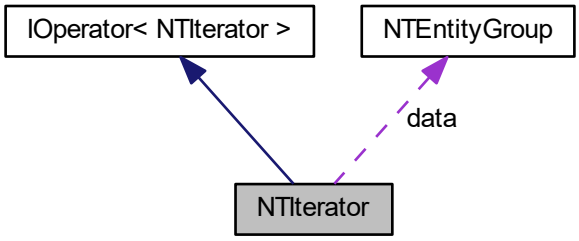
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTFile.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTFile.cpp

## 6.89 NTIterator Class Reference

Iterator of historical data.

`#include <NTIterator.hpp>`

Collaboration diagram for NTIterator:




### Public Member Functions

- NTIterator (const NTEntityGroup *)
  *Construt from historical data.*
- virtual auto operator-- () const -> std::shared_ptr< NTIterator >=0
  *Get iterator to previous element.*
- virtual auto operator++ () const -> std::shared_ptr< NTIterator >=0
  *Get iterator to next element.*
- virtual auto operator== (const NTIterator &) const -> bool=0
  *Whether an iterator is equal with the iterator.*
- virtual auto operator< (const NTIterator &) const -> bool=0
  *Whether the iterator is less than an iterator.*

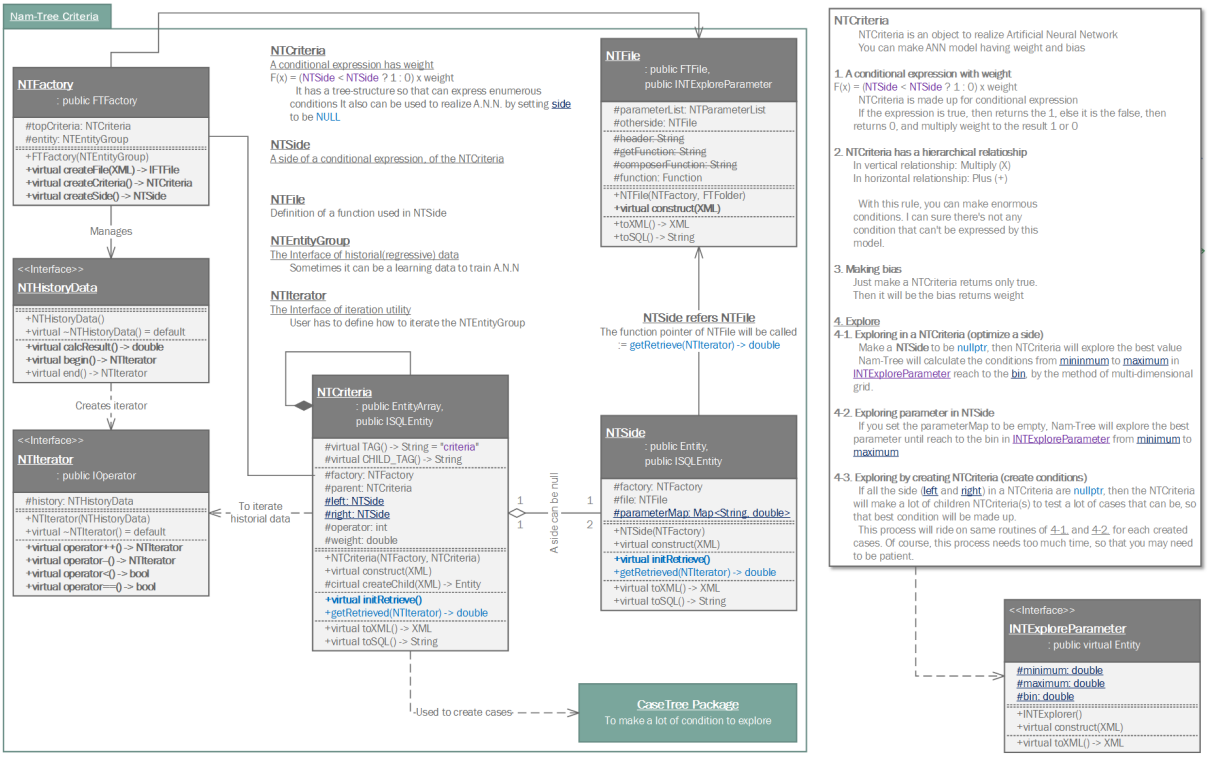
### Protected Attributes

- const NTEntityGroup * data
  *A historical data, source of the iterator.*

### 6.89.1 Detailed Description

Iterator of historical data.

NTIterator is an abstract iterator of NTEntityGroup.




### See also

samchon::namtree

### Author

Jeongho Nam

## 6.89.2 Member Function Documentation

### 6.89.2.1 virtual auto operator-- ( ) const -> std::shared_ptr< NTIterator > [pure virtual]

Get iterator to previous element.

If current iterator is the first item(equal with *begin()*), returns end().

**Returns**

An iterator of the previous item.

### 6.89.2.2 virtual auto operator++ ( ) const -> std::shared_ptr< NTIterator > [pure virtual]

Get iterator to next element.

If current iterator is the last item, returns end().

**Returns**

An iterator of the next item.

### 6.89.2.3 virtual auto operator== ( const NTIterator & ) const -> bool [pure virtual]

Whether an iterator is equal with the iterator.

Compare two iterators and returns whether they are equal or not.

**Parameters**

| | |
|---|---|
| *obj* | An iterator to compare |

**Returns**

Indicates whether equal or not.

#### 6.89.2.4 virtual auto operator< ( const NTIterator & ) const -> bool [pure virtual]

Whether the iterator is less than an iterator.

Compare two iterators and returns whether this iterator is less.

**Parameters**

| | |
|---|---|
| *obj* | An iterator to compare |

**Returns**

Indicates whether less or not.

The documentation for this class was generated from the following files:

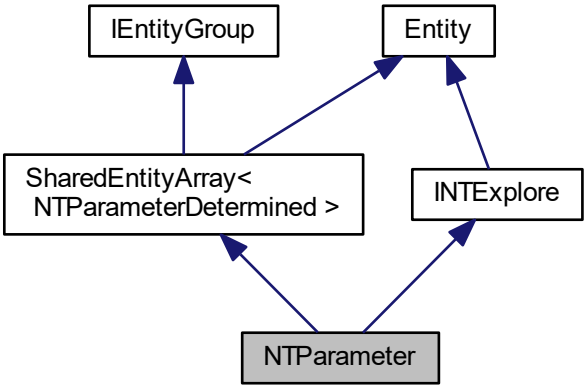
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTIterator.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTIterator.cpp

## 6.90 NTParameter Class Reference

A metadata of a parameter in a function.

`#include <NTParameter.hpp>`

Collaboration diagram for NTParameter:




### Public Member Functions

- NTParameter ()

  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override

*Construct data of the Entity from an XML object.*

- virtual auto key () const -> std::string override

  *Get a key that can identify the Entity uniquely.*
- auto getName () const -> std::string

  *Get name.*
- auto getInitialValue () const -> double

  *Get initial, default vlaue.*
- virtual auto TAG () const -> std::string override

  *A tag name when represented by XML.*
- virtual auto CHILD_TAG () const -> std::string override

  *A tag name of children.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the Entity.*

## Protected Member Functions

- virtual auto createChild (std::shared_ptr< library::XML >) -> NTParameterDetermined *override

  *Factory method of a child Entity.*

## Protected Attributes

- std::string name

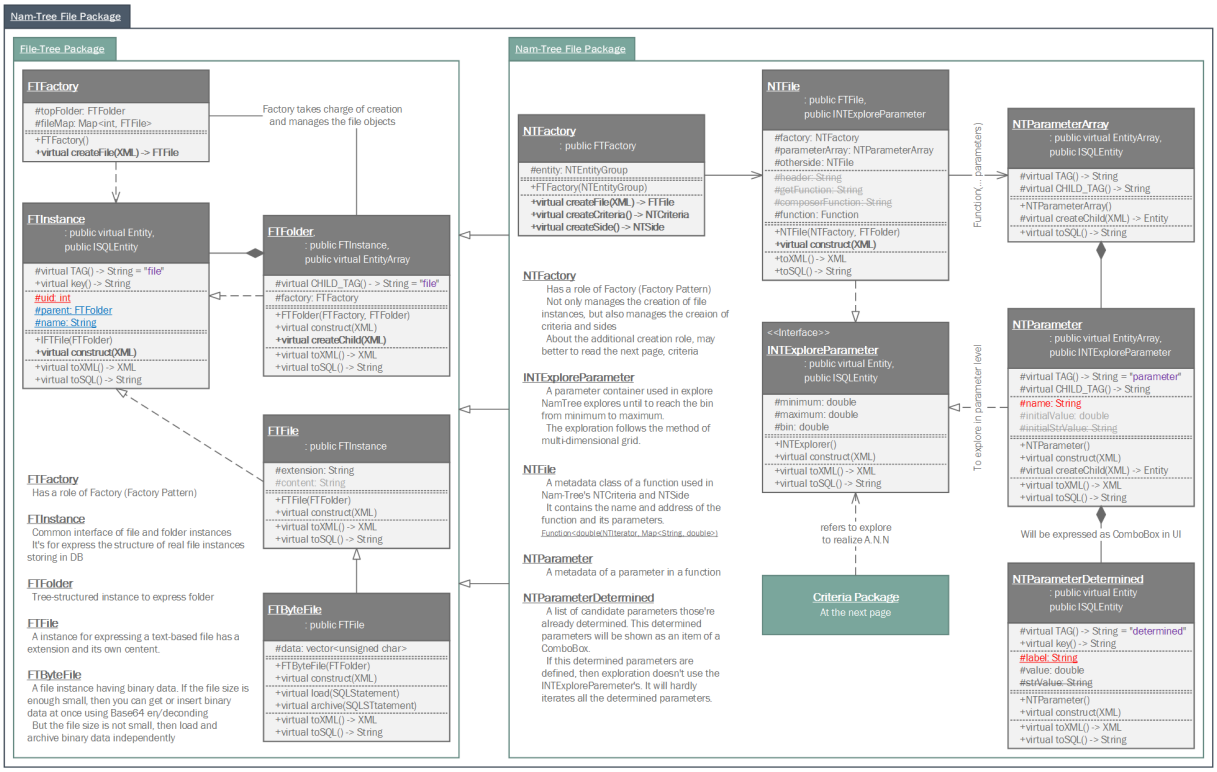
  *Name of a paremeter.*
- double initialValue

  *An initial, default value.*

### 6.90.1 Detailed Description

A metadata of a parameter in a function.

NTParameter is a class containing metadata of a parameter which is belonged to a class, metadata of a function, NTFile. Between the NTFile and NTParameter(s), there's a associate relationship.



**See also**

samchon::namtree

**Author**

Jeongho Nam

### 6.90.2 Member Function Documentation

#### 6.90.2.1 void construct ( std::shared_ptr< library::XML > ) [override], [virtual]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from INTExplore.

#### 6.90.2.2 auto createChild ( std::shared_ptr< library::XML > ) -> NTParameterDetermined *override [override], [protected], [virtual]

Factory method of a child Entity.

EntityGroup::createChild() is a factory method creating a new child Entity which is belonged to the Entity↩ Group. This method is called by EntityGroup::construct(). The children construction methods Entity↩ ::construct() will be called by abstract method of the EntityGroup::construct().

**Returns**

A new child Entity belongs to EntityGroup.

Implements EntityGroup< _Container, _ETy, _Ty >.

#### 6.90.2.3 auto key ( ) const -> std::string [override], [virtual]

Get a key that can identify the Entity uniquely.

If identifier of the Entity is not atomic value, returns a string represents the composite identifier. If identifier of the Entity is not string, converts the identifier to string and returns the string.

**Returns**

An identifier

Reimplemented from Entity.

#### 6.90.2.4 auto TAG ( ) const -> std::string [override], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

#### 6.90.2.5 auto CHILD_TAG ( ) const -> std::string [override], [virtual]

A tag name of children.

< TAG>
<CHILD_TAG />
<CHILD_TAG />
</TAG>

Implements IEntityGroup.

#### 6.90.2.6 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from INTExplore.

### 6.90.3 Member Data Documentation

#### 6.90.3.1 std::string name [protected]

Name of a paremeter.

The string label is identifier of a NTParameter. It must be unique.

The documentation for this class was generated from the following files:

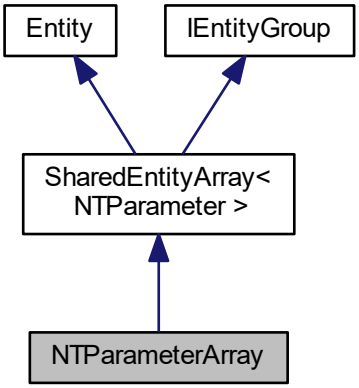
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTParameter.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTParameter.cpp

## 6.91 NTParameterArray Class Reference

An Array of NTParameter.

```
#include <NTParameterArray.hpp>
```

Collaboration diagram for NTParameterArray:




### Public Member Functions

- virtual auto TAG () const -> std::string override

  *A tag name when represented by XML.*
- virtual auto CHILD_TAG () const -> std::string override

  *A tag name of children.*
- NTParameterArray ()

  *Default Constructor.*

### Protected Member Functions

- virtual auto createChild (std::shared_ptr< library::XML >) -> NTParameter *override

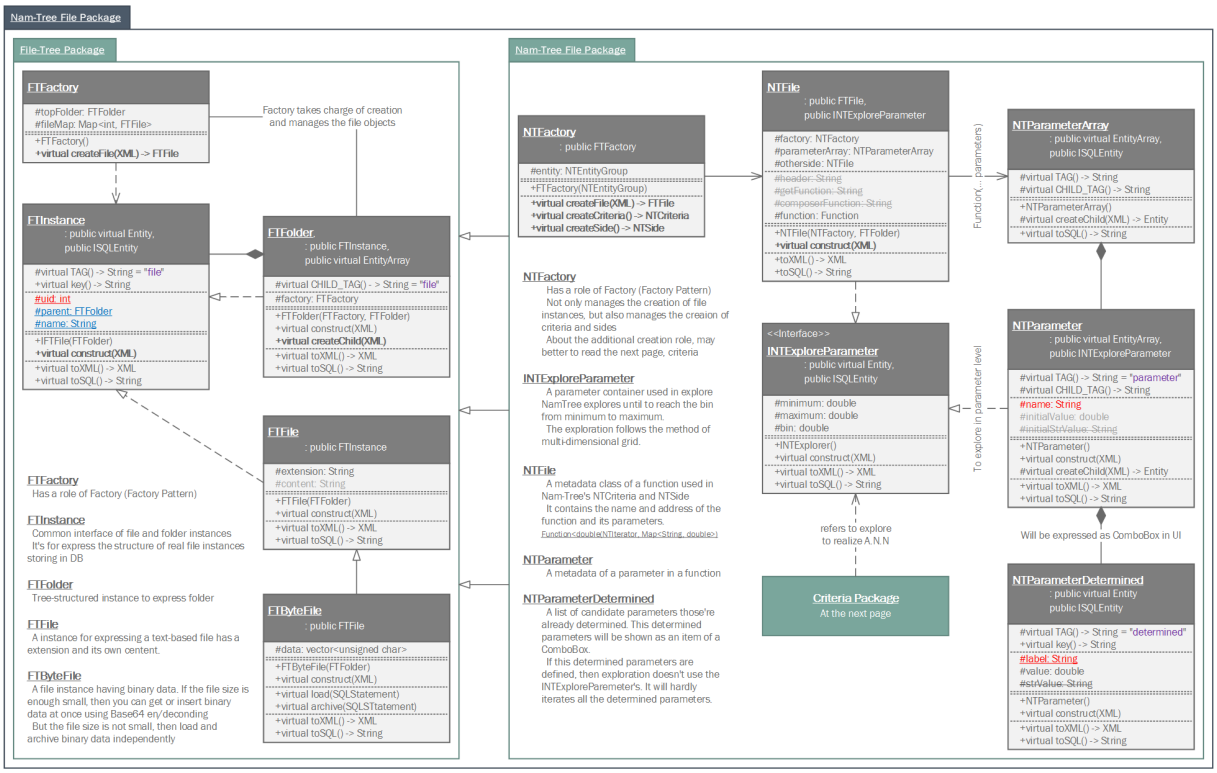
  *Factory method of a child Entity.*

## 6.91.1 Detailed Description

An Array of NTParameter.

NTParameterArray is an array class containing NTParameter objects.

The NTParameter is belonged to a NTFile class to realize associate relationship between NTFile and NT↩ Parameter(s).




### See also

samchon::namtree

### Author

Jeongho Nam

## 6.91.2 Member Function Documentation

### 6.91.2.1 auto TAG ( ) const -> std::string [override], [virtual]

A tag name when represented by XML.

### Returns

A tag name

Implements Entity.

### 6.91.2.2 auto CHILD_TAG ( ) const -> std::string [override], [virtual]

A tag name of children.

< TAG>
<CHILD_TAG />
<CHILD_TAG />
</TAG>

Implements IEntityGroup.

#### 6.91.2.3 auto createChild ( std::shared_ptr< library::XML > ) -> NTParameter *override [override], [protected], [virtual]

Factory method of a child Entity.

EntityGroup::createChild() is a factory method creating a new child Entity which is belonged to the Entity↩ Group. This method is called by EntityGroup::construct(). The children construction methods Entity↩ ::construct() will be called by abstract method of the EntityGroup::construct().

**Returns**

A new child Entity belongs to EntityGroup.

Implements EntityGroup< _Container, _ETy, _Ty >.

The documentation for this class was generated from the following files:

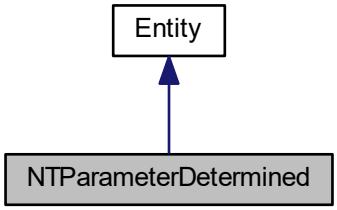
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTParameterArray.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTParameterArray.cpp

## 6.92 NTParameterDetermined Class Reference

A pre-determined value of a parameter.

`#include <NTParameterDetermined.hpp>`

Collaboration diagram for NTParameterDetermined:




### Public Member Functions

- NTParameterDetermined ()

  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*
- virtual auto key () const -> std::string override

  *Get a key that can identify the Entity uniquely.*
- auto getLabel () const -> std::string

  *Get label.*
- auto getValue () const -> double

  *Get value.*
- virtual auto TAG () const -> std::string override

  *A tag name when represented by XML.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

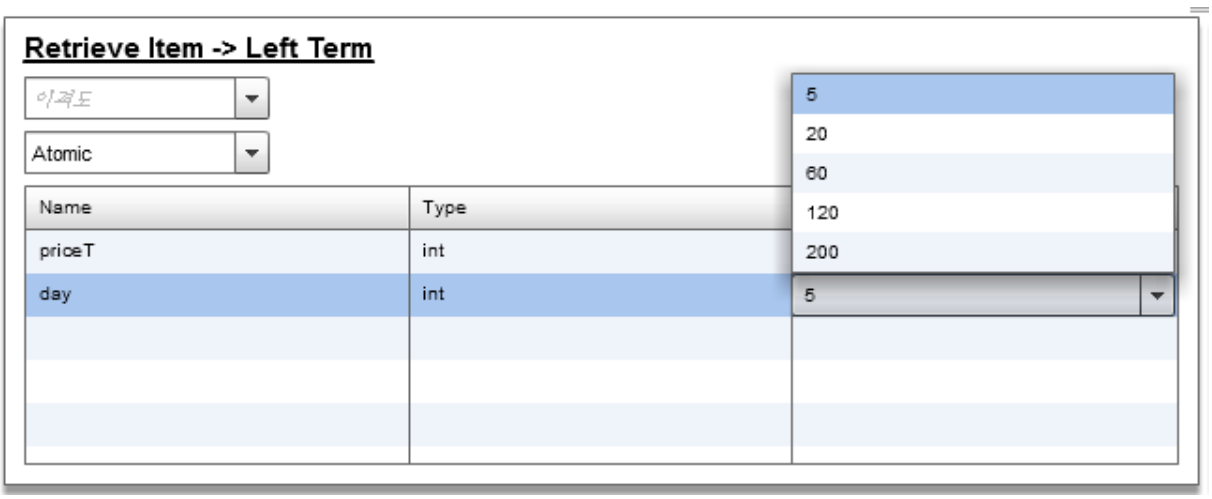
  *Get an XML object represents the Entity.*

### Protected Attributes

- std::string label
  *A label will be printed in a combo-box.*
- double value
  *A value, pre-defined.*

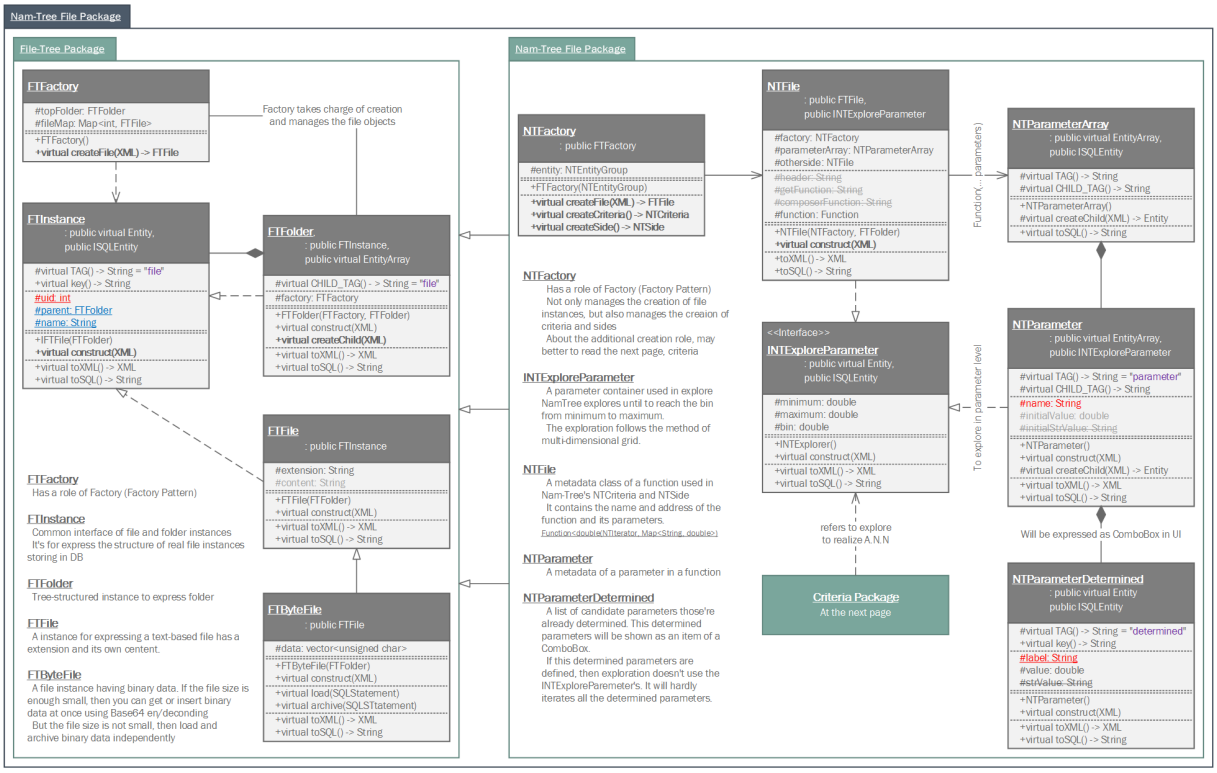
## 6.92.1 Detailed Description

A pre-determined value of a parameter.




NTParameterDetermined is a class belonged to a NTParameter object presents a pre-defined value. In UI module of Nam-Tree, the NTParameterDetermined is expressed by an item of a ComboBox.

When optimization of Nam-Tree, in a part of NTParameter, if the pre-determined value is defined optimizer does not explore with grid method from referencing INTExplore. Just selects a value between the pre-defineds. (One of NTParameterDetermined is selected in NTParameter).



**See also**

samchon::namtree

**Author**

Jeongho Nam

### 6.92.2 Member Function Documentation

#### 6.92.2.1 void construct ( std::shared_ptr< library::XML > ) [override], [virtual]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Implements Entity.

#### 6.92.2.2 auto key ( ) const -> std::string [override], [virtual]

Get a key that can identify the Entity uniquely.

If identifier of the Entity is not atomic value, returns a string represents the composite identifier. If identifier of the Entity is not string, converts the identifier to string and returns the string.

**Returns**

An identifier

Reimplemented from Entity.

#### 6.92.2.3 auto TAG ( ) const -> std::string [override], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

#### 6.92.2.4 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

### 6.92.3 Member Data Documentation

#### 6.92.3.1 std::string label [protected]

A label will be printed in a combo-box.

The string label is identifier of a NTParameterDetermined. It must be unique.

The documentation for this class was generated from the following files:

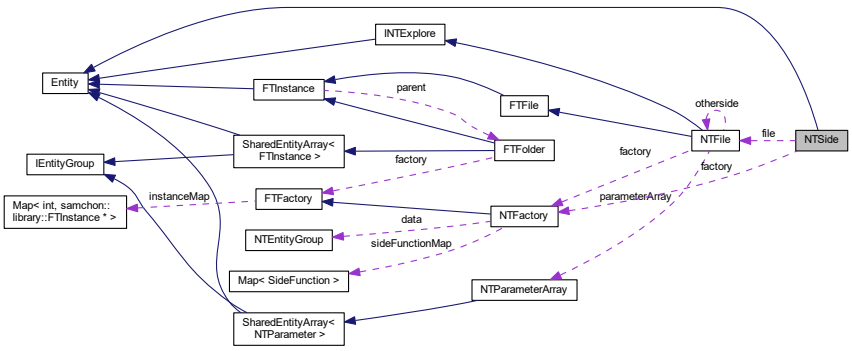
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTParameterDetermined.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTParameterDetermined.cpp

## 6.93 NTSide Class Reference

A side of a conditional expresson.

`#include <NTSide.hpp>`

Collaboration diagram for NTSide:




### Public Member Functions

- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the Entity.*

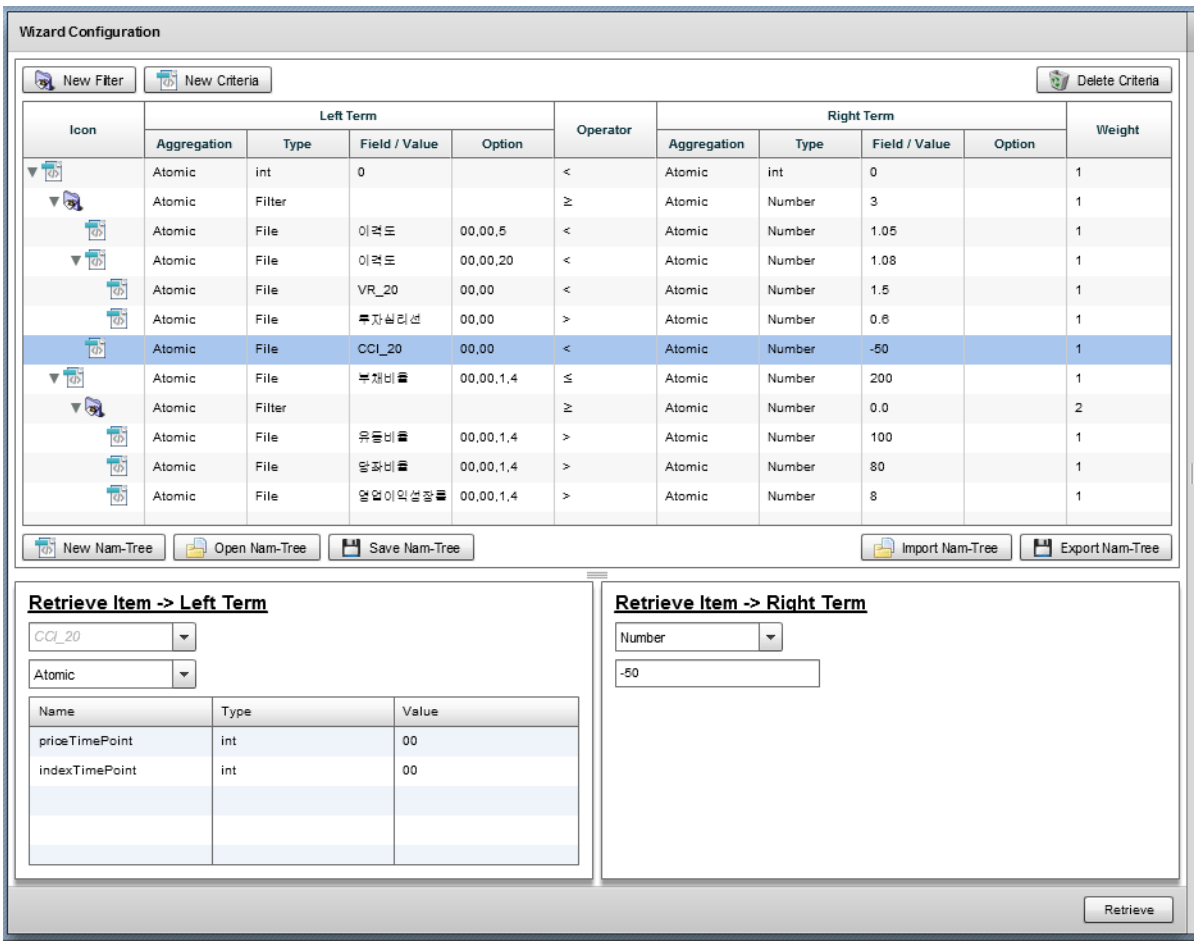
### Protected Member Functions

- virtual auto TAG () const -> std::string override

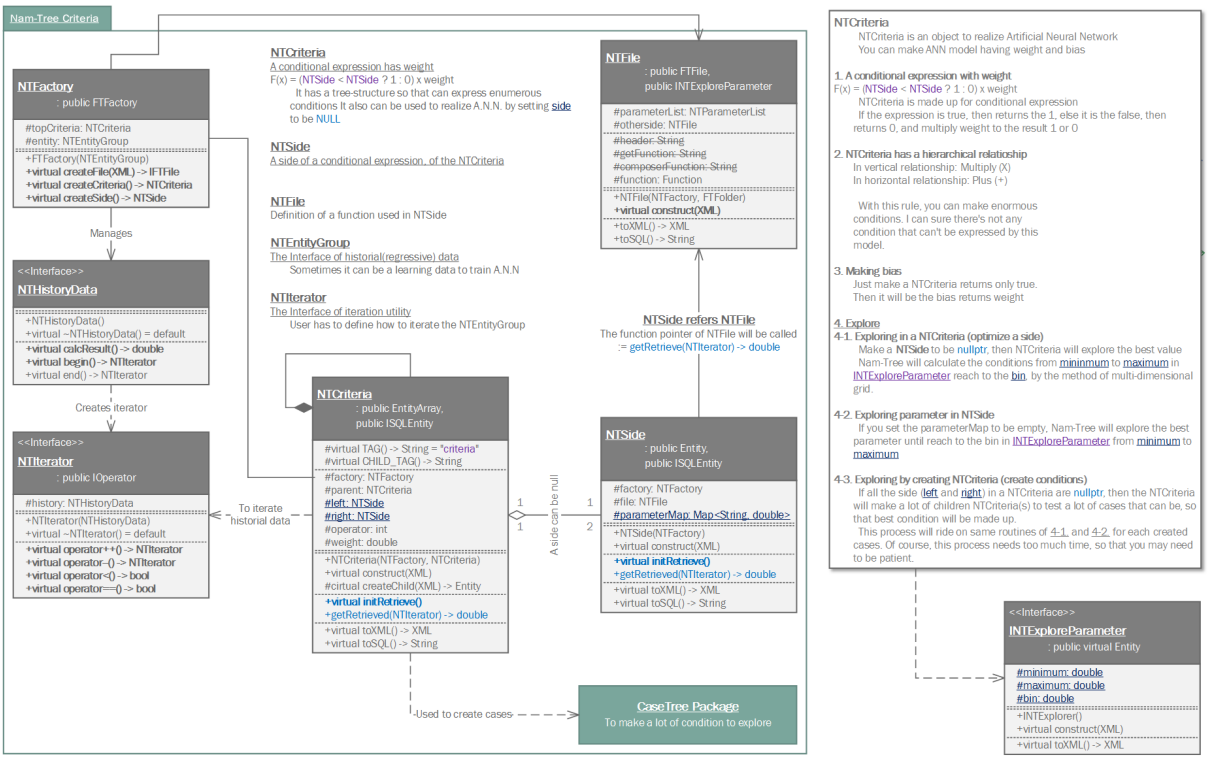
  *A tag name when represented by XML.*

### 6.93.1 Detailed Description

A side of a conditional expresson.




Two NTSide classes are belonged to a NTCriteria as left and right side. The NTSide class has a NTFile representing a function and parameters to adjust to the function.




### See also

samchon::namtree

### Author

Jeongho Nam

## 6.93.2 Member Function Documentation

### 6.93.2.1 auto TAG ( ) const -> std::string [override], [protected], [virtual]

A tag name when represented by XML.

### Returns

A tag name

Implements Entity.

### 6.93.2.2 void construct ( std::shared_ptr< library::XML > ) [override], [virtual]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

### Parameters

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Implements Entity.

#### 6.93.2.3 auto toXML ( ) const -> std::shared_ptr<library::XML> [override],[virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

The documentation for this class was generated from the following files:

- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTSide.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/namtree/NTSide.cpp

## 6.94 Packer Class Reference

A packer planning the best packaging.

```
#include <Packer.hpp>
```

### Public Member Functions

- Packer (std::vector< Product > *, std::vector< Wrapper > *)

  *Construct from products and wrapper.*
- Packer (const Packer &)

  *Copy Constructor.*
- void optimize ()

  *Find the best packaging method.*
- auto calcPrice () const -> int

  *Calculate price of the wrappers.*
- auto toString () const -> std::string

  *Return a string represents an packaging method.*

### Private Attributes

- std::vector< Product > * productArray

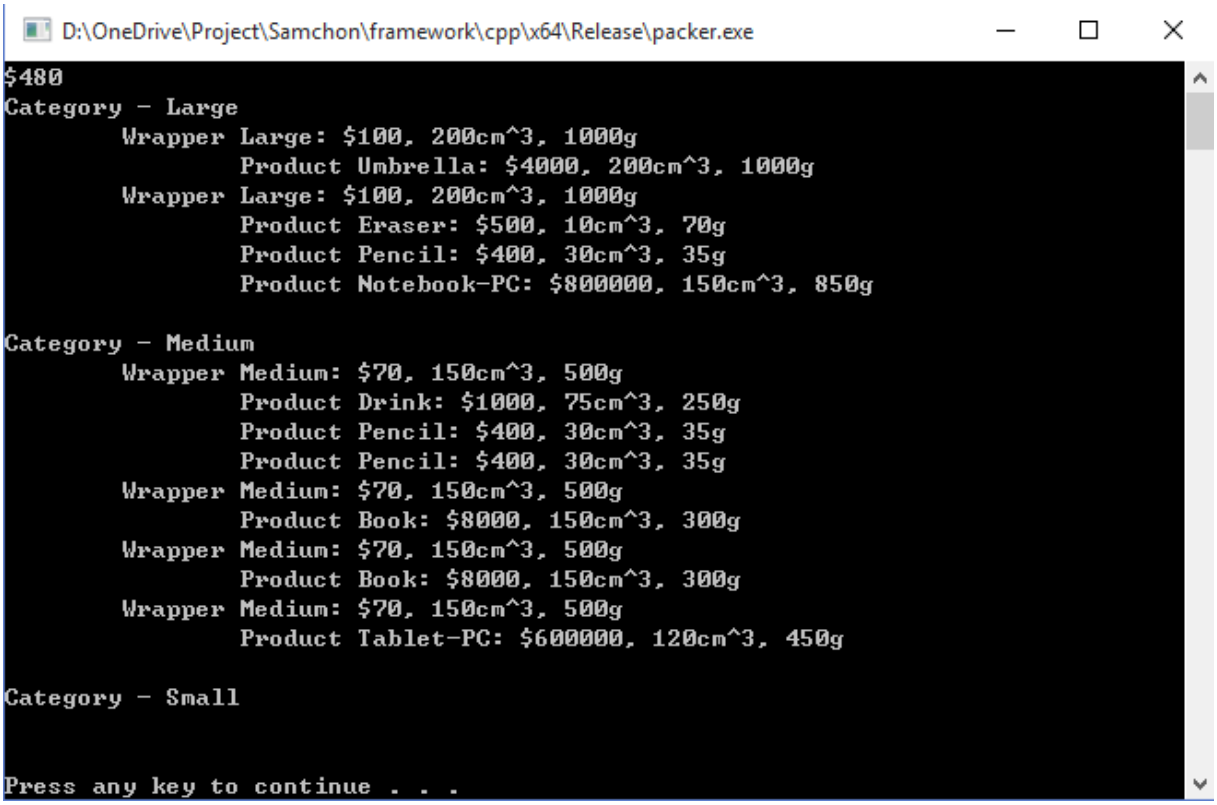
  *Prodcut(s) to package in some Wrapper(s)*
- std::vector< Wrapper > * wrapperArray

  *Type of Wrapper(s) to be used for packaging.*

### 6.94.1 Detailed Description

A packer planning the best packaging.

Retrieves the solution of packaging by combination permuation and factorial case.




**Warning**

Be careful about number of products and wrappers.

The time complexity of Packer overs O(m^n). Elapsed time of calculation increases enourmously. Do not use Packer if the digits of number of products or wrappers overs 2.

**Author**

Jeongho Nam

### 6.94.2 Constructor & Destructor Documentation

#### 6.94.2.1 Packer ( std::vector< Product > * *productArray*, std::vector< Wrapper > * *wrapperArray* )

Construct from products and wrapper.

**Parameters**

| | |
|---|---|
| *productArray* | Product(s) to input some Wrapper |
| *wrapperArray* | Type of Wrapper(s) to be used |

#### 6.94.2.2 Packer ( const Packer & *packer* )

Copy Constructor.

Copy constructor of Packer does not copy children items.

Only copies member variables(productArray, wrapperArray) of Packer's.

The documentation for this class was generated from the following files:

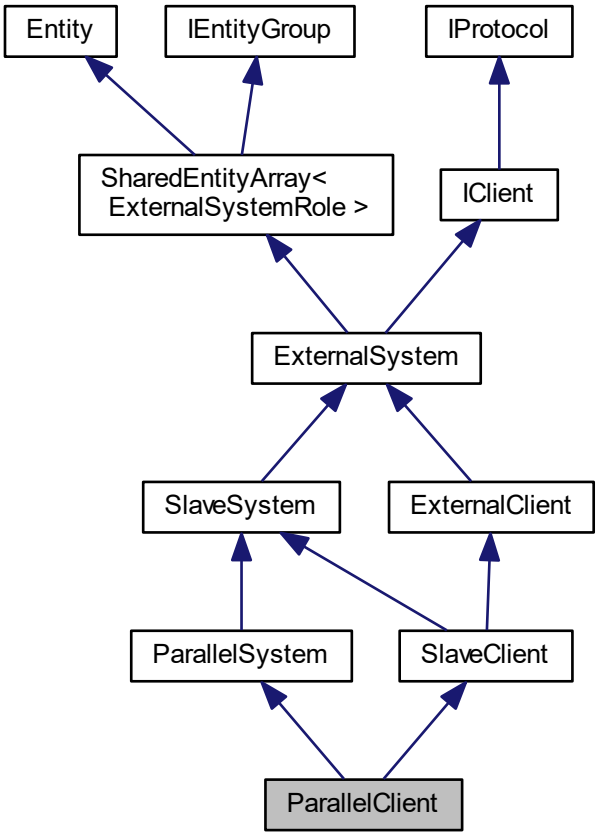
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/packer/Packer.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/packer/Packer.cpp

## 6.95 ParallelClient Class Reference

A slave parallel client.

`#include <ParallelClient.hpp>`

Collaboration diagram for ParallelClient:




### Public Member Functions

- ParallelClient ()

  *Default Constructor.*

### Additional Inherited Members

### 6.95.1 Detailed Description

A slave parallel client.

ParallelClient is a ParallelSystem class specialized in server driver.

[Inherited]

ParallelSystem is a class processing segmented Invoke messages from master.

[Inherited]

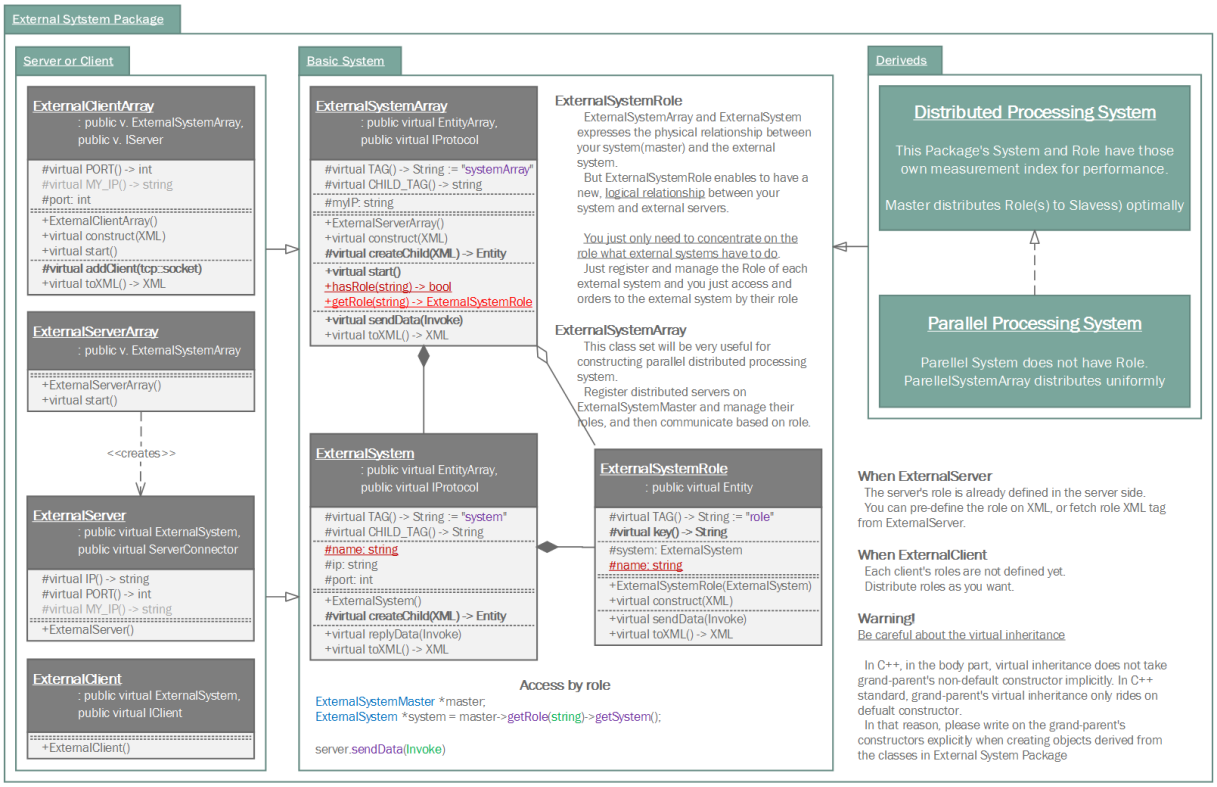
SlaveSystem, literally, means a slave system belongs to a maste system.

The SlaveSystem class is used in opposite side system of master::DistributedSystem and master::Parallel↩System and reports elapsed time of each commmand (by Invoke message) for estimation of its performance.

[Inherited]

ExternalSystem is a boundary class interacting with an external system by network communication. Also, ExternalSystem is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.



**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystem↩ Role.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩ SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an External↩ System. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

The documentation for this class was generated from the following file:

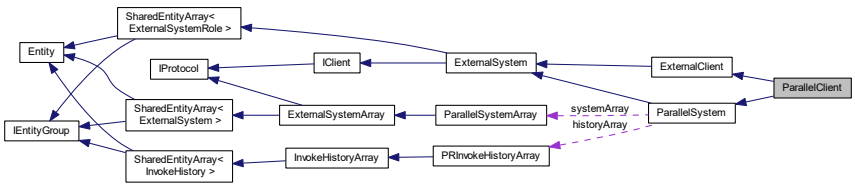
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/slave/ParallelClient.hpp

## 6.96 ParallelClient Class Reference

A network driver for a parallel client.

`#include <ParallelClient.hpp>`

Collaboration diagram for ParallelClient:




### Public Member Functions

- ParallelClient ()

  *Default Constructor.*

### Additional Inherited Members

### 6.96.1 Detailed Description

A network driver for a parallel client.

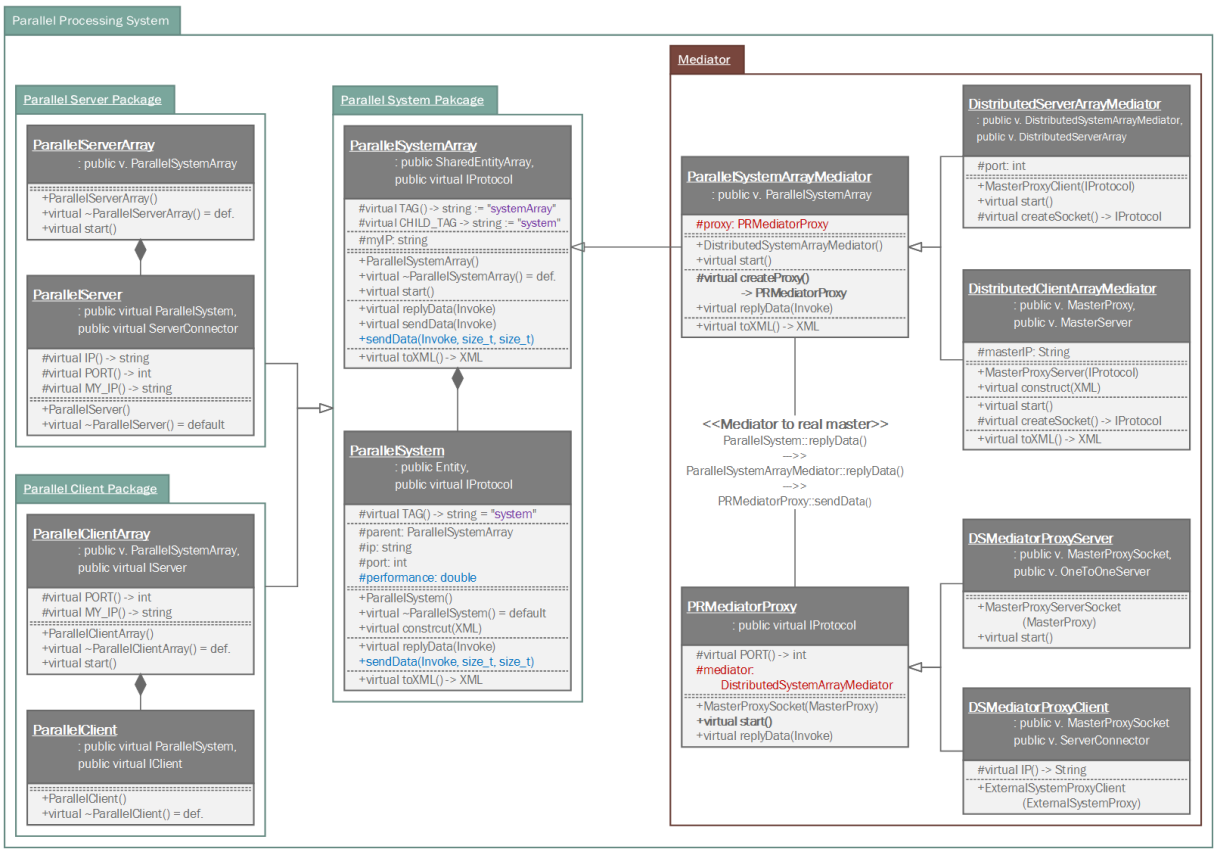
ParallelClient is an ParallelSystem specialized in client driver.

**[Inherited]**

ParallelSystem class is an ExternalSystem having performance index and history logs of handled Invoke messages with those elapsed times. Those performance index and history logs are used to determine how much segmentation to be allocated.

Each segmentation in requested process (Invoke message) is equivalent. Thus, role of ParallelSystem objects in a ParallelSystemArray are almost same and does not need to specify ExternalSystemRole on ParallelSystem.

- Not a matter to specifying ExternalSystemRole objects to each ParallelSystem. In that case, Invoke messages having segmentation size will be processed by ParallelSystem's own logic and Invoke messages without segmentation size will be handled by ordinary logic of ExternalSystem's own.




**[Inherited]**

The documentation for this class was generated from the following file:

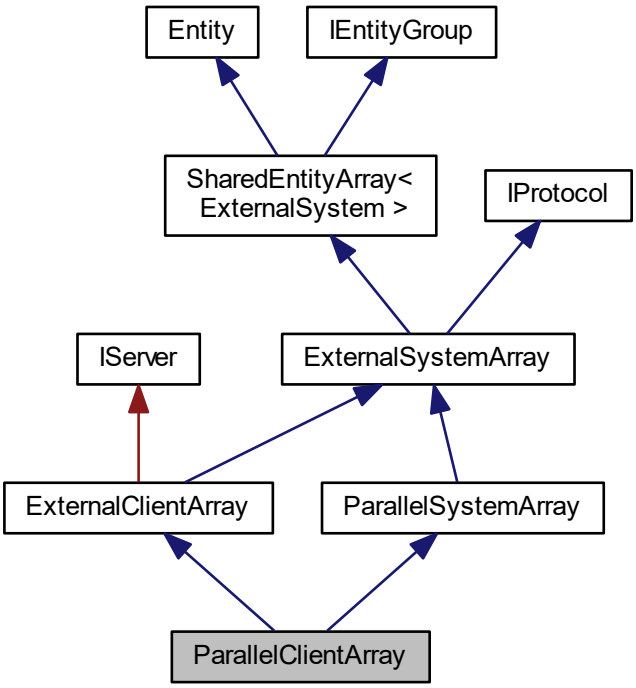
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelClient.hpp

## 6.97 ParallelClientArray Class Reference

An array of ParallelClient(s).

```
#include <ParallelClientArray.hpp>
```

Collaboration diagram for ParallelClientArray:




### Public Member Functions

- ParallelClientArray ()

  *Default Constructor.*

### Additional Inherited Members

### 6.97.1 Detailed Description

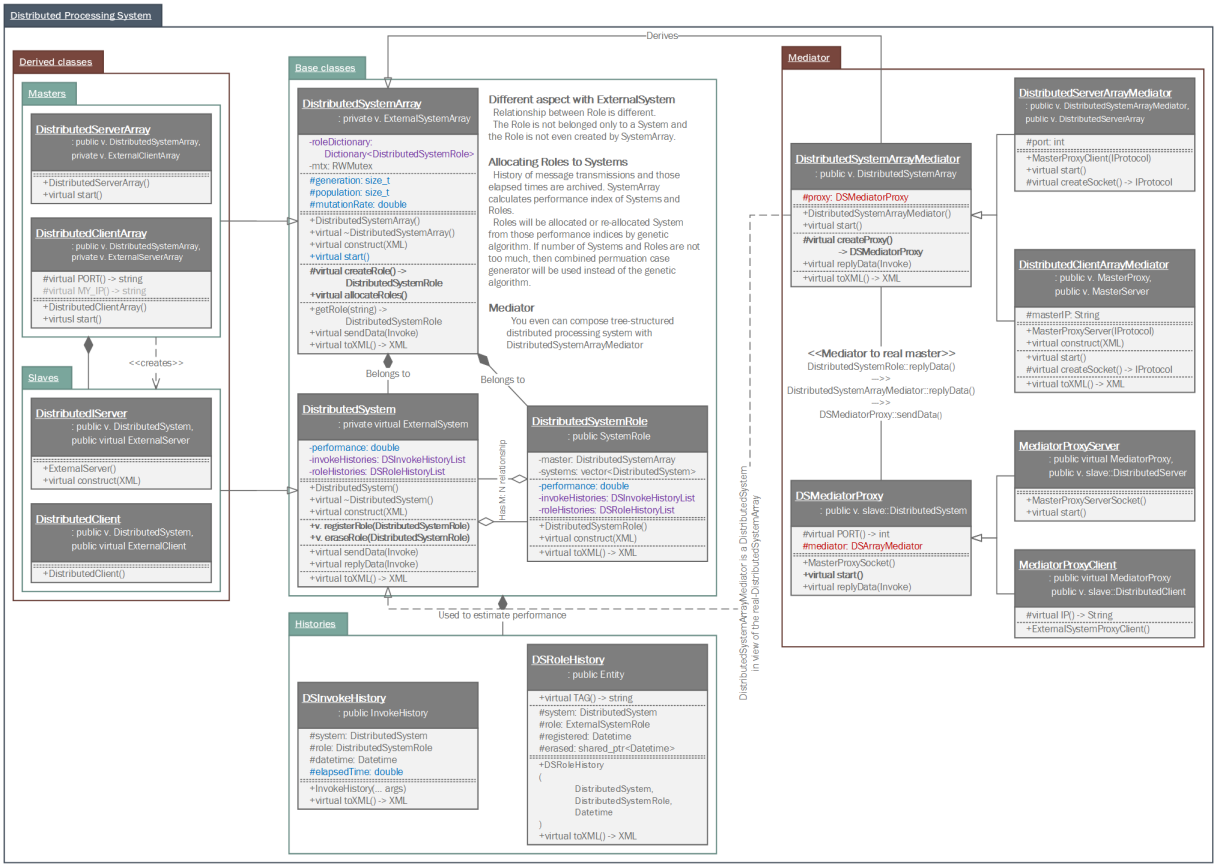
An array of ParallelClient(s).

ParallelClientArray is an ParallelSystemArray specialized in clients' driver.

**[Inherited]**

DistributedSystemArray class is an ExternalSystemArray and an abstract class containing and managing distributed system drivers within framework of master. The DistributedSystemArray class allocates DistributedSystemRole objects to DistributedSystem objects for optimization.

Unlike the ExternalSystemRole class which is dependent on an ExternalSystem, DistributedSystemRole is not dependent on a DistributedSystem and even can be allocated to multiple DistributedSystem objects. Allocation of DistributedSystemRole(s) to DistributedSystem(s) is determined by estimation of performance index pursuing best distribution. If number of DistributedSystem and DistributedSystemRole objects is not a lot, optimize by combined permuation algorithm. Else the objects are a lot, the allocation will be optimized by genetic algorithm.



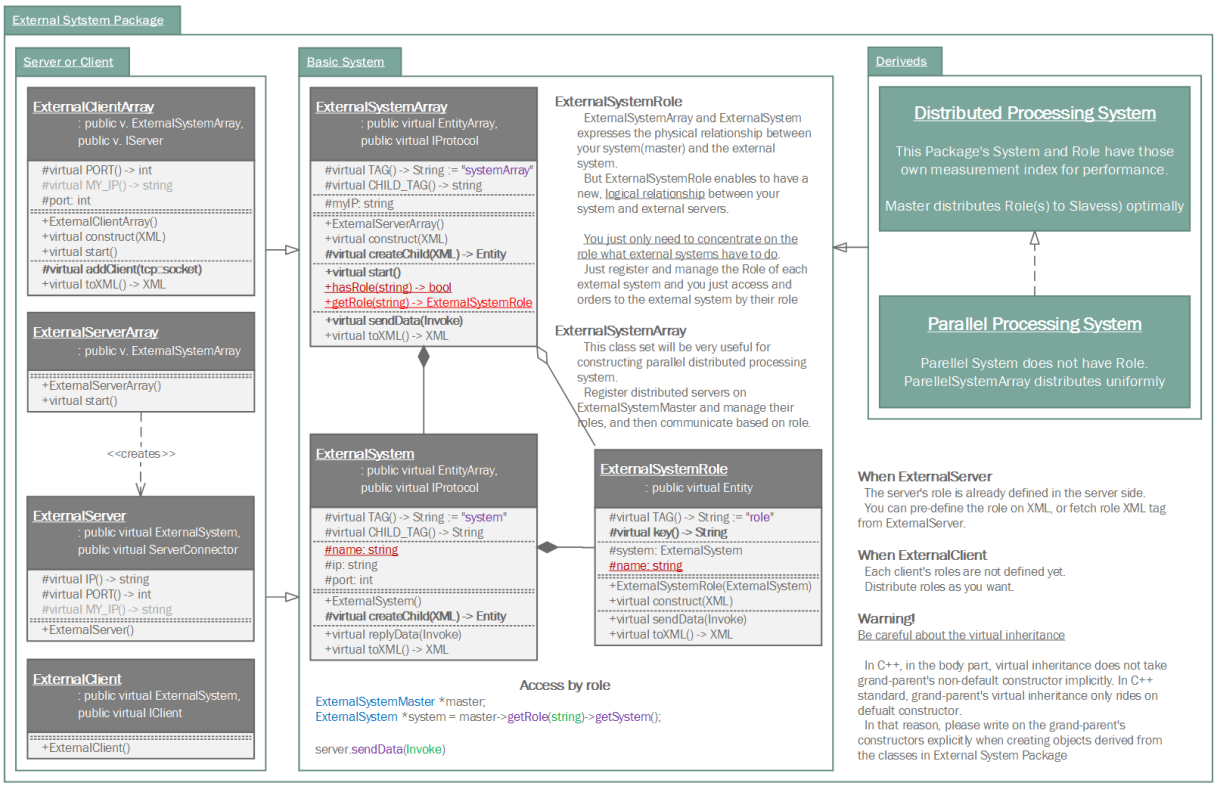

**[Inherited]**

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




### See also

samchon::protocol

### Author

Jeongho Nam

The documentation for this class was generated from the following files:

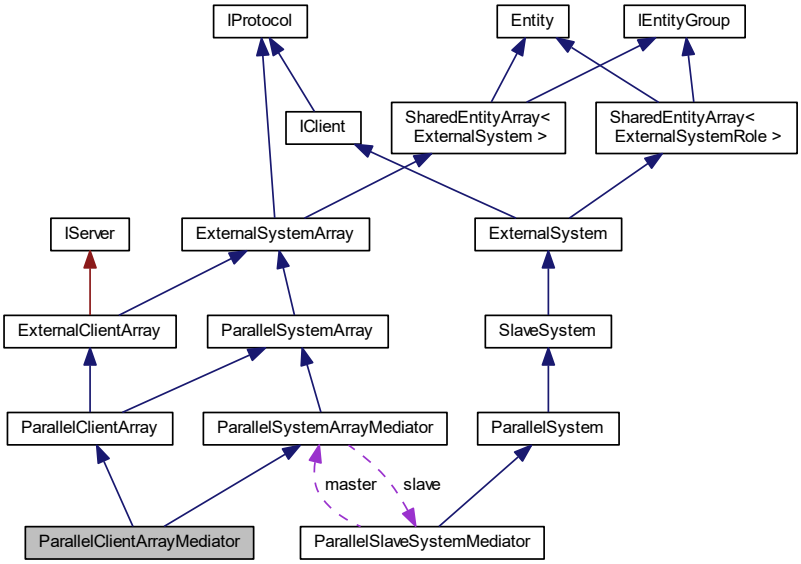
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelClientArray.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelClientArray.cpp

## 6.98 ParallelClientArrayMediator Class Reference

A mediator of parallel system between master and slaves.

```
#include <ParallelClientArrayMediator.hpp>
```

Collaboration diagram for ParallelClientArrayMediator:




## Public Member Functions

- ParallelClientArrayMediator ()

  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*
- virtual void start () override

  *Start interaction.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the EntityGroup.*

## Additional Inherited Members

### 6.98.1 Detailed Description

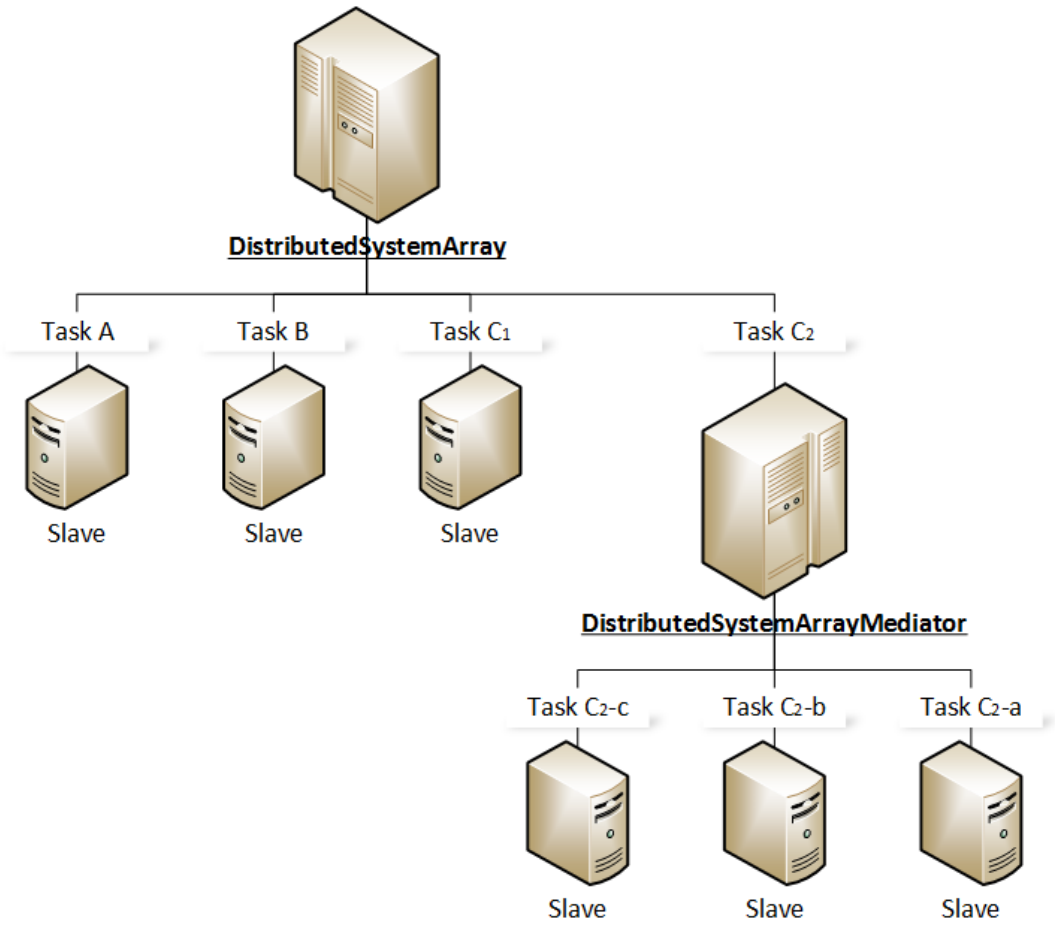
A mediator of parallel system between master and slaves.

ParallelClientArrayMediator is a ParallelSystemArrayMediator specialized in clients' driver. ParallelClient↩ ArrayMediator is a client for its master and also manages children clients' slaves.

**[Inherited]**

ParallelSystemArrayMediator class is used to realizing a mediator system of tree-structured parallel processing system. ParallelSystemArrayMediator intermediates between origin-master(ParallelSystemArray) and its slaves(slave::ParallelSystem).

ParallelSystemArrayMediator is a master(ParallelSystemArray) within the framework of slaves systems (slave::ParallelSystem objects) and also can be a slave system (slave::ParallelSystem) within framework of its master(ParallelSystemArray) by having ParallelSlaveSystemMediator.




[Inherited]

ParallelSystemArray is an ExternalSystemArray and an abstract class containing. and managing parallel system drvers within framework of master. The ParallelSystemArray class allocates segmented processes (Invoke message containing segmentation size) following by each system's performance index.

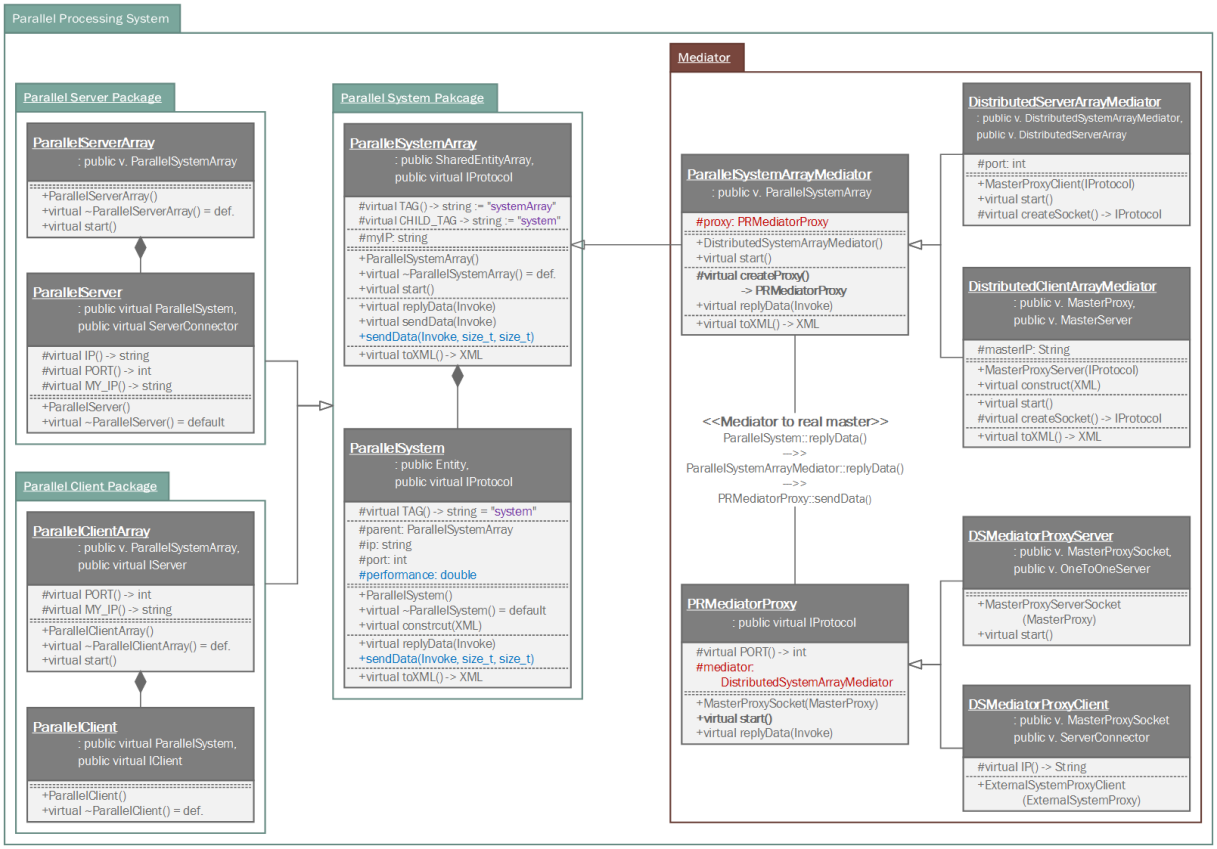
Unlike DistributedSystemArray, ParallelSystemArray does not have such complicate relationships and logics. All segmentation sent by sendData(Invoke, size_t) requires uniform performance. ParallelSystemArray just calculates each system's performance index by elapsing time such easily.

Of course, DistributedSystemArray determines which size of segmentation allocation will be suitable for each system by the performance index

.

Each segmentation in requested process (Invoke message) is equivalent. Thus, role of ParallelSystem objects in a ParallelSystemArray are almost same and does not need to specify ExternalSystemRole on each ParallelSystem.

- Not a matter to specifying ExternalSystemRole objects to each ParallelSystem. In that case, Invoke messages having segmentation size will be processed by ParallelSystemArray's own logic and Invoke messages without segmentation size will be handled by ordinary logic of ExternalSystemArray's own.



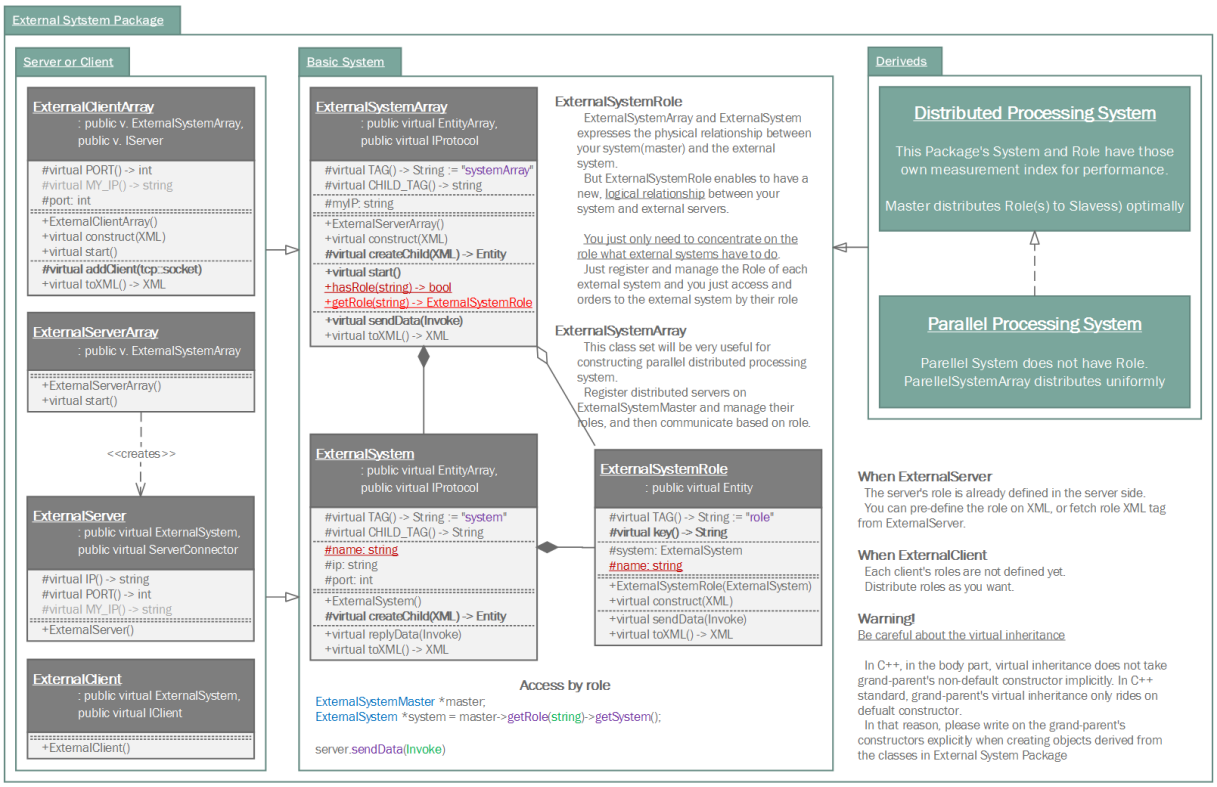

**[Inherited]**

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




**See also**

samchon::protocol

**Author**

Jeongho Nam

## 6.98.2 Member Function Documentation

### 6.98.2.1 virtual void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from ParallelSystemArrayMediator.

#### 6.98.2.2 virtual void start ( ) [override], [virtual]

Start interaction.

An abstract method starting interaction with external systems.

If external systems are servers, starts connection to them, else clients, opens a server and accepts the external systems. You can addict your own procudures of starting drivers, but if you directly override method of abstract ExternalSystemArray, be careful about virtual inheritance.

- DistributedClientArray::start() calls DistributedSystemArray::start() and ExternalClientArray:start()

Reimplemented from ParallelSystemArrayMediator.

#### 6.98.2.3 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from ParallelSystemArrayMediator.

The documentation for this class was generated from the following file:

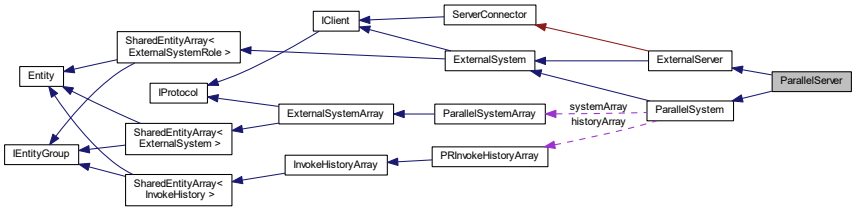
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelClientArrayMediator.↩hpp

## 6.99 ParallelServer Class Reference

A network driver for a parallel server.

```
#include <ParallelServer.hpp>
```

Collaboration diagram for ParallelServer:




### Public Member Functions

- ParallelServer ()

  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override

  *Construct data of the Entity from an XML object.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override

  *Get an XML object represents the EntityGroup.*

### Additional Inherited Members

### 6.99.1 Detailed Description

A network driver for a parallel server.

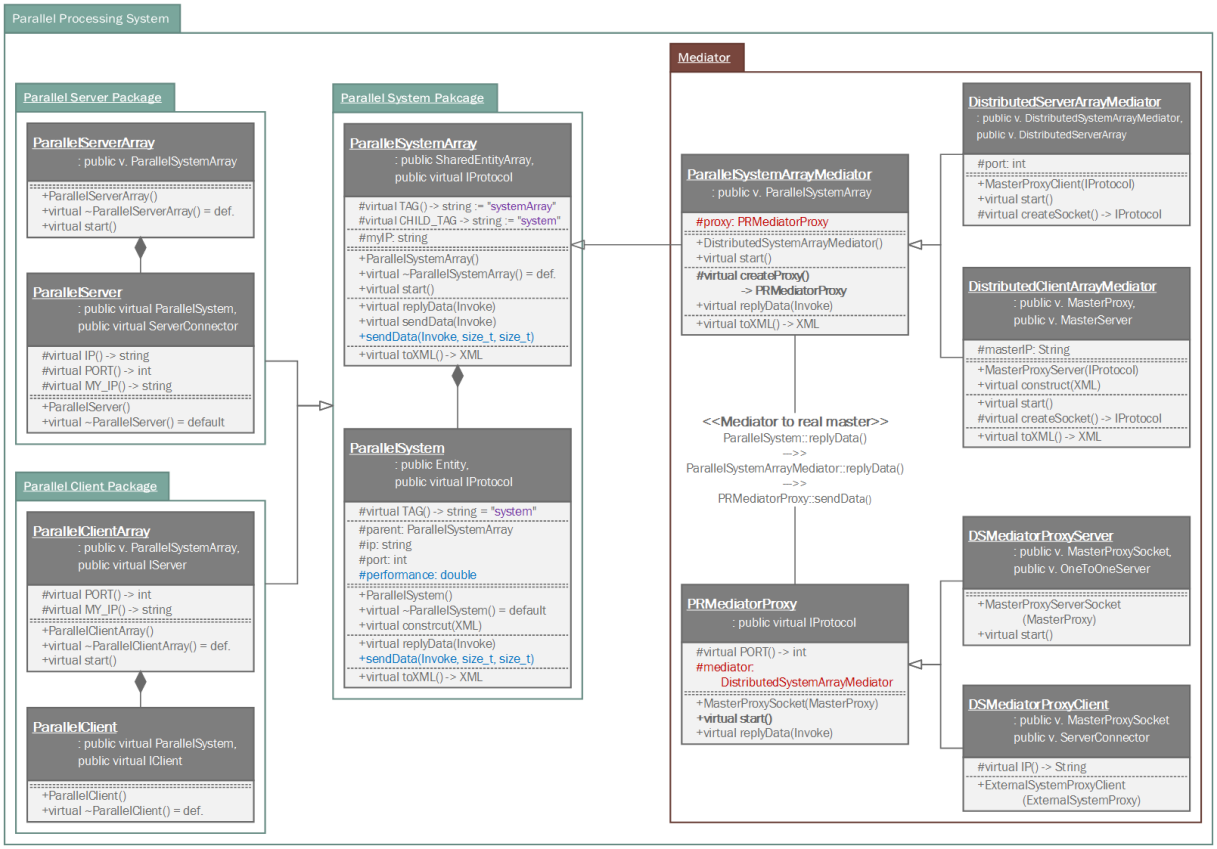
ParallelServer is an ParallelSystem specialized in server driver.

**[Inherited]**

ParallelSystem class is an ExternalSystem having performance index and history logs of handled Invoke messages with those elapsed times. Those performance index and history logs are used to determine how much segmentation to be allocated.

Each segmentation in requested process (Invoke message) is equivalent. Thus, role of ParallelSystem objects in a ParallelSystemArray are almost same and does not need to specify ExternalSystemRole on ParallelSystem.

- Not a matter to specifying ExternalSystemRole objects to each ParallelSystem. In that case, Invoke messages having segmentation size will be processed by ParallelSystem's own logic and Invoke messages without segmentation size will be handled by ordinary logic of ExternalSystem's own.




[Inherited]

### 6.99.2 Member Function Documentation

#### 6.99.2.1 virtual void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

[Inherited]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from ExternalServer.

#### 6.99.2.2 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from ExternalServer.

The documentation for this class was generated from the following file:

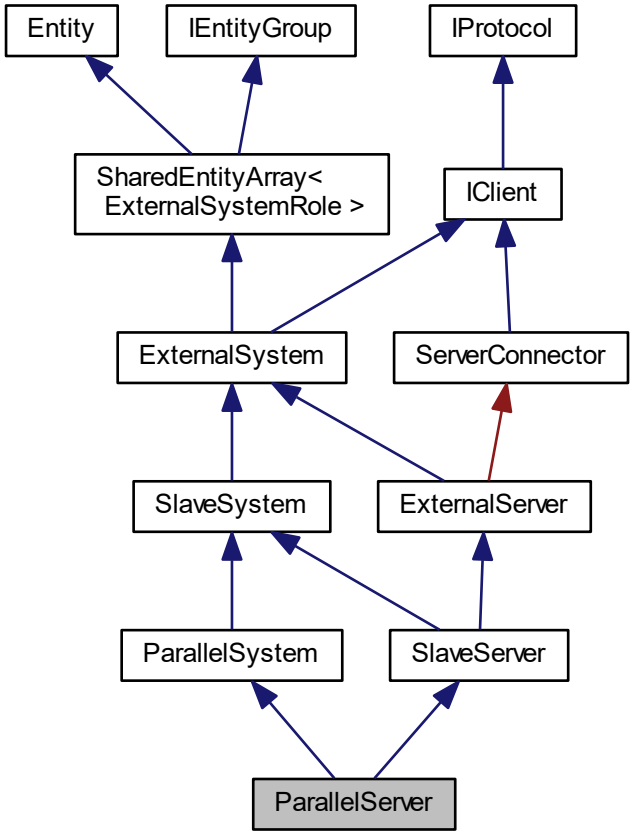
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelServer.hpp

## 6.100 ParallelServer Class Reference

A slave parallel server.

```
#include <ParallelServer.hpp>
```

Collaboration diagram for ParallelServer:




## Public Member Functions

- ParallelServer ()

  *Default Constructor.*

## Additional Inherited Members

### 6.100.1 Detailed Description

A slave parallel server.

ParallelSystem is a ParallelSystem class specialized in server driver.

**[Inherited]**

ParallelSystem is a class processing segmented Invoke messages from master.

**[Inherited]**

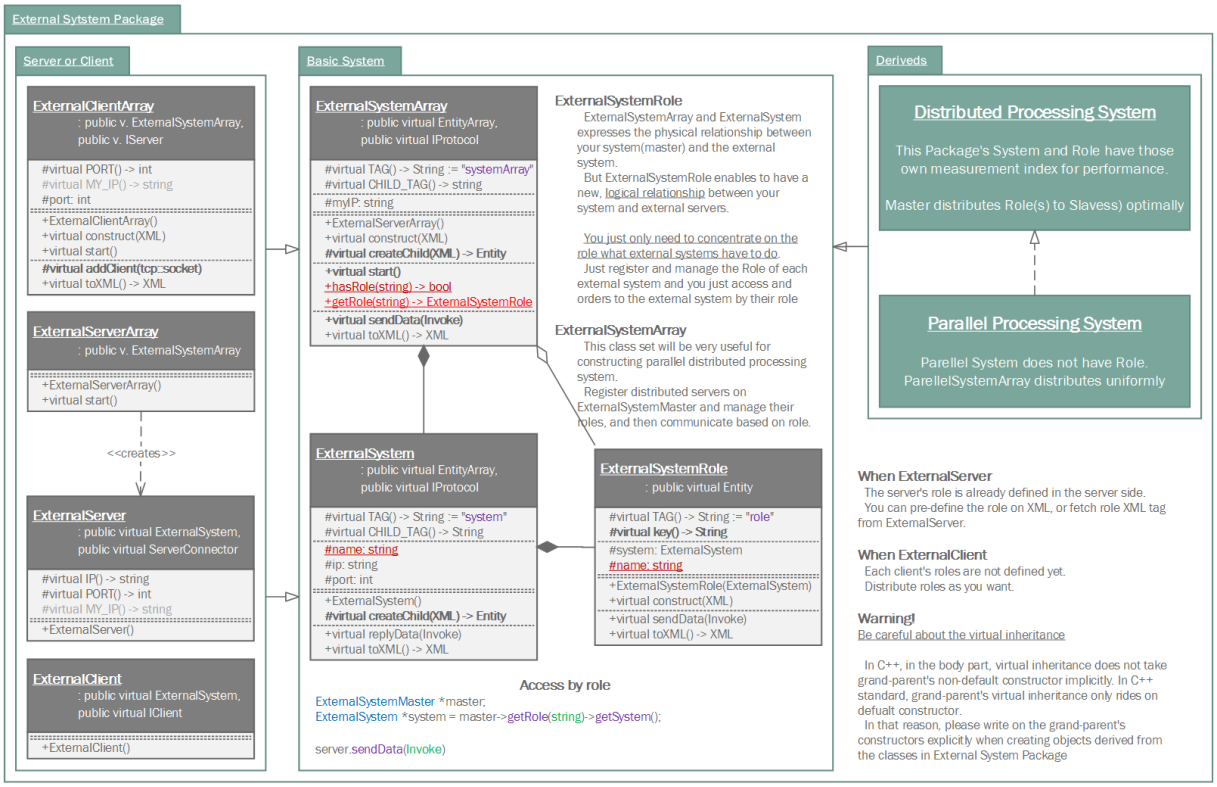
SlaveSystem, literally, means a slave system belongs to a maste system.

The SlaveSystem class is used in opposite side system of master::DistributedSystem and master::Parallel↩System and reports elapsed time of each commmand (by Invoke message) for estimation of its performance.

**[Inherited]**

ExternalSystem is a boundary class interacting with an external system by network communication. Also, ExternalSystem is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystem↩Role.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an External↩System. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

The documentation for this class was generated from the following file:

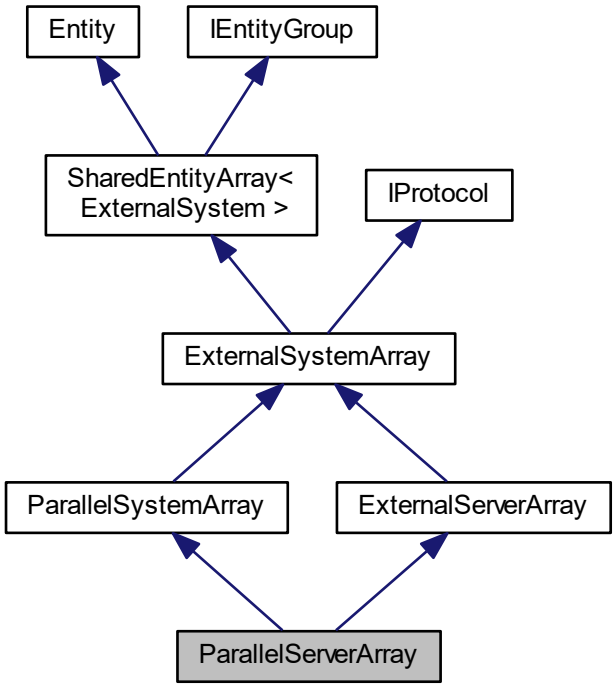
– D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/slave/ParallelServer.hpp

## 6.101 ParallelServerArray Class Reference

An array of ParallelServer(s).

`#include <ParallelServerArray.hpp>`

Collaboration diagram for ParallelServerArray:




### Public Member Functions

– ParallelServerArray ()

*Default Constructor.*

### Additional Inherited Members

### 6.101.1 Detailed Description

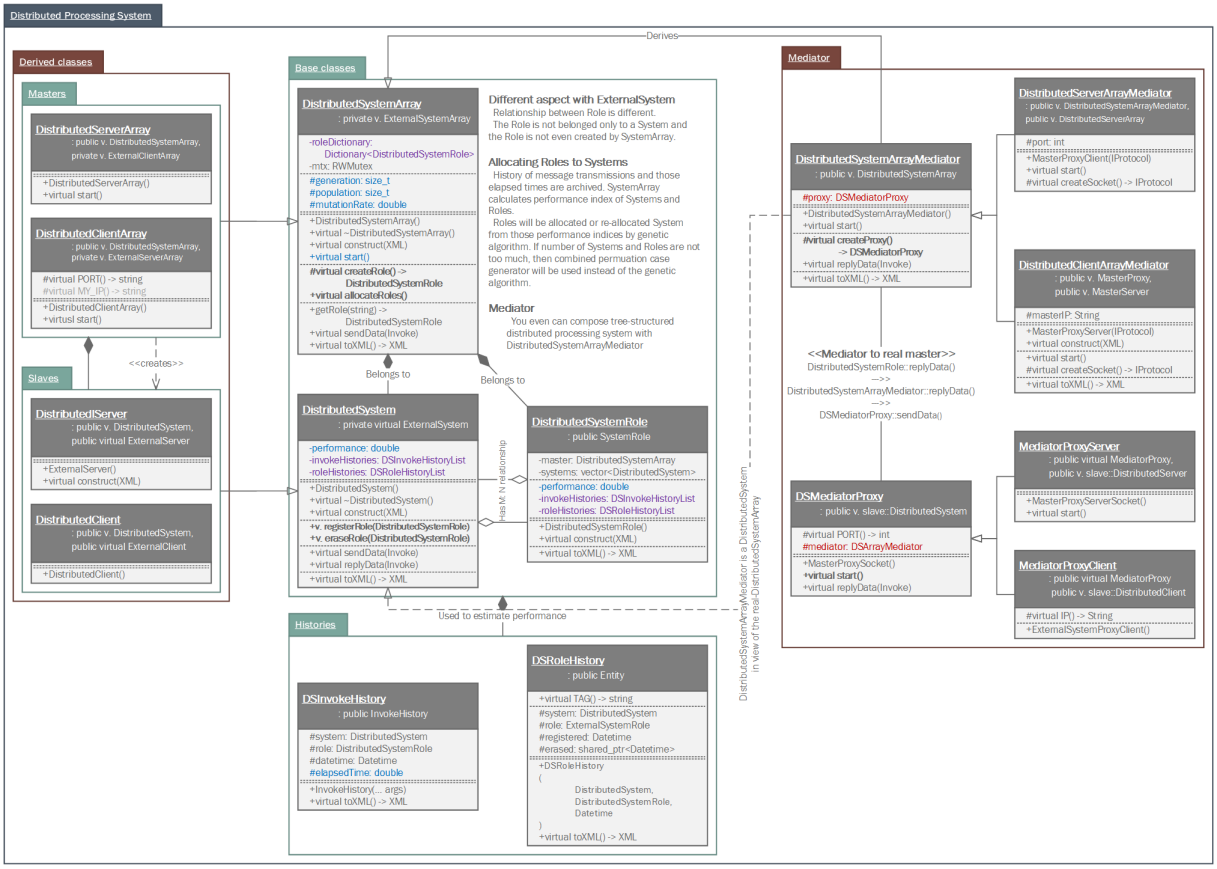
An array of ParallelServer(s).

ParallelServerArray is an ParallelSystemArray specialized in servers' driver.

[Inherited]

DistributedSystemArray class is an ExternalSystemArray and an abstract class containing and managing distributed system drivers within framework of master. The DistributedSystemArray class allocates DistributedSystemRole objects to DistributedSystem objects for optimization.

Unlike the ExternalSystemRole class which is dependent on an ExternalSystem, DistributedSystemRole is not dependent on a DistributedSystem and even can be allocated to multiple DistributedSystem objects. Allocation of DistributedSystemRole(s) to DistributedSystem(s) is determined by estimation of performance index pursuing best distribution. If number of DistributedSystem and DistributedSystemRole objects is not a lot, optimize by combined permuation algorithm. Else the objects are a lot, the allocation will be optimized by genetic algorithm.



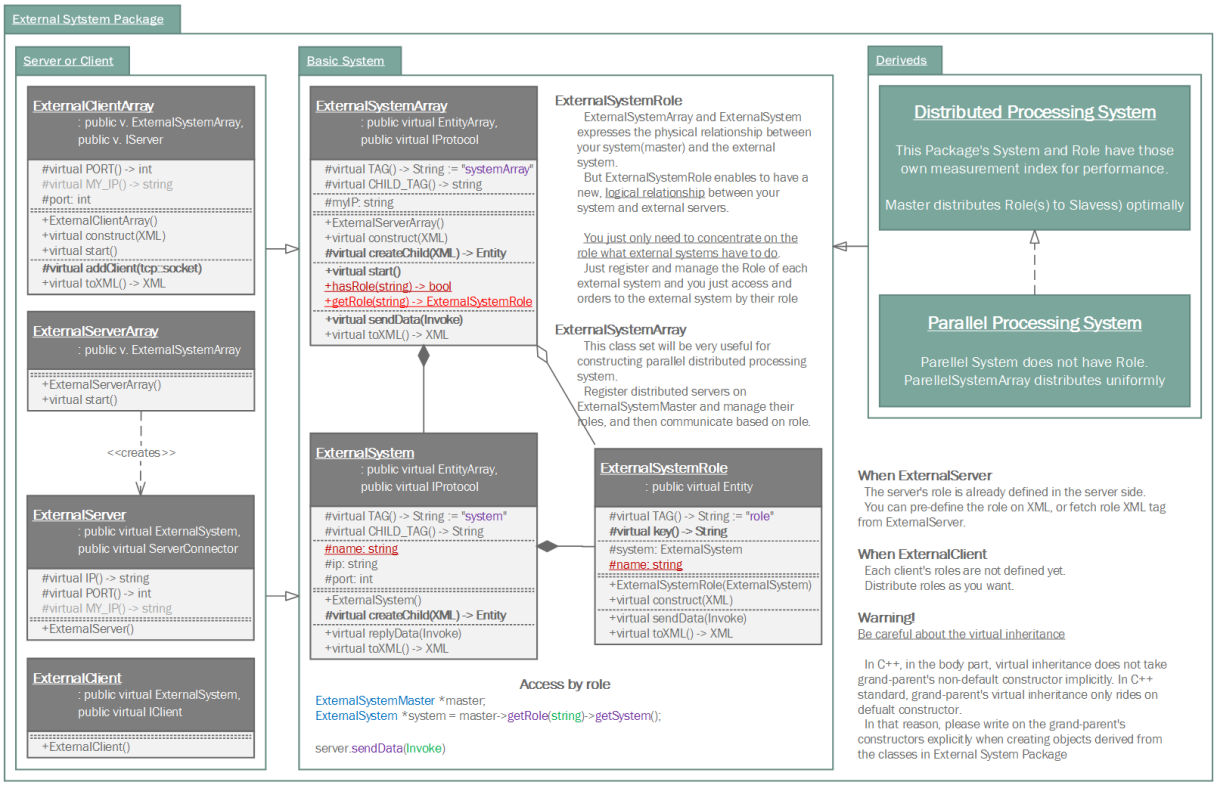

[Inherited]

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




### See also

samchon::protocol

### Author

Jeongho Nam

The documentation for this class was generated from the following files:

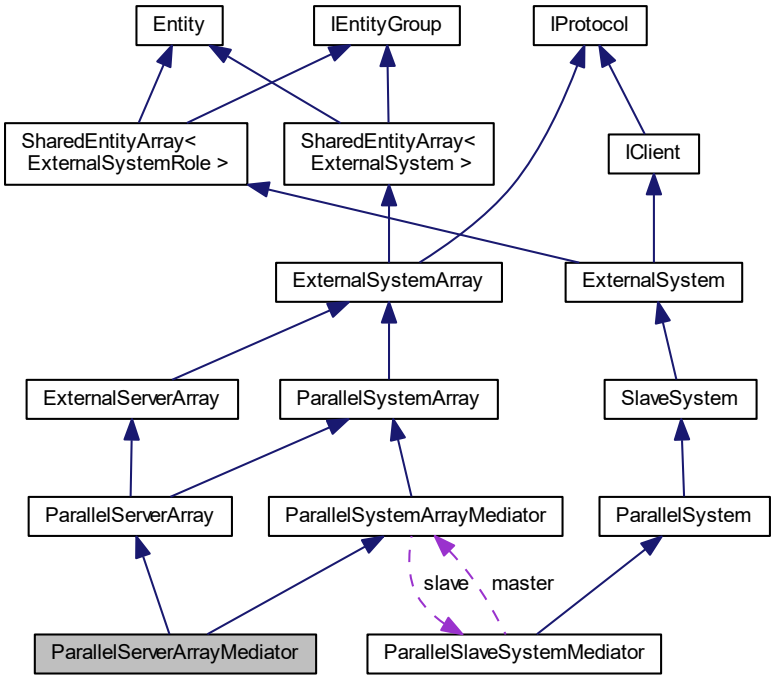
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelServerArray.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelServerArray.cpp

## 6.102 ParallelServerArrayMediator Class Reference

A mediator of parallel system between master and slaves.

```
#include <ParallelServerArrayMediator.hpp>
```

Collaboration diagram for ParallelServerArrayMediator:




## Public Member Functions

- ParallelServerArrayMediator ()

  *Default Constructor.*
- virtual void start () override

  *Start interaction.*

## Additional Inherited Members

### 6.102.1 Detailed Description

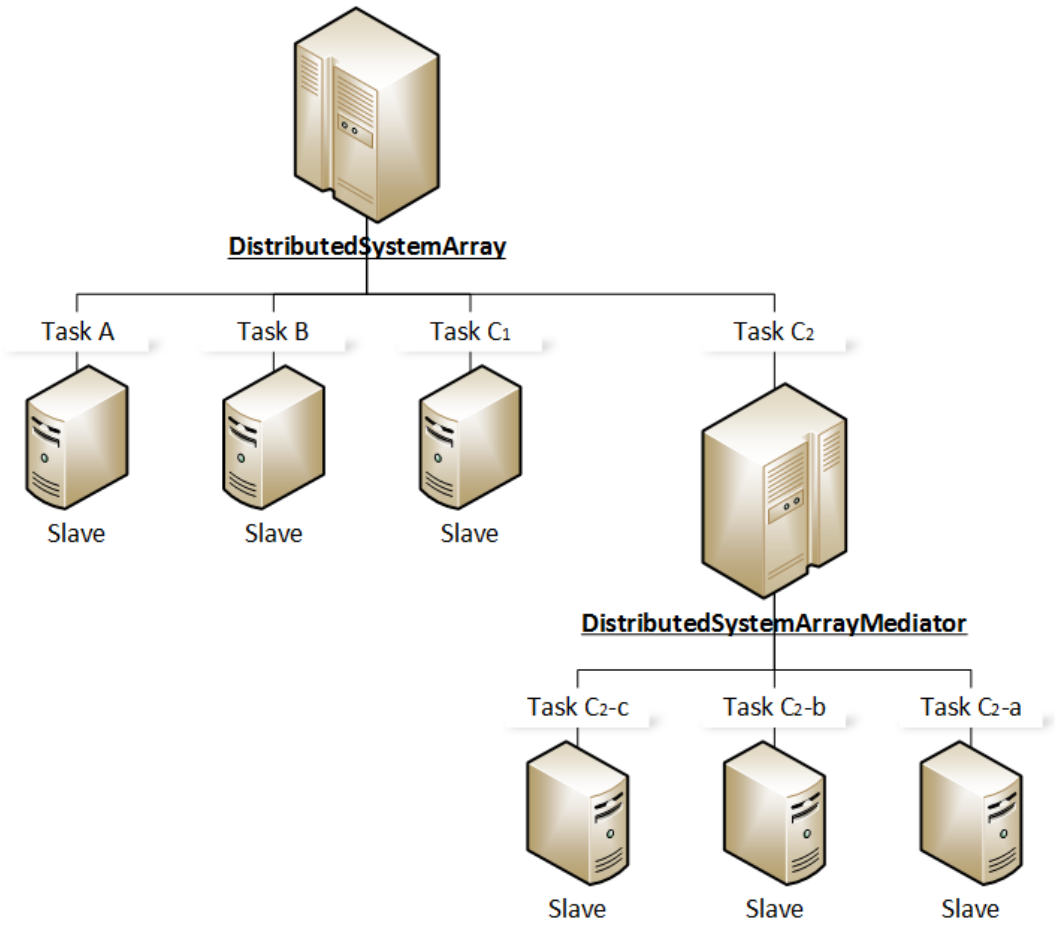
A mediator of parallel system between master and slaves.

ParallelServerArrayMediator is a ParallelSystemArrayMediator specialized in servers' driver. ParallelServer↩ ArrayMediator is a server for its master and also manages children servers' slaves.

**[Inherited]**

ParallelSystemArrayMediator class is used to realizing a mediator system of tree-structured parallel processing system. ParallelSystemArrayMediator intermediates between origin-master(ParallelSystemArray) and its slaves(slave::ParallelSystem).

ParallelSystemArrayMediator is a master(ParallelSystemArray) within the framework of slaves systems (slave::ParallelSystem objects) and also can be a slave system (slave::ParallelSystem) within framework of its master(ParallelSystemArray) by having ParallelSlaveSystemMediator.




[Inherited]

ParallelSystemArray is an ExternalSystemArray and an abstract class containing. and managing parallel system drvers within framework of master. The ParallelSystemArray class allocates segmented processes (Invoke message containing segmentation size) following by each system's performance index.

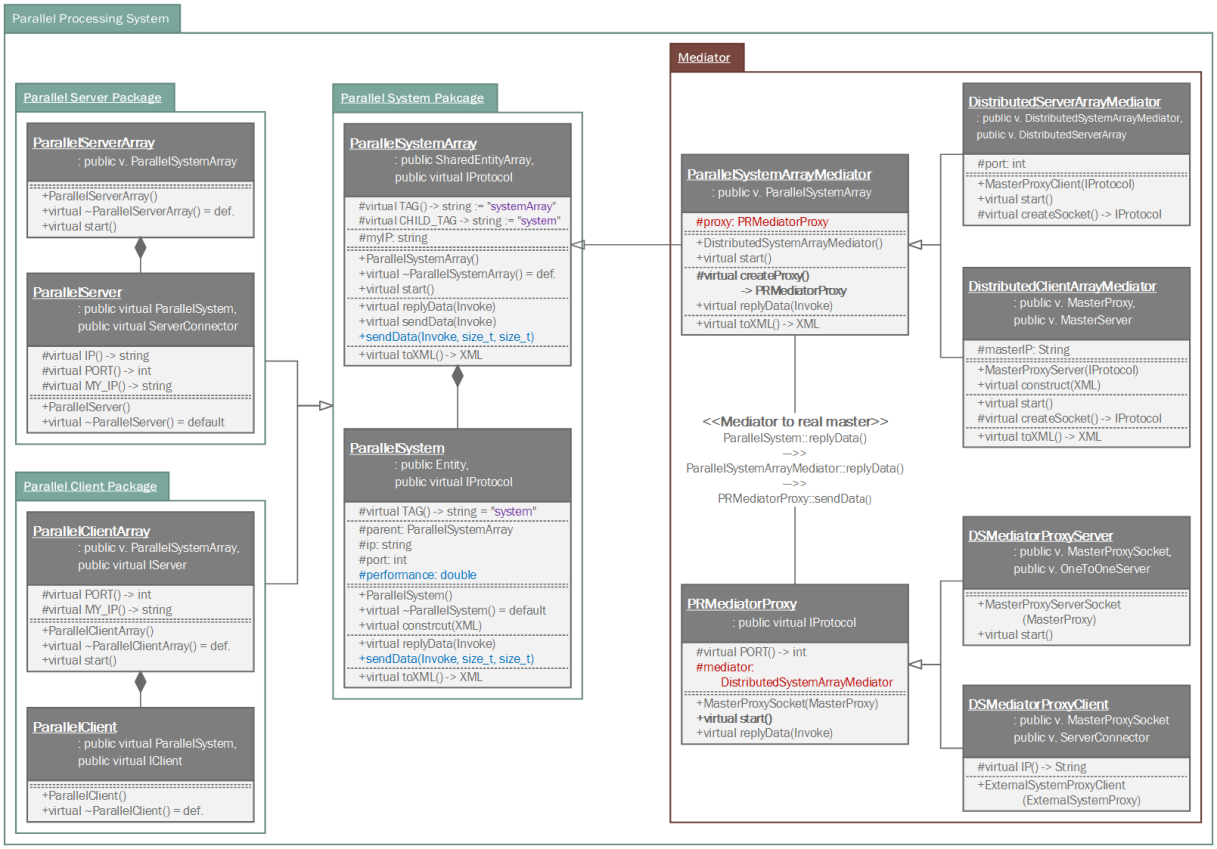
Unlike DistributedSystemArray, ParallelSystemArray does not have such complicate relationships and logics. All segmentation sent by sendData(Invoke, size_t) requires uniform performance. ParallelSystemArray just calculates each system's performance index by elapsing time such easily.

Of course, DistributedSystemArray determines which size of segmentation allocation will be suitable for each system by the performance index

.

Each segmentation in requested process (Invoke message) is equivalent. Thus, role of ParallelSystem objects in a ParallelSystemArray are almost same and does not need to specify ExternalSystemRole on each ParallelSystem.

- Not a matter to specifying ExternalSystemRole objects to each ParallelSystem. In that case, Invoke messages having segmentation size will be processed by ParallelSystemArray's own logic and Invoke messages without segmentation size will be handled by ordinary logic of ExternalSystemArray's own.



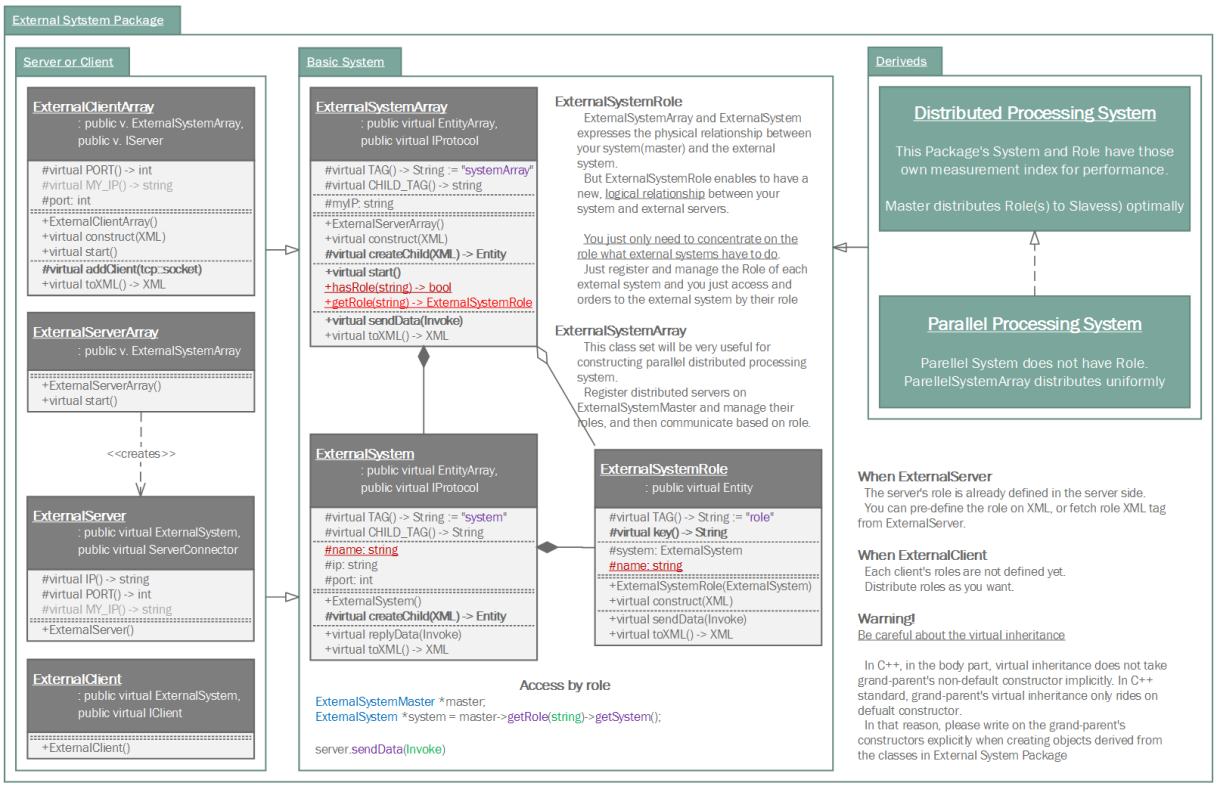

**[Inherited]**

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

- ExternalSystemArray::getRole("something")->sendData(invoke);




**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.102.2 Member Function Documentation

#### 6.102.2.1 virtual void start ( ) [override], [virtual]

Start interaction.

An abstract method starting interaction with external systems.

If external systems are servers, starts connection to them, else clients, opens a server and accepts the external systems. You can addict your own procudures of starting drivers, but if you directly override method of abstract ExternalSystemArray, be careful about virtual inheritance.

- DistributedClientArray::start() calls DistributedSystemArray::start() and ExternalClientArray:start()

Reimplemented from ParallelSystemArrayMediator.

The documentation for this class was generated from the following file:

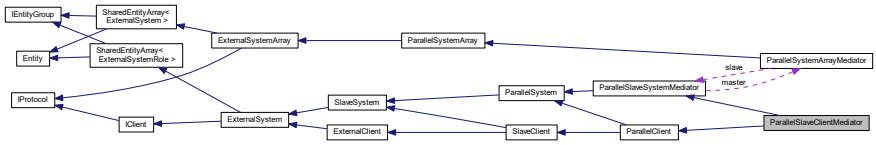
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelServerArrayMediator.↩ hpp

## 6.103 ParallelSlaveClientMediator Class Reference

A parallel slave client for mediation.

```
#include <ParallelSlaveClientMediator.hpp>
```

Collaboration diagram for ParallelSlaveClientMediator:




## Public Member Functions

– ParallelSlaveClientMediator ()

*Default Constructor.*

## Additional Inherited Members

### 6.103.1 Detailed Description

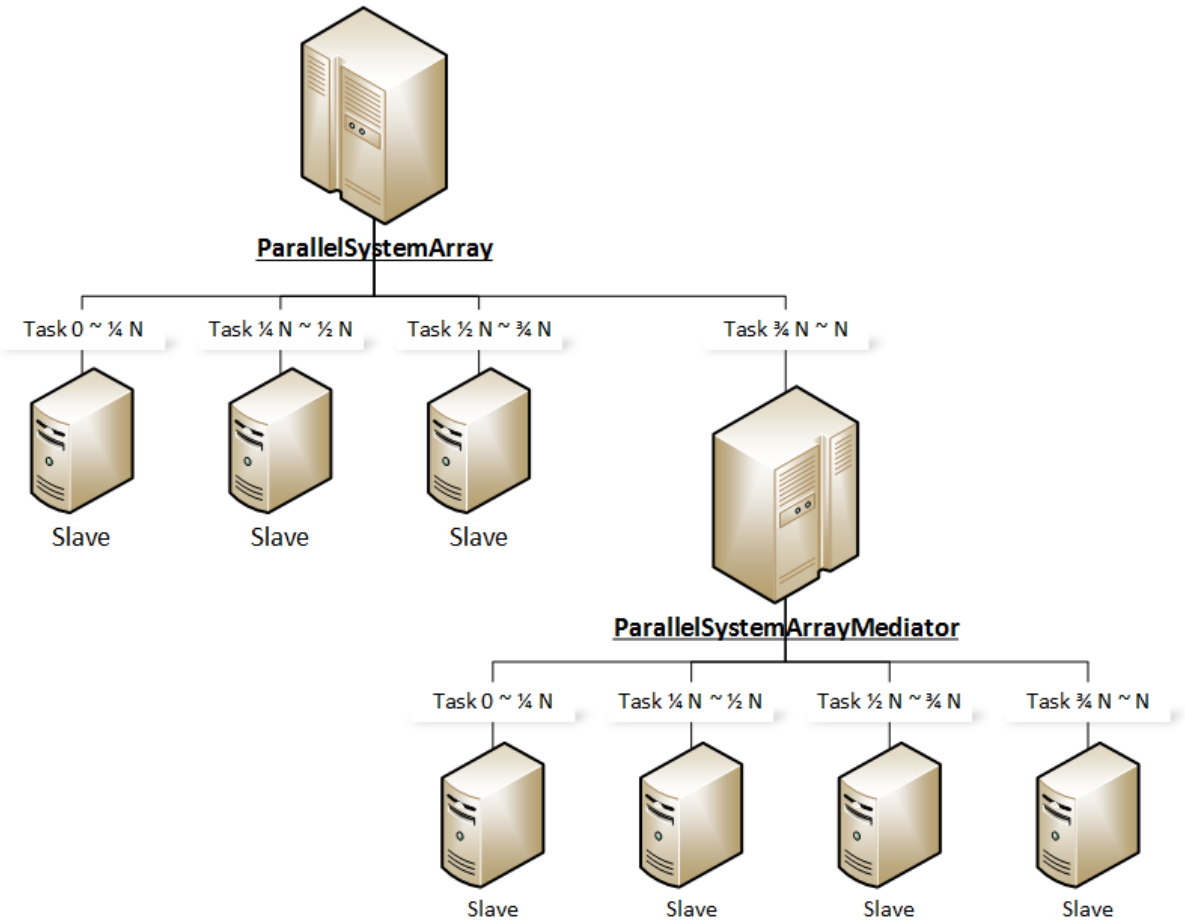
A parallel slave client for mediation.

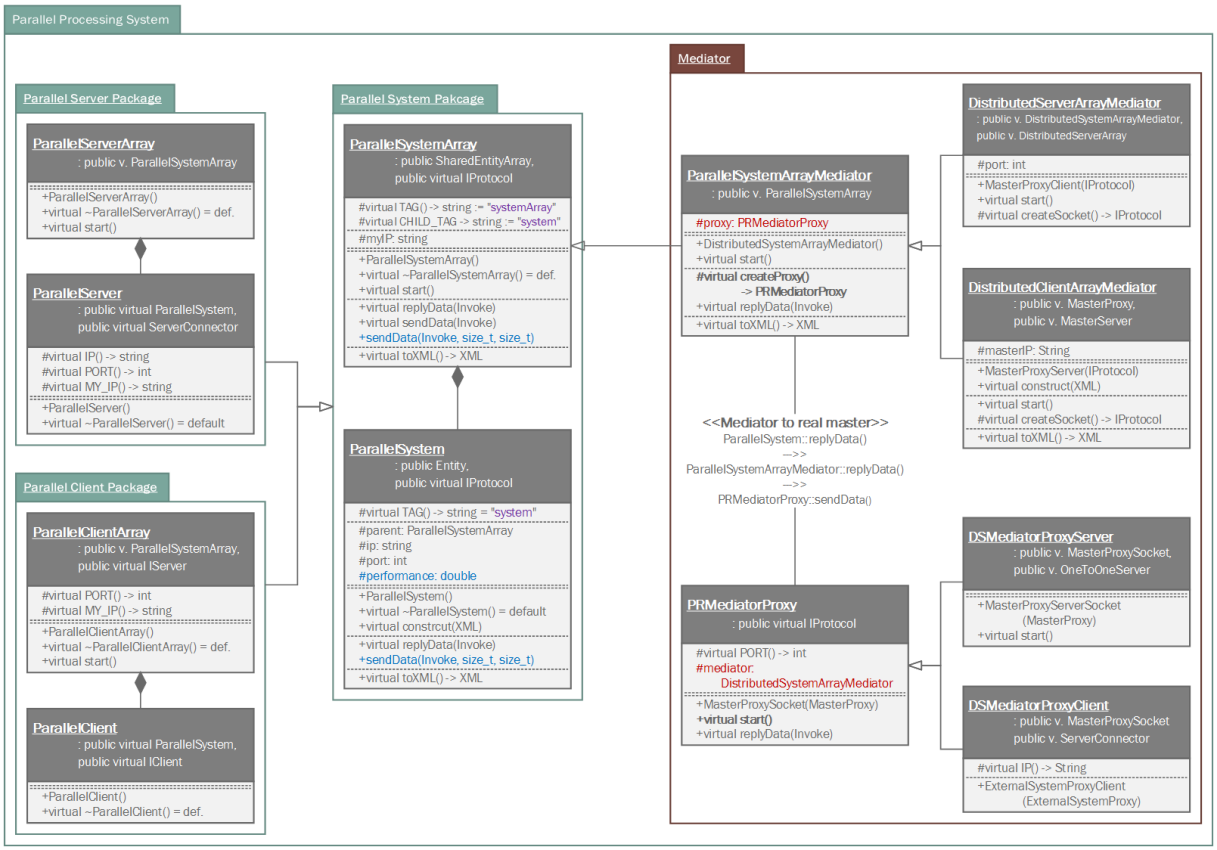
ParallelSlaveClientMediator is a ParallelSlaveSystemMediator class specialized in client driver.

**[Inherited]**

ParallelSlaveSystemMediator is an abstract class derived from slave::ParallelSystem for realizing tree-structured distriuted processins system. ParallelSlaveSystemMediator acts a slave system's role for its master, on the above level.

ParallelSystemArrayMediator and ParallelSlaveSystemMediator classes are paired to act a mediator system role by acting their own role, master system role for below slaves and slave system role for above master system.


ParallelSystemArray
Task 0 ~ ¼ N
Task ¼ N ~ ½ N
Task ½ N ~ ¾ N
Task ¾ N ~ N
Slave
Slave
Slave
ParallelSystemArrayMediator
Task 0 ~ ¼ N
Task ¼ N ~ ½ N
Task ½ N ~ ¾ N
Task ¾ N ~ N
Slave
Slave
Slave
Slave


Parallel Processing System
Parallel Server Package
ParallelServerArray
: public v. ParallelSystemArray
+ParallelServerArray()
+virtual ~ParallelServerArray() = def.
+virtual start()
ParallelServer
: public virtual ParallelSystem,
public virtual ServerConnector
#virtual IP() -> string
#virtual PORT() -> int
#virtual MY_IP() -> string
+ParallelServer()
+virtual ~ParallelServer() = default
Parallel Client Package
ParallelClientArray
: public v. ParallelSystemArray,
public virtual IServer
#virtual PORT() -> int
#virtual MY_IP() -> string
+ParallelClientArray()
+virtual ~ParallelClientArray() = def.
+virtual start()
ParallelClient
: public virtual ParallelSystem,
public virtual IClient
+ParallelClient()
+virtual ~ParallelClient() = def.
Parallel System Pakcage
ParallelSystemArray
: public SharedEntityArray,
public virtual IProtocol
#virtual TAG() -> string := "systemArray"
#virtual CHILD_TAG -> string := "system"
#myIP: string
+ParallelSystemArray()
+virtual ~ParallelSystemArray() = def.
+virtual start()
+virtual replyData(Invoke)
+virtual sendData(Invoke)
+sendData(Invoke, size_t, size_t)
+virtual toXML() -> XML
ParallelSystem
: public Entity,
public virtual IProtocol
#virtual TAG() -> string = "system"
#parent: ParallelSystemArray
#ip: string
#port: int
#performance: double
+ParallelSystem()
+virtual ~ParallelSystem() = default
+virtual constrcut(XML)
+virtual replyData(Invoke)
+sendData(Invoke, size_t, size_t)
+virtual toXML() -> XML
Mediator
ParallelSystemArrayMediator
: public v. ParallelSystemArray
#proxy: PRMediatorProxy
+DistributedSystemArrayMediator()
+virtual start()
#virtual createProxy()
-> PRMediatorProxy
+virtual replyData(Invoke)
+virtual toXML() -> XML
DistributedServerArrayMediator
: public v. DistributedSystemArrayMediator,
public v. DistributedServerArray
#port: int
+MasterProxyClient(IProtocol)
+virtual start()
#virtual createSocket() -> IProtocol
DistributedClientArrayMediator
: public v. MasterProxy,
public v. MasterServer
#masterIP: String
+MasterProxyServer(IProtocol)
+virtual construct(XML)
+virtual start()
#virtual createSocket() -> IProtocol
+virtual toXML() -> XML
<<Mediator to real master>>
ParallelSystem::replyData()
-->>
ParallelSystemArrayMediator::replyData()
-->>
PRMediatorProxy::sendData()
PRMediatorProxy
: public virtual IProtocol
#virtual PORT() -> int
#mediator:
DistributedSystemArrayMediator
+MasterProxySocket(MasterProxy)
+virtual start()
+virtual replyData(Invoke)
DSMediatorProxyServer
: public v. MasterProxySocket,
public v. OneToOneServer
+MasterProxyServerSocket
(MasterProxy)
+virtual start()
DSMediatorProxyClient
: public v. MasterProxySocket
public v. ServerConnector
#virtual IP() -> String
+ExternalSystemProxyClient
(ExternalSystemProxy)

**[Inherited]**

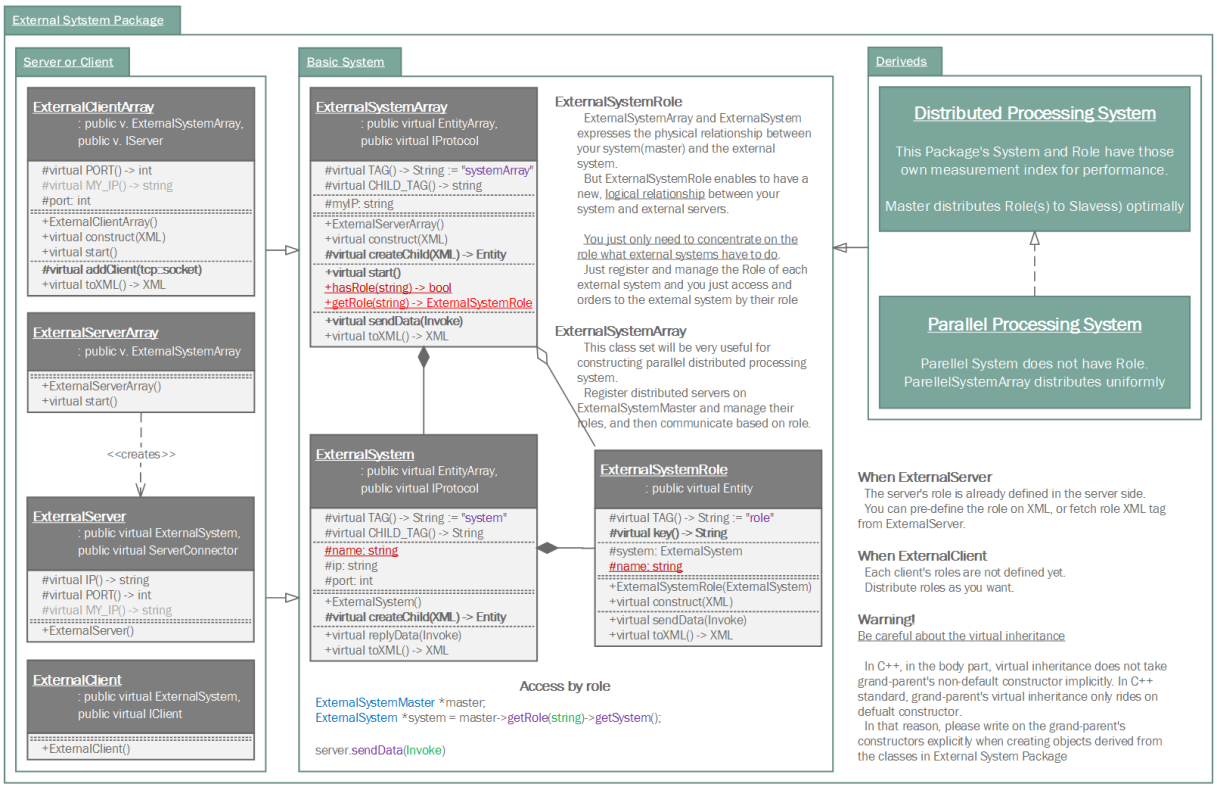
SlaveSystem, literally, means a slave system belongs to a maste system.

The SlaveSystem class is used in opposite side system of master::DistributedSystem and master::Parallel↩System and reports elapsed time of each commmand (by Invoke message) for estimation of its performance.

**[Inherited]**

ExternalSystem is a boundary class interacting with an external system by network communication. Also, ExternalSystem is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystem↩Role.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an External↩System. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

The documentation for this class was generated from the following file:

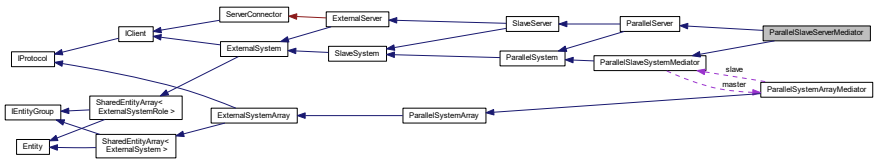
– D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/slave/ParallelSlaveClientMediator.hpp

## 6.104 ParallelSlaveServerMediator Class Reference

A parallel slave server for mediation.

```
#include <ParallelSlaveServerMediator.hpp>
```

Collaboration diagram for ParallelSlaveServerMediator:




### Public Member Functions

– ParallelSlaveServerMediator ()

*Default Constructor.*

### Additional Inherited Members

### 6.104.1 Detailed Description

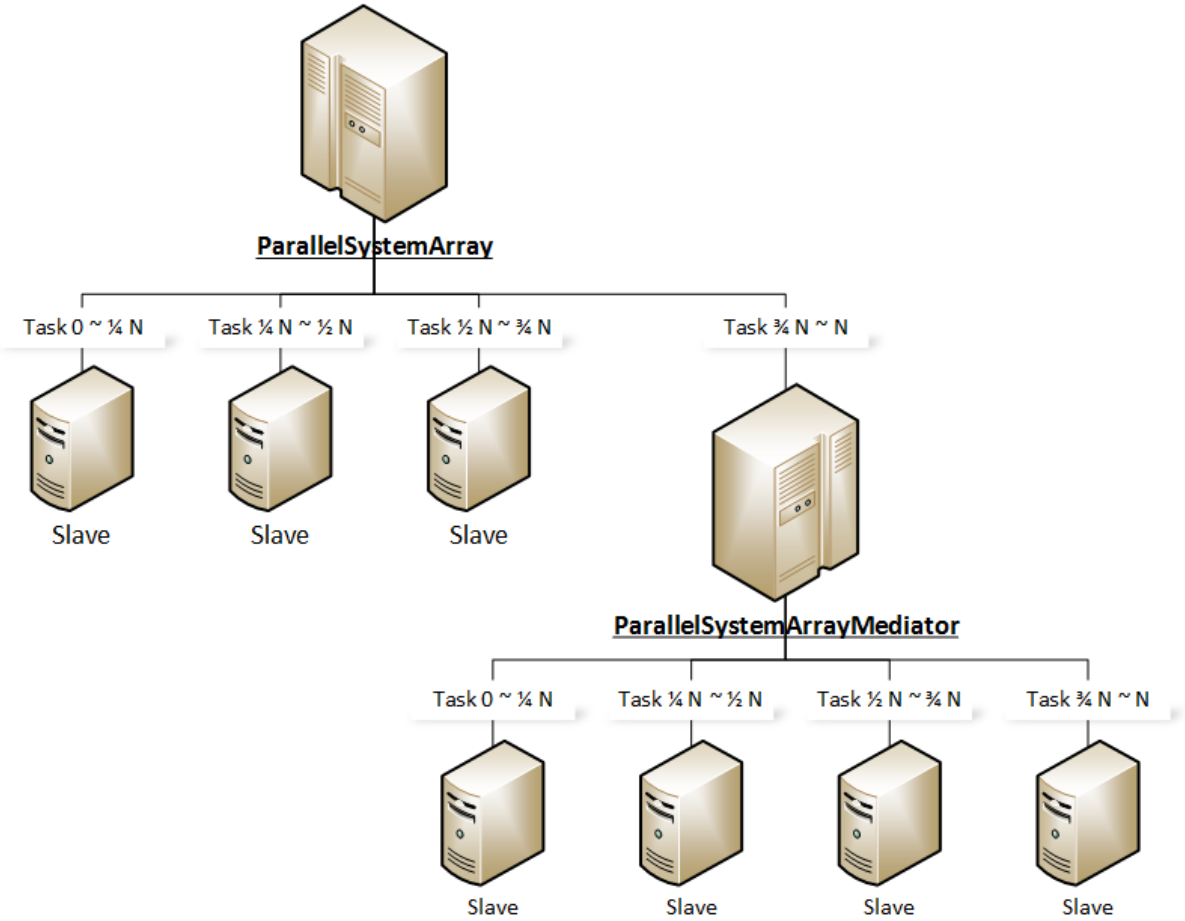
A parallel slave server for mediation.

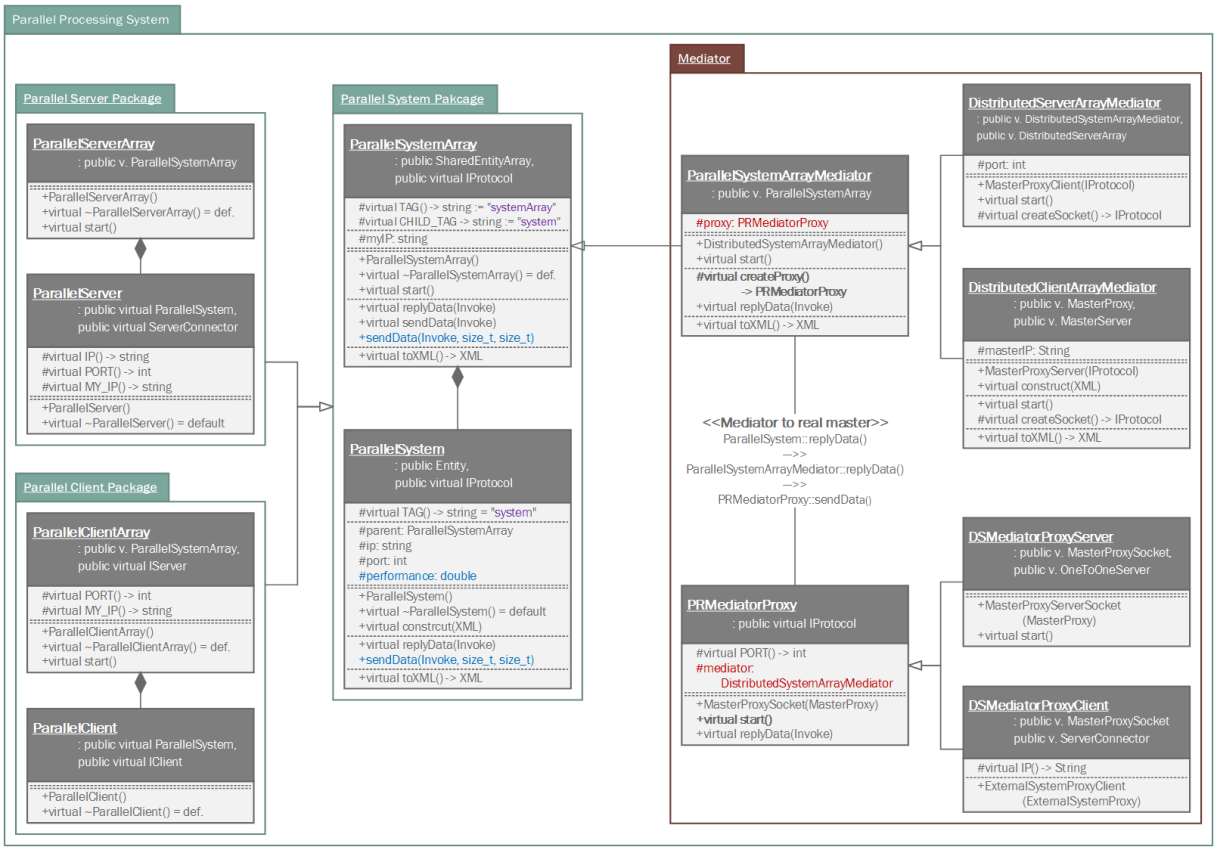
ParallelSlaveServerMediator is a ParallelSlaveSystemMediator class specialized in server driver.

**[Inherited]**

ParallelSlaveSystemMediator is an abstract class derived from slave::ParallelSystem for realizing tree-structured distriuted processins system. ParallelSlaveSystemMediator acts a slave system's role for its master, on the above level.

ParallelSystemArrayMediator and ParallelSlaveSystemMediator classes are paired to act a mediator system role by acting their own role, master system role for below slaves and slave system role for above master system.


ParallelSystemArray
Task 0 ~ ¼ N
Task ¼ N ~ ½ N
Task ½ N ~ ¾ N
Task ¾ N ~ N
Slave
Slave
Slave
ParallelSystemArrayMediator
Task 0 ~ ¼ N
Task ¼ N ~ ½ N
Task ½ N ~ ¾ N
Task ¾ N ~ N
Slave
Slave
Slave
Slave


Parallel Processing System
Parallel Server Package
ParallelServerArray
: public v. ParallelSystemArray
+ParallelServerArray()
+virtual ~ParallelServerArray() = def.
+virtual start()
ParallelServer
: public virtual ParallelSystem,
public virtual ServerConnector
#virtual IP() -> string
#virtual PORT() -> int
#virtual MY_IP() -> string
+ParallelServer()
+virtual ~ParallelServer() = default
Parallel Client Package
ParallelClientArray
: public v. ParallelSystemArray,
public virtual IServer
#virtual PORT() -> int
#virtual MY_IP() -> string
+ParallelClientArray()
+virtual ~ParallelClientArray() = def.
+virtual start()
ParallelClient
: public virtual ParallelSystem,
public virtual IClient
+ParallelClient()
+virtual ~ParallelClient() = def.
Parallel System Pakcage
ParallelSystemArray
: public SharedEntityArray,
public virtual IProtocol
#virtual TAG() -> string := "systemArray"
#virtual CHILD_TAG -> string := "system"
#myIP: string
+ParallelSystemArray()
+virtual ~ParallelSystemArray() = def.
+virtual start()
+virtual replyData(Invoke)
+virtual sendData(Invoke)
+sendData(Invoke, size_t, size_t)
+virtual toXML() -> XML
ParallelSystem
: public Entity,
public virtual IProtocol
#virtual TAG() -> string = "system"
#parent: ParallelSystemArray
#ip: string
#port: int
#performance: double
+ParallelSystem()
+virtual ~ParallelSystem() = default
+virtual constrcut(XML)
+virtual replyData(Invoke)
+sendData(Invoke, size_t, size_t)
+virtual toXML() -> XML
Mediator
ParallelSystemArrayMediator
: public v. ParallelSystemArray
#proxy: PRMediatorProxy
+DistributedSystemArrayMediator()
+virtual start()
#virtual createProxy()
-> PRMediatorProxy
+virtual replyData(Invoke)
+virtual toXML() -> XML
DistributedServerArrayMediator
: public v. DistributedSystemArrayMediator,
public v. DistributedServerArray
#port: int
+MasterProxyClient(IProtocol)
+virtual start()
#virtual createSocket() -> IProtocol
DistributedClientArrayMediator
: public v. MasterProxy,
public v. MasterServer
#masterIP: String
+MasterProxyServer(IProtocol)
+virtual construct(XML)
+virtual start()
#virtual createSocket() -> IProtocol
+virtual toXML() -> XML
<<Mediator to real master>>
ParallelSystem::replyData()
-->>
ParallelSystemArrayMediator::replyData()
-->>
PRMediatorProxy::sendData()
PRMediatorProxy
: public virtual IProtocol
#virtual PORT() -> int
#mediator:
DistributedSystemArrayMediator
+MasterProxySocket(MasterProxy)
+virtual start()
+virtual replyData(Invoke)
DSMediatorProxyServer
: public v. MasterProxySocket,
public v. OneToOneServer
+MasterProxyServerSocket
(MasterProxy)
+virtual start()
DSMediatorProxyClient
: public v. MasterProxySocket
public v. ServerConnector
#virtual IP() -> String
+ExternalSystemProxyClient
(ExternalSystemProxy)

[Inherited]

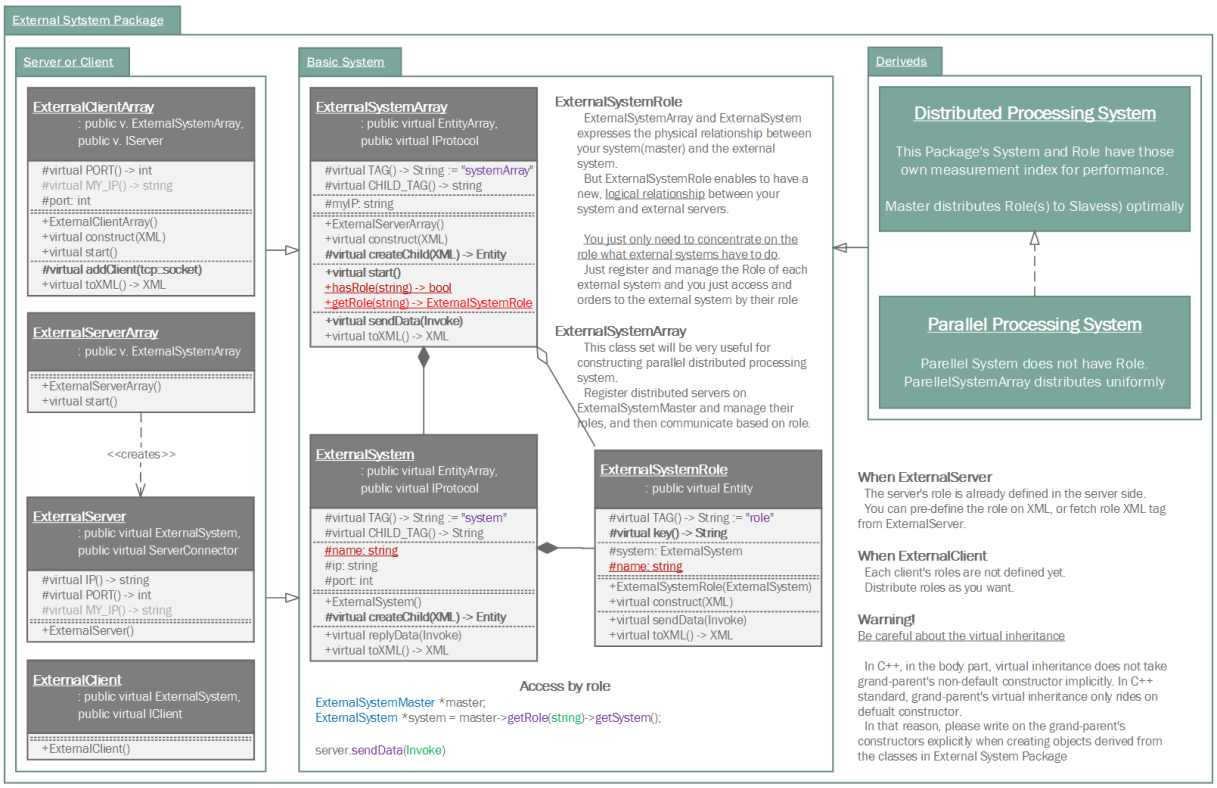
SlaveSystem, literally, means a slave system belongs to a maste system.

The SlaveSystem class is used in opposite side system of master::DistributedSystem and master::Parallel↩System and reports elapsed time of each commmand (by Invoke message) for estimation of its performance.

[Inherited]

ExternalSystem is a boundary class interacting with an external system by network communication. Also, ExternalSystem is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystem↩Role.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an External↩System. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

The documentation for this class was generated from the following file:

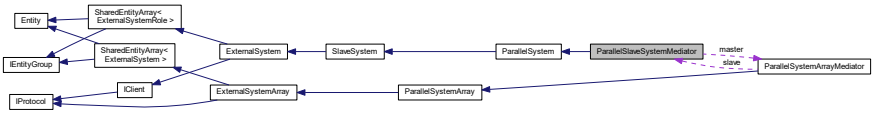
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/slave/ParallelSlaveServerMediator.↩ hpp

## 6.105 ParallelSlaveSystemMediator Class Reference

A parallel slave system for mediation.

`#include <ParallelSlaveSystemMediator.hpp>`

Collaboration diagram for ParallelSlaveSystemMediator:




### Public Member Functions

- ParallelSlaveSystemMediator ()

  *Default Constructor.*
- virtual void replyData (std::shared_ptr< Invoke >) override

  *Handling replied message from an external system.*
- virtual auto TAG () const -> std::string override

  *A tag name when represented by XML.*

### Protected Attributes

- ParallelSystemArrayMediator * master

  *A master system for mediation.*

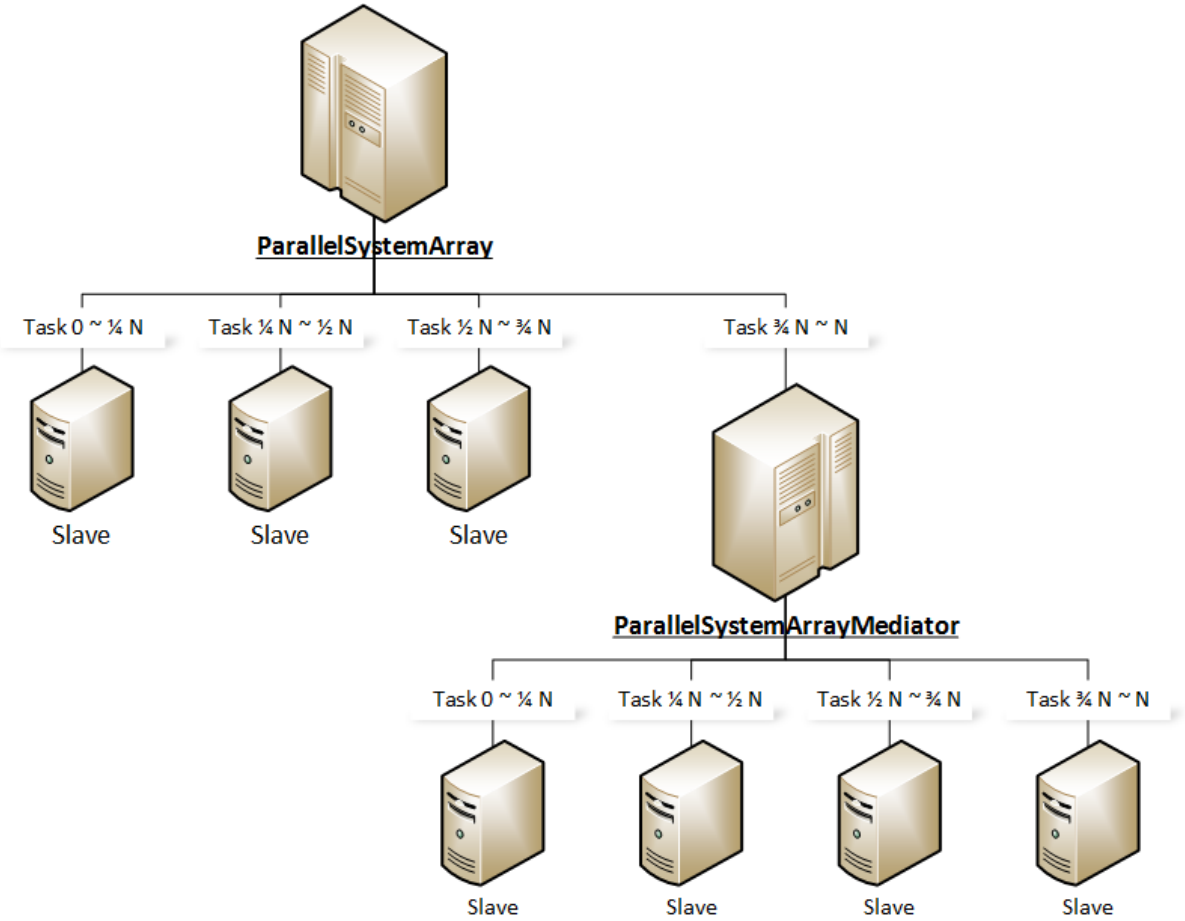
### Additional Inherited Members

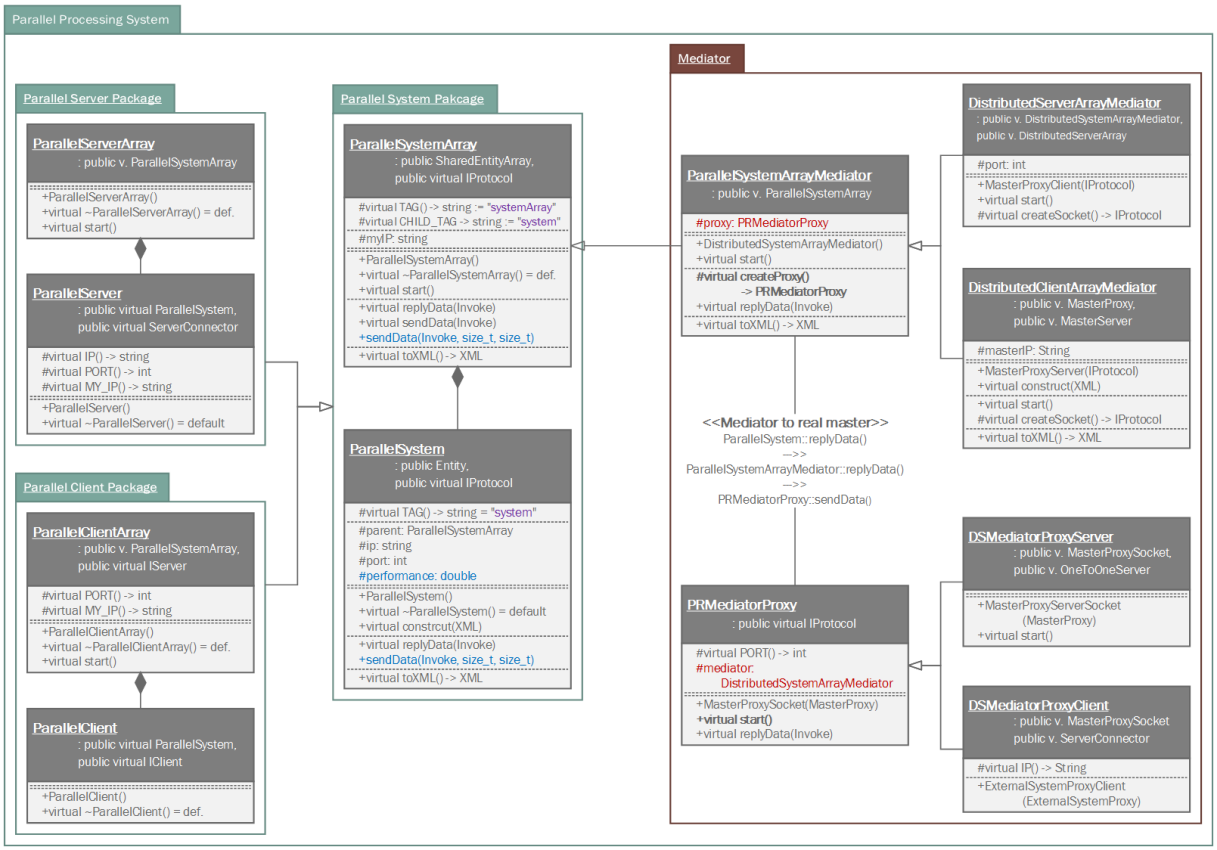
#### 6.105.1 Detailed Description

A parallel slave system for mediation.

ParallelSlaveSystemMediator is an abstract class derived from slave::ParallelSystem for realizing tree-structured distriuted processins system. ParallelSlaveSystemMediator acts a slave system's role for its master, on the above level.

ParallelSystemArrayMediator and ParallelSlaveSystemMediator classes are paired to act a mediator system role by acting their own role, master system role for below slaves and slave system role for above master system.


ParallelSystemArray
Task 0 ~ ¼ N
Task ¼ N ~ ½ N
Task ½ N ~ ¾ N
Task ¾ N ~ N
Slave
Slave
Slave
ParallelSystemArrayMediator
Task 0 ~ ¼ N
Task ¼ N ~ ½ N
Task ½ N ~ ¾ N
Task ¾ N ~ N
Slave
Slave
Slave
Slave


Parallel Processing System
Parallel Server Package
ParallelServerArray
: public v. ParallelSystemArray
+ParallelServerArray()
+virtual ~ParallelServerArray() = def.
+virtual start()
ParallelServer
: public virtual ParallelSystem,
public virtual ServerConnector
#virtual IP() -> string
#virtual PORT() -> int
#virtual MY_IP() -> string
+ParallelServer()
+virtual ~ParallelServer() = default
Parallel Client Package
ParallelClientArray
: public v. ParallelSystemArray,
public virtual IServer
#virtual PORT() -> int
#virtual MY_IP() -> string
+ParallelClientArray()
+virtual ~ParallelClientArray() = def.
+virtual start()
ParallelClient
: public virtual ParallelSystem,
public virtual IClient
+ParallelClient()
+virtual ~ParallelClient() = def.
Parallel System Pakcage
ParallelSystemArray
: public SharedEntityArray,
public virtual IProtocol
#virtual TAG() -> string := "systemArray"
#virtual CHILD_TAG -> string := "system"
#myIP: string
+ParallelSystemArray()
+virtual ~ParallelSystemArray() = def.
+virtual start()
+virtual replyData(Invoke)
+virtual sendData(Invoke)
+sendData(Invoke, size_t, size_t)
+virtual toXML() -> XML
ParallelSystem
: public Entity,
public virtual IProtocol
#virtual TAG() -> string = "system"
#parent: ParallelSystemArray
#ip: string
#port: int
#performance: double
+ParallelSystem()
+virtual ~ParallelSystem() = default
+virtual constrcut(XML)
+virtual replyData(Invoke)
+sendData(Invoke, size_t, size_t)
+virtual toXML() -> XML
Mediator
ParallelSystemArrayMediator
: public v. ParallelSystemArray
#proxy: PRMediatorProxy
+DistributedSystemArrayMediator()
+virtual start()
#virtual createProxy()
-> PRMediatorProxy
+virtual replyData(Invoke)
+virtual toXML() -> XML
DistributedServerArrayMediator
: public v. DistributedSystemArrayMediator,
public v. DistributedServerArray
#port: int
+MasterProxyClient(IProtocol)
+virtual start()
#virtual createSocket() -> IProtocol
DistributedClientArrayMediator
: public v. MasterProxy,
public v. MasterServer
#masterIP: String
+MasterProxyServer(IProtocol)
+virtual construct(XML)
+virtual start()
#virtual createSocket() -> IProtocol
+virtual toXML() -> XML
<<Mediator to real master>>
ParallelSystem::replyData()
-->>
ParallelSystemArrayMediator::replyData()
-->>
PRMediatorProxy::sendData()
PRMediatorProxy
: public virtual IProtocol
#virtual PORT() -> int
#mediator:
DistributedSystemArrayMediator
+MasterProxySocket(MasterProxy)
+virtual start()
+virtual replyData(Invoke)
DSMediatorProxyServer
: public v. MasterProxySocket,
public v. OneToOneServer
+MasterProxyServerSocket
(MasterProxy)
+virtual start()
DSMediatorProxyClient
: public v. MasterProxySocket
public v. ServerConnector
#virtual IP() -> String
+ExternalSystemProxyClient
(ExternalSystemProxy)

[Inherited]

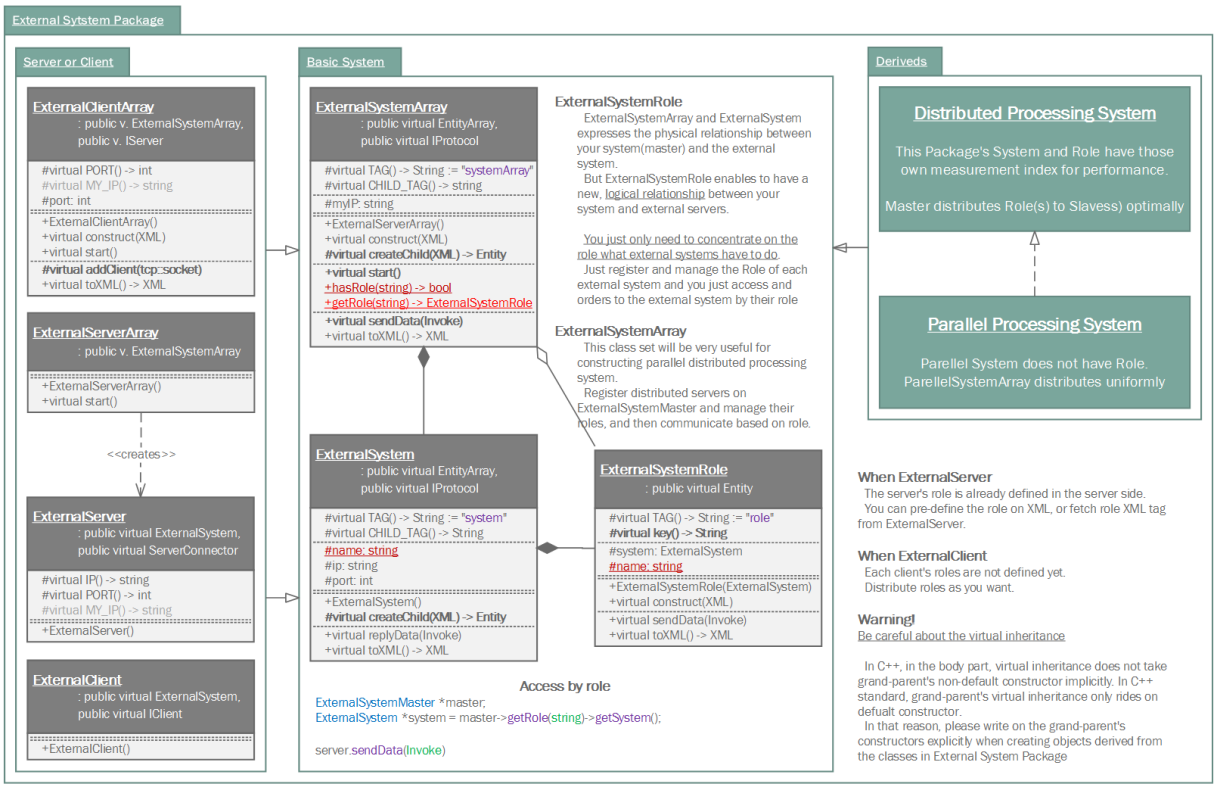
SlaveSystem, literally, means a slave system belongs to a maste system.

The SlaveSystem class is used in opposite side system of master::DistributedSystem and master::Parallel↩System and reports elapsed time of each commmand (by Invoke message) for estimation of its performance.

[Inherited]

ExternalSystem is a boundary class interacting with an external system by network communication. Also, ExternalSystem is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystem↩Role.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an External↩SystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an External↩System. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.105.2 Member Function Documentation

#### 6.105.2.1 virtual void replyData ( std::shared_ptr< Invoke > ) [override], [virtual]

Handling replied message from an external system.

If there's a related ExternalSystemRole, shifts responsibility to the ExternalSystemRole.

**Parameters**

| | |
|---|---|
| *invoke* | Replied Invoke message |

Reimplemented from ExternalSystem.

#### 6.105.2.2 virtual auto TAG ( ) const -> std::string [override], [virtual]

A tag name when represented by XML.

**Returns**

A tag name

Reimplemented from ExternalSystem.

The documentation for this class was generated from the following file:

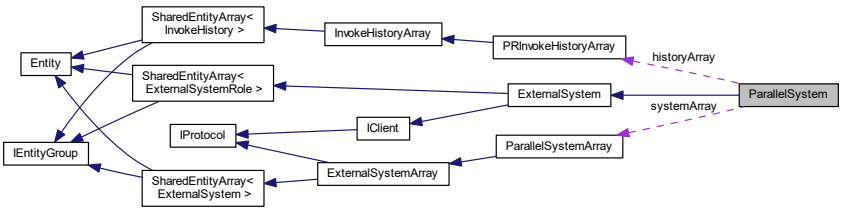
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelSlaveSystemMediator.↩ hpp

## 6.106 ParallelSystem Class Reference

A network driver for a parallel system.

`#include <ParallelSystem.hpp>`

Collaboration diagram for ParallelSystem:




### Public Member Functions

- ParallelSystem ()
  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override
  *Construct data of the Entity from an XML object.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override
  *Get an XML object represents the EntityGroup.*

### Protected Member Functions

- virtual void _replyData (std::shared_ptr< Invoke >) override

  *A method for pre-processing replied Invoke message.*

### Protected Attributes

- PRInvokeHistoryArray * historyArray

  *A list of history log for reported Invoke messages.*

- double performance

  *A performance index.*

### Private Member Functions

- void sendSegmentData (std::shared_ptr< Invoke >, size_t, size_t)

  *Send a message with segmentation index.*

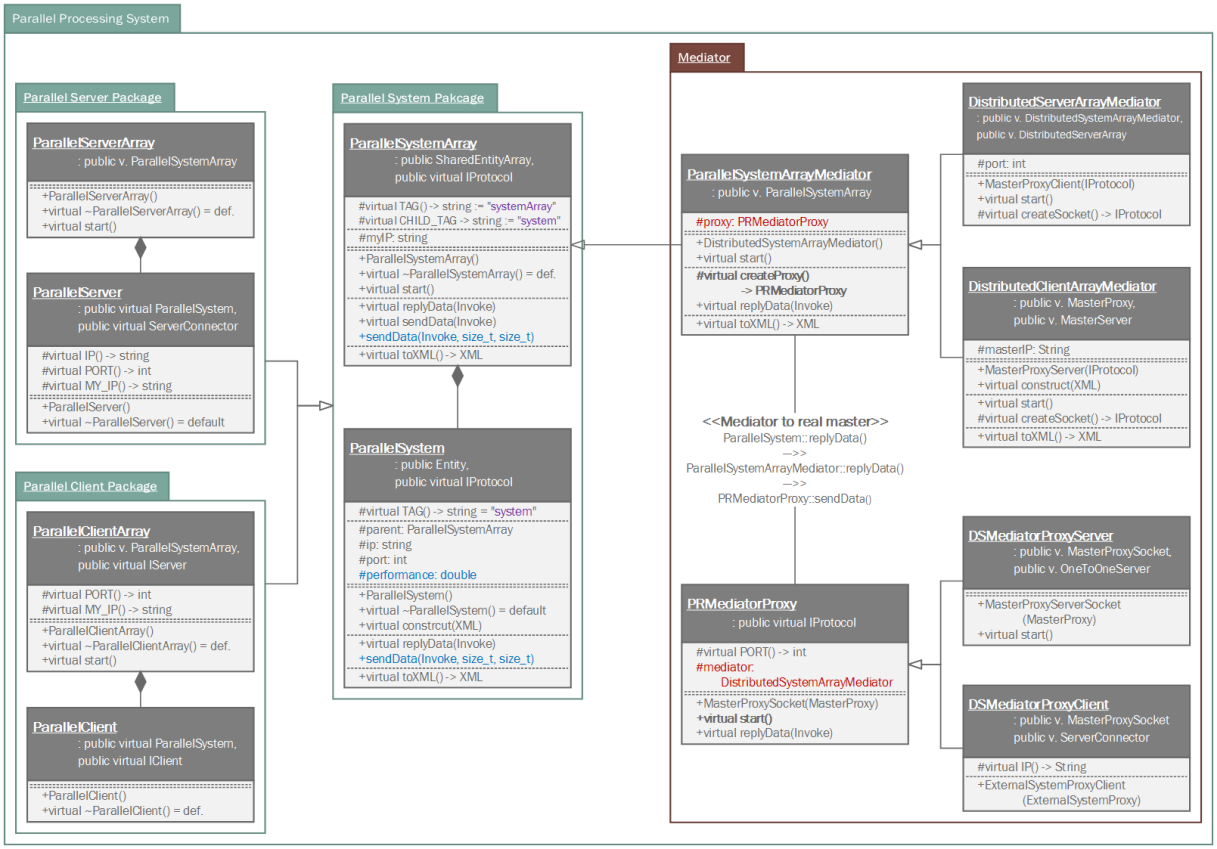
## 6.106.1 Detailed Description

A network driver for a parallel system.

ParallelSystem class is an ExternalSystem having performance index and history logs of handled Invoke messages with those elapsed times. Those performance index and history logs are used to determine how much segmentation to be allocated.

Each segmentation in requested process (Invoke message) is equivalent. Thus, role of ParallelSystem objects in a ParallelSystemArray are almost same and does not need to specify ExternalSystemRole on ParallelSystem.

- Not a matter to specifying ExternalSystemRole objects to each ParallelSystem. In that case, Invoke messages having segmentation size will be processed by ParallelSystem's own logic and Invoke messages without segmentation size will be handled by ordinary logic of ExternalSystem's own.




[Inherited]

### 6.106.2 Member Function Documentation

#### 6.106.2.1 void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

[Inherited]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from ExternalSystem.

Reimplemented in ParallelServer.

#### 6.106.2.2 virtual void _replyData ( std::shared_ptr< Invoke > ) [override], [protected], [virtual]

A method for pre-processing replied Invoke message.

You can realize a pre-processing about the replied Invoke message by overriding the IClient::_replyData().

Archiving a history log, filtering and truncating, let handling the message with a new thread, calculating performance by estimating elapsed time about the Invoke message, and so on. Anything you can define pre-processing works before IProtocol::replyData().

- Archive history log -> cloud service
- Estimating performance -> distributed and parallel processing system

**Parameters**

| | |
|---|---|
| *invoke* | An invoke message to be pre-processed and shifted to IProtocol::replyData(). |

Reimplemented from IClient.

#### 6.106.2.3 void sendSegmentData ( std::shared_ptr< Invoke > , size_t , size_t ) [private]

Send a message with segmentation index.

**Parameters**

| | |
|---|---|
| *invoke* | An invoke message requesting a process. |
| *startIndex* | Starting index number of segmentation. |
| *size* | Size of segmentation. |

#### 6.106.2.4 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from ExternalSystem.

Reimplemented in ParallelServer.

### 6.106.3 Member Data Documentation

#### 6.106.3.1 double performance [protected]

A performance index.

A performance index z is calculated by normalization calculating reverse number of

whole parallel system's average elapsed times and its z value between the normal distribution.

- X = (

  If a parallel system has no history of handling Invoke message, then set the performance index to 0 as default. The performance index will be re-calcuated whenever segmented process has sent (ParallelSystemArray::sendData(Invoke, size_t)).

  The documentation for this class was generated from the following files:

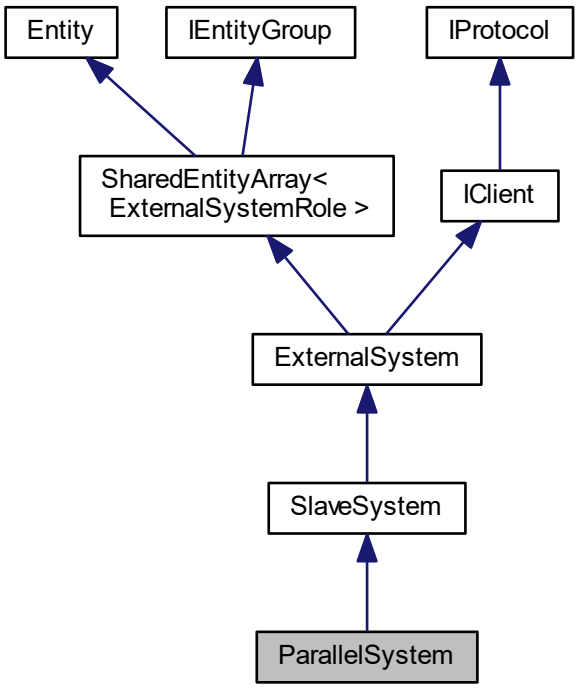
  * D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelSystem.hpp
  * D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelSystem.cpp

## 6.107 ParallelSystem Class Reference

A slave parallel system.

`#include <ParallelSystem.hpp>`

Collaboration diagram for ParallelSystem:



### Public Member Functions

* ParallelSystem ()
  *Default Constructor.*

### Protected Member Functions

* virtual void _replyData (std::shared_ptr< Invoke >) override
  *Pre-processor for segmented processes and reporting elapsed time.*
* virtual void replyData (std::shared_ptr< Invoke >, size_t, size_t)=0
  *Handle requested processes which are segmented.*

### Additional Inherited Members

## 6.107.1 Detailed Description

A slave parallel system.

ParallelSystem is a class processing segmented Invoke messages from master.

**[Inherited]**

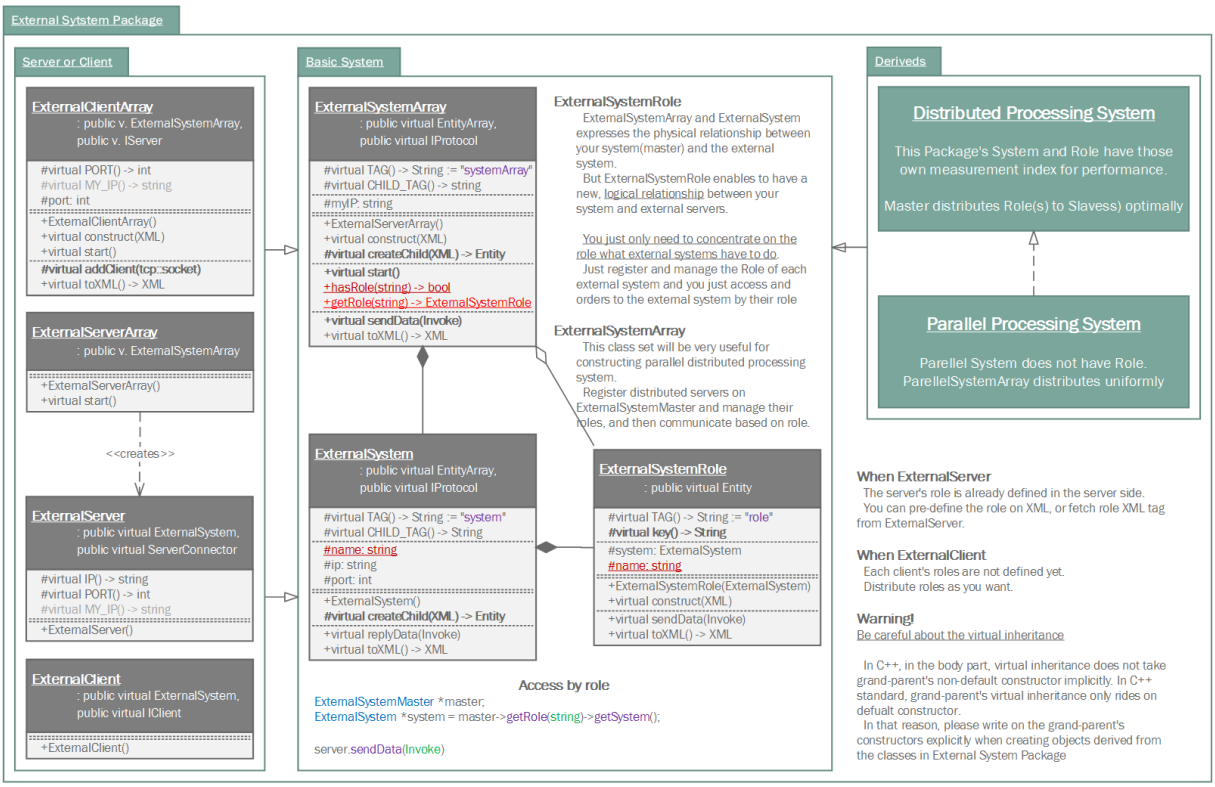
SlaveSystem, literally, means a slave system belongs to a maste system.

The SlaveSystem class is used in opposite side system of master::DistributedSystem and master::↩ ParallelSystem and reports elapsed time of each commmand (by Invoke message) for estimation of its performance.

**[Inherited]**

ExternalSystem is a boundary class interacting with an external system by network communication. Also, ExternalSystem is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystemRole.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an ExternalSystem. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.107.2 Member Function Documentation

#### 6.107.2.1 virtual void _replyData ( std::shared_ptr< Invoke > ) [override], [protected], [virtual]

Pre-processor for segmented processes and reporting elapsed time.

**[Inherited]**

You can realize a pre-processing about the replied Invoke message by overriding the IClient::_reply↩Data().

Archiving a history log, filtering and truncating, let handling the message with a new thread, calculating performance by estimating elapsed time about the Invoke message, and so on. Anything you can define pre-processing works before IProtocol::replyData().

* Archive history log -> cloud service
* Estimating performance -> distributed and parallel processing system

**Parameters**

| | |
|---|---|
| *invoke* | An invoke message to be pre-processed and shifted to IProtocol::replyData(). |

Reimplemented from SlaveSystem.

#### 6.107.2.2 virtual void replyData ( std::shared_ptr< Invoke > , size_t , size_t ) [protected], [pure virtual]

Handle requested processes which are segmented.

**Parameters**

| | |
|---|---|
| *invoke* | An invoke message containing segmented process requestments. |
| *startIndex* | Starting index number of segmentation. |
| *size* | Size of segmentation. |

The documentation for this class was generated from the following file:

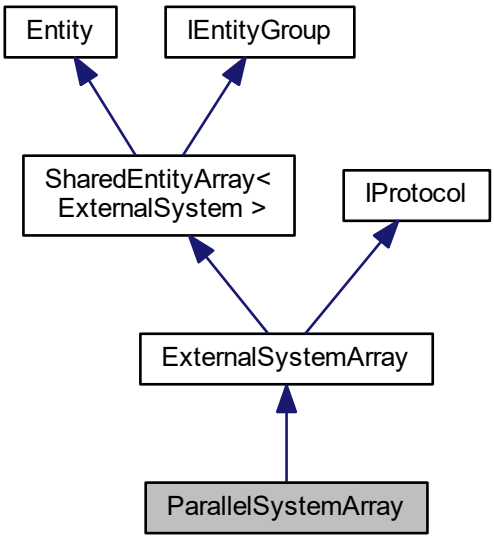
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/slave/ParallelSystem.hpp

## 6.108 ParallelSystemArray Class Reference

An array of parallel system drivers.

`#include <ParallelSystemArray.hpp>`

Collaboration diagram for ParallelSystemArray:




### Public Member Functions

* ParallelSystemArray ()
  *Default Constructor.*
* virtual void sendSegmentData (std::shared_ptr< Invoke >, size_t)
  *Send a message with segmentation size.*

### Additional Inherited Members

### 6.108.1 Detailed Description

An array of parallel system drivers.

ParallelSystemArray is an ExternalSystemArray and an abstract class containing. and managing parallel system drvers within framework of master. The ParallelSystemArray class allocates segmented processes (Invoke message containing segmentation size) following by each system's performance index.

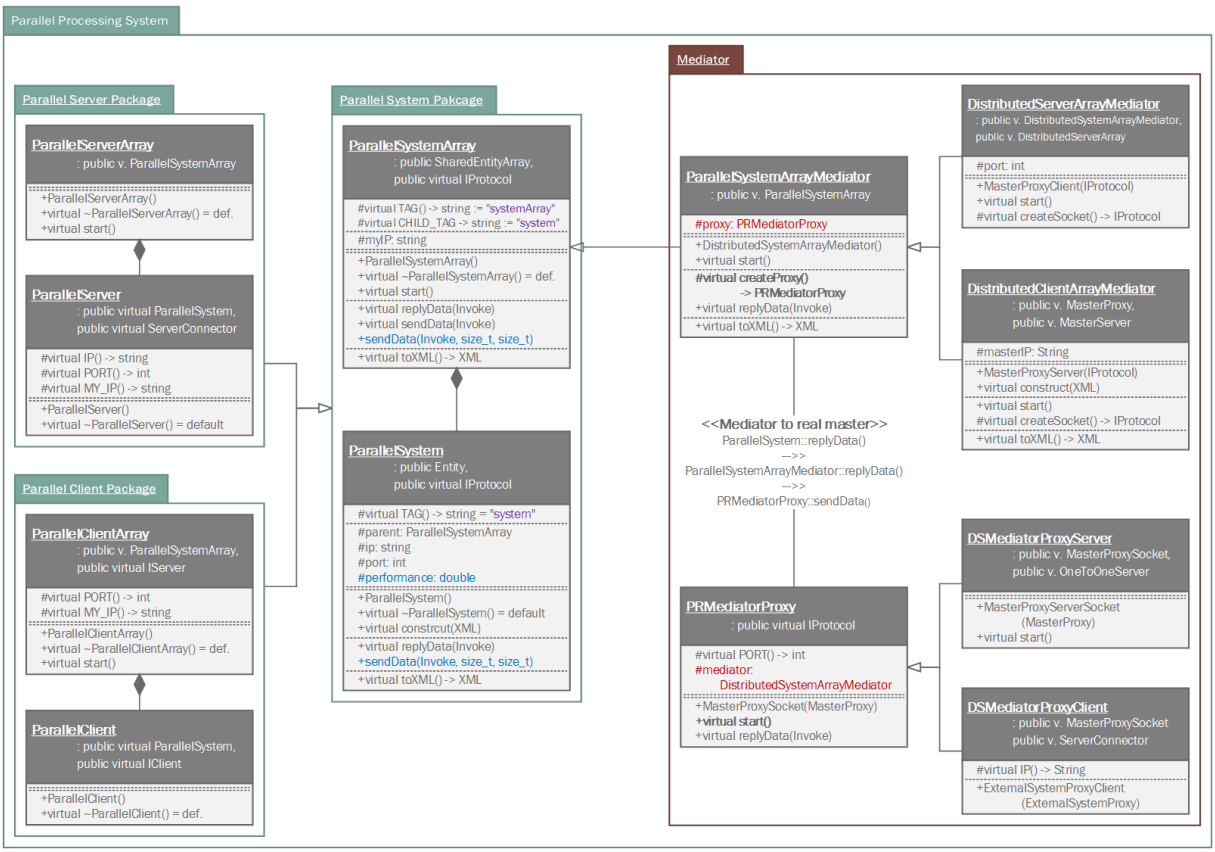
Unlike DistributedSystemArray, ParallelSystemArray does not have such complicate relationships and logics. All segmentation sent by sendData(Invoke, size_t) requires uniform performance. ParallelSystemArray just calculates each system's performance index by elapsing time such easily.

Of course, DistributedSystemArray determines which size of segmentation allocation will be suitable for each system by the performance index

.

Each segmentation in requested process (Invoke message) is equivalent. Thus, role of ParallelSystem objects in a ParallelSystemArray are almost same and does not need to specify ExternalSystemRole on each ParallelSystem.

* Not a matter to specifying ExternalSystemRole objects to each ParallelSystem. In that case, Invoke messages having segmentation size will be processed by ParallelSystemArray's own logic and Invoke messages without segmentation size will be handled by ordinary logic of ExternalSystemArray's own.




[Inherited]

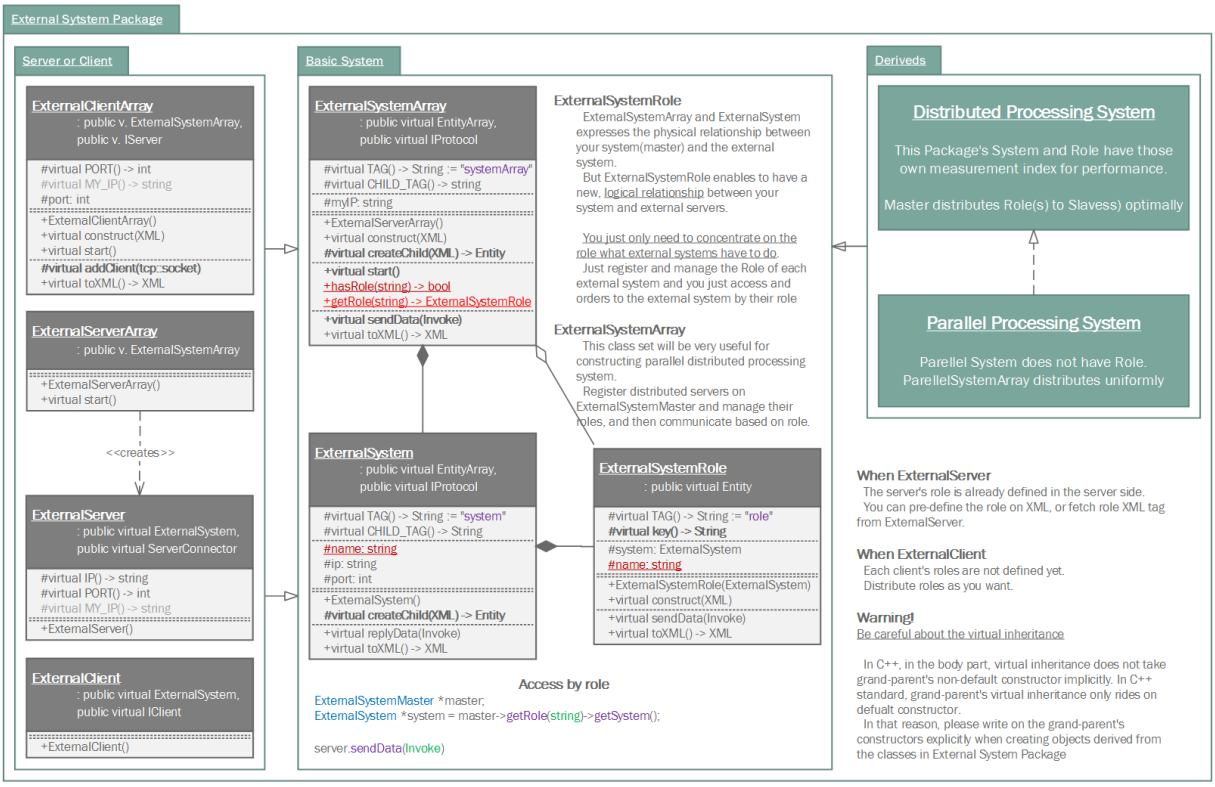
ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole

is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an External↩ SystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which External↩ System.

* ExternalSystemArray::getRole("something")->sendData(invoke);




**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.108.2 Member Function Documentation

#### 6.108.2.1 void sendSegmentData ( std::shared_ptr< Invoke >, size_t ) [virtual]

Send a message with segmentation size.

**Parameters**

| | |
|---|---|
| *invoke* | An invoke message requesting a process. |
| *size* | Size of segmentation. |

The documentation for this class was generated from the following files:

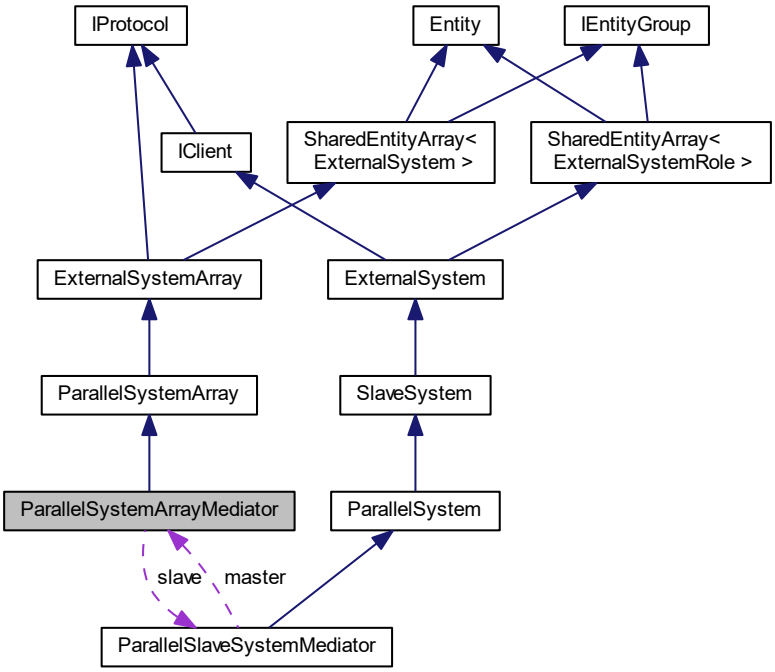
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelSystemArray.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelSystemArray.cpp

## 6.109 ParallelSystemArrayMediator Class Reference

A mediator of parallel system between master and slaves.

```
#include <ParallelSystemArrayMediator.hpp>
```

Collaboration diagram for ParallelSystemArrayMediator:




## Public Member Functions

- ParallelSystemArrayMediator ()
  *Default Constructor.*
- virtual void construct (std::shared_ptr< library::XML >) override
  *Construct data of the Entity from an XML object.*
- virtual void start () override
  *Start interaction.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override
  *Get an XML object represents the EntityGroup.*

## Protected Member Functions

- virtual auto createSlave () const -> ParallelSlaveSystemMediator *=0
  *Factory method of slave system for mediation.*

## Protected Attributes

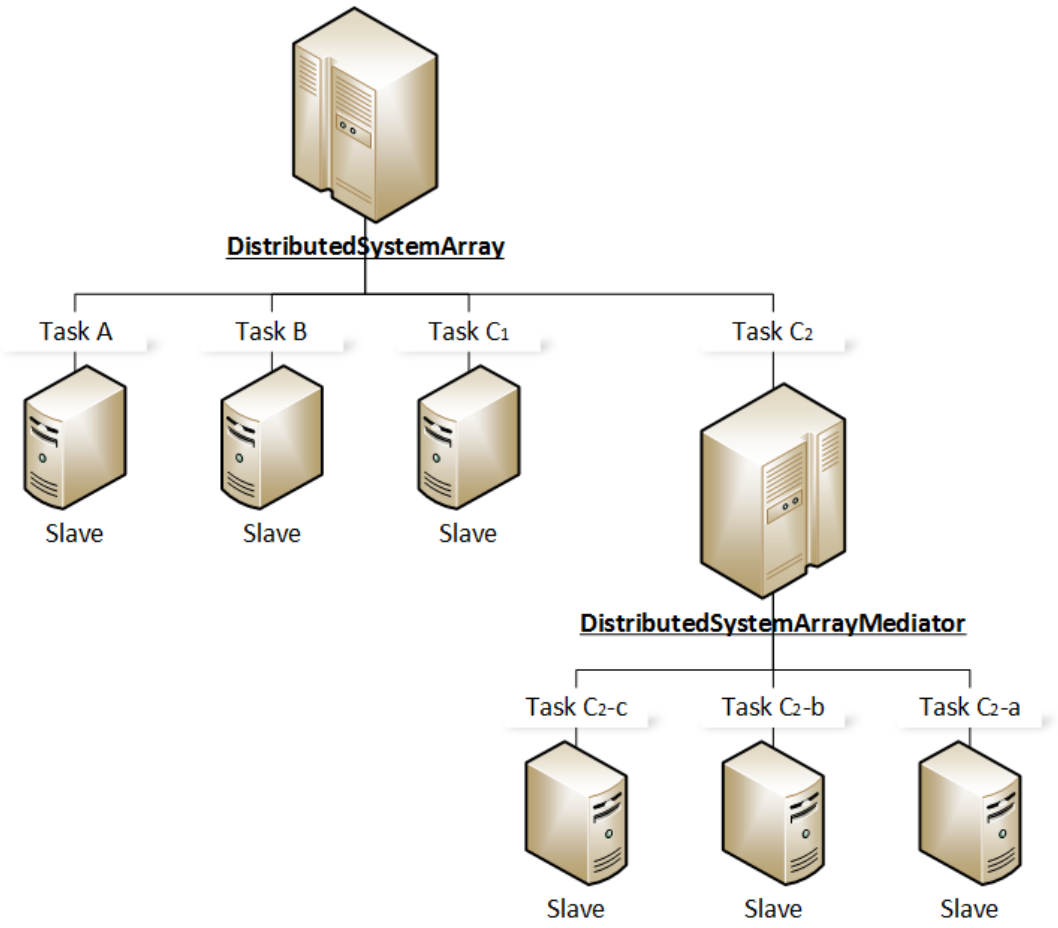
- ParallelSlaveSystemMediator * slave
  *A slave system for mediation.*

### 6.109.1 Detailed Description

A mediator of parallel system between master and slaves.

ParallelSystemArrayMediator class is used to realizing a mediator system of tree-structured parallel processing system. ParallelSystemArrayMediator intermediates between origin-master(ParallelSystem↩Array) and its slaves(slave::ParallelSystem).

ParallelSystemArrayMediator is a master(ParallelSystemArray) within the framework of slaves systems (slave::ParallelSystem objects) and also can be a slave system (slave::ParallelSystem) within framework of its master(ParallelSystemArray) by having ParallelSlaveSystemMediator.




**[Inherited]**

ParallelSystemArray is an ExternalSystemArray and an abstract class containing. and managing parallel system drvers within framework of master. The ParallelSystemArray class allocates segmented processes (Invoke message containing segmentation size) following by each system's performance index.

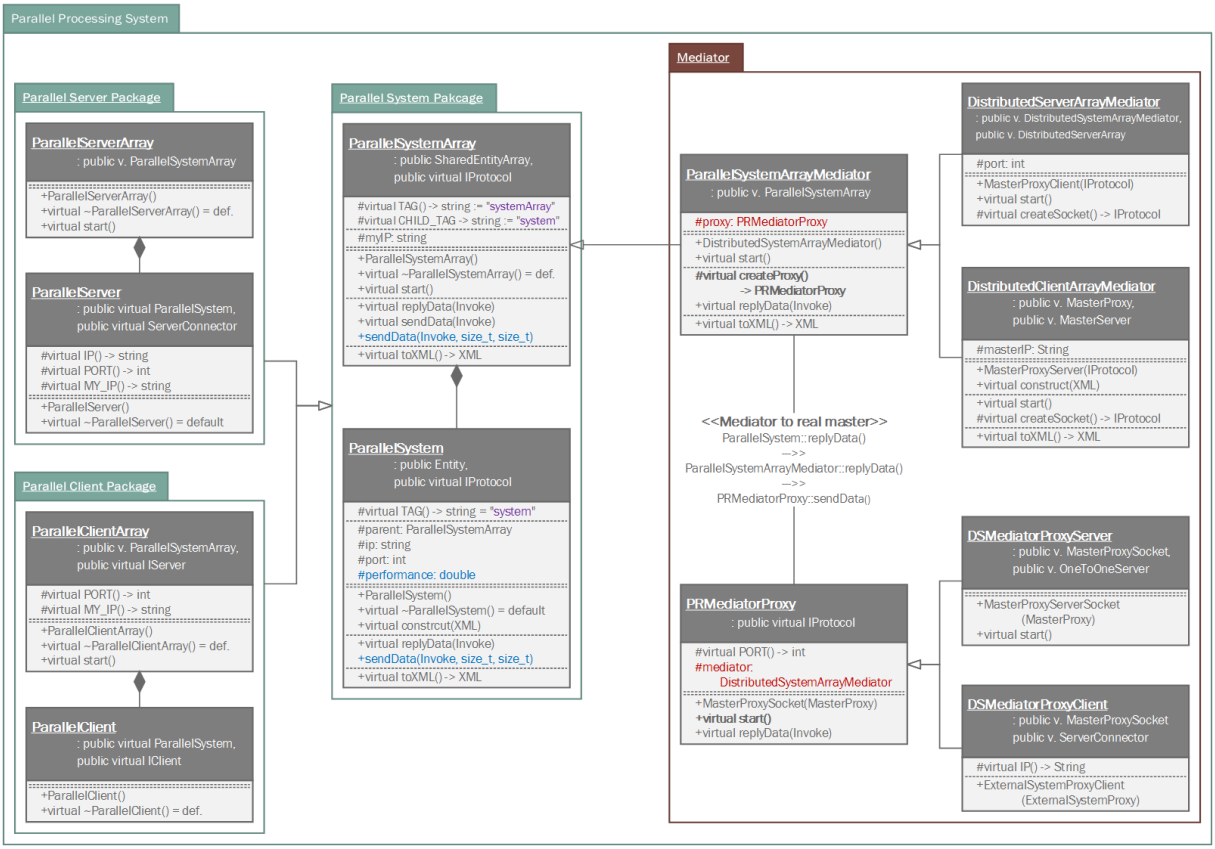
Unlike DistributedSystemArray, ParallelSystemArray does not have such complicate relationships and logics. All segmentation sent by sendData(Invoke, size_t) requires uniform performance. ParallelSystemArray just calculates each system's performance index by elapsing time such easily.

Of course, DistributedSystemArray determines which size of segmentation allocation will be suitable for each system by the performance index

.

Each segmentation in requested process (Invoke message) is equivalent. Thus, role of ParallelSystem objects in a ParallelSystemArray are almost same and does not need to specify ExternalSystemRole on each ParallelSystem.

* Not a matter to specifying ExternalSystemRole objects to each ParallelSystem. In that case, Invoke messages having segmentation size will be processed by ParallelSystemArray's own logic and Invoke messages without segmentation size will be handled by ordinary logic of ExternalSystemArray's own.



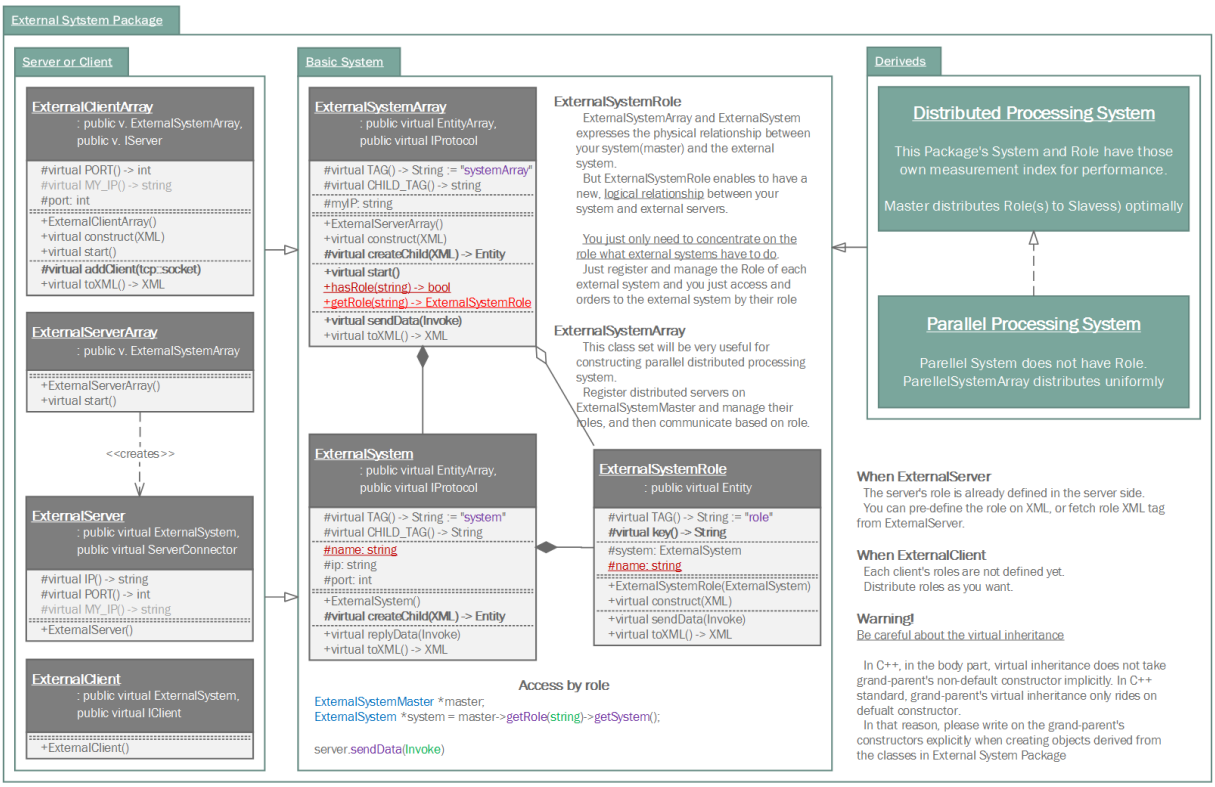

**[Inherited]**

ExternalSystemArray is an abstract class containing and managing external system drivers.

Also, ExternalSystemArray can access to ExternalSystemRole(s) directly. With the method, you can use an ExternalSystemRole as "logical proxy" of an ExternalSystem. Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an External↩ SystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, the ExternalSystemRole acted a role of proxy.

It's called as "Proxy pattern". With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which External↩ System.

* ExternalSystemArray::getRole("something")->sendData(invoke);




**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.109.2 Member Function Documentation

#### 6.109.2.1 virtual void construct ( std::shared_ptr< library::XML > *xml* ) [override], [virtual]

Construct data of the Entity from an XML object.

Constructs the EntityGroup's own member variables only from the input XML object.

Do not consider about constructing children Entity objects' data in EntityGroup::construct(). Those children Entity objects' data will constructed by their own construct() method. Even insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Constructs only data of EntityGroup's own.

**[Inherited]**

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from EntityGroup< _Container, _ETy, _Ty >.

Reimplemented in ParallelClientArrayMediator.

#### 6.109.2.2 virtual auto createSlave ( ) const -> ParallelSlaveSystemMediator * [protected], [pure virtual]

Factory method of slave system for mediation.

**Exceptions**

| | |
|---|---|
| *invalid_parameter* | If ParallelServerArrayMediator, slave must be a type of ParallelSlaveServer↩ Mediator |

#### 6.109.2.3 virtual void start ( ) [override], [virtual]

Start interaction.

An abstract method starting interaction with external systems.

If external systems are servers, starts connection to them, else clients, opens a server and accepts the external systems. You can addict your own procudures of starting drivers, but if you directly override method of abstract ExternalSystemArray, be careful about virtual inheritance.

* DistributedClientArray::start() calls DistributedSystemArray::start() and ExternalClientArray:start()

Implements ExternalSystemArray.

Reimplemented in ParallelClientArrayMediator, and ParallelServerArrayMediator.

#### 6.109.2.4 virtual auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the EntityGroup.

Archives the EntityGroup's own member variables only to the returned XML object.

Do not consider about archiving children Entity objects' data in EntityGroup::toXML(). Those children Entity objects will converted to XML object by their own toXML() method. The insertion of XML objects representing children are done by abstract method of EntityGroup::toXML().

Archives only data of EntityGroup's own.

**[Inherited]**

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from EntityGroup< _Container, _ETy, _Ty >.

Reimplemented in ParallelClientArrayMediator.

The documentation for this class was generated from the following file:

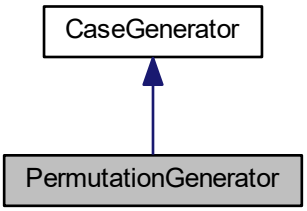
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/ParallelSystemArray↩ Mediator.hpp

## 6.110 PermutationGenerator Class Reference

A permutation case generator.

```
#include <PermutationGenerator.hpp>
```

Collaboration diagram for PermutationGenerator:




### Public Member Functions

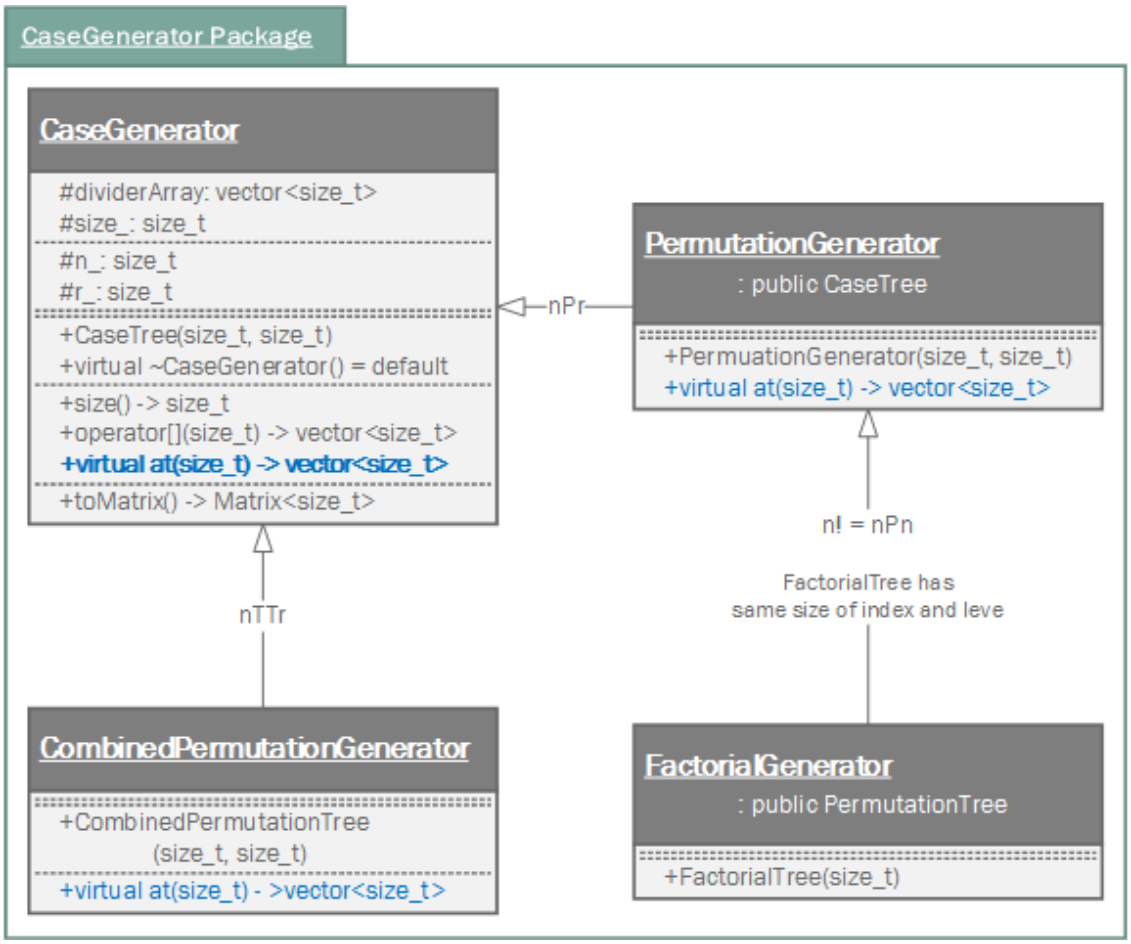
* PermutationGenerator (size_t n, size_t r)
  *Construct from size of N and R.*
* virtual auto operator[ ] (size_t) const -> std::vector< size_t > override
  *Get x'th case.*

### Additional Inherited Members

### 6.110.1 Detailed Description

A permutation case generator.

nPr




**See also**

samchon::library

**Author**

Jeongho Nam

### 6.110.2 Constructor & Destructor Documentation

#### 6.110.2.1 PermutationGenerator ( size_t *n*, size_t *r* )

Construct from size of N and R.

**Parameters**

| | |
|---|---|
| *n* | Size of candidates |
| *r* | Size of elements of each case |

### 6.110.3 Member Function Documentation

#### 6.110.3.1 auto operator[] ( size_t ) const -> std::vector< size_t > [override], [virtual]

Get x'th case.

**Returns**

The row of the x'th in combined permuation case

Implements CaseGenerator.

The documentation for this class was generated from the following files:

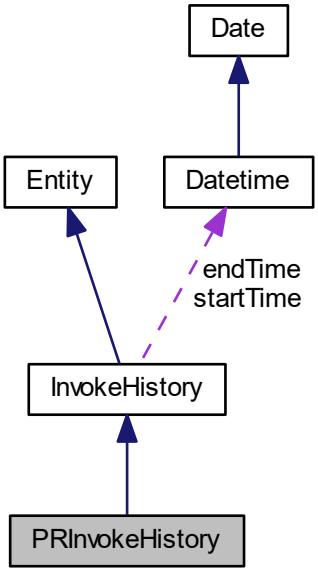
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/PermutationGenerator.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/PermutationGenerator.cpp

## 6.111 PRInvokeHistory Class Reference

A reported history of an Invoke message.

`#include <PRInvokeHistory.hpp>`

Collaboration diagram for PRInvokeHistory:




### Public Member Functions

- PRInvokeHistory ()
  *Default Constructor.*
- PRInvokeHistory (std::shared_ptr< Invoke >)
  *Construct from an Invoke message.*
- virtual void construct (std::shared_ptr< library::XML >) override
  *Construct data of the Entity from an XML object.*
- auto getIndex () const -> size_t
  *Get index.*
- auto getSize () const -> size_t
  *Get size.*
- virtual auto toXML () const -> std::shared_ptr< library::XML > override
  *Get an XML object represents the Entity.*

### Protected Attributes

- size_t index
  *Start index.*
- size_t size
  *The Size.*

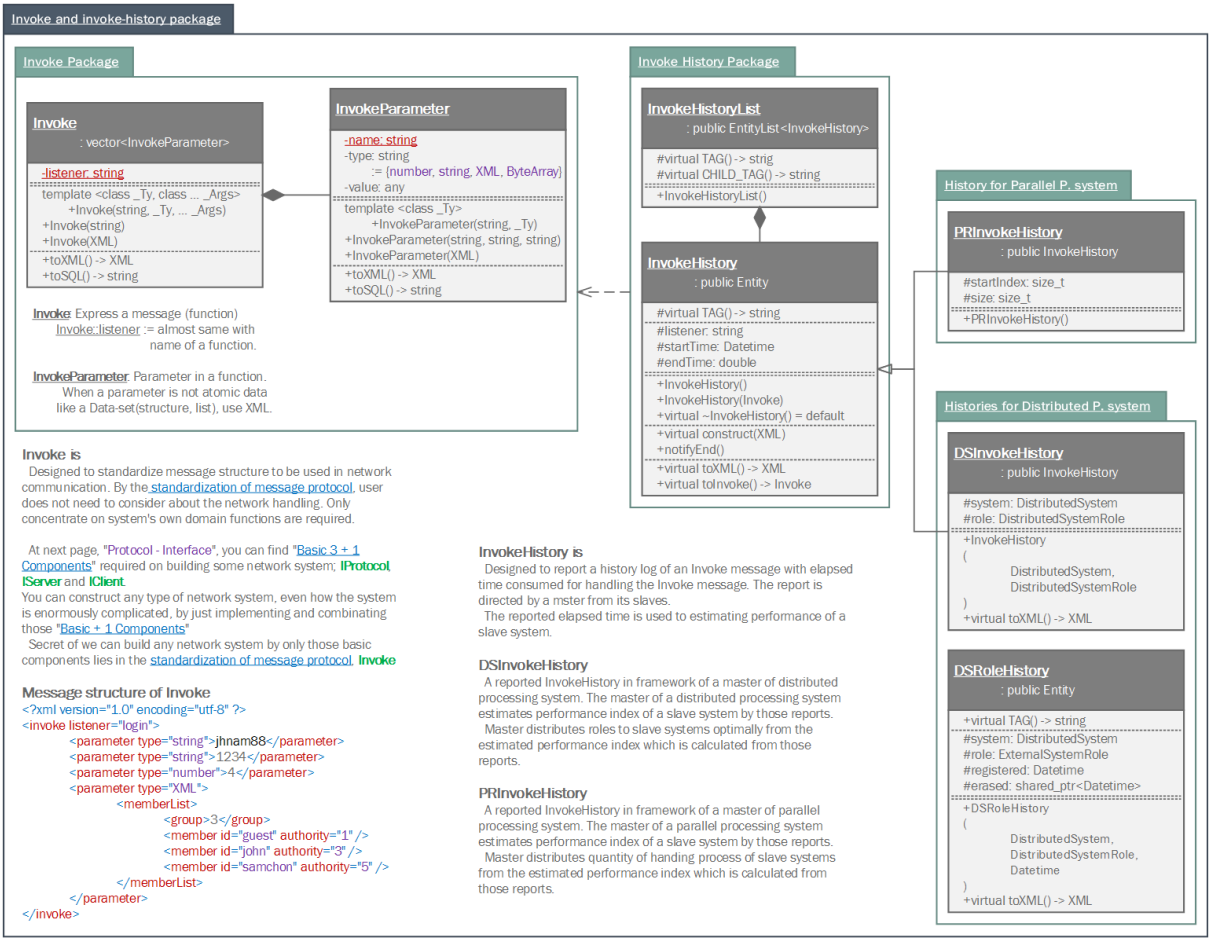
### 6.111.1 Detailed Description

A reported history of an Invoke message.

**[Inherited]**

InvokeHistory is a class for reporting history log of an Invoke message with elapsed time from a slave to its master.

With the elapsed time, consumed time for a process of handling the Invoke message, InvokeHistory is reported to the master. The master utilizies the elapsed time to estimating performances of each slave system. With the estimated performan index, master retrives the optimal solution of distributing processes.




### See also

samchon::protocol
samchon::protocol::master
samchon::protocol::slave

### Author

Jeongho Nam

## 6.111.2 Constructor & Destructor Documentation

### 6.111.2.1 PRInvokeHistory ( std::shared_ptr< Invoke > )

Construct from an Invoke message.

InvokeHistory does not archive entire Invoke message, only archives its listener.

**Parameters**

| | |
|---|---|
| *invoke* | A message to archive its history log |

### 6.111.3 Member Function Documentation

#### 6.111.3.1 void construct ( std::shared_ptr< library::XML > ) [override],[virtual]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Reimplemented from InvokeHistory.

#### 6.111.3.2 auto toXML ( ) const -> std::shared_ptr<library::XML> [override],[virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from InvokeHistory.

The documentation for this class was generated from the following files:

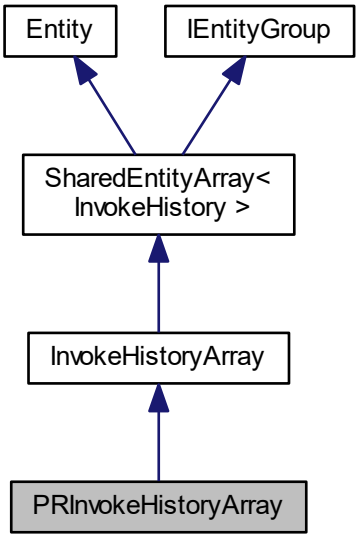
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/PRInvokeHistory.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/PRInvokeHistory.cpp

## 6.112 PRInvokeHistoryArray Class Reference

An array of PRInvokeHistory.

```
#include <PRInvokeHistoryArray.hpp>
```

Collaboration diagram for PRInvokeHistoryArray:




### Public Member Functions

* PRInvokeHistoryArray ()
  *Default Constructor.*

### Protected Member Functions

* virtual auto createChild (std::shared_ptr< library::XML >) -> InvokeHistory *override
  *Factory method of a child Entity.*

## 6.112.1 Detailed Description

An array of PRInvokeHistory.

**Author**

Jeongho Nam

## 6.112.2 Member Function Documentation

### 6.112.2.1 auto createChild ( std::shared_ptr< library::XML > ) -> InvokeHistory *override

`[override], [protected], [virtual]`

Factory method of a child Entity.

EntityGroup::createChild() is a factory method creating a new child Entity which is belonged to the EntityGroup. This method is called by EntityGroup::construct(). The children construction methods Entity::construct() will be called by abstract method of the EntityGroup::construct().

**Returns**

A new child Entity belongs to EntityGroup.

Reimplemented from InvokeHistoryArray.

The documentation for this class was generated from the following files:

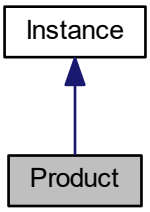
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/PRInvokeHistoryArray.↩hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/master/PRInvokeHistoryList.cpp

## 6.113 Product Class Reference

A product, merchandise.

`#include <Product.hpp>`

Collaboration diagram for Product:




### Public Member Functions

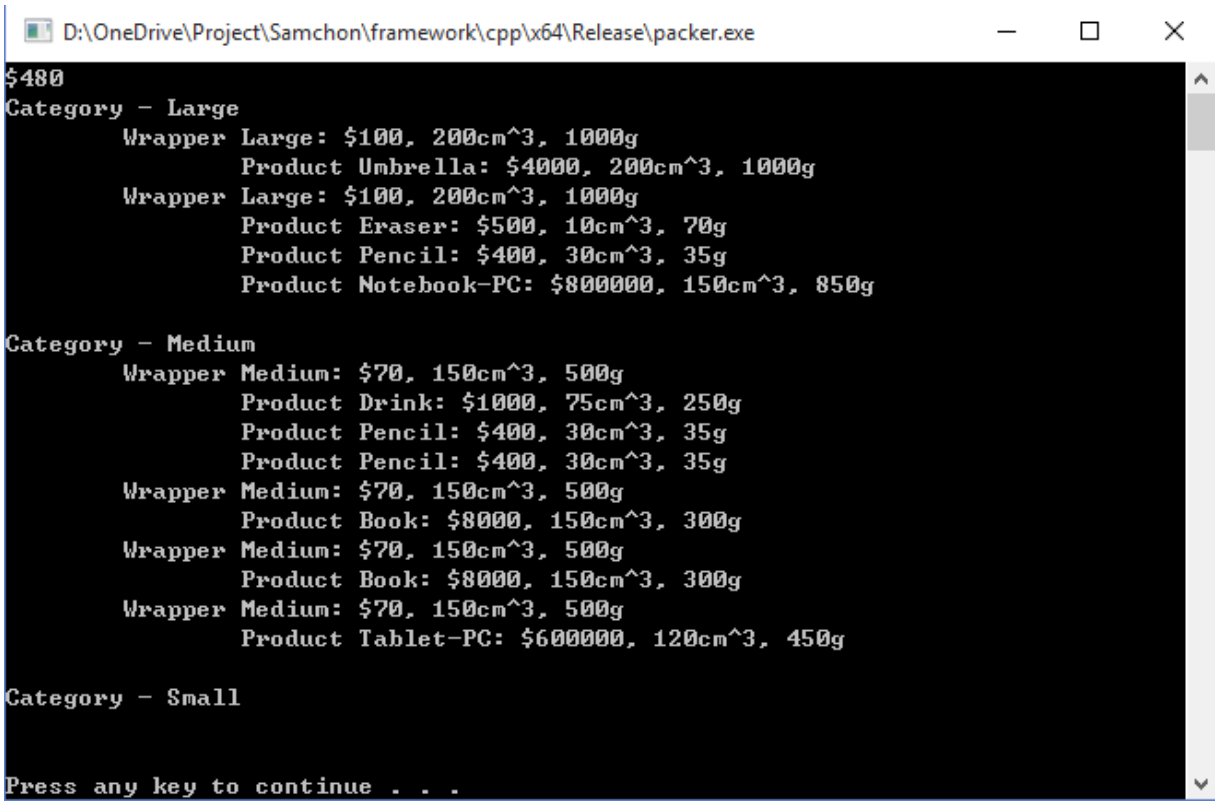
* Product (const std::string &name, int price, int volume, int weight)
  *Construct from arguments.*
* virtual auto toString () const -> std::string override
  *Return a string represents the Instance.*

### Additional Inherited Members

### 6.113.1 Detailed Description

A product, merchandise.

A merchandise with its price, volume and weight.




**Author**

Jeongho Nam

### 6.113.2 Constructor & Destructor Documentation

#### 6.113.2.1 Product ( const std::string & *name*, int *price*, int *volume*, int *weight* )

Construct from arguments.

**Parameters**

| | |
|---|---|
| *name* | Name of a product can be an identifier |
| *price* | Price of the product |
| *volume* | Volume of the product |
| *weight* | Weight of the product |

The documentation for this class was generated from the following files:

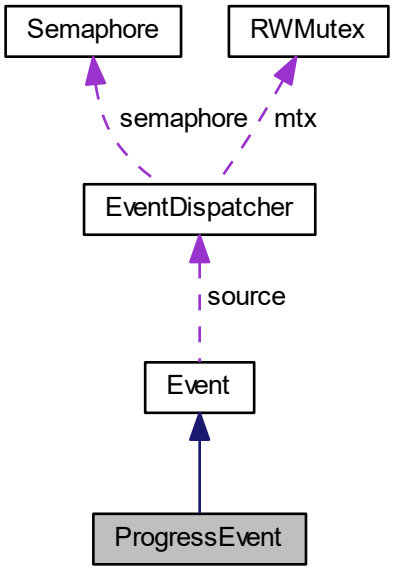
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/packer/Product.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/packer/Product.cpp

## 6.114 ProgressEvent Class Reference

Event representing a progress.

```
#include <ProgressEvent.hpp>
```

Collaboration diagram for ProgressEvent:




### Public Member Functions

- ProgressEvent (EventDispatcher *, size_t, size_t)
  *Construct from source and progress.*
- auto getNumerator () const -> size_t
  *Get numerator, number of current progress.*
- auto getDenominator () const -> size_t
  *Get denominator, number of total progress.*
- auto getPercent () const -> double
  *Get percentage of the progress.*

### Protected Attributes

- size_t numerator
  *The number of current progress.*
- size_t denominator
  *The number of total progress.*

## 6.114.1 Detailed Description

Event representing a progress.

**[Inherited]**

## 6.114.2 Constructor & Destructor Documentation

### 6.114.2.1 ProgressEvent ( EventDispatcher * *source*, size_t *numerator*, size_t *denominator* )

Construct from source and progress.

**Parameters**

| | |
|---|---|
| *source* | Source of the event; who made the event |
| *numerator* | The number of current progress |
| *denominator* | The number of total progress |

**Exceptions**

| | |
|---|---|
| *exception* | denominator is zero |

### 6.114.3 Member Data Documentation

#### 6.114.3.1 size_t denominator [protected]

The number of total progress.

**Warning**

denominator cannot be zero

The documentation for this class was generated from the following files:

* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/ProgressEvent.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/ProgressEvent.cpp

## 6.115 RWMutex Class Reference

rw_mutex

```
#include <RWMutex.hpp>
```

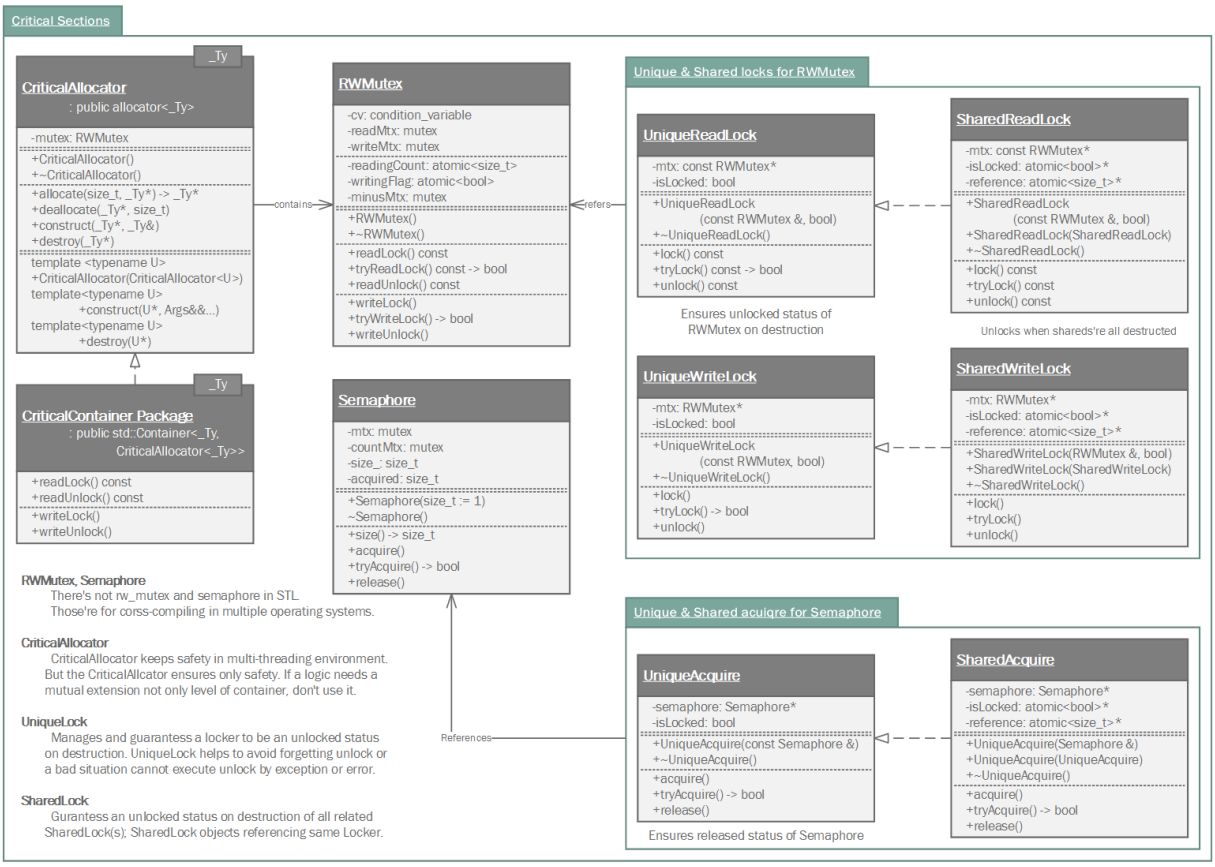
### Public Member Functions

* RWMutex ()
  *Default Constructor.*
* void readLock () const
  *Lock on read.*
* void readUnlock () const
  *Unlock of read.*
* void writeLock ()
  *Lock on writing.*
* void writeUnlock ()
  *Unlock on writing.*

### 6.115.1 Detailed Description

rw_mutex

A mutex divided into reading and writing.




**Note**

Of course, rw_mutex is already defined in linux C. But it is dependent on the linux OS, so that cannot be compiled in Window having the rw_mutex. There's not a class like rw_mutex in STL yet. It's the reason why RWMutex is provided.

As that reason, if STL supports the rw_mutex in near future, the RWMutex can be depreciated.

**See also**

samchon::library

**Author**

Jeongho Nam

### 6.115.2 Member Function Documentation

#### 6.115.2.1 void readLock ( ) const

Lock on read.

Increases a reading count.

When write_lock is on a progress, wait until write_unlock to be called.

* Reading can be done by multiple sections.
* Reading can't be done when writing.

**Warning**

You've to call read_unlock when the reading work is terminated.

#### 6.115.2.2 void readUnlock ( ) const

Unlock of read.

Decreases a reading count.

When write_lock had done after read_lock, it continues by read_unlock if the reading count was 1 (read_unlock makes the count to be zero).

#### 6.115.2.3 void writeLock ( )

Lock on writing.

Changes writing flag to true.

If another write_lock or read_lock is on a progress, wait until them to be unlocked.

* Writing can be done by only a section at once.
* Writing can't be done when reading.

**Note**

You've to call write_unlock when writing work was terminated.

The documentation for this class was generated from the following files:

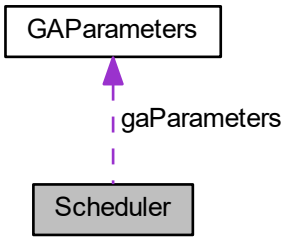
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/RWMutex.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/RWMutex.cpp

## 6.116 Scheduler Class Reference

A scheduler.

`#include <Scheduler.hpp>`

Collaboration diagram for Scheduler:




### Public Member Functions

* Scheduler (std::shared_ptr< Travel >, const struct GAParameters &)
  *Construct from points and parameter of genetic algorithm.*
* auto optimize () -> std::shared_ptr< Travel >
  *Derive optimized schedule.*

### Private Attributes

* std::shared_ptr< Travel > travel
  *A travel to optimize or optimized.*
* struct GAParameters gaParameters
  *Parameters for Genetic-Algorithm.*

### 6.116.1 Detailed Description

A scheduler.

Scheduler deducts an optimal schdule(Travel) by genetic algorithm.

**Author**

Jeongho Nam

### 6.116.2 Member Function Documentation

#### 6.116.2.1 auto optimize ( ) -> std::shared_ptr<Travel>

Derive optimized schedule.

**Returns**

An optimized travel schedule.

The documentation for this class was generated from the following files:

* D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/tsp/Scheduler.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/tsp/Scheduler.cpp

## 6.117 Semaphore Class Reference

A semaphore.

```
#include <Semaphore.hpp>
```

### Public Member Functions

* Semaphore (size_t=2)
* void setSize (size_t)
  *Set size.*
* auto size () const -> size_t
  *Get size.*
* auto acquiredSize () const -> size_t
  *Get acquired size.*
* void acquire ()
  *Acquire admission.*
* auto tryAcquire () -> bool
  *Try to acquire admission.*
* void release ()
  *Release an admission.*

### Private Attributes

* size_t size_
  *The size.*
* size_t acquired
  *Acquired count.*
* std::mutex * mtx
  *Locker.*

### 6.117.1 Detailed Description

A semaphore.

In computer science, particularly in operating systems, a semaphore is a variable or abstract data type that is used for controlling access, by multiple processes, to a common resource in a concurrent system such as a multiprogramming operating system.

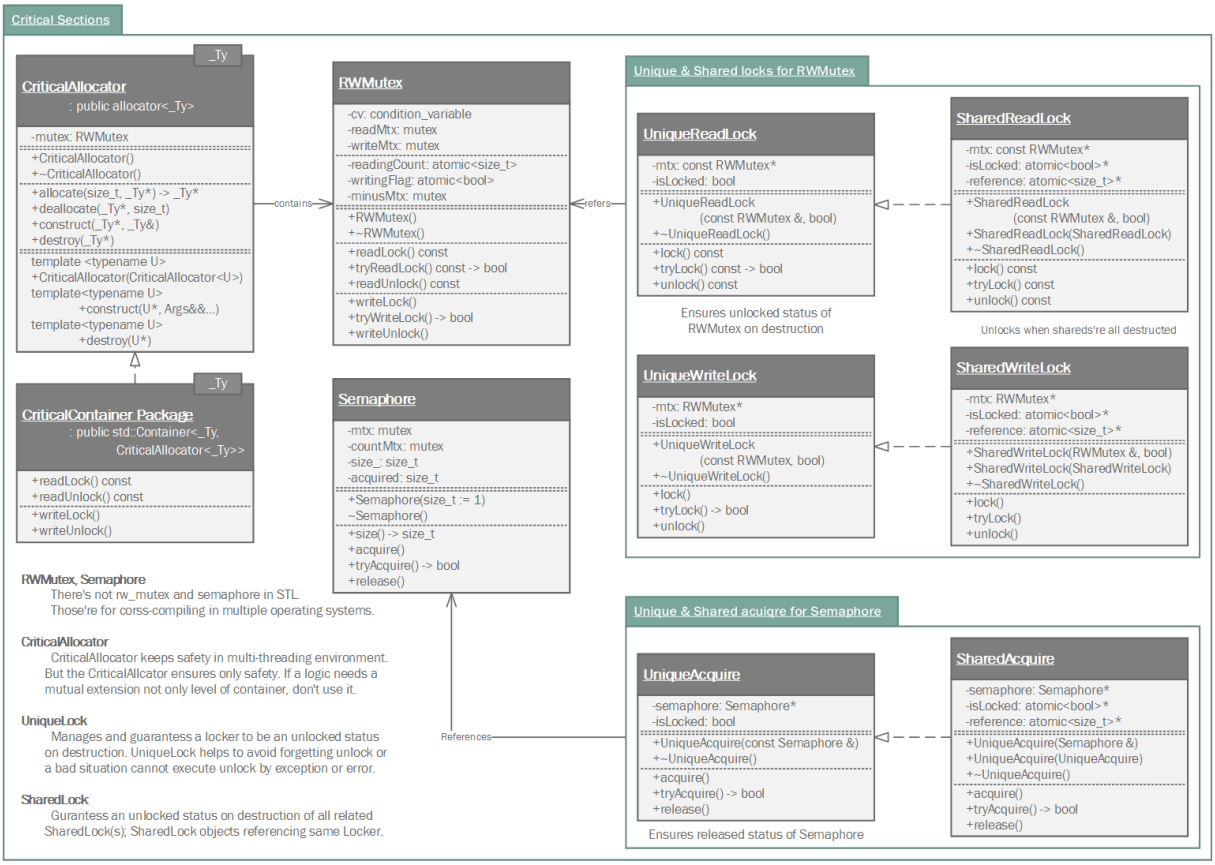
A trivial semaphore is a plain variable that is changed (for example, incremented or decremented, or toggled) depending on programmer-defined conditions. The variable is then used as a condition to control access to some system resource.

A useful way to think of a semaphore as used in the real-world systems is as a record of how many units of a particular resource are available, coupled with operations to safely (i.e., without race conditions) adjust that record as units are required or become free, and, if necessary, wait until a unit of the resource becomes available. Semaphores are a useful tool in the prevention of race conditions; however, their use is by no means a guarantee that a program is free from these problems. Semaphores which allow an arbitrary resource count are called counting semaphores, while semaphores which are restricted to the values 0 and 1 (or locked/unlocked, unavailable/available) are called binary semaphores

* Categorized in binary semaphore

Referenced Wediapedia

* https://en.wikipedia.org/wiki/Semaphore_(programming)




**Note**

Of course, semaphore is already defined in linux C and MFC in Window. But it is dependent on each operating system, so that cannot be compiled in another OS with those semaphores. There's not a class like semaphore in STL yet. It's the reason why Semaphore is provided.

As that reason, if STL supports the semaphore in near future, the Semaphore can be depreciated.

**See also**

samchon::library

**Author**

Jeongho Nam

### 6.117.2 Constructor & Destructor Documentation

#### 6.117.2.1 Semaphore ( size_t *size* = 2 )

Constructor.

**Parameters**

| | |
|---|---|
| *size* | The size of the semaphore to permit |

### 6.117.3 Member Function Documentation

#### 6.117.3.1 void setSize ( size_t *val* )

Set size.
Set permitted size of the semaphore.

#### 6.117.3.2 auto size ( ) const -> size_t

Get size.
Returns size which means the permitted count of the semaphore
**Returns**

The size of semaphore

#### 6.117.3.3 void acquire ( )

Acquire admission.
Acquires an admission and increases count of admission by 1.
If the count is over permitted size, wait until other admissions to be released.

* Lock on mutex

#### 6.117.3.4 auto tryAcquire ( ) -> bool

Try to acquire admission.
If admission count is below the permitted size, acquire admission and increase the count by 1 and return true which means succeded to get admission.

* If the count is matched to the permitted size, lock the mutex

Else, do not acquire admission and return false which means failed to get admmission.
**Returns**

Whether succeded to acquire an admission or not

#### 6.117.3.5 void release ( )

Release an admission.
Releases an admission what you've acquired. If the admission count was over the limited size, unlock the mutex.

### 6.117.4 Member Data Documentation

#### 6.117.4.1 size_t size_ [private]

The size.
Permitted size of the semaphore

#### 6.117.4.2 std::mutex* mtx [private]

Locker.
Manages lock and unlock of the semaphore
The documentation for this class was generated from the following files:

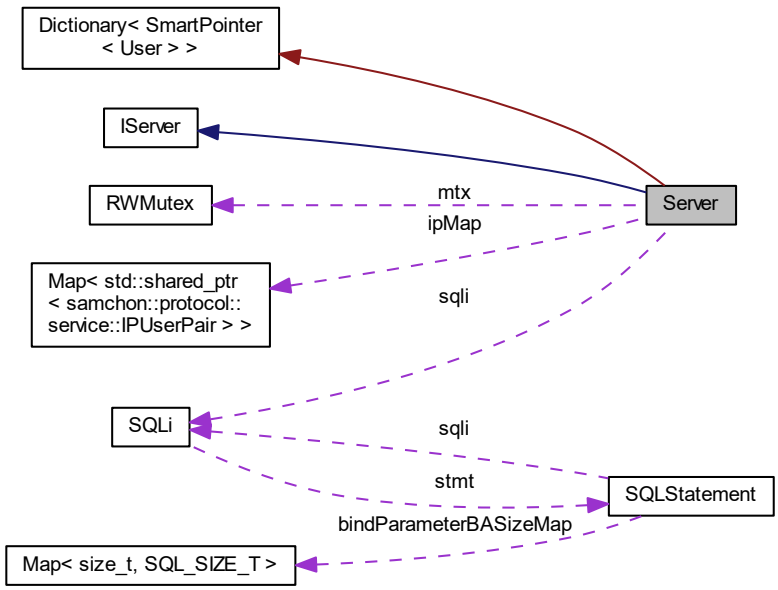
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Semaphore.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/Semaphore.cpp

## 6.118 Server Class Reference

A server for (cloud) service.

`#include <Server.hpp>`

Collaboration diagram for Server:




### Public Member Functions

- Server ()
  *Default Constructor.*
- auto size () const -> size_t
  *Size of User(s).*
- auto begin () const -> const_iterator
  *A const iterator of begin.*
- auto end () const -> const_iterator
  *A const iterator of end.*

### Protected Member Functions

- virtual auto NAME () const -> std::string=0
  *A name can be an identifier of a cloud server.*
- virtual auto createUser () -> User *=0
  *Factory method of User.*
- virtual void addClient (Socket *) override
  *Handling connection of a client.*

### Protected Attributes

- library::SQLi * sqli
  *SQLi for archiving log.*

### Private Attributes

- Dictionary< std::shared_ptr< IPUserPair > > ipMap

*Dictionary of issuer of session ID of each ip.*

* size_t sequence

  *Sequence for issuing session ID.*

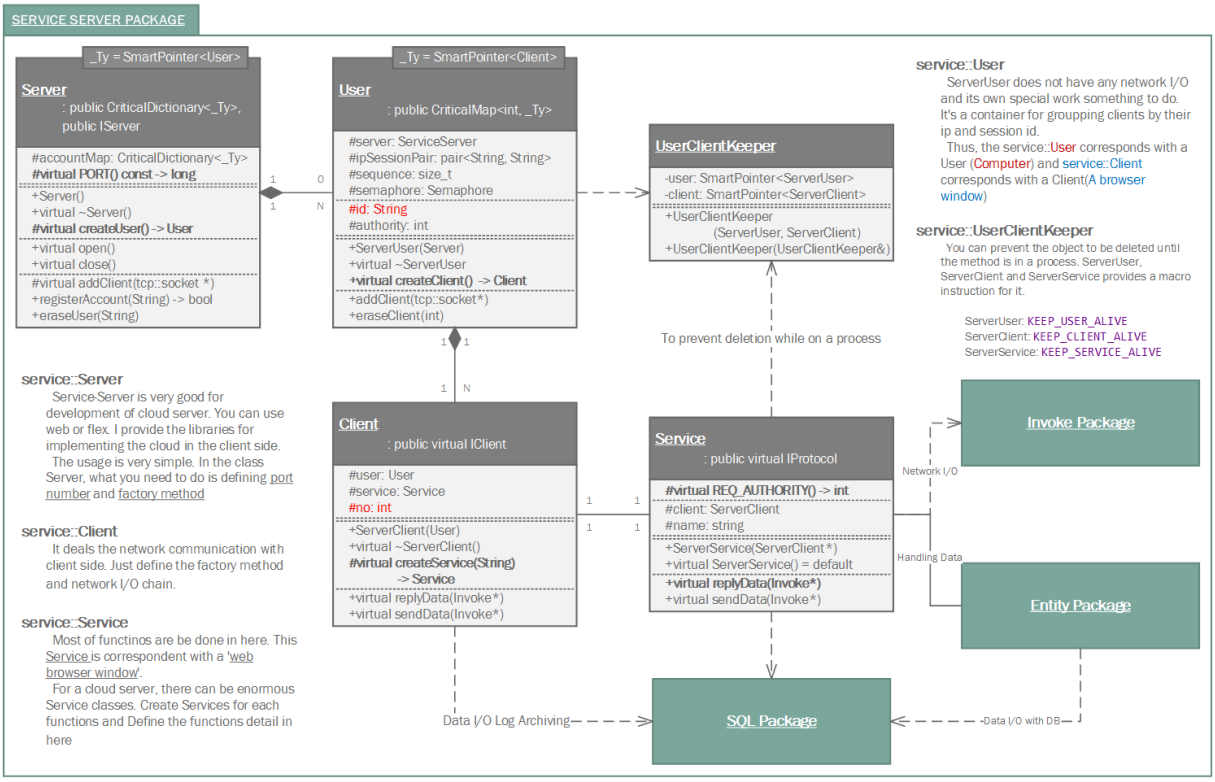
## Additional Inherited Members

### 6.118.1 Detailed Description

A server for (cloud) service.

A server class representing the real physical server of a cloud.

The Server is very good for development of a cloud server. You can use web or flex as (physical) client. The usage is very simple. In the class Server, what you need to do are overriding getter of port number and factory method creating an User.




**Note**

Override those methods.

* Server::NAME()
* Server::PORT()
* Server::createUser()

**See also**

samchon::protocol
samchon::protocol::service

**Author**

Jeongho Nam

### 6.118.2 Member Function Documentation

#### 6.118.2.1 auto begin ( ) const -> const_iterator

A const iterator of begin.

**Note**

Be careful about concurrency

#### 6.118.2.2 auto end ( ) const -> const_iterator

A const iterator of end.

**Note**

Be careful about concurrency

The documentation for this class was generated from the following files:

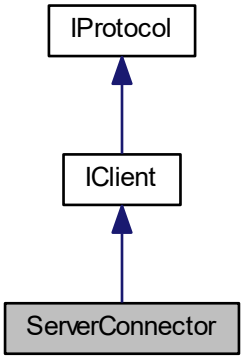
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/service/Server.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/service/Server.cpp

## 6.119 ServerConnector Class Reference

A server connector for a physical client.

`#include <ServerConnector.hpp>`

Collaboration diagram for ServerConnector:




### Public Member Functions

* ServerConnector ()
  *Default Constructor.*
* virtual auto getIP () const -> std::string=0
  *Destinatio IP.*
* virtual auto getPort () const -> int=0
  *Destination port.*
* virtual auto getMyIP () const -> std::string
  *(optional) My IP, if you want to bind*
* virtual void connect ()
  *Connect to a server.*

### Protected Attributes

* boost::asio::io_service * ioService
  *An io_service of Boost.Asio's own.*
* EndPoint * endPoint
  *An endpoint directing a server.*
* EndPoint * localEndPoint
  *(Optional) An local endpoint of the client (my system)*

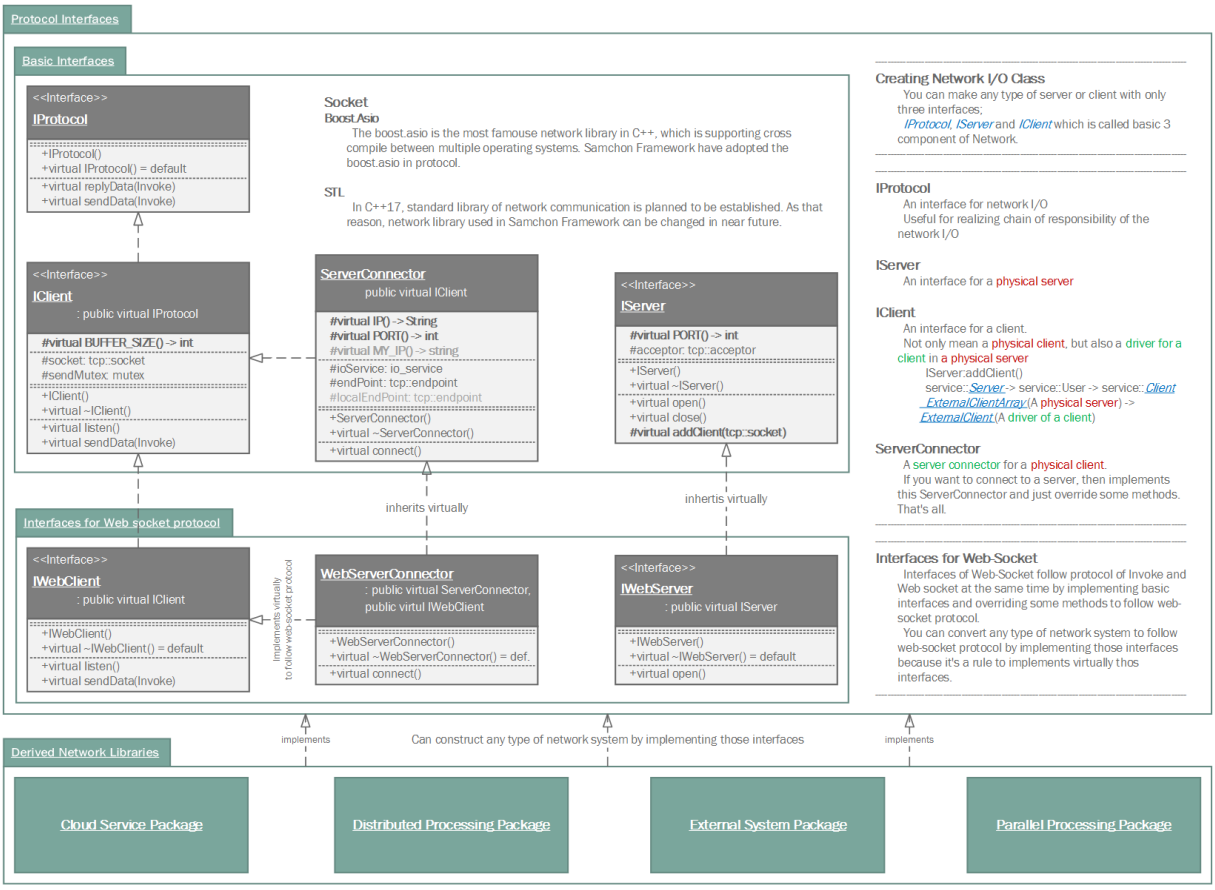
## Additional Inherited Members

### 6.119.1 Detailed Description

A server connector for a physical client.

ServerConnector is a class for a physical client connecting a server. If you want to connect to a server, then implements this ServerConnector and just override some methods like getIP(), getPort() and replyData(). That's all.

In Samchon Framework, package protocol, There are basic 3 + 1 components that can make any type of network system in Samchon Framework. The basic 3 components are IProtocol, IServer and IClient. The last, surplus one is the ServerConnector. Looking around classes in Samchon Framework, especially module master and slave which are designed for realizing distributed processing systems and parallel processing systems, physical client classes are all derived from this ServerConnector.




**Author**

Jeongho Nam

### 6.119.2 Member Function Documentation

#### 6.119.2.1 void connect ( ) [virtual]

Connect to a server.

Connects to a server with configured ip address and port number. After connection, listens data replied from the server (IClient::listen()).

**Note**

It monopolies a thread

Reimplemented in WebServerConnector.

### 6.119.3 Member Data Documentation

#### 6.119.3.1 EndPoint* localEndPoint [protected]

(Optional) An local endpoint of the client (my system)

An local endpoint fof my system. It binds my ip to custom. It acts when my_ip is configured. If the my_ip is not configured, does not act.

The documentation for this class was generated from the following files:

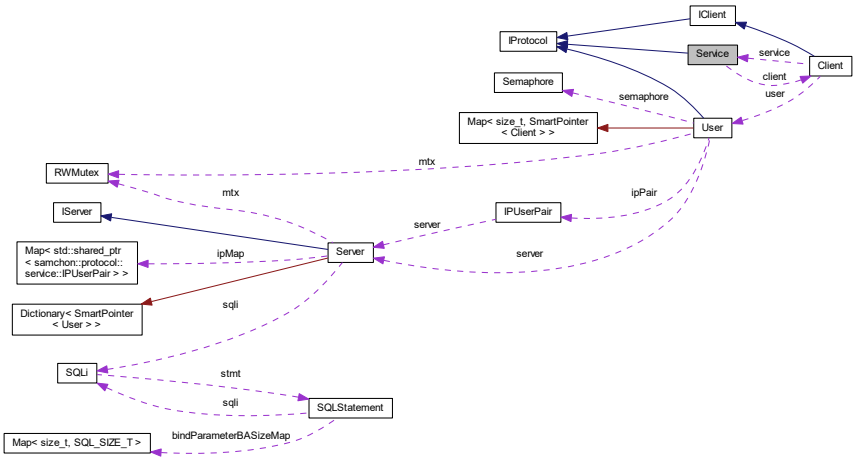
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ServerConnector.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/ServerConnector.cpp

## 6.120 Service Class Reference

A service.

`#include <Service.hpp>`

Collaboration diagram for Service:




### Public Member Functions

* Service (Client *)
  *Construct from Client.*
* auto getClient () const -> Client *
  *Get Client.*
* virtual void sendData (std::shared_ptr< Invoke >)
  *Shift the responsibility of sending an Invoke message to Client.*

### Protected Member Functions

* virtual auto REQUIRE_AUTHORITY () const -> int=NULL
  *Required authority to access the service.*

### Private Attributes

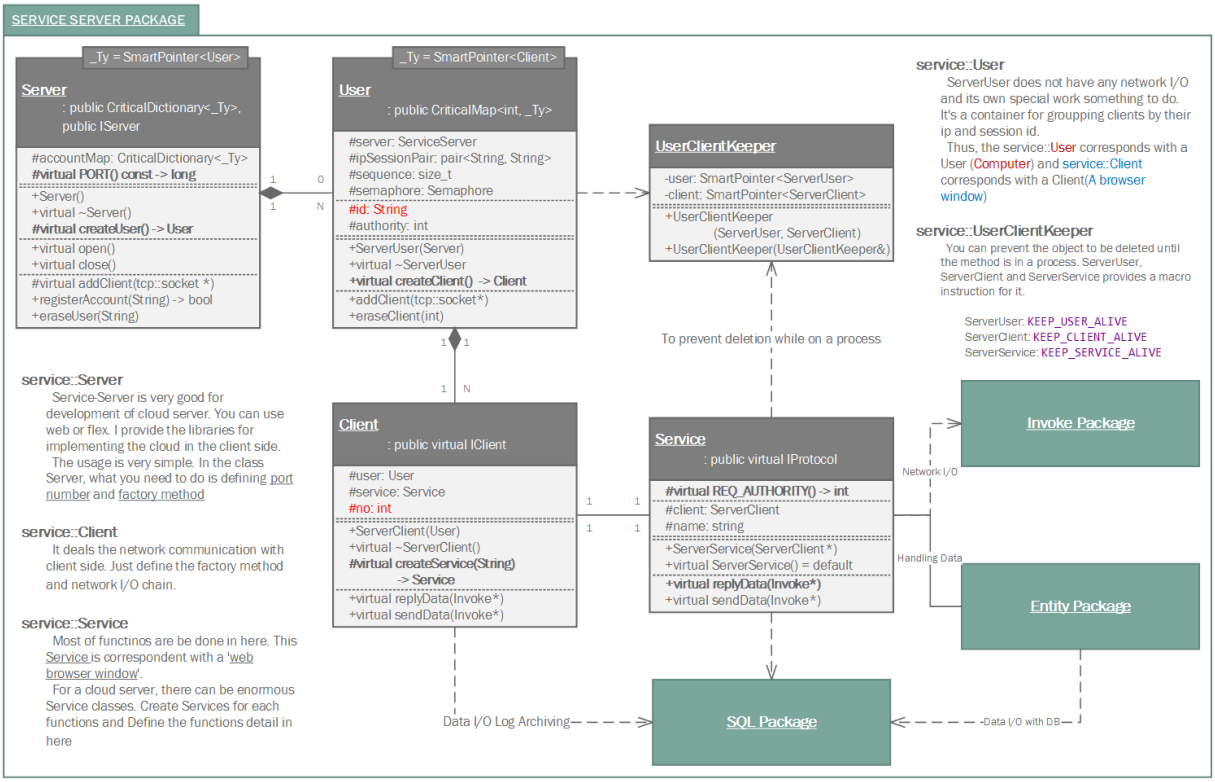
* Client * client
  *Client object Service is belonged to.*
* std::string name
  *A name represents a Service.*

### 6.120.1 Detailed Description

A service.

A service represents an unique functions of a web page

Most of functinos are realized in here. The Service is correspondent with a 'a service of a web page'. For a cloud Server, there can be enormous Service classes. Create Services for each functions and Define the functions detail in here.




**See also**

samchon::protocol
samchon::protocol::service

**Author**

Jeongho Nam

### 6.120.2 Constructor & Destructor Documentation

#### 6.120.2.1 Service ( Client * *client* )

Construct from Client.

**Parameters**

| | |
|---|---|
| *client* | Client object Service is belonged to |

### 6.120.3 Member Function Documentation

#### 6.120.3.1 void sendData ( std::shared_ptr< Invoke > ) [virtual]

Shift the responsibility of sending an Invoke message to Client.

**Parameters**

| | |
|---|---|
| *in* | An Invoke message to be sent to the (physical) client |

Reimplemented from IProtocol.

The documentation for this class was generated from the following files:

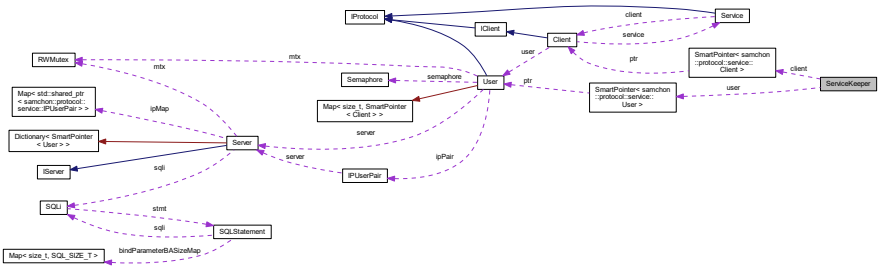
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/service/Service.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/service/Service.cpp

## 6.121 ServiceKeeper Class Reference

A keeper blocking destrunction of User and Client.

```
#include <ServiceKeeper.hpp>
```

Collaboration diagram for ServiceKeeper:




### Public Member Functions

* ServiceKeeper (const User *user, const Client *client)
  *Construct from User and Client.*
* ServiceKeeper (const ServiceKeeper &)
  *Copy Constructor.*
* ServiceKeeper (ServiceKeeper &&)
  *Movie Constructor.*

### Private Attributes

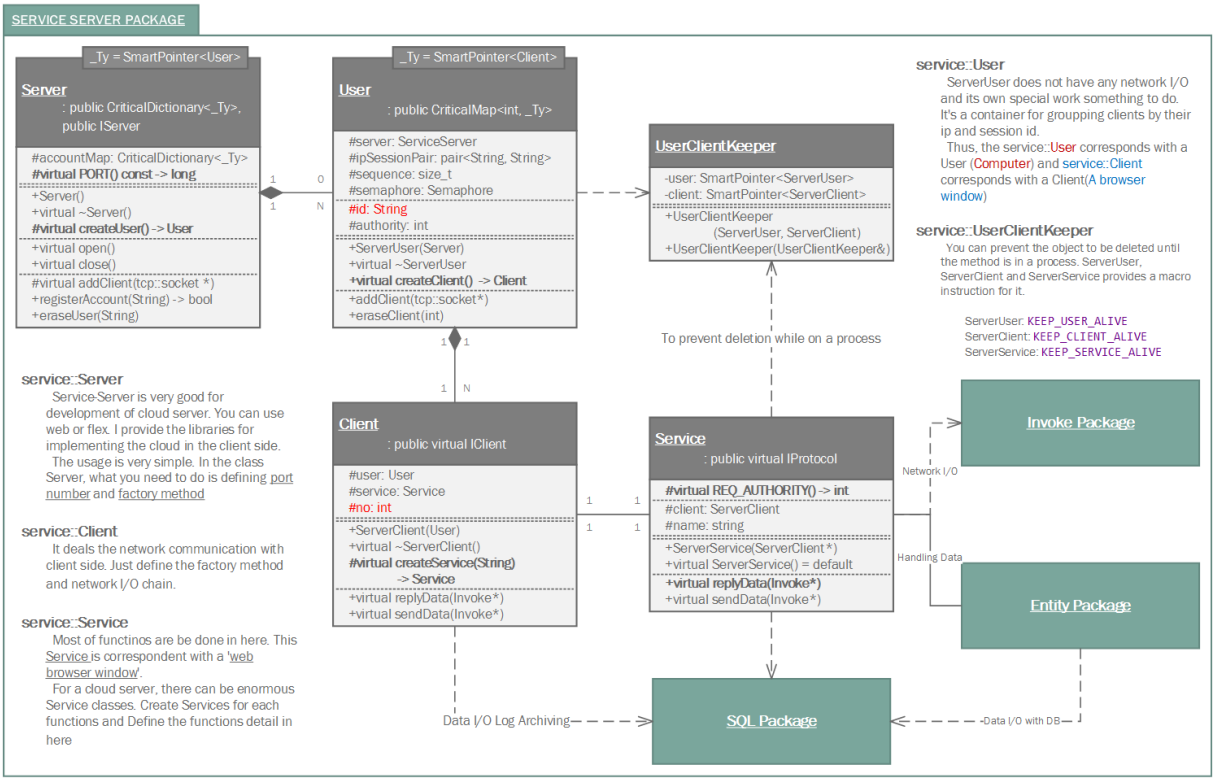
* SmartPointer< User > user
  *A shared pionter of an User.*
* SmartPointer< Client > client
  *A shared pointer of a Client.*

### 6.121.1 Detailed Description

A keeper blocking destrunction of User and Client.

Keeps User, Client and Service objects until termination of a stack.

You can prevent the object to be destructed until the method is in a process. User, Client and Service provides a macro instruction for it.




### Note

Defined macros

- KEEP_USER_ALIVE
- KEEP_CLIENT_ALIVE
- KEEP_SERVICE_ALIVE

### See also

samchon::protocol
samchon::protocol::service

### Author

Jeongho Nam

## 6.121.2 Constructor & Destructor Documentation

### 6.121.2.1 ServiceKeeper ( const User * *user*, const Client * *client* )

Construct from User and Client.

user An User to keep client A Client to keep

The documentation for this class was generated from the following files:

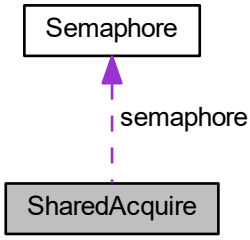
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/service/ServiceKeeper.hpp
- D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/service/ServiceKeeper.cpp

# 6.122 SharedAcquire Class Reference

Shared acquire from a Semaphore.

```
#include <SharedAcquire.hpp>
```

Collaboration diagram for SharedAcquire:




### Public Member Functions

- SharedAcquire (Semaphore &, bool=true)
  *Construct from Semaphore.*
- SharedAcquire (const SharedAcquire &)
  *Copy Constructor.*
- SharedAcquire (SharedAcquire &&)
  *Move Constructor.*
- ~SharedAcquire ()
  *Default Destructor.*
- void acquire ()
  *Acquire admission.*
- void release ()
  *Release an admission.*

### Private Attributes

- Semaphore * semaphore
  *Managed Semaphore.*
- std::atomic< size_t > * reference
  *Referencing count sharing same Semaphore.*
- std::atomic< bool > * isLocked
  *Whether the mutex was locked by SharedAcquire.*

### 6.122.1 Detailed Description

Shared acquire from a Semaphore.

A SharedAcquire is an object manages a Semaphore with shared ownership in both states.

- acquired
- released

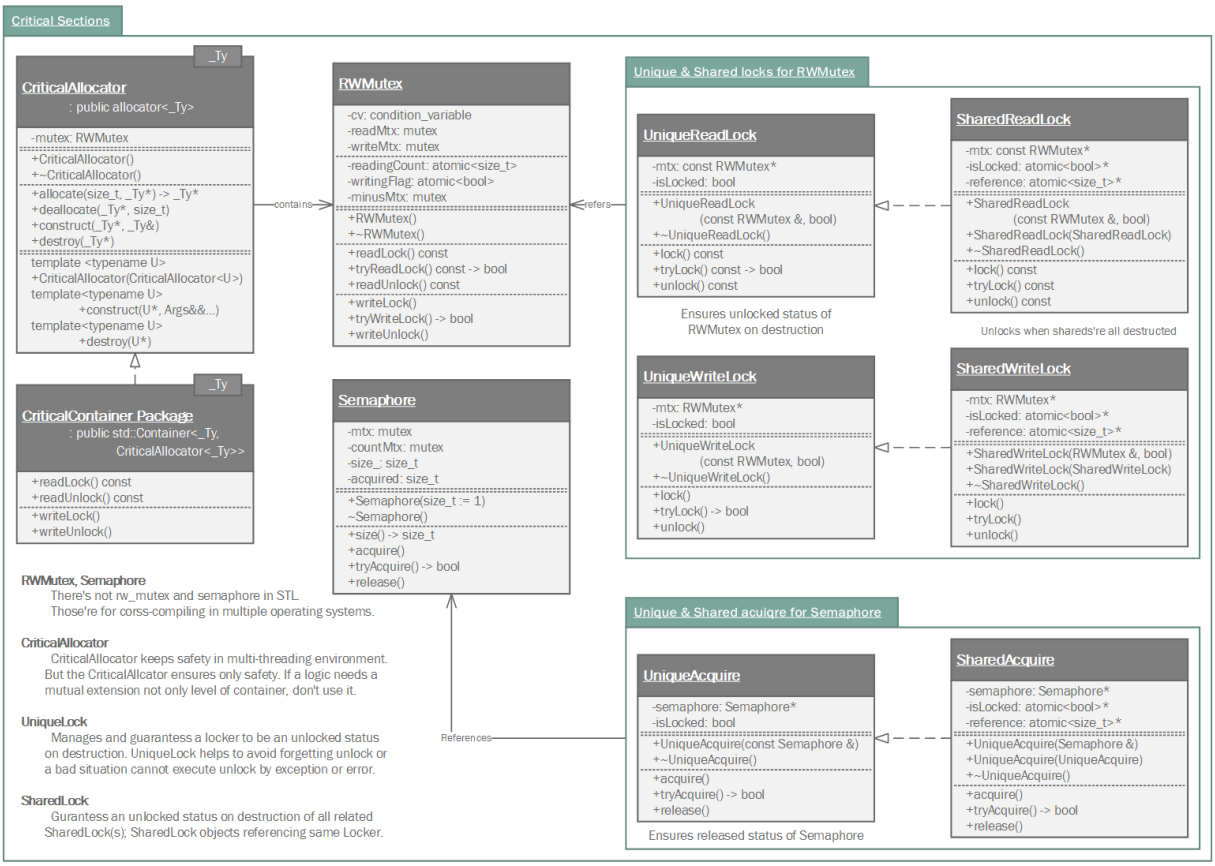
On default construction, the object acquires a Semaphore object, for whose acquiring and releasing operations becomes responsible. When copy constructions, responsibilities of acquiring and releasing Semaphore are shared with copied with those SharedAcquire objects.

The class shared_lock is a general-purpose shared mutex ownership wrapper allowing deferred locking, timed locking and transfer of lock ownership. Locking a shared_lock locks the associated shared mutex in shared mode (to lock it in exclusive mode, std::unique_lock can be used)

This class guarantees a released status on destruction of all shared objects (even if not called explicitly). Therefore it is especially useful as an object with automatic duration, as it guarantees the Semaphore object is properly released in case an exception is thrown.

Referenced comments of std::unique_lock

- http://www.cplusplus.com/reference/mutex/unique_lock/




**Note**

Though, that the SharedAcquire object does not manage the lifetime of the Semaphore object in any way: the duration of the Semaphore object shall extend at least until the destruction of the Shared↩ Acquire that manages it.

**See also**

library::UniqueAcquire
samchon::library

**Author**

Jeongho Nam

### 6.122.2 Constructor & Destructor Documentation

#### 6.122.2.1 SharedAcquire ( Semaphore & *semaphore*, bool *doLock* = `true` )

Construct from Semaphore.

**Parameters**

| | |
|---|---|
| *semaphore* | Semaphore to manage |
| *doLock* | Whether to lock directly or not |

### 6.122.3 Member Function Documentation

#### 6.122.3.1 void acquire ( )

Acquire admission.

Acquires an admission and increases count of admission by 1.

If the count is over permitted size, wait until other admissions to be released.

* Lock on mutex

#### 6.122.3.2 void release ( )

Release an admission.

Releases an admission what you've acquired. If the admission count was over the limited size, unlock the mutex.

The documentation for this class was generated from the following files:

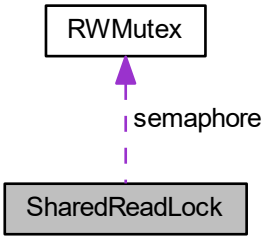
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/SharedAcquire.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/SharedAcquire.cpp

## 6.123 SharedReadLock Class Reference

Shared lock from a RWMutex.

`#include <SharedReadLock.hpp>`

Collaboration diagram for SharedReadLock:




### Public Member Functions

* SharedReadLock (const RWMutex &, bool=true)
  *Construct from RWMutex.*
* SharedReadLock (const SharedReadLock &)
  *Copy Constructor.*
* SharedReadLock (SharedReadLock &&)
  *Move Constructor.*
* ~SharedReadLock ()
  *Default Destructor.*
* void lock () const
  *Lock on read.*
* void unlock () const
  *Unlock of read.*

### Private Attributes

* const RWMutex * semaphore
  *Managed RWMutex.*
* std::atomic< size_t > * reference
  *Referencing count sharing same RWMutex.*
* std::atomic< bool > * isLocked
  *Whether the mutex was locked by SharedReadLock.*

### 6.123.1 Detailed Description

Shared lock from a RWMutex.

A SharedReadLock is an object manages a RWMutex with shared ownership in both states.

* locked
* unlocked

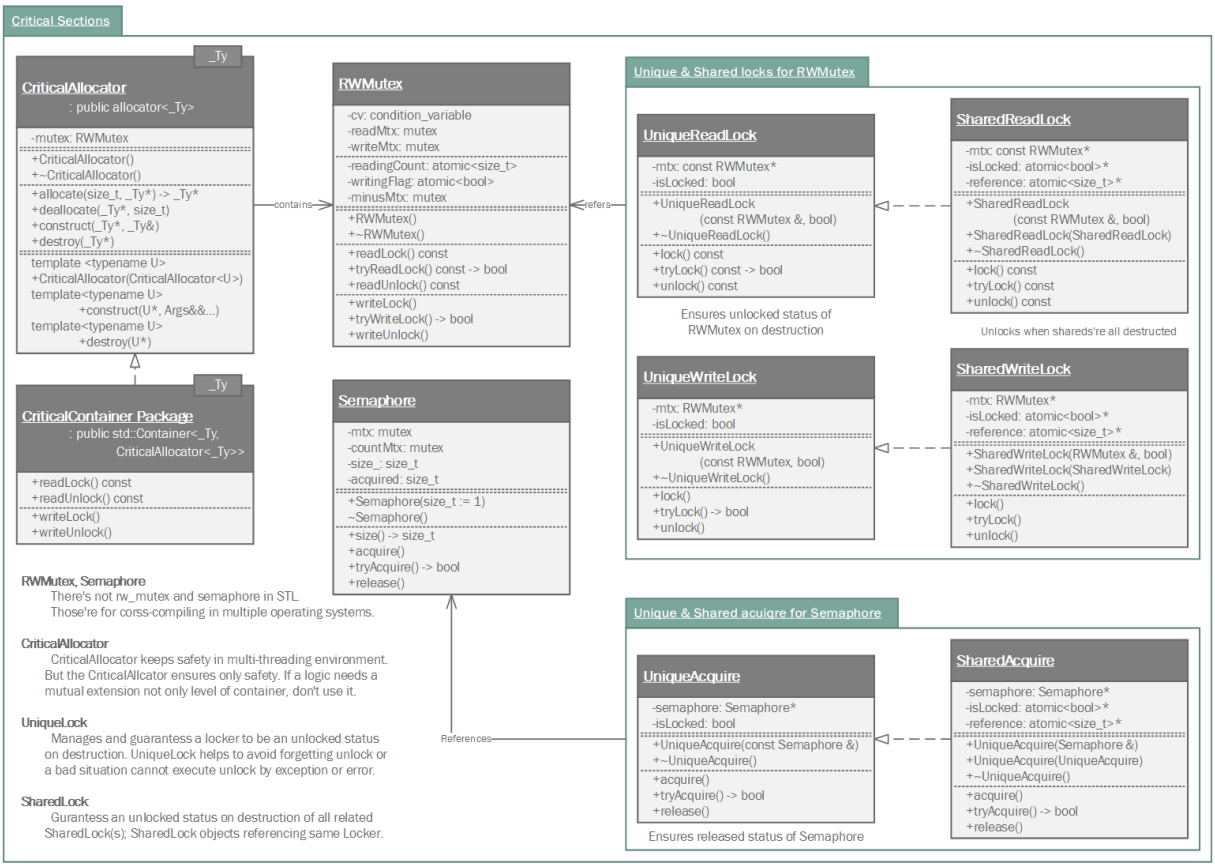
On default construction, the object acquires a RWMutex object, for whose locking and unlocking operations becomes responsible. When copy constructions, responsibilities of locking and unlocking RW↩ Mutex are shared with copied with those SharedReadLock objects.

The class shared_lock is a general-purpose shared mutex ownership wrapper allowing deferred locking, timed locking and transfer of lock ownership. Locking a shared_lock locks the associated shared mutex in shared mode (to lock it in exclusive mode, std::unique_lock can be used)

This class guarantees a unlocked status on destruction of all shared objects (even if not called explicitly). Therefore it is especially useful as an object with automatic duration, as it guarantees the RWMutex object is properly unlocked in case an exception is thrown.

Referenced comments of std::unique_lock

* http://www.cplusplus.com/reference/mutex/unique_lock/




### Note

Though, that the SharedReadLock object does not manage the lifetime of the RWMutex object in any way: the duration of the RWMutex object shall extend at least until the destruction of the SharedRead↩ Lock that manages it.

### See also

library::UniqueAcquire
samchon::library

### Author

Jeongho Nam

### 6.123.2 Constructor & Destructor Documentation

#### 6.123.2.1 SharedReadLock ( const RWMutex & *semaphore*, bool *doLock* = `true` )

Construct from RWMutex.

**Parameters**

| | |
|---|---|
| *semaphore* | RWMutex to manage |
| *doLock* | Whether to lock directly or not |

### 6.123.3 Member Function Documentation

#### 6.123.3.1 void lock ( ) const

Lock on read.

Increases a reading count.

When write_lock is on a progress, wait until write_unlock to be called.

* Reading can be done by multiple sections.
* Reading can't be done when writing.

**Warning**

You've to call read_unlock when the reading work is terminated.

#### 6.123.3.2 void unlock ( ) const

Unlock of read.

Decreases a reading count.

When write_lock had done after read_lock, it continues by read_unlock if the reading count was 1 (read_unlock makes the count to be zero).

The documentation for this class was generated from the following files:

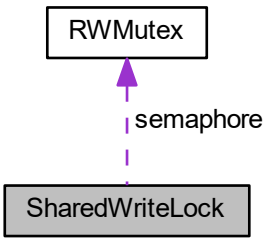
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/SharedReadLock.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/SharedReadLock.cpp

## 6.124 SharedWriteLock Class Reference

Shared lock from a RWMutex.

`#include <SharedWriteLock.hpp>`

Collaboration diagram for SharedWriteLock:




### Public Member Functions

* SharedWriteLock (RWMutex &, bool=true)
  *Construct from RWMutex.*
* SharedWriteLock (const SharedWriteLock &)
  *Copy Constructor.*

* SharedWriteLock (SharedWriteLock &&)
  *Move Constructor.*
* ~SharedWriteLock ()
  *Default Destructor.*
* void lock ()
  *Lock on writing.*
* void unlock ()
  *Unlock on writing.*

### Private Attributes

* RWMutex * semaphore
  *Managed RWMutex.*
* std::atomic< size_t > * reference
  *Referencing count sharing same RWMutex.*
* std::atomic< bool > * isLocked
  *Whether the mutex was locked by SharedWriteLock.*

## 6.124.1 Detailed Description

Shared lock from a RWMutex.

A SharedWriteLock is an object manages a RWMutex with shared ownership in both states.

* locked
* unlocked

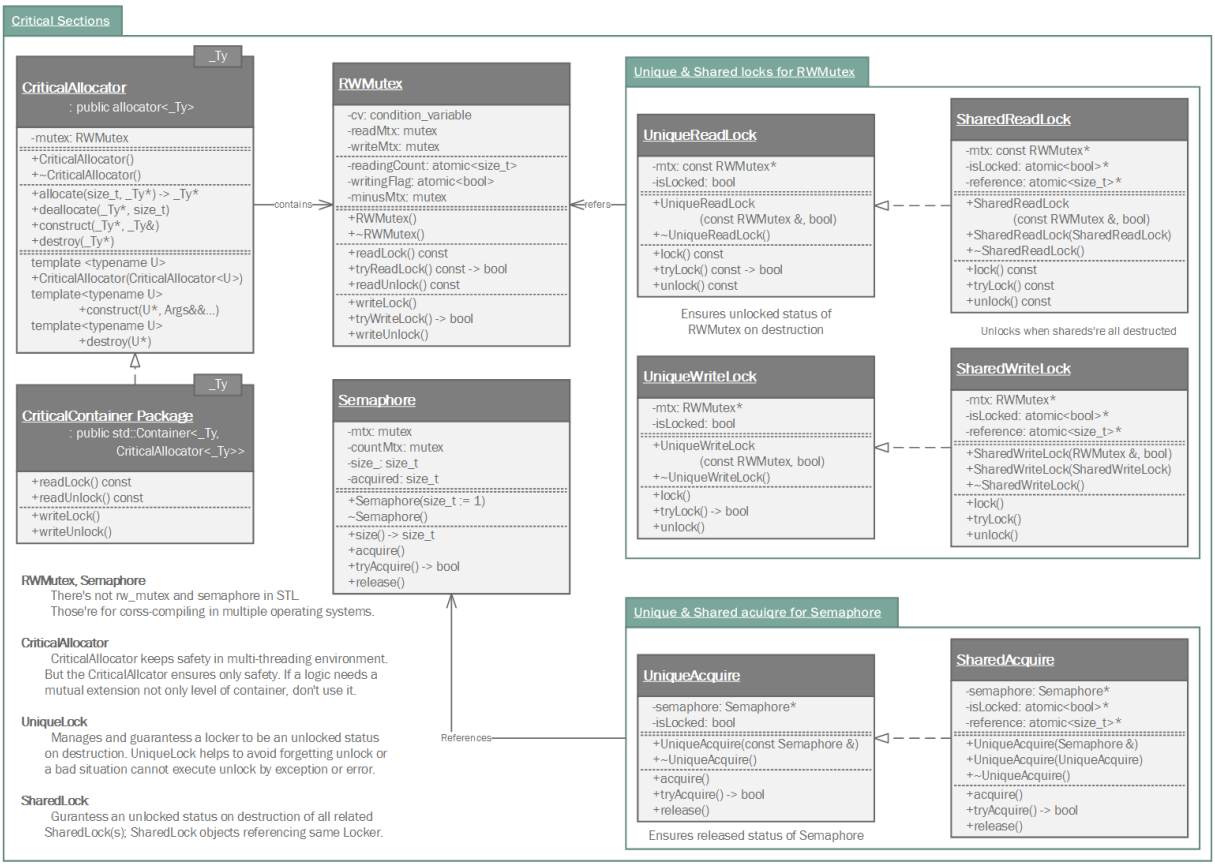
On default construction, the object acquires a RWMutex object, for whose locking and unlocking operations becomes responsible. When copy constructions, responsibilities of locking and unlocking RWMutex are shared with copied with those SharedWriteLock objects.

The class shared_lock is a general-purpose shared mutex ownership wrapper allowing deferred locking, timed locking and transfer of lock ownership. Locking a shared_lock locks the associated shared mutex in shared mode (to lock it in exclusive mode, std::unique_lock can be used)

This class guarantees a unlocked status on destruction of all shared objects (even if not called explicitly). Therefore it is especially useful as an object with automatic duration, as it guarantees the RWMutex object is properly unlocked in case an exception is thrown.

Referenced comments of std::unique_lock

* http://www.cplusplus.com/reference/mutex/unique_lock/




**Note**

Though, that the SharedWriteLock object does not manage the lifetime of the RWMutex object in any way: the duration of the RWMutex object shall extend at least until the destruction of the SharedWrite↩Lock that manages it.

**See also**

library::UniqueAcquire
samchon::library

**Author**

Jeongho Nam

## 6.124.2 Constructor & Destructor Documentation

### 6.124.2.1 SharedWriteLock ( RWMutex & *semaphore*, bool *doLock* = `true` )

Construct from RWMutex.

**Parameters**

| | |
|---|---|
| *semaphore* | RWMutex to manage |
| *doLock* | Whether to lock directly or not |

## 6.124.3 Member Function Documentation

### 6.124.3.1 void lock ( )

Lock on writing.

Changes writing flag to true.

If another write_lock or read_lock is on a progress, wait until them to be unlocked.

* Writing can be done by only a section at once.
* Writing can't be done when reading.

**Note**

You've to call write_unlock when writing work was terminated.

#### 6.124.3.2 void unlock ( )

Unlock on writing.

The documentation for this class was generated from the following files:

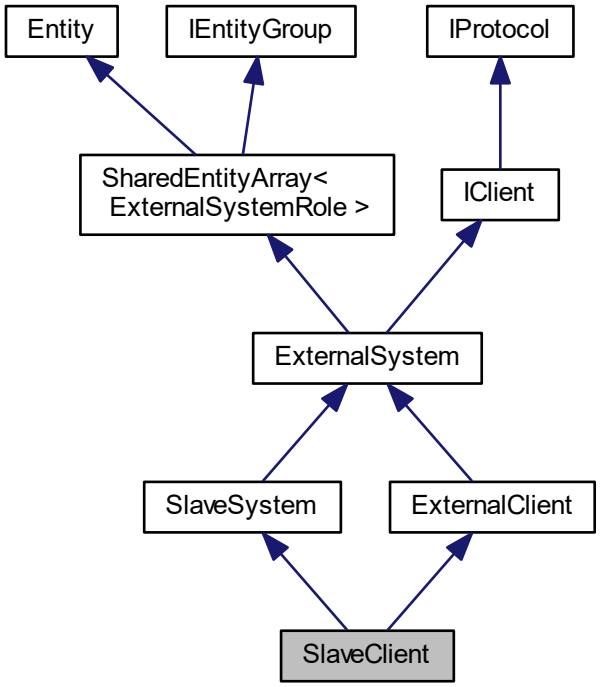
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/SharedWriteLock.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/SharedWriteLock.cpp

## 6.125 SlaveClient Class Reference

A slave client.

`#include <SlaveClient.hpp>`

Collaboration diagram for SlaveClient:




### Public Member Functions

* SlaveClient ()
  *Default Constructor.*

### Additional Inherited Members

### 6.125.1 Detailed Description

A slave client.

SlaveClient is a SlaveSystem specialized in client driver.

**[Inherited]**

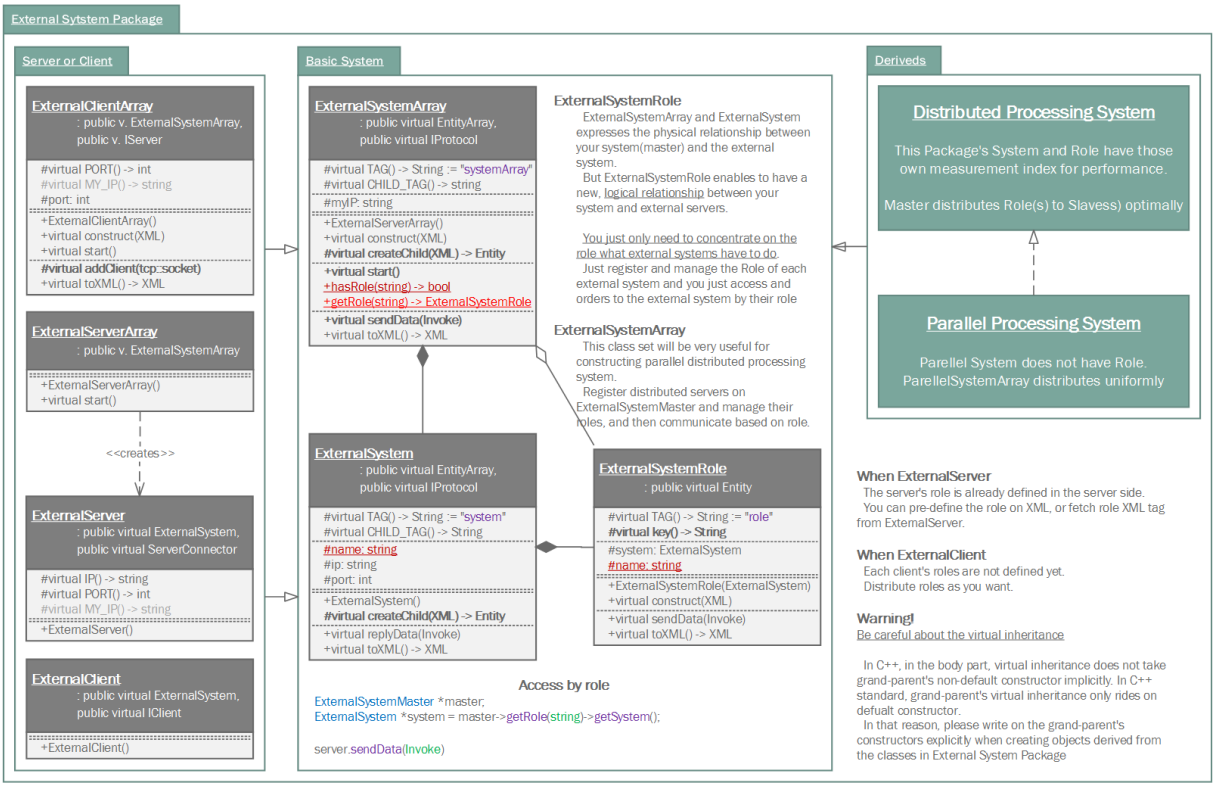
SlaveSystem, literally, means a slave system belongs to a maste system.

The SlaveSystem class is used in opposite side system of master::DistributedSystem and master::↩ ParallelSystem and reports elapsed time of each commmand (by Invoke message) for estimation of its performance.

**[Inherited]**

ExternalSystem is a boundary class interacting with an external system by network communication. Also, ExternalSystem is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystemRole.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem,

and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an ExternalSystem. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

The documentation for this class was generated from the following file:

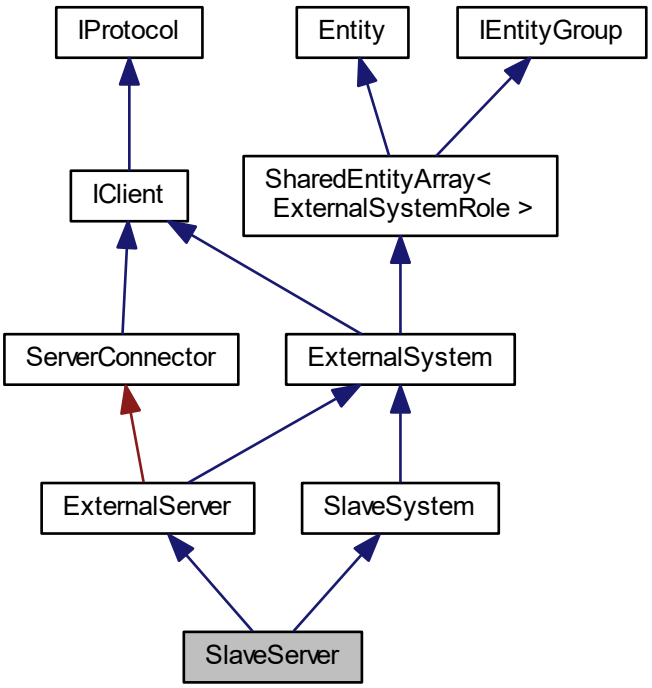
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/slave/SlaveClient.hpp

## 6.126 SlaveServer Class Reference

A slave server.

`#include <SlaveServer.hpp>`

Collaboration diagram for SlaveServer:




### Public Member Functions

* SlaveServer ()
  *Default Constructor.*

### Additional Inherited Members

### 6.126.1 Detailed Description

A slave server.

SlaveServer is a SlaveSystem specialized in server driver.

**[Inherited]**

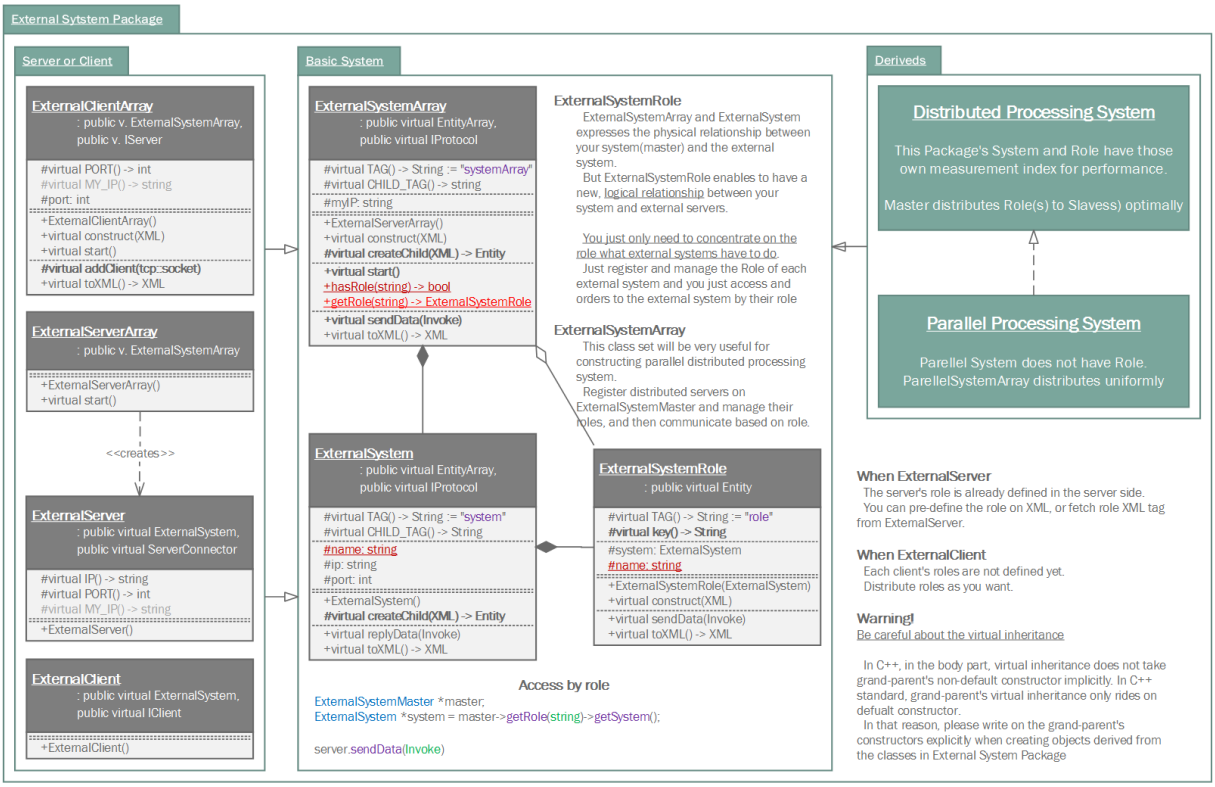
SlaveSystem, literally, means a slave system belongs to a maste system.

The SlaveSystem class is used in opposite side system of master::DistributedSystem and master::↩ ParallelSystem and reports elapsed time of each commmand (by Invoke message) for estimation of its performance.

**[Inherited]**

ExternalSystem is a boundary class interacting with an external system by network communication. Also, ExternalSystem is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystemRole.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem,

and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

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**See also**

samchon::protocol

**Author**

Jeongho Nam

The documentation for this class was generated from the following file:

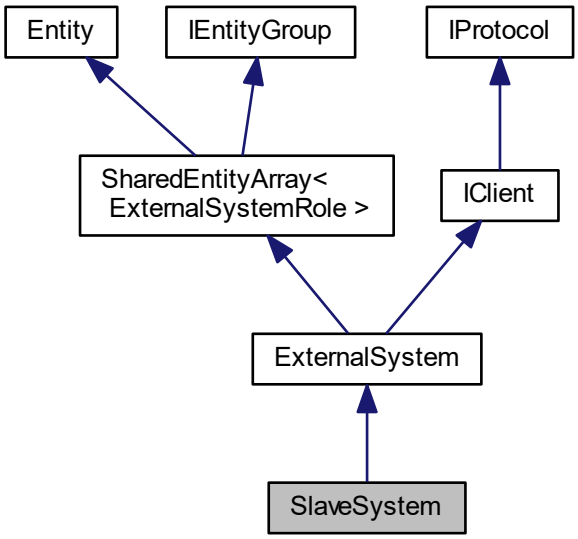
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/slave/SlaveServer.hpp

## 6.127 SlaveSystem Class Reference

A slave system.

`#include <SlaveSystem.hpp>`

Collaboration diagram for SlaveSystem:




### Public Member Functions

* SlaveSystem ()
  *Default Constructor.*

### Protected Member Functions

* virtual void _replyData (std::shared_ptr< Invoke >) override
  *Pre-processor for reporting elapsed time.*

### Additional Inherited Members

### 6.127.1 Detailed Description

A slave system.

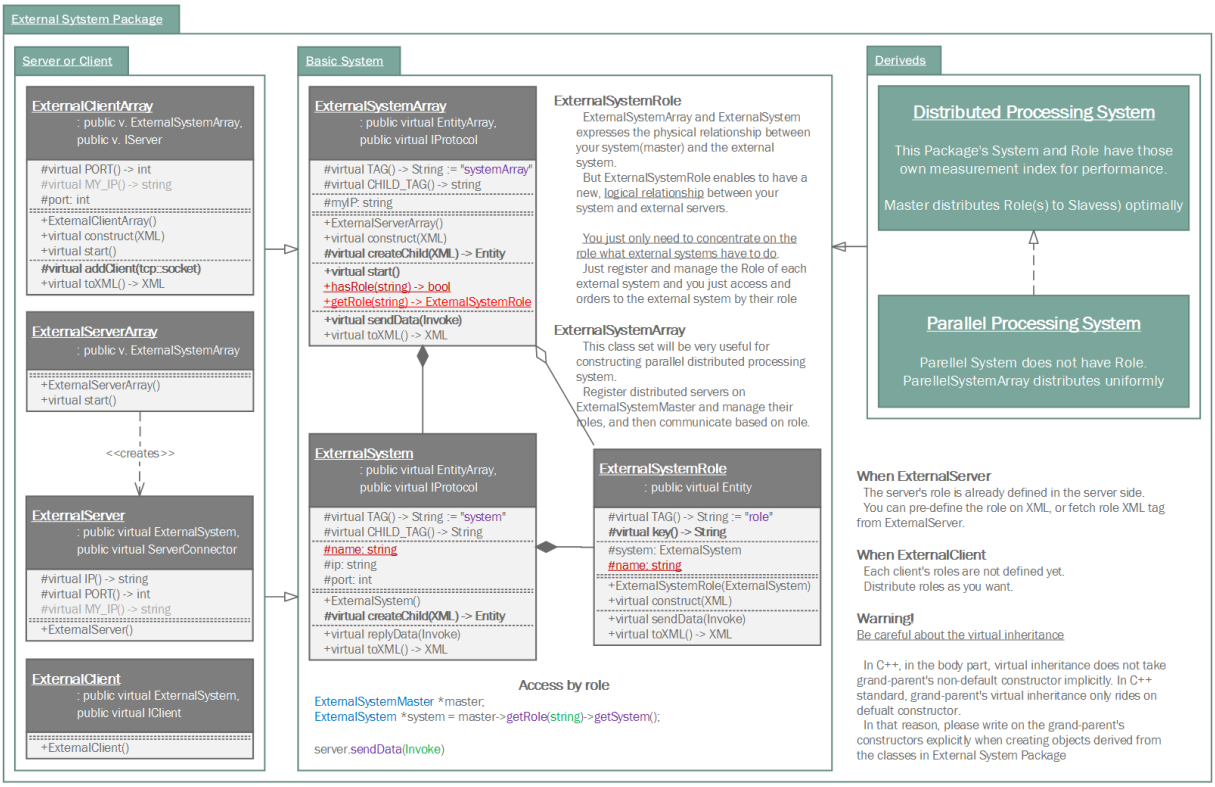
SlaveSystem, literally, means a slave system belongs to a maste system.

The SlaveSystem class is used in opposite side system of master::DistributedSystem and master::↩ ParallelSystem and reports elapsed time of each commmand (by Invoke message) for estimation of its performance.

**[Inherited]**

ExternalSystem is a boundary class interacting with an external system by network communication. Also, ExternalSystem is an abstract class that a network role, which one is server and which one is client, is not determined yet.

The ExternalSystem has ExternalSystemRole(s) groupped methods, handling Invoke message interacting with the external system, by subject or unit of a moudle. The ExternalSystemRole is categorized in a 'control'.




**Note**

The ExternalSystem class takes a role of interaction with external system in network level. However, within a framework of Samchon Framework, a boundary class like the ExternalSystem is not such important. You can find some evidence in a relationship between ExternalSystemArray, ExternalSystem and ExternalSystemRole.

Of course, the ExternalSystemRole is belonged to an ExternalSystem. However, if you access an ExternalSystemRole from an ExternalSystemArray directly, not passing by a belonged ExternalSystem, and send an Invoke message even you're not knowing which ExternalSystem is related in, it's called "Proxy pattern".

Like the explanation of "Proxy pattern", you can utilize an ExternalSystemRole as a proxy of an ExternalSystem. With the pattern, you can only concentrate on ExternalSystemRole itself, what to do with Invoke message, irrespective of the ExternalSystemRole is belonged to which ExternalSystem.

**See also**

samchon::protocol

**Author**

Jeongho Nam

### 6.127.2 Member Function Documentation

#### 6.127.2.1 virtual void _replyData ( std::shared_ptr< Invoke > ) [override], [protected], [virtual]

Pre-processor for reporting elapsed time.

**[Inherited]**

You can realize a pre-processing about the replied Invoke message by overriding the IClient::_reply↩Data().

Archiving a history log, filtering and truncating, let handling the message with a new thread, calculating performance by estimating elapsed time about the Invoke message, and so on. Anything you can define pre-processing works before IProtocol::replyData().

* Archive history log -> cloud service
* Estimating performance -> distributed and parallel processing system

**Parameters**

| | |
|---|---|
| *invoke* | An invoke message to be pre-processed and shifted to IProtocol::replyData(). |

Reimplemented from IClient.

Reimplemented in ParallelSystem.

The documentation for this class was generated from the following file:

* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/slave/SlaveSystem.hpp

## 6.128 SmartPointer< _Ty > Class Template Reference

Global shared pointer

.

```
#include <SmartPointer.hpp>
```

### Public Member Functions

* SmartPointer ()
  *Default Constructor.*
* SmartPointer (const _Ty *ptr)
  *Constrct from pointer.*
* SmartPointer (const SmartPointer &smartPointer)
  *Copy Constructor.*
* SmartPointer (SmartPointer &&smartPointer)
  *Move constructor.*
* ~SmartPointer ()
  *Destroy SmartPointer.*
* void reset (const _Ty *ptr)
  *Reset pointer.*
* auto get () const -> _Ty *
  *Get pointer.*
* auto operator-> () const -> _Ty *
  *Dereference object membr.*
* auto operator* () const -> _Ty &
  *Dereference object.*

### Private Attributes

* _Ty * ptr
  *A pointer managed by SmartPointer.*

### Static Private Attributes

* static std::map< _Ty *, size_t > useCountMap
  *Map of use count of each pointer.*
* static std::mutex mtx
  *Mutex assigned to useCountMap.*

## 6.128.1 Detailed Description

**template<typename _Ty>class samchon::SmartPointer< _Ty >**

Global shared pointer

.

SmartPointer is a global shared pointer based on map, map referencing.

Manages the storage of a pointer, providing a limited garbage-collection facility, possibly sharing that management with other objects.

Referenced comments of std::allocator.

* http://www.cplusplus.com/reference/memory/shared_ptr/

**Template Parameters**

| | |
|---|---|
| *The* | type of managed object |

**Author**

Jeongho Nam

## 6.128.2 Constructor & Destructor Documentation

### 6.128.2.1 SmartPointer ( ) [inline]

Default Constructor.

The object is empty (owns no pointer, use count of zero)

### 6.128.2.2 SmartPointer ( const _Ty * *ptr* ) [inline],[explicit]

Constrct from pointer.

The object owns ptr, setting the use count to add 1

**Parameters**

| | |
|---|---|
| *ptr* | The pointer to own |

### 6.128.2.3 SmartPointer ( const SmartPointer< _Ty > & *smartPointer* ) [inline]

Copy Constructor.

The object shares ownership of smartPointer's asset and increases the use count

**Parameters**

| | |
|---|---|
| *smartPointer* | The object to copy |

### 6.128.2.4 SmartPointer ( SmartPointer< _Ty > && *smartPointer* ) [inline]

Move constructor.

The object acquires the content managed by smartPointer

The ceding object becomes empty and there's no change on use count

**Parameters**

| | |
|---|---|
| *smartPointer* | The object to move |

#### 6.128.2.5 ~SmartPointer ( ) [inline]

Destroy SmartPointer.

Destroys the object. But, before, it may produce the following side effects depending on the use_count of member

* If use_count is greater than 1: The use count is decreased by 1.
* If use_count is 1 (i.e., the object is the unique owner of the managed pointer): the object pointed by its owned pointer is deleted.
* If use_count is zero (i.e., the object is empty), this destructor has no side effects.

### 6.128.3 Member Function Documentation

#### 6.128.3.1 void reset ( const _Ty * *ptr* ) [inline]

Reset pointer.

Reset pointer to manage and shrink use count of previous pointer.

Additionally, a call to this function has the same side effects as if SmartPointer's destructor was called before its value changed (including the deletion of the managed object if this SmartPointer was unique).

**Parameters**

| | |
|---|---|
| *Pointer* | whose ownership is taken over by the object. Unlike std::shared_ptr, ptr being managed by another SmartPointer does not cause any problem |

#### 6.128.3.2 auto get ( ) const -> _Ty* [inline]

Get pointer.

Returns the stored pointer.

The stored pointer points to the object the shared_ptr object dereferences to, which is generally the same as its owned pointer.

**Returns**

The stored pointer

#### 6.128.3.3 auto operator-> ( ) const -> _Ty* [inline]

Dereference object membr.

Returns a pointer to the object pointed by the stored pointer in order to access one of its members. This member function shall not be called if the stored pointer is a null pointer.

It returns the same value as get().

**Returns**

A pointer to be managed by SmartPointer

#### 6.128.3.4 auto operator* ( ) const -> _Ty& [inline]

Dereference object.

Returns a reference to the object pointerd by pointer. It is equivalent to: *get()

**Returns**

A reference to the object pointed

The documentation for this class was generated from the following file:

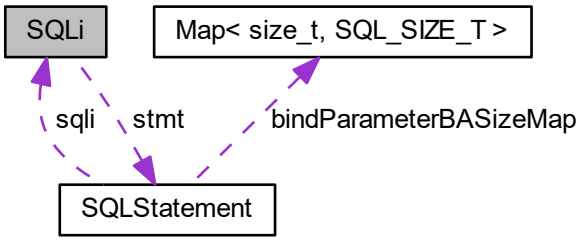
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/SmartPointer.hpp

## 6.129 SQLi Class Reference

A SQL interface; DBMS connector.

`#include <SQLi.hpp>`

Collaboration diagram for SQLi:




### Public Member Functions

- SQLi (const std::string &driver, int port)
  *Construct from driver name and port.*
- virtual void connect (const std::string &ip, const std::string &db, const std::string &id, const std↩ ::string &pwd)
  *Connect to the DBMS*
  .
- virtual void disconnect ()
  *Disconnect from DBMS.*
- virtual auto createStatement () -> std::shared_ptr< SQLStatement >
  *Factory method for creating SQLStatement.*

### Protected Attributes

- std::string driver
  *Driver; name of DBMS used for connection.*
- int port
  *Port number of DBMS.*

### Private Attributes

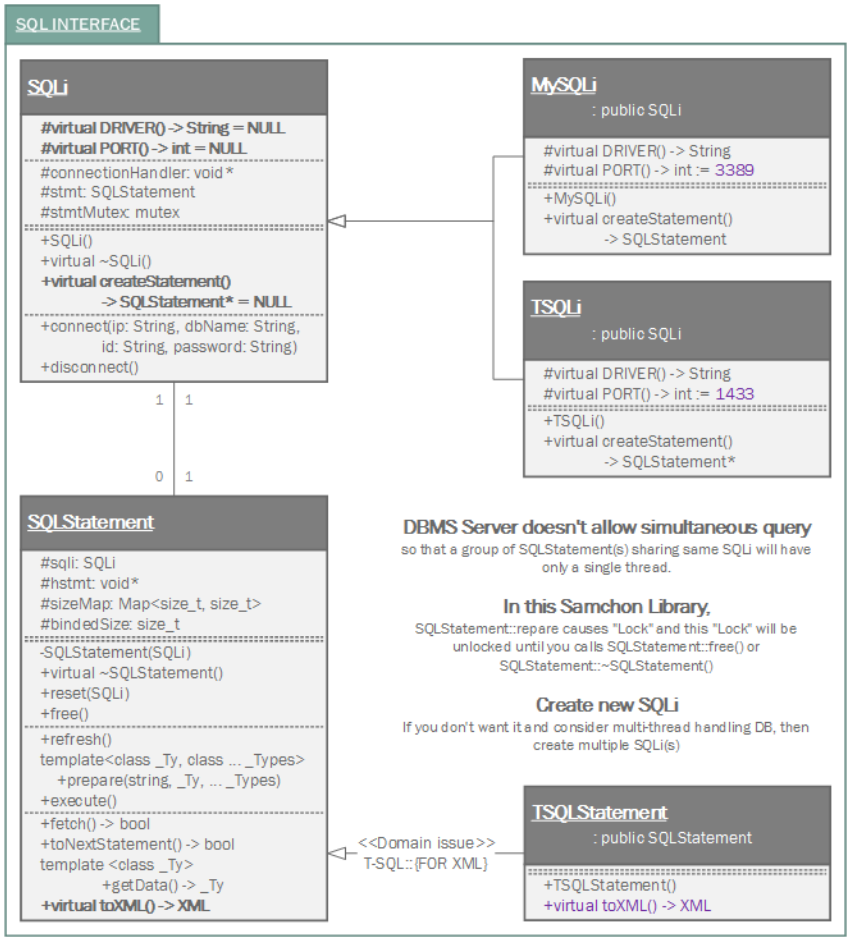
- void * hdbc
  *Handler of DB-connector.*
- SQLStatement * stmt
  *SQLStatement's pointer linked with the SQLi.*
- std::mutex stmtMutex
  *Mutex ensuring concurrency with SQLStatement.*

### 6.129.1 Detailed Description

A SQL interface; DBMS connector.

SQLi is an abstract class managing connection (session) with a specific database and manages SQL statements are executed and results are returned within the context of a connection.

The reason why SQLStatement(s) are managed by SQLi is because of a principle of DBMS, DBM↩ S system doesn't allow simultaneous query from a session (connection). Only a query (process0) is allowed at a time. If you try to simultaneous query from a SQLi, ODBC throws error. To avoid the error, an execute of query from SQLStatement will lock a mutex of SQLi to ensure exclusiveness.




**Note**

To ensure the exclusiveness, you've to make SQLStatement from SQLi. Do not make SQLStatement by yourself. call SQLi::createSQLStatement() instead. Even you make a derived class from SQLStatement, don't make its constructor to have public accessor.

Becuase execution of a sql statement causes lock on mutex in SQLi, you've to destruct the SQL↩ Statement or call SQLStatement::free() method(). If you don't, the mutex will not be unlocked, thus you can't do anything by the SQLi.

**See also**

samchon::library

**Author**

Jeongho Nam

## 6.129.2 Constructor & Destructor Documentation

### 6.129.2.1 SQLi ( const std::string & *driver*, int *port* )

Construct from driver name and port.

**Parameters**

| | |
|---|---|
| *driver* | Driver name of DBMS |

| | |
|---|---|
| *port* | Port number of DBMS |

### 6.129.3 Member Function Documentation

#### 6.129.3.1 void connect ( const std::string & *ip*, const std::string & *db*, const std::string & *id*, const std::string & *pwd* ) [virtual]

Connect to the DBMS

.

**Parameters**

| | |
|---|---|
| *ip* | An IP address of the DBMS |
| *db* | A name of database to access |
| *id* | Your own ID authorified from DBMS |
| *pwd* | A password for the ID |

**Exceptions**

| | |
|---|---|
| *exception* | Error message from DBMS |

#### 6.129.3.2 auto createStatement ( ) -> std::shared_ptr<SQLStatement> [virtual]

Factory method for creating SQLStatement.

Recommend to create SQLStatement by this method. Direct creation is not recommended as the reason of domain problem of each DBMS

**Returns**

A SQLStatement matched for the domain SQLi

Reimplemented in TSQLi.

### 6.129.4 Member Data Documentation

#### 6.129.4.1 std::string driver [protected]

Driver; name of DBMS used for connection.

* MySQL: "{MySQL Server}"
* MS-SQL: "{SQL Server}"
* PL-SQL: "{Oracle}"

#### 6.129.4.2 int port [protected]

Port number of DBMS.

* MySQL: 3306
* MS-SQL: 1433
* PL-SQL: 1521

The documentation for this class was generated from the following files:

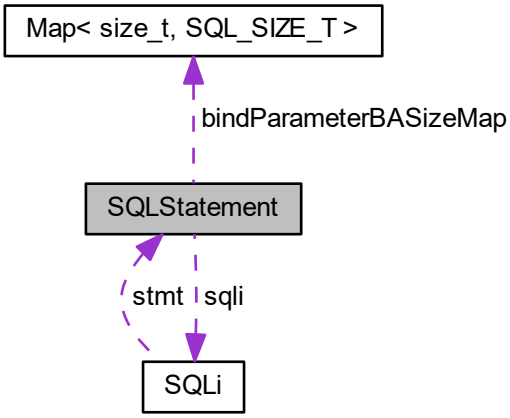
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/SQLi.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/SQLi.cpp

## 6.130 SQLStatement Class Reference

A sql statement.

```
#include <SQLStatement.hpp>
```

Collaboration diagram for SQLStatement:




## Public Member Functions

- void free ()
  *Free the sql statement.*
- void refresh ()
  *Refresh the sql statement.*
- template<typename _Ty , typename... _Args>
  void prepare (const std::string &sql, const _Ty &val, const _Args &...args)
  *Prepare a sql statement.*
- void execute ()
  *Execute the prepared sql statement.*
- void executeDirectly (const std::string &)
  *Execute sql-statement direclty.*
- auto fetch () const -> bool
  *Fetch a record.*
- auto next () const -> bool
  *Move cursor to the next sql-statement.*
- auto size () const -> size_t
  *Get size of columns.*
- template<typename _Ty >
  auto at (size_t index) const -> _Ty
  *Get column's data by its index.*
- template<typename _Ty >
  auto get (const std::string &) const -> _Ty
  *Get a column data by its name.*
- virtual auto toXML () const -> std::shared_ptr< XML >
  *Result sets to XML.*

## Protected Member Functions

- SQLStatement (SQLi *sqli)
  *Protected Constructor.*

## Protected Attributes

- SQLi * sqli
  *SQLi who created the SQLStatement.*
- void * hstmt
  *Handler of sql statement (OBDC)*

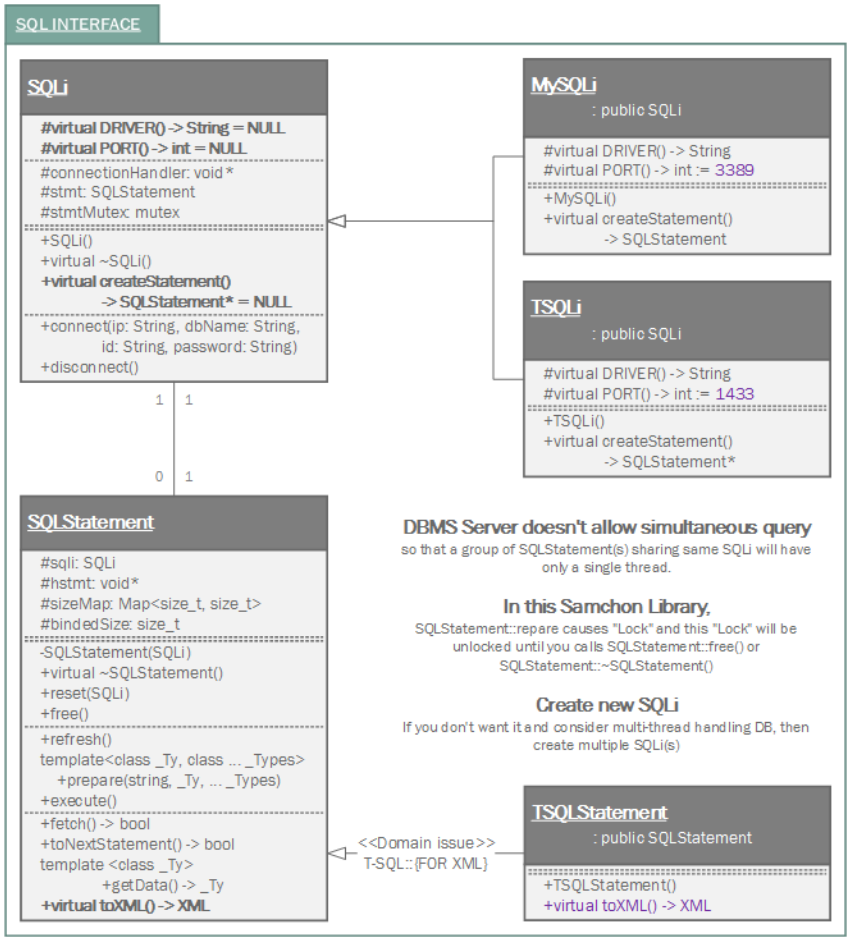
* size_t bindParameterCount
  *Count of binded parameters*
  .
* Map< size_t, SQL_SIZE_T > bindParameterBASizeMap
  *A map for binary size.*

### 6.130.1 Detailed Description

A sql statement.

A SQLStatement instance is used to executing a SQL statement and returning the results it produces against a SQL database that is opened through a SQLi instance.

Through the SQLi, it's the reason why a principle of DBMS, DBMS system doesn't allow simultaneous query from a session (connection). Only a query (process) is allowed at a time. If you try to simultaneous query from a SQLi, ODBC throws error. To avoid the error, an execute of query from SQLStatement will lock a mutex of SQLi to ensure exclusiveness.




**Note**

To ensure the exclusiveness, you've to make SQLStatement from SQLi. Do not make SQLStatement by yourself. call SQLi::createSQLStatement() instead. Even you make a derived class from SQLStatement, don't make its constructor to have public accessor.

Becuase execution of a sql statement causes lock on mutex in SQLi, you've to destruct the SQL↩ Statement or call SQLStatement::free() method(). If you don't, the mutex will not be unlocked, thus you can't do anything by the SQLi.

**See also**

samchon::library

**Author**

Jeongho Nam

### 6.130.2 Constructor & Destructor Documentation

#### 6.130.2.1 SQLStatement ( SQLi * *sqli* ) [protected]

Protected Constructor.

SQLStatement's constructor have to created by SQLi::createStatement().

**Note**

Don't create SQLStatement by yourself.

SQLStatement has to be created by SQLi::createStatement().

**Parameters**

| | |
|---|---|
| *sqli* | Parent SQLi who created the SQLStatement |

### 6.130.3 Member Function Documentation

#### 6.130.3.1 void prepare ( const std::string & *sql*, const _Ty & *val*, const _Args &... *args* ) [inline]

Prepare a sql statement.

Prepare a sql statement with parameters to bind for execution

**Warning**

Be careful for destructions of binded parameters

**Parameters**

| | |
|---|---|
| *sql* | A sql-statement to prepare |
| ... | args The parameters to bind |

#### 6.130.3.2 void execute ( )

Execute the prepared sql statement.

**Exceptions**

| | |
|---|---|
| *exception* | Error message from DBMS |

#### 6.130.3.3 void executeDirectly ( const std::string & *sql* )

Execute sql-statement direclty.

Executes the given sql-statement without preparing or binding any parameter

**Warning**

* Cannot use if prepare statement has already defined. Use execute instead.
* Not recommended when the case of dynamic sql and the sql-statement is not for procedure but for direct access to table. Use prepare and execute instead.

**Parameters**

| | |
|---|---|
| *sql* | sql-statement you want to execute |

**Exceptions**

| | |
|---|---|
| *exception* | Error message from DBMS |
| *exception* | Method prepare is already called |

#### 6.130.3.4 auto fetch ( ) const -> bool

Fetch a record.

**Returns**

Whether succeded to fetch a record.

False means there's not any record or previous record was the last.

#### 6.130.3.5 auto next ( ) const -> bool

Move cursor to the next sql-statement.

**Returns**

Whether succeded to move cursor to the next statement.

#### 6.130.3.6 auto size ( ) const -> size_t

Get size of columns.

Returns the number of columns in a result set.

**Warning**

Not size of rows.

#### 6.130.3.7 auto at ( size_t *index* ) const -> _Ty [inline]

Get column's data by its index.

Returns column's data from fetched-record by specified column index

**Parameters**

| | |
|---|---|
| *index* | Index number of a column wants to get |

**Returns**

Data stored in the record at the position of specifield column

#### 6.130.3.8 auto get ( const std::string & ) const -> _Ty [inline]

Get a column data by its name.

Returns column's data from fetchched-recrod by specified column name

Get data from fetched-record by specified column name

**Parameters**

| | |
|---|---|
| *name* | Name of a column wants to get |

**Returns**

Data stored in the record at the position of specifield column

#### 6.130.3.9 auto toXML ( ) const -> std::shared_ptr<XML> [virtual]

Result sets to XML.

Converts the records of current sql-statement to XML.

Recommends to override for each DBMS's domain XML rule.

**Returns**

XML representing records of the statement

Reimplemented in TSQLStatement.

### 6.130.4 Member Data Documentation

#### 6.130.4.1 Map<size_t, SQL_SIZE_T> bindParameterBASizeMap [protected]

A map for binary size.

When calls ByteArray::size(), the returned size_t value can't be kept until

The documentation for this class was generated from the following files:

* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/SQLStatement.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/SQLStatement.cpp

## 6.131 StringUtil Class Reference

Utility class for string.

`#include <StringUtil.hpp>`

### Static Public Member Functions

* template<typename _Ty , typename... _Args>
  static auto substitute (const std::string &format, const _Ty &val, const _Args &...args) -> std::string
  *Substitutes "{n}" tokens within the specified string with the respective arguments passed in.*
* template<typename _Ty , typename... _Args>
  static auto substituteSQL (const std::string &format, const _Ty &value, const _Args &...args) -> std::string
  *Substitutes "{n}" tokens within the specified sql-string with the respective arguments passed in.*
  .
* static auto isNumeric (const std::string &str) -> bool
  *Returns wheter the std::string represents Number or not*
  .
* static auto toNumber (const std::string &str) -> double
  *Number std::string to Number having ',' symbols.*
* static auto numberFormat (double val, int precision=2) -> std::string
* static auto percentFormat (double val, int precision=2) -> std::string
  *Returns a percentage string converted from the number rounded off from specified precision with "," symbols*
  *ex) percentFormat(11.3391, 1) => 1,133.9%.*
* static auto colorNumberFormat (double value, int precision=2, double delimiter=0.0) -> std::string
  *Returns a string converted from the number rounded off from specified precision with "," symbols and color tag*
  *ex) numberFormat(17151.339, 2) => <font color="red">17,151.34</font>*
* static auto colorPercentFormat (double value, int precision=2, double delimiter=0.0) -> std::string
  *Returns a percentage string converted from the number rounded off from specified precision with "," symbols*
  *ex) percentFormat(11.3391, 1) => 1,133.9%.*
* static auto trim (const std::string &val, const std::vector< std::string > &delims) -> std::string
  *Removes all designated characters from the beginning and end of the specified string.*
* static auto ltrim (const std::string &val, const std::vector< std::string > &delims) -> std::string
  *Removes all designated characters from the beginning of the specified string.*
* static auto rtrim (const std::string &val, const std::vector< std::string > &delims) -> std::string
  *Removes all designated characters from the end of the specified string.*
* static auto finds (const std::string &str, const std::vector< std::string > &delims, size_t start↩Index=0) -> IndexPair< std::string >

*Finds first occurence in string.*

* static auto rfinds (const std::string &str, const std::vector< std::string > &delims, size_t end↩ Index=SIZE_MAX) -> IndexPair< std::string >

  *Finds last occurence in string.*
* static auto substring (const std::string &str, size_t startIndex, size_t endIndex=SIZE_MAX) -> std↩ ::string

  *Generates a substring.*
* static auto between (const std::string &str, const std::string &start="", const std::string &end="") -> std::string

  *Generates a substring.*
* static auto addTab (const std::string &str, size_t n=1) -> std::string

  *Adds tab() character to first position of each line.*
* static auto split (const std::string &str, const std::string &delim) -> std::vector< std::string >

  *Generates substrings.*
* static auto betweens (const std::string &str, const std::string &start="", const std::string &end="") -> std::vector< std::string >

  *Generates substrings.*
* static auto toLowerCase (const std::string &str) -> std::string

  *Returns a string that all uppercase characters are converted to lowercase*

  .
* static auto toUpperCase (const std::string &str) -> std::string
* static auto replaceAll (const std::string &str, const std::string &before, const std::string &after) -> std::string

  *Returns a string specified word is replaced.*
* static auto replaceAll (const std::string &str, const std::vector< std::pair< std::string, std::string >> &pairs) -> std::string

  *Returns a string specified words are replaced.*

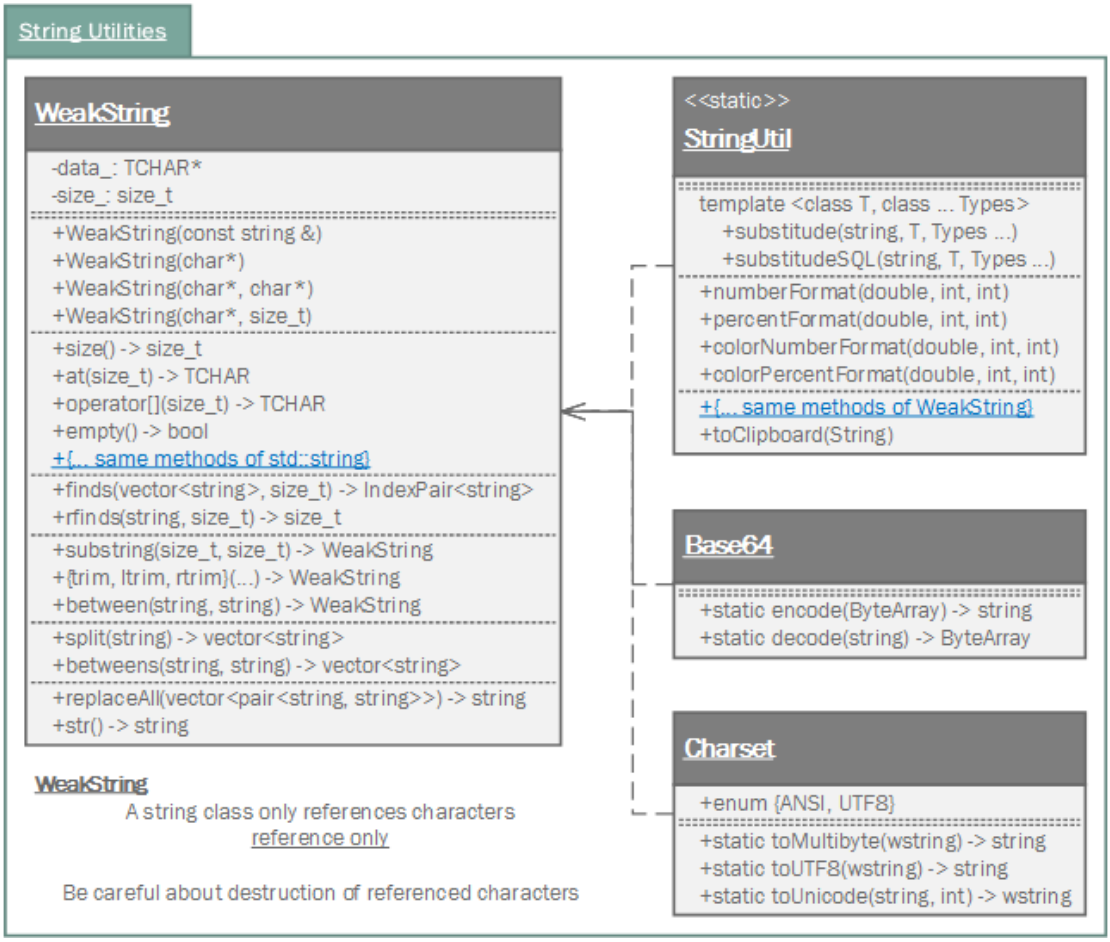
### 6.131.1 Detailed Description

Utility class for string.

StringUtil is an utility class providing lots of static methods for std::string.

There are two methods to strength std::string to have addictional uility methods like trim and split. The way of first is to make std::string class inheriting from std::string. The second is to make StringUtil class having static methods.

But those methods have problems. std::string class violates standard and StringUtil class violates principle of Object-Oriented Design. For the present, I've made the StringUtil class, but if you have a good opinion about the issue, please write your opinion on my github.




**See also**

library::WeakString
samchon::library

**Author**

Jeongho Nam

## 6.131.2 Member Function Documentation

### 6.131.2.1 static auto substitute ( const std::string & *format,* const _Ty & *val,* const _Args &... *args* ) -> std::string [inline], [static]

Substitutes "{n}" tokens within the specified string with the respective arguments passed in.

**Parameters**

| | |
|---|---|
| *format* | The string to make substitutions in.<br>This string can contain special tokens of the form {n}, where n is a zero based index, that will be replaced with the additional parameters found at that index if specified |
| *val* | Target value to substitute the minimum {n} tokens |
| *args* | Additional parameters that can be substituted in the str parameter at each {n} location, where n is an integer (zero based) index value into the varadics of values specified. |

**Returns**

New string with all of the {n} tokens replaced with the respective arguments specified.

#### 6.131.2.2 static auto substituteSQL ( const std::string & *format,* const _Ty & *value,* const _Args &... *args* ) -> std::string [inline],[static]

Substitutes "{n}" tokens within the specified sql-string with the respective arguments passed in.
.

**Warning**

substituteSQL creates the dynamic sql-statement.
Not recommended when the dynamic sql-statement is not only for procedure.

**Parameters**

| | |
|---|---|
| *format* | The string to make substitutions in.<br>This string can contain special tokens of the form {n}, where n is a zero based index, that will be replaced with the additional parameters found at that index if specified |
| *val* | Target value to substitute the minimum {n} tokens |
| *args* | Additional parameters that can be substituted in the str parameter at each {n} location, where n is an integer (zero based) index value into the varadics of values specified. |

**Returns**

New sql-string with all of the {n} tokens replaced with the respective arguments specified.

#### 6.131.2.3 auto isNumeric ( const std::string & *str* ) -> bool [static]

Returns wheter the std::string represents Number or not
.

**Parameters**

| | |
|---|---|
| *str* | Target std::string to check |

**Returns**

Whether the std::string can be converted to Number or not

#### 6.131.2.4 auto toNumber ( const std::string & *str* ) -> double [static]

Number std::string to Number having ',' symbols.

**Parameters**

| | |
|---|---|
| *str* | Target std::string you want to convert to Number |

**Returns**

Number from std::string

#### 6.131.2.5 auto numberFormat ( double *val,* int *precision* = 2 ) -> std::string [static]

Returns a string converted from the number rounded off from specified precision with "," symbols ex) numberFormat(17151.339, 2) => 17,151.34

**Parameters**

| | |
|---|---|
| *val* | A number wants to convert to string |

| | |
|---|---|
| *precision* | Target precision of roundoff |

**Returns**

A string representing the number with roundoff and "," symbols

#### 6.131.2.6 auto percentFormat ( double *val,* int *precision* = 2 ) -> std::string [static]

Returns a percentage string converted from the number rounded off from specified precision with "," symbols
ex) percentFormat(11.3391, 1) => 1,133.9%.

**Warning**

Do not multiply by 100 to the value representing percent

**Parameters**

| | |
|---|---|
| *val* | A number wants to convert to percentage string |
| *precision* | Target precision of roundoff |

#### 6.131.2.7 auto colorNumberFormat ( double *value,* int *precision* = 2, double *delimiter* = 0.0 ) -> std::string [static]

Returns a string converted from the number rounded off from specified precision with "," symbols and color tag
ex) numberFormat(17151.339, 2) => <font color="red">17,151.34</font>
Which color would be chosen

* Number is positive, color is RED
* Number is zero (0), color is BLACK
* Number is negative, color is BLUE

**Parameters**

| | |
|---|---|
| *val* | A number wants to convert to colored string |
| *precision* | Target precision of roundoff |

**Returns**

A colored string representing the number with roundoff and "," symbols

#### 6.131.2.8 auto colorPercentFormat ( double *value,* int *precision* = 2, double *delimiter* = 0.0 ) -> std::string [static]

Returns a percentage string converted from the number rounded off from specified precision with "," symbols
ex) percentFormat(11.3391, 1) => 1,133.9%.

**Warning**

Do not multiply by 100 to the value representing percent

**Parameters**

| | |
|---|---|
| *val* | A number wants to convert to percentage string |
| *precision* | Target precision of roundoff |

#### 6.131.2.9 static auto trim ( const std::string & *val,* const std::vector< std::string > & *delims* ) -> std::string [static]

Removes all designated characters from the beginning and end of the specified string.

**Parameters**

| | |
|---|---|
| *str* | The string should be trimmed |
| *delims* | Designated character(s) |

**Returns**

Updated string where designated characters was removed from the beginning and end

#### 6.131.2.10 static auto ltrim ( const std::string & *val,* const std::vector< std::string > & *delims* ) -> std::string [static]

Removes all designated characters from the beginning of the specified string.

**Parameters**

| | |
|---|---|
| *str* | The string should be trimmed |
| *delims* | Designated character(s) |

**Returns**

Updated string where designated characters was removed from the beginning

#### 6.131.2.11 static auto rtrim ( const std::string & *val,* const std::vector< std::string > & *delims* ) -> std::string [static]

Removes all designated characters from the end of the specified string.

**Parameters**

| | |
|---|---|
| *str* | The string should be trimmed |
| *delims* | Designated character(s) |

**Returns**

Updated string where designated characters was removed from the end

#### 6.131.2.12 auto finds ( const std::string & *str,* const std::vector< std::string > & *delims,* size_t *startIndex* = 0 ) -> IndexPair<std::string> [static]

Finds first occurence in string.

Finds first occurence position of each delim in the string after startIndex and returns the minimum position of them

If startIndex is not specified, then starts from 0.

If failed to find any substring, returns -1 (std::string::npos)

**Parameters**

| | |
|---|---|
| *str* | Target string to find |
| *delims* | The substrings of target(str) which to find |
| *startIndex* | Specified starting index of find. Default is 0 |

**Returns**

pair<size_t := position, string := matched substring>

#### 6.131.2.13 auto rfinds ( const std::string & *str,* const std::vector< std::string > & *delims,* size_t *endIndex* = SIZE_MAX ) -> IndexPair<std::string> [static]

Finds last occurence in string.

Finds last occurence position of each delim in the string before endIndex and returns the maximum position of them

If index is not specified, then starts str.size() - 1

If failed to find any substring, returns -1 (std::string::npos)

**Parameters**

| | |
|---|---|
| *str* | Target string to find |
| *delims* | The substrings of target(str) which to find |
| *endIndex* | Specified starting index of find. Default is str.size() - 1 |

**Returns**

pair<size_t := position, string := matched substring>

#### 6.131.2.14 auto substring ( const std::string & *str*, size_t *startIndex*, size_t *endIndex* = `SIZE_MAX` ) -> std::string `[static]`

Generates a substring.

Extracts a string consisting of the character specified by startIndex and all characters up to endIndex - 1 If endIndex is not specified, string::size() will be used instead.
If endIndex is greater than startIndex, then those will be swapped

**Parameters**

| | |
|---|---|
| *str* | Target string to be applied substring |
| *startIndex* | Index of the first character.<br>If startIndex is greater than endIndex, those will be swapped |
| *endIndex* | Index of the last character - 1.<br>If not specified, then string::size() will be used instead |

**Returns**

Extracted string by specified index(es)

#### 6.131.2.15 auto between ( const std::string & *str*, const std::string & *start* = " ", const std::string & *end* = " " ) -> std::string `[static]`

Generates a substring.

Extracts a substring consisting of the characters from specified start to end It's same with str.substring( ? = (str.find(start) + start.size()), str.find(end, ?) )
ex) between("ABCD[EFGH]IJK", "[", "]") => "EFGH"

If start is not specified, extracts from begin of the string to end
If end is not specified, extracts from start to end of the string
If start and end are all omitted, returns str, itself.

**Parameters**

| | |
|---|---|
| *str* | Target string to be applied between |
| *start* | A string for separating substring at the front |
| *end* | A string for separating substring at the end |

**Returns**

substring by specified terms

#### 6.131.2.16 auto addTab ( const std::string & *str*, size_t *n* = `1` ) -> std::string `[static]`

Adds tab() character to first position of each line.

**Parameters**

| | |
|---|---|
| *str* | Target str to add tabs |

| | |
|---|---|
| *n* | The size of tab to be added for each line |

**Returns**

A string added multiple tabs

#### 6.131.2.17 auto split ( const std::string & *str,* const std::string & *delim* ) -> std::vector<std::string> [static]

Generates substrings.
Splits a string into an array of substrings by dividing the specified delimiter

**Parameters**

| | |
|---|---|
| *str* | Target string to split |
| *delim* | The pattern that specifies where to split this string |

**Returns**

An array of substrings

#### 6.131.2.18 auto betweens ( const std::string & *str,* const std::string & *start* = " ", const std::string & *end* = " " ) -> std::vector<std::string> [static]

Generates substrings.
Splits a string into an array of substrings dividing by specified delimeters of start and end
It's the array of substrings adjusted the between

If startStr is omitted, it's same with the split by endStr not having last item
If endStr is omitted, it's same with the split by startStr not having first item
If startStr and endStar are all omitted, returns {str}

**Parameters**

| | |
|---|---|
| *str* | Target string to split by between |
| *start* | A string for separating substring at the front<br>If omitted, it's same with split(end) not having last item |
| *end* | A string for separating substring at the end<br>If omitted, it's same with split(start) not having first item |

**Returns**

An array of substrings

#### 6.131.2.19 auto toLowerCase ( const std::string & *str* ) -> std::string [static]

Returns a string that all uppercase characters are converted to lowercase
.

**Parameters**

| | |
|---|---|
| *str* | Target string to convert uppercase to lowercase |

**Returns**

A string converted to lowercase

#### 6.131.2.20 auto toUpperCase ( const std::string & *str* ) -> std::string [static]

Returns a string all lowercase characters are converted to uppercase

**Parameters**

| | |
|---|---|
| *str* | Target string to convert lowercase to uppercase |

**Returns**

A string converted to uppercase

#### 6.131.2.21 static auto replaceAll ( const std::string & *str*, const std::string & *before*, const std::string & *after* ) -> std::string [static]

Returns a string specified word is replaced.

**Parameters**

| | |
|---|---|
| *str* | Target string to replace |
| *before* | Specific word you want to be replaced |
| *after* | Specific word you want to replace |

**Returns**

A string specified word is replaced

#### 6.131.2.22 static auto replaceAll ( const std::string & *str*, const std::vector< std::pair< std::string, std::string >> & *pairs* ) -> std::string [static]

Returns a string specified words are replaced.

**Parameters**

| | |
|---|---|
| *str* | Target string to replace |
| *pairs* | A specific word's pairs you want to replace and to be replaced |

**Returns**

A string specified words are replaced

The documentation for this class was generated from the following files:

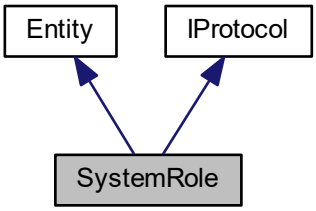
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/StringUtil.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/StringUtil.cpp

## 6.132 SystemRole Class Reference

A role belongs to a system.

`#include <SystemRole.hpp>`

Collaboration diagram for SystemRole:



### Public Member Functions

* SystemRole ()
  *Default Constructor.*
* virtual void construct (std::shared_ptr< library::XML >) override
  *Construct data of the Entity from an XML object.*
* virtual auto key () const -> std::string override
  *Get a key that can identify the Entity uniquely.*
* auto hasListener (const std::string &) const -> bool
  *Test whether has a listener in the role.*
* virtual auto TAG () const -> std::string override
  *A tag name when represented by XML.*
* virtual auto toXML () const -> std::shared_ptr< library::XML > override
  *Get an XML object represents the Entity.*

### Protected Attributes

* std::string name
  *A name representing the role.*
* std::set< std::string > listeners
  *Listeners belongs to the role.*

## 6.132.1 Detailed Description

A role belongs to a system.

SystemRole is an abstract and a 'control' class groupping methods, handling Invoke messages interacting with an system that the SystemRole is belonged to, by a subject or unit of a module.

**Author**

Jeongho Nam

## 6.132.2 Member Function Documentation

### 6.132.2.1 void construct ( std::shared_ptr< library::XML > ) [override],[virtual]

Construct data of the Entity from an XML object.

Overrides the construct() method and fetch data of member variables from the XML.

By recommended guidance, data representing member variables are contained in properties of the put XML object.

**Parameters**

| | |
|---|---|
| *xml* | An xml used to construct data of entity |

Implements Entity.

### 6.132.2.2 auto key ( ) const -> std::string [override],[virtual]

Get a key that can identify the Entity uniquely.

If identifier of the Entity is not atomic value, returns a string represents the composite identifier. If identifier of the Entity is not string, converts the identifier to string and returns the string.

**Returns**

An identifier

Reimplemented from Entity.

### 6.132.2.3 auto TAG ( ) const -> std::string [override],[virtual]

A tag name when represented by XML.

**Returns**

A tag name

Implements Entity.

#### 6.132.2.4 auto toXML ( ) const -> std::shared_ptr<library::XML> [override], [virtual]

Get an XML object represents the Entity.

Returns an XML object that can represents the Entity containing member variables into properties.

A member variable (not object, but atomic value like number, string or date) is categorized as a property within the framework of entity side. Thus, when overriding a toXML() method and archiving member variables to an XML object to return, puts each variable to be a property belongs to only an XML object.

Don't archive the member variable of atomic value to XML::value causing enormouse creation of XML objects to number of member variables. An Entity must be represented by only an XML instance (tag).

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

**Returns**

An XML object representing the Entity.

Reimplemented from Entity.

The documentation for this class was generated from the following files:

* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/SystemRole.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/SystemRole.cpp

## 6.133 Travel Class Reference

Represent a travel containning Point(s)

`#include <Travel.hpp>`

### Public Member Functions

* Travel ()
  *Default Constructor.*
* Travel (const Travel &)
  *Copy Constructor.*
* Travel (Travel &&)
  *Move Constructor.*
* auto operator< (const Travel &) const -> bool
  *Compare which object is less.*
* auto toString () const -> std::string
  *Convert the Travel to String.*

### Private Member Functions

* auto calcDistance () const -> double
  *Calculate distance to move.*

### Private Attributes

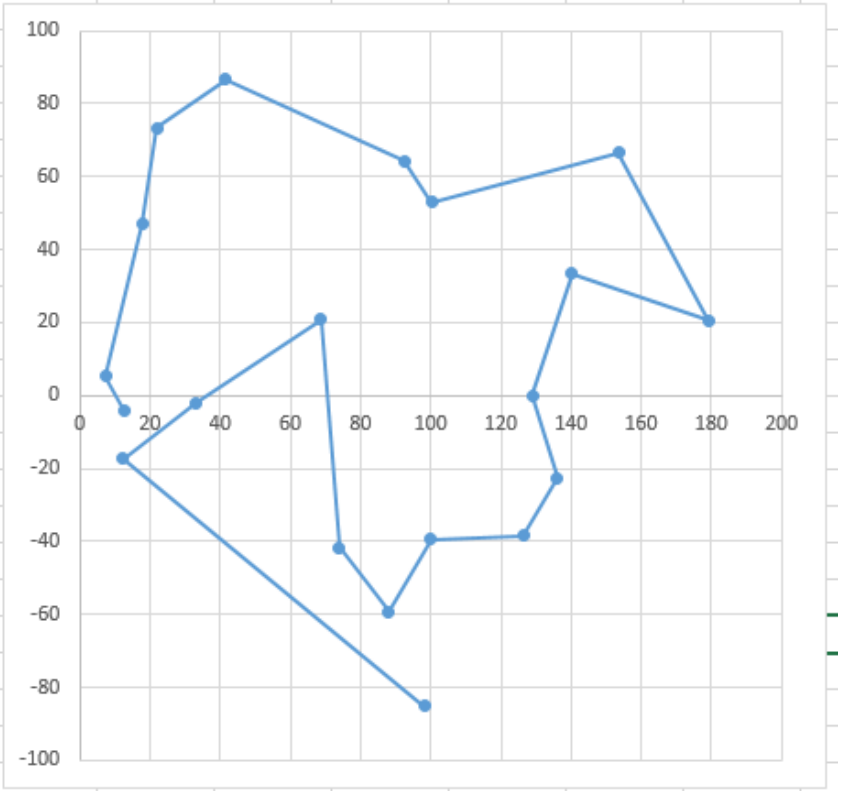
* double distance
  *Estimated hours to move.*

### 6.133.1 Detailed Description

Represent a travel containning Point(s)

Travel class is not only an array containing Point(s) but also a sequence listing of the Point(s).

| Distance: 64,896.70 km | | |
|---|---|---|
| uid | longitude | latitude |
| 18 | 12.5233 | -3.95529 |
| 15 | 7.23275 | 5.18342 |
| 7 | 17.7528 | 46.8665 |
| 2 | 22.0434 | 73.4133 |
| 20 | 41.6615 | 86.5372 |
| 13 | 92.427 | 64.3369 |
| 1 | 100.345 | 53.1067 |
| 9 | 153.521 | 66.5119 |
| 3 | 179.118 | 20.5073 |
| 10 | 140.113 | 33.3537 |
| 17 | 128.885 | 0.054607 |
| 4 | 136.012 | -22.4915 |
| 6 | 126.352 | -38.5031 |
| 16 | 99.9775 | -39.3696 |
| 11 | 87.8859 | -59.3663 |
| 14 | 73.8477 | -41.5867 |
| 5 | 68.6563 | 20.8528 |
| 12 | 33.2162 | -1.92823 |
| 8 | 12.1839 | -17.3552 |
| 19 | 98.0967 | -85.195 |




**Author**

Jeongho Nam

### 6.133.2 Constructor & Destructor Documentation

#### 6.133.2.1 Travel ( const Travel & *travel* )

Copy Constructor.

Travel is an array of Point(s) as gene(s). The copy constructor of Travel doesn't copy member variables which are related to G.A. because the sequence of gene(Point)s can be shuffled by process of evolution of genetic algorithm.

### 6.133.3 Member Function Documentation

#### 6.133.3.1 auto operator< ( const Travel & *travel* ) const -> bool

Compare which object is less.

Compares distances to move. The result is used to optimize and evolve genes by G.A.

**Parameters**

| | |
|---|---|
| *Target* | object to compare |

**Returns**

Whether this object is less than target

#### 6.133.3.2 auto toString ( ) const -> std::string

Convert the Travel to String.

Have of form of tab and enter delimeters for Excel.

```
{$uid1}    {$x}    {$y}
```

```
{$uid2}    {$x}    {$y}
```

```
{$uid3}    {$x}    {$y}
```

...

**Returns**

A string can represent the Travel

### 6.133.4 Member Data Documentation

#### 6.133.4.1 double distance [private]

Estimated hours to move.

A variable for avoiding duplicated calculation

**See also**

calcDistance()

The documentation for this class was generated from the following files:

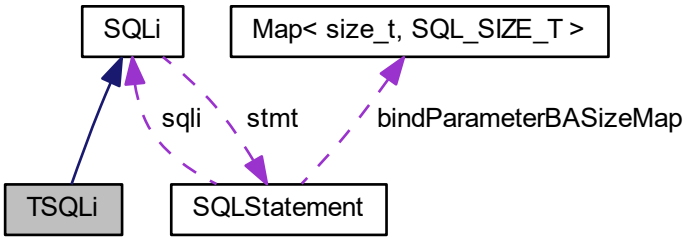
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/tsp/Travel.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/tsp/Travel.cpp

## 6.134 TSQLi Class Reference

A SQL interface for T-SQL.

`#include <TSQLi.hpp>`

Collaboration diagram for TSQLi:




### Public Member Functions

* TSQLi (int port=1433)
  *Construct from port.*
* virtual auto createStatement () -> std::shared_ptr< SQLStatement >
  *Factory method for creating T-SQL statement.*

### Additional Inherited Members

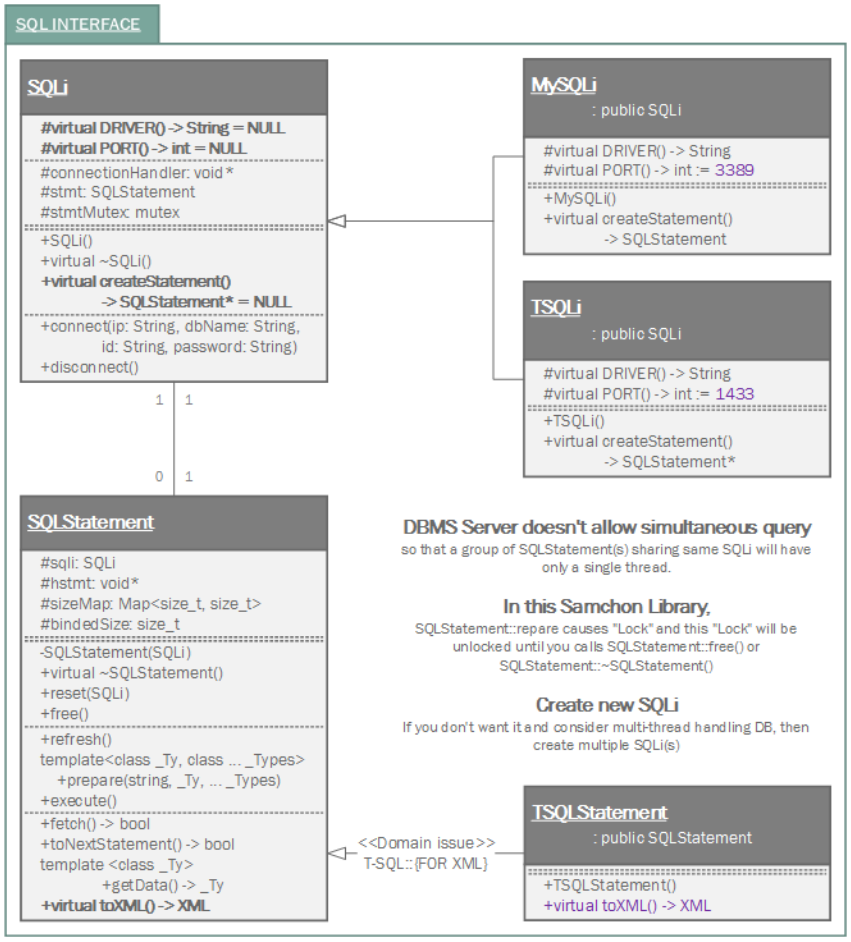
### 6.134.1 Detailed Description

A SQL interface for T-SQL.

**[Inherited]**

SQLi is an abstract class managing connection (session) with a specific database and manages SQL statements are executed and results are returned within the context of a connection.

The reason why SQLStatement(s) are managed by SQLi is because of a principle of DBMS, DBMS system doesn't allow simultaneous query from a session (connection). Only a query (process0) is allowed at a time. If you try to simultaneous query from a SQLi, ODBC throws error. To avoid the error, an execute of query from SQLStatement will lock a mutex of SQLi to ensure exclusiveness.




**Note**

To ensure the exclusiveness, you've to make SQLStatement from SQLi. Do not make SQLStatement by yourself. call SQLi::createSQLStatement() instead. Even you make a derived class from SQLStatement, don't make its constructor to have public accessor.

Becuase execution of a sql statement causes lock on mutex in SQLi, you've to destruct the SQLStatement or call SQLStatement::free() method(). If you don't, the mutex will not be unlocked, thus you can't do anything by the SQLi.

**See also**

samchon::library

**Author**

Jeongho Nam

### 6.134.2 Constructor & Destructor Documentation

#### 6.134.2.1 TSQLi ( int *port* = 1433 )

Construct from port.

**Parameters**

| | |
|---|---|
| *port* | Port number of T-SQL. default is 1433. |

### 6.134.3 Member Function Documentation

#### 6.134.3.1 auto createStatement ( ) -> std::shared_ptr<SQLStatement> [virtual]

Factory method for creating T-SQL statement.

To realize domain function in T-SQL, 'FOR XML' statement.

**[Inherited]**

SQLi::createStatement()

**Returns**

A T-SQL statement

Reimplemented from SQLi.

The documentation for this class was generated from the following files:

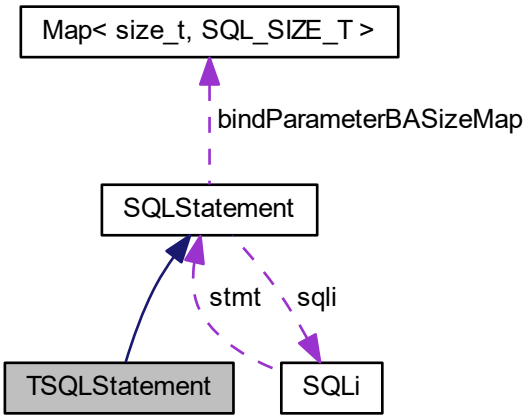
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/TSQLi.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/MSSQLi.cpp

## 6.135 TSQLStatement Class Reference

A t-sql statement.

`#include <TSQLStatement.hpp>`

Collaboration diagram for TSQLStatement:



### Public Member Functions

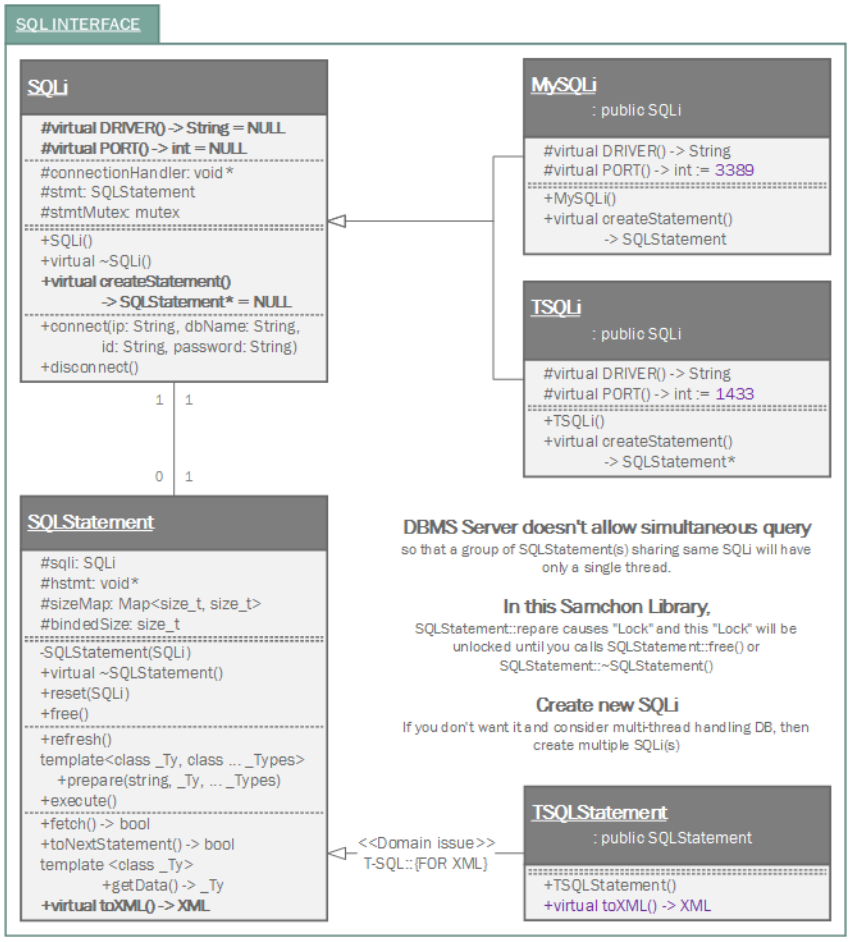
* virtual auto toXML () const -> std::shared_ptr< XML > override
  *Return an XML representing records.*

### Additional Inherited Members

### 6.135.1 Detailed Description

A t-sql statement.
TSQLStatement is a SQLStatement for adjusting domain function f T-SQL, 'FOR XML' statement.
**[Inherited]**

A SQLStatement instance is used to executing a SQL statement and returning the results it produces against a SQL database that is opened through a SQLi instance.
Through the SQLi, it's the reason why a principle of DBMS, DBMS system doesn't allow simultaneous query from a session (connection). Only a query (process) is allowed at a time. If you try to simultaneous query from a SQLi, ODBC throws error. To avoid the error, an execute of query from SQLStatement will lock a mutex of SQLi to ensure exclusiveness.




**Note**

To ensure the exclusiveness, you've to make SQLStatement from SQLi. Do not make SQLStatement by yourself. call SQLi::createSQLStatement() instead. Even you make a derived class from SQLStatement, don't make its constructor to have public accessor.
Becuase execution of a sql statement causes lock on mutex in SQLi, you've to destruct the SQL↩ Statement or call SQLStatement::free() method(). If you don't, the mutex will not be unlocked, thus you can't do anything by the SQLi.

**See also**

samchon::library

**Author**

Jeongho Nam

### 6.135.2 Member Function Documentation

#### 6.135.2.1 auto toXML ( ) const -> std::shared_ptr<XML> [override], [virtual]

Return an XML representing records.

Get an XML object generated from a sql statement containing 'FOR XML'

**Returns**

XML represents records

Reimplemented from SQLStatement.

The documentation for this class was generated from the following files:

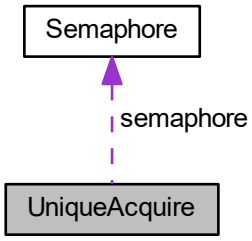
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/TSQLStatement.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/MSSQLStatement.cpp

## 6.136 UniqueAcquire Class Reference

Unique acquire from a Semaphore.

`#include <UniqueAcquire.hpp>`

Collaboration diagram for UniqueAcquire:




### Public Member Functions

* UniqueAcquire (Semaphore &, bool=true)
  *Construct from semaphore.*
* UniqueAcquire (const UniqueAcquire &)=delete
  *Prohibited Copy Constructor.*
* UniqueAcquire (UniqueAcquire &&)
  *Move Constructor.*
* ~UniqueAcquire ()
  *Default Destructor.*
* void acquire ()
  *Acquire admission.*
* void release ()
  *Release an admission.*

### Private Attributes

* Semaphore * semaphore
  *Managed semaphore.*
* bool isLocked
  *Whether the semaphore was acquired by the UniqueLock.*

## 6.136.1 Detailed Description

Unique acquire from a Semaphore.

A UniqueAcquire is an object manages a Semaphore with unique ownership in both states.

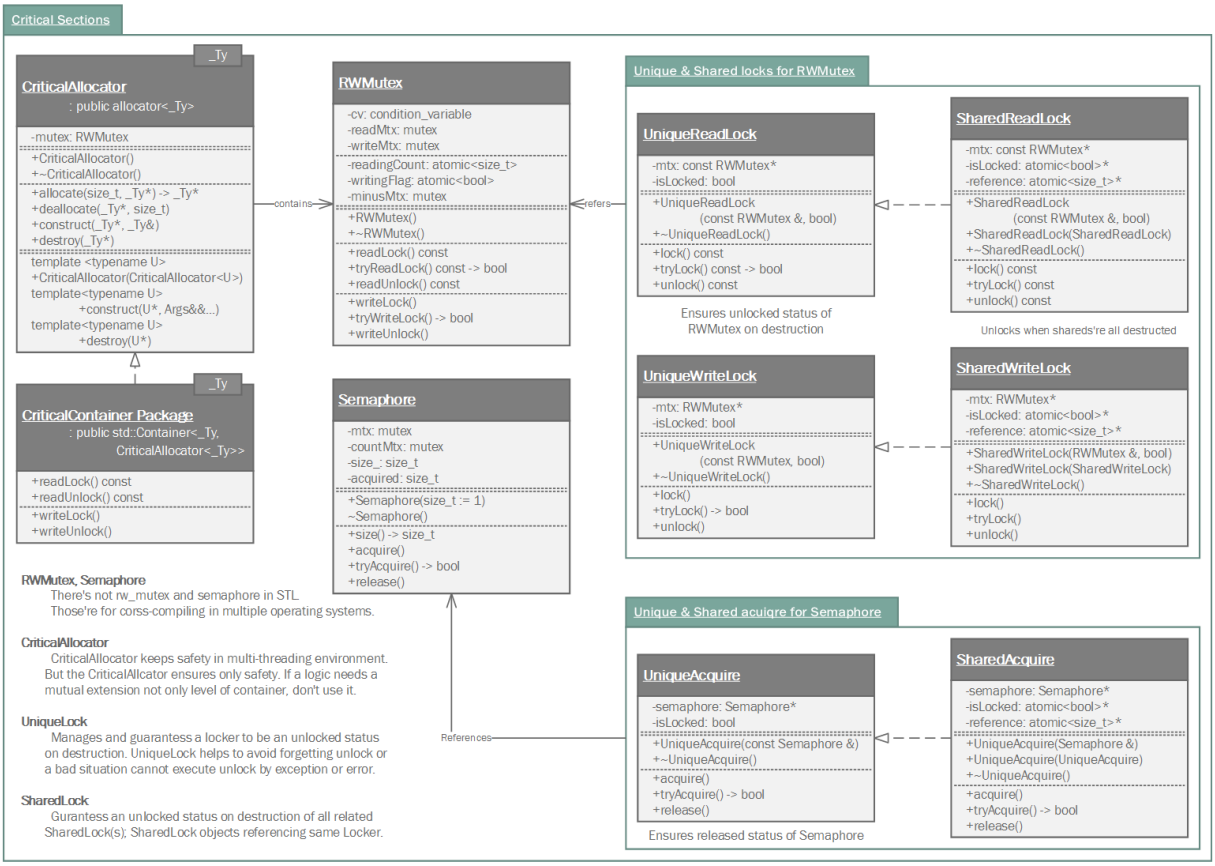
* acquired
* released

On construction (or by move-assigning to it), the object acquires a semaphore object, for whose acquiring and releasing operations becomes responsible.

This class guarantees a released status on destruction (even if not called explicitly). Therefore it is especially useful as an object with automatic duration, as it guarantees the semaphore object is properly released in case an exception is thrown.

Referenced comments of std::unique_lock

* http://www.cplusplus.com/reference/mutex/unique_lock/




### Note

Though, that the UniqueAcquire object does not manage the lifetime of the semaphore object in any way: the duration of the semaphore object shall extend at least until the destruction of the Unique↩ Acquire that manages it.

The UniqueAcquire is movable, but not copyable.

**See also**

samchon::library

**Author**

Jeongho Nam

### 6.136.2 Constructor & Destructor Documentation

#### 6.136.2.1 UniqueAcquire ( Semaphore & *semaphore*, bool *doLock* = `true` )

Construct from semaphore.

**Parameters**

| | |
|---|---|
| *semaphore* | Semaphore to manage |
| *doLock* | Whether to lock directly or not |

#### 6.136.2.2 UniqueAcquire ( const UniqueAcquire & ) `[delete]`

Prohibited Copy Constructor.

UniqueAcquire can't be copied. Use pointer, reference instead.

If what you want is UniqueAcquire(s) references each other and unlock when all related UniqueAcquire objects are destructed, SharedAcquire is the best way.

**Parameters**

| | |
|---|---|
| *obj* | Tried object to copy. |

#### 6.136.2.3 UniqueAcquire ( UniqueAcquire && *obj* )

Move Constructor.

**Parameters**

| | |
|---|---|
| *An* | object to move |

#### 6.136.2.4 ~UniqueAcquire ( )

Default Destructor.

If read lock has done by the UniqueLock, unlock it

### 6.136.3 Member Function Documentation

#### 6.136.3.1 void acquire ( )

Acquire admission.

Acquires an admission and increases count of admission by 1.

If the count is over permitted size, wait until other admissions to be released.

* Lock on mutex

#### 6.136.3.2 void release ( )

Release an admission.

Releases an admission what you've acquired. If the admission count was over the limited size, unlock the mutex.

The documentation for this class was generated from the following files:

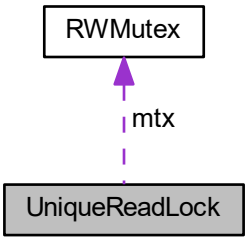
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/UniqueAcquire.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/UniqueAcquire.cpp

## 6.137 UniqueReadLock Class Reference

Unique lock for reading.

`#include <UniqueReadLock.hpp>`

Collaboration diagram for UniqueReadLock:




### Public Member Functions

- UniqueReadLock (const RWMutex &, bool=true)
  *Construct from mutex.*
- UniqueReadLock (const UniqueReadLock &)=delete
  *Prohibited Copy Constructor.*
- UniqueReadLock (UniqueReadLock &&)
  *Move Constructor.*
- ~UniqueReadLock ()
  *Default Destructor.*
- void lock () const
  *Lock on read.*
- void unlock () const
  *Unlock of read.*

### Private Attributes

- const RWMutex * mtx
  *Managed mutex.*
- bool isLocked
  *Whether the mutex was locked by UniqueLock.*

### 6.137.1 Detailed Description

Unique lock for reading.

A UniqueAcquire is an object manages a RWMutex with unique ownership in both states.

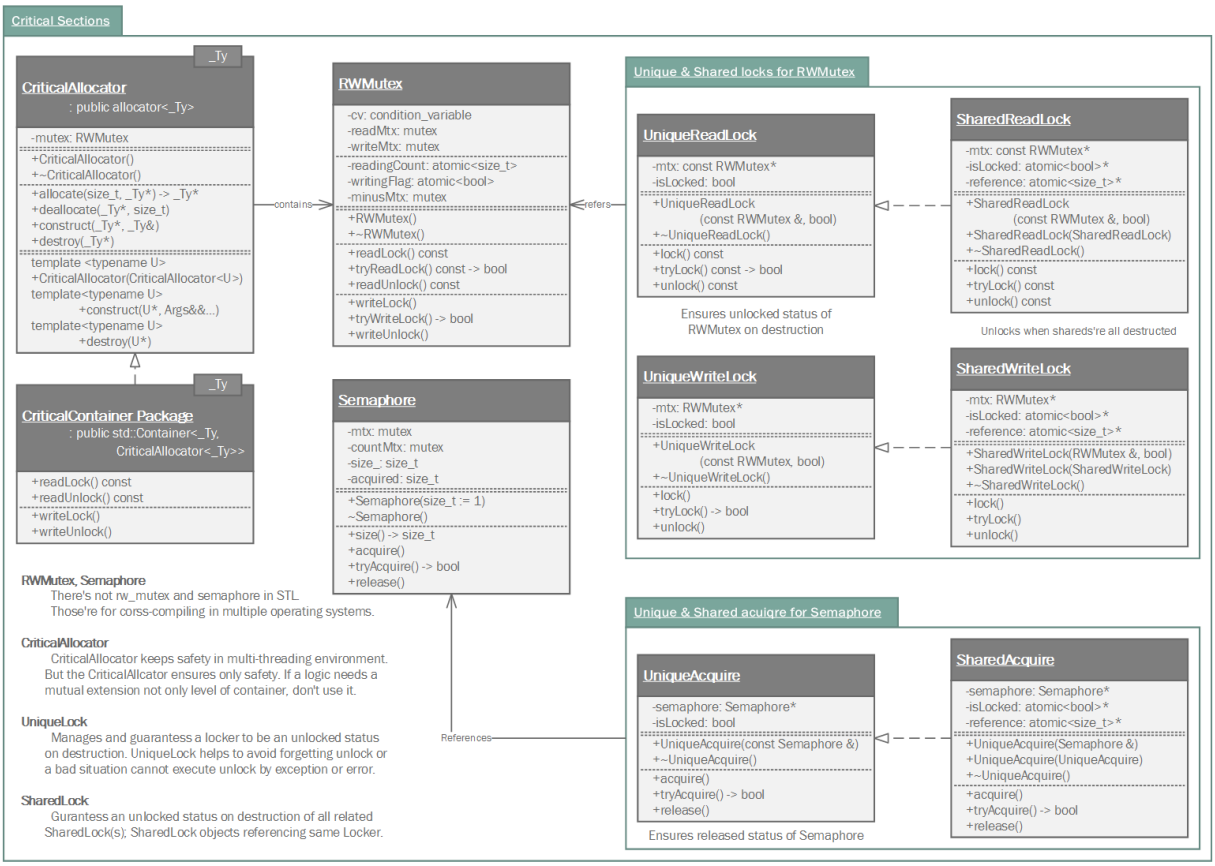
- locked
- unlocked

On construction (or by move-assigning to it), the object locks a RWMutex object on reading side, for whose locking and unlocking operations becomes responsible.

This class guarantees a unlocked status on destruction (even if not called explicitly). Therefore it is especially useful as an object with automatic duration, as it guarantees the RWMutex object is properly unlocked in case an exception is thrown.

Referenced comments of std::unique_lock

- http://www.cplusplus.com/reference/mutex/unique_lock/




**Note**

Though, that the UniqueReadLock object does not manage the lifetime of the RWMutex object in any way: the duration of the RWMutex object shall extend at least until the destruction of the UniqueReadLock that manages it.

**See also**

samchon::library

**Author**

Jeongho Nam

## 6.137.2 Constructor & Destructor Documentation

### 6.137.2.1 UniqueReadLock ( const RWMutex & *mtx*, bool *doLock* = `true` )

Construct from mutex.

**Parameters**

| | |
|---|---|
| *mtx* | Mutex to manage |
| *doLock* | Whether to lock directly or not |

### 6.137.2.2 UniqueReadLock ( const UniqueReadLock & ) `[delete]`

Prohibited Copy Constructor.

UniqueAcquire can't be copied. Use pointer, reference instead.

If what you want is UniqueAcquire(s) references each other and unlock when all related UniqueAcquire objects are destructed, SharedAcquire is the best way.

**Parameters**

| | |
|---|---|
| *obj* | Tried object to copy. |

#### 6.137.2.3 UniqueReadLock ( UniqueReadLock && *obj* )

Move Constructor.

**Parameters**

| | |
|---|---|
| *An* | object to move |

#### 6.137.2.4 ~UniqueReadLock ( )

Default Destructor.

If read lock has done by the UniqueLock, unlock it

### 6.137.3 Member Function Documentation

#### 6.137.3.1 void lock ( ) const

Lock on read.

Increases a reading count.

When write_lock is on a progress, wait until write_unlock to be called.

* Reading can be done by multiple sections.
* Reading can't be done when writing.

**Warning**

You've to call read_unlock when the reading work is terminated.

#### 6.137.3.2 void unlock ( ) const

Unlock of read.

Decreases a reading count.

When write_lock had done after read_lock, it continues by read_unlock if the reading count was 1 (read_unlock makes the count to be zero).

The documentation for this class was generated from the following files:

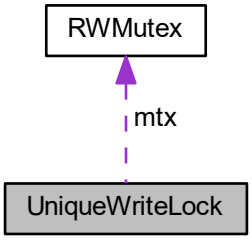
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/UniqueReadLock.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/UniqueReadLock.cpp

## 6.138 UniqueWriteLock Class Reference

Unique lock for writing.

```
#include <UniqueWriteLock.hpp>
```

Collaboration diagram for UniqueWriteLock:




### Public Member Functions

- UniqueWriteLock (RWMutex &, bool=true)
  *Construct from mutex.*
- UniqueWriteLock (const UniqueWriteLock &)=delete
  *Prohibited Copy Constructor.*
- UniqueWriteLock (UniqueWriteLock &&)
  *Move Constructor.*
- ~UniqueWriteLock ()
  *Destructor.*
- void lock ()
  *Lock on writing.*
- void unlock ()
  *Unlock on writing.*

### Private Attributes

- RWMutex * mtx
  *Managed mutex.*
- bool isLocked
  *Whether the mutex was locked by UniqueLock.*

### 6.138.1 Detailed Description

Unique lock for writing.

A UniqueWriteLock is an object manages a RWMutex with unique ownership in both states.

- acquired
- released

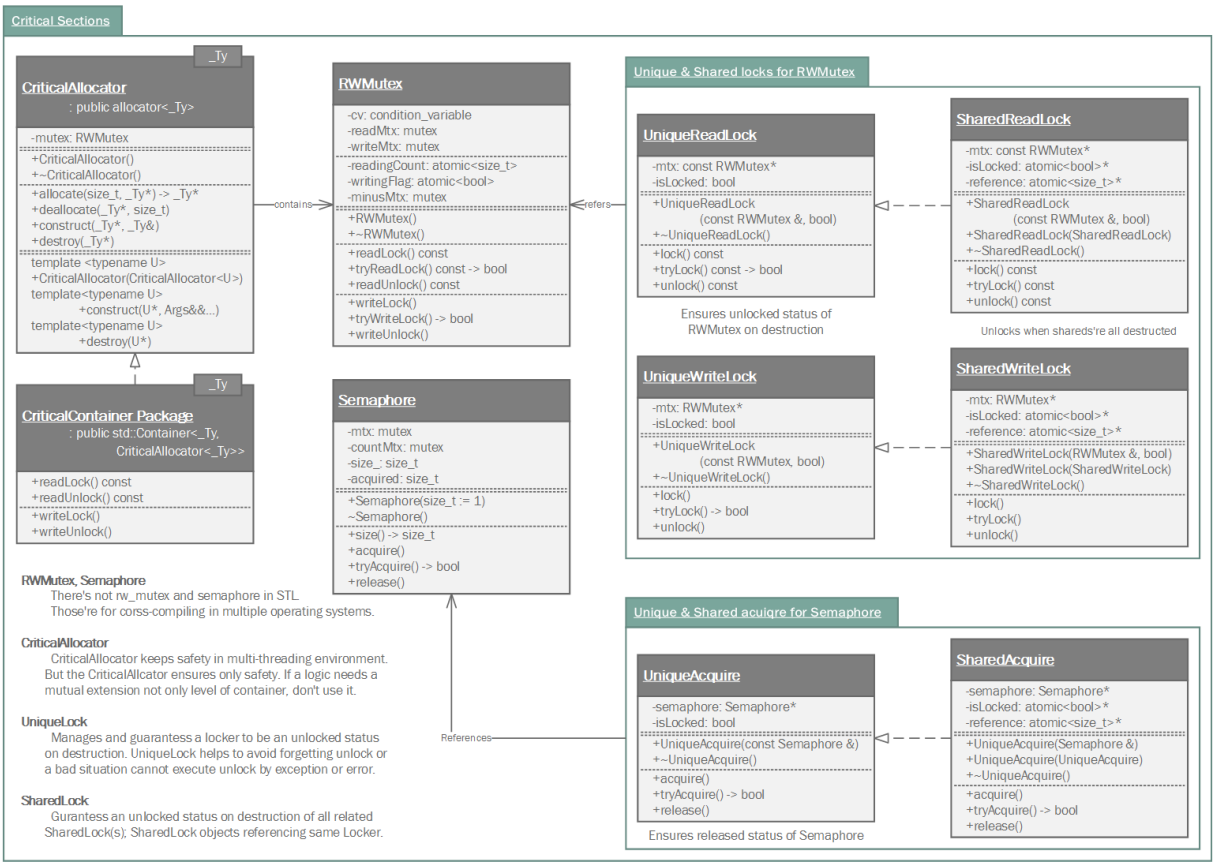
On construction (or by move-assigning to it), the object locks a RWMutex object on writing side, for whose locking and unlocking operations becomes responsible.

The object supports both states: locked and unlocked.

This class guarantees a unlocked status on destruction (even if not called explicitly). Therefore it is especially useful as an object with automatic duration, as it guarantees the RWMutex object is properly unlocked in case an exception is thrown.

Referenced comments of std::unique_lock

- http://www.cplusplus.com/reference/mutex/unique_lock/




**Note**

Though, that the UniqueWriteLock object does not manage the lifetime of the RWMutex object in any way: the duration of the RWMutex object shall extend at least until the destruction of the UniqueWriteLock that manages it.

**See also**

samchon::library

**Author**

Jeongho Nam

## 6.138.2 Constructor & Destructor Documentation

### 6.138.2.1 UniqueWriteLock ( RWMutex & *mtx*, bool *doLock* = `true` )

Construct from mutex.

**Parameters**

| | |
|---|---|
| *mtx* | Mutex to manage |
| *doLock* | Whether to lock directly or not |

### 6.138.2.2 UniqueWriteLock ( const UniqueWriteLock & ) `[delete]`

Prohibited Copy Constructor.

UniqueAcquire can't be copied. Use pointer, reference instead.

If what you want is UniqueAcquire(s) references each other and unlock when all related UniqueAcquire objects are destructed, SharedAcquire is the best way.

**Parameters**

| | |
|---|---|
| *obj* | Tried object to copy. |

#### 6.138.2.3 UniqueWriteLock ( UniqueWriteLock && *obj* )

Move Constructor.

**Parameters**

| | |
|---|---|
| *An* | object to move |

#### 6.138.2.4 ~UniqueWriteLock ( )

Destructor.

If write lock has done by the UniqueLock, unlock it

### 6.138.3 Member Function Documentation

#### 6.138.3.1 void lock ( )

Lock on writing.

Changes writing flag to true.

If another write_lock or read_lock is on a progress, wait until them to be unlocked.

* Writing can be done by only a section at once.
* Writing can't be done when reading.

**Note**

You've to call write_unlock when writing work was terminated.

#### 6.138.3.2 void unlock ( )

Unlock on writing.

The documentation for this class was generated from the following files:

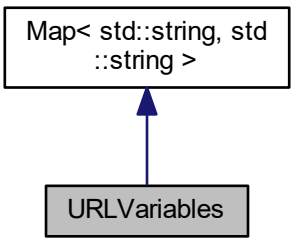
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/UniqueWriteLock.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/UniqueWriteLock.cpp

## 6.139 URLVariables Class Reference

URLVariables class is for representing variables of HTTP.

```
#include <URLVariables.hpp>
```

Collaboration diagram for URLVariables:



### Public Member Functions

- URLVariables ()
  *Default Constructor.*
- URLVariables (const WeakString &flashVars)
  *Constructor by a string representing encoded properties.*
- auto toString () const -> std::string
  *Get the string representing URLVariables.*

### Static Public Member Functions

- static auto encode (const WeakString &) -> std::string
  *Encode a string into a valid URI.*
- static auto decode (const WeakString &) -> std::string
  *Decode a URI string.*

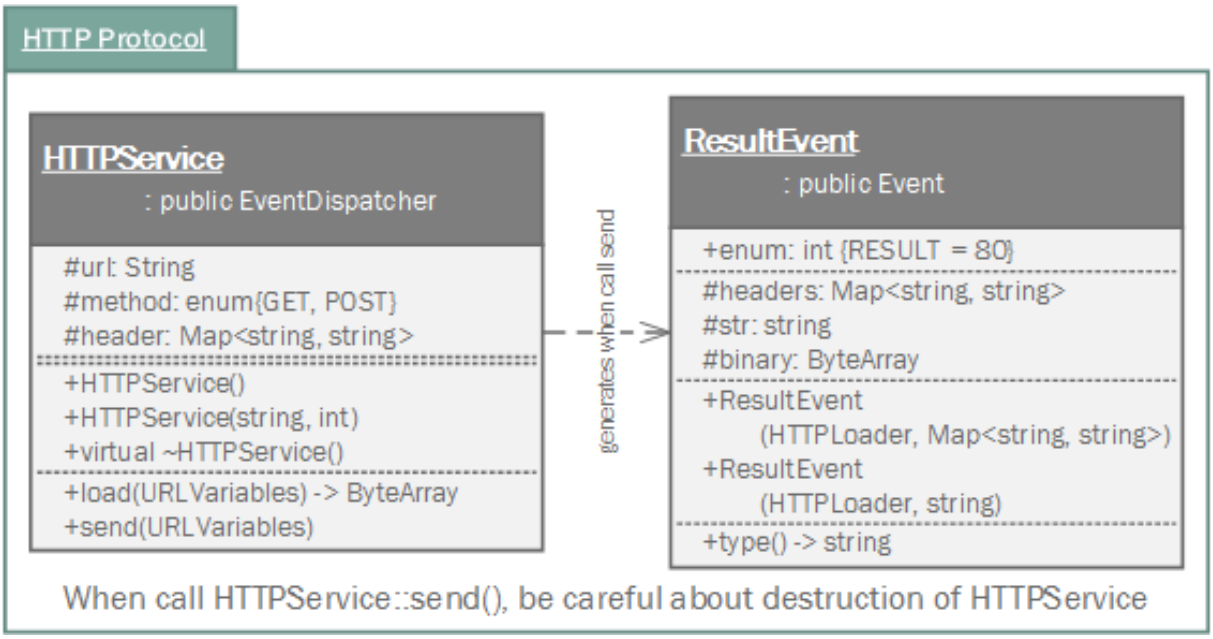
## 6.139.1 Detailed Description

URLVariables class is for representing variables of HTTP.

URLVariables class allows you to transfer variables between an application and server. When transferring, URLVariables will be converted to a URI string.

- URI: Uniform Resource Identifier

Use URLVariabels objects with methods of HTTPLoader class.




**Example code**

**See also**

samchon::library

**Author**

Jeongho Nam

## 6.139.2 Constructor & Destructor Documentation

### 6.139.2.1 URLVariables ( const WeakString & *flashVars* )

Constructor by a string representing encoded properties.

Converts the variable string to properties of the specified URLVariables object.

* URLVariables("id=jhnam88&name=Jeongho+Nam") => {{\"id", "jhnam88"}, {"name", "Jeongho Nam"}}

**Parameters**

| | |
|---|---|
| *A* | uri-encoded string containing pair of properties |

### 6.139.3 Member Function Documentation

#### 6.139.3.1 auto encode ( const WeakString & *wstr* ) -> std::string [static]

Encode a string into a valid URI.

Encodes a string to follow URI standard format.

**Parameters**

| | |
|---|---|
| *A* | string to encode to URI |

**Returns**

A string converted to URI

#### 6.139.3.2 auto decode ( const WeakString & *wstr* ) -> std::string [static]

Decode a URI string.

Decodes a URI string to its original

**Parameters**

| | |
|---|---|
| *A* | string encoded |

**Returns**

A string decoded from URI

#### 6.139.3.3 auto toString ( ) const -> std::string

Get the string representing URLVariables.

Returns a string object representing URLVariables following the URI

* URLVariables({{"id", "jhnam88"}, {"name", "Jeongho Nam"}}).toString() => "id=jhnam88&name=↩ Jeongho+Nam"

**Returns**

A string representing URLVariables following the URI

The documentation for this class was generated from the following files:

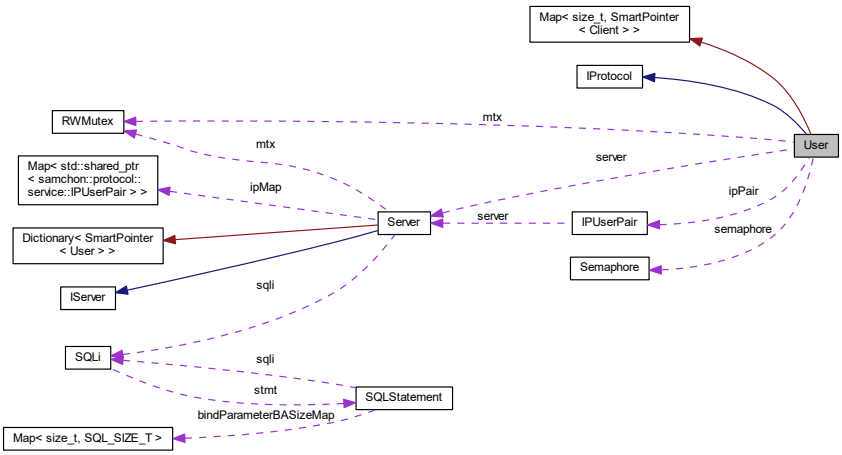
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/URLVariables.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/URLVariables.cpp

## 6.140 User Class Reference

User containing Client(s) with session-id.

```
#include <User.hpp>
```

Collaboration diagram for User:




## Public Member Functions

- User (Server *)
  *Construct from server.*
- auto getServer () const -> Server *
  *Get server.*
- auto getSemaphore () const -> library::Semaphore *
  *Get semaphore.*
- auto getID () const -> std::string
  *Get user's account id.*
- auto getAuthority () const -> int
  *Get authority of user.*
- virtual void sendData (std::shared_ptr< Invoke >) override
  *Send a message.*
- virtual void replyData (std::shared_ptr< Invoke >) override
  *Reply a message.*

## Protected Member Functions

- virtual auto createClient () -> Client *=0
  *Factory method of a Client.*
- virtual auto doLogin (std::shared_ptr< Invoke >) -> bool=0
  *Login and return whether success.*
- virtual auto doJoin (std::shared_ptr< Invoke >) -> bool=0
  *Join and returns whether success.*

## Private Member Functions

- void addClient (Socket *)
  *Add a client in user.*
- void eraseClient (size_t)
  *Erase a Client.*
- void goLogin (std::shared_ptr< Invoke >)
  *Log-in.*
- void goJoin (std::shared_ptr< Invoke >)
  *Join as a member.*
- virtual void goLogout ()
  *Log-out.*

## Private Attributes

- Server * server

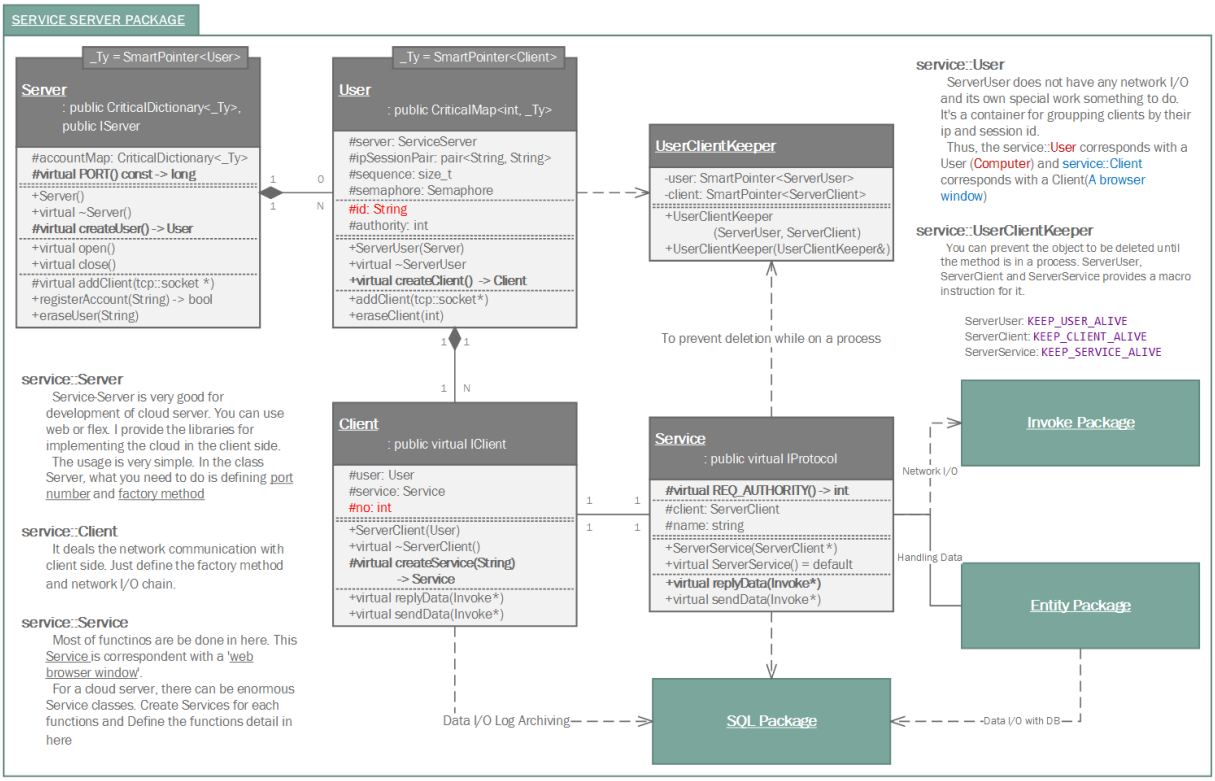
*Server containing the user.*

* std::string sessionID
  *Session ID of the user.*
* library::RWMutex mtx
  *Mutex for container.*
* library::Semaphore * semaphore
  *Semaphore to limit number of thread.*
* std::string id
  *Account id.*
* int authority
  *Authority allocated to user.*

### 6.140.1 Detailed Description

User containing Client(s) with session-id.

The User does not have any network I/O and its own special work something to do. It's a container for groupping clients by their session id. Thus, the User corresponds with an user (Computer) and Client corresponds with a client (A browser window)




Override those methods

* createClient()
* doLogin()
* doJoin()

**Author**

Jeongho Nam

### 6.140.2 Constructor & Destructor Documentation

#### 6.140.2.1 User ( Server * *server* )

Construct from server.

**Parameters**

| | |
|---|---|
| *server* | A server who containing users and clients |
| *sessionID* | A session ID for discriminating User; A logical identifier |

### 6.140.3 Member Function Documentation

#### 6.140.3.1 auto getSemaphore ( ) const -> library::Semaphore*

Get semaphore.

**See also**

User::semaphore

#### 6.140.3.2 auto getAuthority ( ) const -> int

Get authority of user.

**See also**

User::authority

#### 6.140.3.3 void addClient ( Socket * *socket* ) [private]

Add a client in user.

**Parameters**

| | |
|---|---|
| *socket* | Socket for interacting with (physical) client |

#### 6.140.3.4 void eraseClient ( size_t *no* ) [private]

Erase a Client.

Erase a Client from User by its key(no:int).

When a network connection between server and user(person) was disconnected, matched Client is erased from User and the Client object will be destructed.

Some reasons of disconnection

* An user(not object but person using UI) closed the Window
* A "closeWindow" command has sent to the Window
* A network failure has occured

If the Client was the last object remained in the User, the User will be destructed too. However, the User is not destructed directly but waits for 15 seconds. In the 15 seconds, another Client object was created in User, the User doesn't be destructed.

Some reasons of postponing destruction for 15 seconds

* Page direction(href) or redirection in a browser.
* Temporary network failure.

**Note**

There're some tasks that have to completed irrespectively of network connection.

In that case, although user closed the window or logged-out, matched User, Client and Service objects haven't be destructed. They must stay alive until the tasks have completed.

To stay those objects User, Client and Service, use follwing macros. Those macros assure the objects to stay alive until the termination matched each stack.

* KEEP_USER_ALIVE(Client*)
* KEEP_CLIENT_ALIVE
* KEEP_SERVICE_ALIVE

**Parameters**

| | |
|---|---|
| *no* | Sequence number of the client in user |

#### 6.140.3.5 void goLogin ( std::shared_ptr< Invoke > ) [private]

Log-in.

**Parameters**

| | |
|---|---|
| *client* | |
| *invoke* | |

**See also**

User::doLogin()

#### 6.140.3.6 void goJoin ( std::shared_ptr< Invoke > ) [private]

Join as a member.

**Parameters**

| | |
|---|---|
| *client* | An application; who requested the join command |
| *invoke* | AN invoke message containing parameters of joinning |

**See also**

User::doJoin()

#### 6.140.3.7 void goLogout ( ) [private], [virtual]

Log-out.

Log-out account; change id and authority to "guest" and 0.

Default is to send "closeWindow" message to all clients except the applicant.

* Perspective on UI:
  All windows of the user will be closed by getting an invoke message "closeWindow" except who requested the command log-out.
  The applicant window will moved to default log-in page.

**Parameters**

| | |
|---|---|
| *client* | A window of browser; client who requested the log-out command |

#### 6.140.3.8 virtual auto doLogin ( std::shared_ptr< Invoke > ) -> bool [protected], [pure virtual]

Login and return whether success.

**Parameters**

| | |
|---|---|
| *invoke* | Invoke message containing parameters for logging-in |

**Returns**

Whether the log-in is succeded or not

#### 6.140.3.9 virtual auto doJoin ( std::shared_ptr< Invoke > ) -> bool [protected], [pure virtual]

Join and returns whether success.

**Parameters**

| | |
|---|---|
| *invoke* | Invoke message containing paramters for joinning |

**Returns**

Whether the join is succeded or not

#### 6.140.3.10 void sendData ( std::shared_ptr< Invoke > ) [override], [virtual]

Send a message.

Sends Invoke message to a network system or shifts the responsibility to related chain.

**Parameters**

| | |
|---|---|
| *invoke* | An Invoke message to send to a network system |

Reimplemented from IProtocol.

#### 6.140.3.11 void replyData ( std::shared_ptr< Invoke > ) [override], [virtual]

Reply a message.

Handles a replied Invoke message or shifts the responsibility to related chain.

**Parameters**

| | |
|---|---|
| *invoke* | An Invoke message gotten from a network system |

Reimplemented from IProtocol.

### 6.140.4 Member Data Documentation

#### 6.140.4.1 std::string sessionID [private]

Session ID of the user.

**Organization of the Session ID**

* {$name}::{$port}::{$sequence}::{$linux_time}

  1. $name: Name of the Server; Server::NAME()
  2. $port: Port number of the Server; Server::PORT()
  3. $sequence: Sequence number of creation of User in Server
  4. $linux_time: Linux time of current time.

     If the object Server is re-constructed, $sequence can be duplicated. $linux_time is to avoid the duplication so that ensures exclusiveness on session id

#### 6.140.4.2 library::Semaphore* semaphore [private]

Semaphore to limit number of thread.

Semaphore in User is designed to constraint number of thread.

It's recommended to acquire the semaphore when a task from Client or Service occurs a new thread and you want to avoid exhausted allocation of new threads.

**Note**

If a task influences to all clients in a user globally, use lock instead of acquire

#### 6.140.4.3 std::string id [private]

Account id.

Default is "guest"

#### 6.140.4.4 int authority [private]

Authority allocated to user.

The authority means authority(right, power) level allocated to the user.

The default value is zero, which means not logged-in user.

**Note**

Each number of level is not defined clearly. Follwing table is just an example.

| Level | Definition |
|---|---|
| -1 | Banned member<br>The -1 level member is banished by manager or policy |
| 0 | Guest, Not logged in |
| 1 | Unconfired member<br>The member have applied to the join, but the join was not confirmed by manager or policy yet. |
| 2 | Confirmed member<br>The member have joined and have already confirmed by manager or policy |
| 3 | Manager<br>A manager of the application(cloud service).<br>The manager can<br>* Access to the monitoring service. (MonitorService)<br>* Access historical log of members whose level are below Manager.<br>* Banish or modify level of members whose level are below Manager. </u> |
| 4 | Administrator or super Manager<br>Administrator is a Manager of Managers. An administrator can do same thing with Managers, but adminstrator even possible to target Managers as below. |

The documentation for this class was generated from the following files:

* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/service/User.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/service/User.cpp

## 6.141 WeakString Class Reference

A string class only references characeters, reference only.

`#include <WeakString.hpp>`

### Public Member Functions

* WeakString ()
  *Default Constructor does not reference any character.*
* WeakString (const char *data, size_t size)
  *Constructor by characters with specified size.*
* WeakString (const char *begin, const char *end)
  *Constructor by characters of begin and end.*

* WeakString (const char *data)
  *Constructor by characters.*
* WeakString (const char &ch)
  *Constructor by a single character.*
* WeakString (std::initializer_list< char > &il)
  *Constructor by a initializer list.*
* WeakString (const std::string &str)
  *Constructor by string.*
* auto data () const -> const char *
  *Get string data; referenced characeters.*
* auto size () const -> size_t
  *Returns size of the characters which are being referenced.*
* auto empty () const -> bool
  *Tests wheter string is emtpy.*
* auto at (size_t index) const -> const char &
  *Get character of string Returns a const reference to the character at the specified position.*
* auto operator[] (size_t index) const -> const char &
  *Get character of string Returns a const reference to the character at the specified position.*
* auto find (const WeakString &delim, size_t startIndex=NULL) const -> size_t
  *Finds first occurence in string.*
* auto rfind (const WeakString &delim, size_t endIndex=SIZE_MAX) const -> size_t
  *Finds last occurence in string.*
* auto finds (const std::vector< std::string > &delims, size_t startIndex=0) const -> IndexPair< WeakString >
  *Finds first occurence in string.*
* auto rfinds (const std::vector< std::string > &delims, size_t endIndex=SIZE_MAX) const -> IndexPair< WeakString >
  *Finds last occurence in string.*
* auto substr (size_t startIndex, size_t endIndex=SIZE_MAX) const -> WeakString
  *Generates a substring.*
* auto substring (size_t startIndex, size_t size=SIZE_MAX) const -> WeakString
  *Generates a substring.*
* auto between (const WeakString &start={}, const WeakString &end={}) const -> WeakString
  *Generates a substring.*
* auto split (const WeakString &delim) const -> std::vector< WeakString >
  *Generates substrings.*
* auto betweens (const WeakString &start={}, const WeakString &end={}) const -> std::vector< WeakString >
  *Generates substrings.*
* auto trim (const std::vector< std::string > &delims) const -> WeakString
  *Removes all designated characters from the beginning and end of the specified string.*
* auto ltrim (const std::vector< std::string > &delims) const -> WeakString
  *Removes all designated characters from the beginning of the specified string.*
* auto rtrim (const std::vector< std::string > &delims) const -> WeakString
  *Removes all designated characters from the end of the specified string.*
* auto replace (const WeakString &before, const WeakString &after) const -> std::string
  *Replace portion of string once.*
* auto replaceAll (const WeakString &before, const WeakString &after) const -> std::string
  *Returns a string specified word is replaced.*
* auto replaceAll (const std::vector< std::pair< std::string, std::string >> &pairs) const -> std::string
  *Returns a string specified words are replaced.*
* auto toLowerCase () const -> std::string
  *Convert uppercase letters to lowercase.*
* auto toUpperCase () const -> std::string
  *Convert uppercase letters to lowercase.*
* auto str () const -> std::string
  *Get the string content.*

## Static Public Attributes

* static const size_t npos = -1
  *Maximum value for size_t.*

## Private Attributes

* const char * data_
  *Referenced characters's pointer of begining position.*

* size_t size_
  *(Specified) size of referenced characters*

### Static Private Attributes

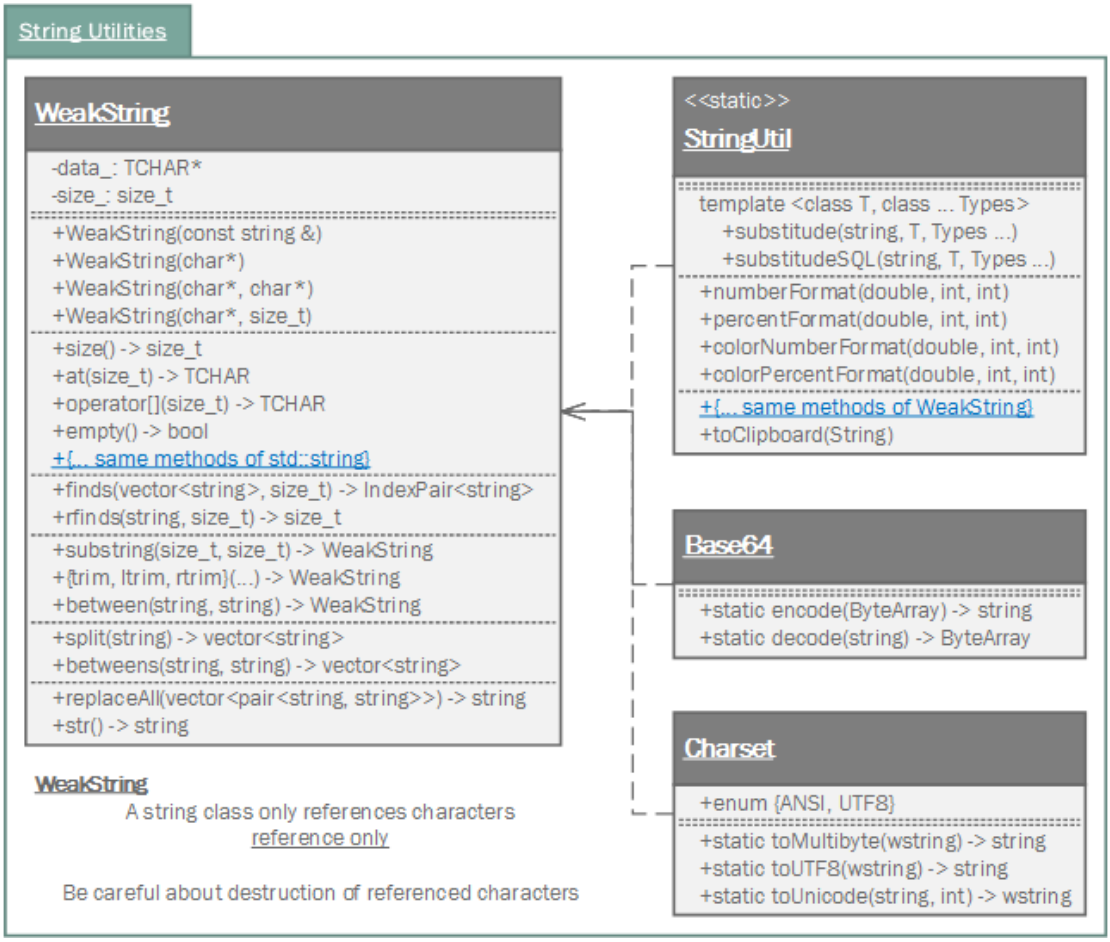
* static const std::vector< std::string > SPACE_ARRAY = { " ", "\t", "\r", "\n" }
  *An array containing whitespaces.*

## 6.141.1 Detailed Description

A string class only references characeters, reference only.

WeakSring does not consider any construction, modification and destruction of characters.

Thus, you can have greater advantages than std::string on the side of performance and memory, but of course, you can't modify the characeters at all.




**Warning**

* WeakString not copy(strcpy) characeters but only references characeters. Be careful about destruction of the characters being referenced by the WeakString
* WeakString will be used for basic data type in most case. Avoid to use WeakString by pre-definition in header (∗.hpp)

**See also**

samchon::library

**Author**

Jeongho Nam

### 6.141.2 Constructor & Destructor Documentation

#### 6.141.2.1 WeakString ( )

Default Constructor does not reference any character.

Constructs an empty string, with zero size

#### 6.141.2.2 WeakString ( const char * *data*, size_t *size* )

Constructor by characters with specified size.

Constructs by characters to be referenced with limited size.

Although the original size of data is over the specified size, you can limit referencing size of the characters

* Referencing a part of characters

**Warning**

WeakString only references. Be careful about destruction of the characters (data)

**Parameters**

| | |
|---|---|
| *data* | Target characters to be referenced by string |
| *size* | |

Specified limit-size of characters to be referenced.

If the specified size is greater than original size, it will be ignored

#### 6.141.2.3 WeakString ( const char * *begin*, const char * *end* )

Constructor by characters of begin and end.

Constructs by characters to be referenced with its end position.

Although the original end point of data is over the specified end, you can limit end point of the characters.

* Referencing a part of characters

**Warning**

WeakString only references. Be careful about destruction of the characters (data).

**Parameters**

| | |
|---|---|
| *begin* | Target characters to be referenced by string |
| *end* | |

Specified end point of characters to be referenced.

If the specified end point is greater than original end point, it will be ignored.

#### 6.141.2.4 WeakString ( const char * *data* )

Constructor by characters.

References the null-terminated character sequence pointed by ptr

**Warning**

WeakString only references. Be careful about destruction of the characeters (data)

**Parameters**

| | |
|---|---|
| *data* | Target characters to be referenced by string |

#### 6.141.2.5 WeakString ( const char & *ch* )

Constructor by a single character.

References a single character

**Warning**

WeakString only references. Be careful about destruction of the characeter (data)

**Parameters**

| | |
|---|---|
| *ch* | Target character to be referenced by string |

#### 6.141.2.6 WeakString ( std::initializer_list< char > & *il* )

Constructor by a initializer list.

References initializer list of character

**Warning**

WeakString only references. Be careful about destruction of the characeters (data)

**Parameters**

| | |
|---|---|
| *il* | Target initializer list of characters to be referenced by string |

#### 6.141.2.7 WeakString ( const std::string & *str* )

Constructor by string.

References whole chracters of the string

**Warning**

WeakString only references. Be careful about destruction of the string

**Parameters**

| | |
|---|---|
| *str* | Target string to be referenced by string |

### 6.141.3 Member Function Documentation

#### 6.141.3.1 auto data ( ) const -> const char*

Get string data; referenced characeters.

Returns a pointer to an array that contains a null-terminated sequence of characters representing the current value of the string object

**Warning**

Returned pointer's size can be longer than string's specified size if the string references only a part of the characters

**Returns**

A pointer of characters being referenced by the string

#### 6.141.3.2 auto size ( ) const -> size_t

Returns size of the characters which are being referenced.

Returns the length of the string, in terms of number of referenced characters

**Returns**

size of characters being referenced by string

#### 6.141.3.3 auto empty ( ) const -> bool

Tests wheter string is emtpy.
Returns wheter characters' size is zero or not.
Of course, string references nothing, then returns false, too.

**Returns**

Wheter size is zero or not

#### 6.141.3.4 auto at ( size_t *index* ) const -> const char&

Get character of string Returns a const reference to the character at the specified position.

**Returns**

const reference of character at the specified index

#### 6.141.3.5 auto operator[ ] ( size_t *index* ) const -> const char&

Get character of string Returns a const reference to the character at the specified position.

**Returns**

const reference of character at the specified index

#### 6.141.3.6 auto find ( const WeakString & *delim*, size_t *startIndex* = NULL ) const -> size_t

Finds first occurence in string.
Finds the string after startIndex and returns the position of first occurence of delim.
If delim is not found, returns -1 (npos)

**Parameters**

| | |
|---|---|
| *delim* | The substring of the string which to find |
| *startIndex* | Specified starting index of find. Default is 0 |

**Returns**

Index of first occurence of the specified substring or -1

#### 6.141.3.7 auto rfind ( const WeakString & *delim*, size_t *endIndex* = SIZE_MAX ) const -> size_t

Finds last occurence in string.
Finds the string before endIndex and returns the position of last occurence of delim. If delim is not found, returns -1 (npos)

**Parameters**

| | |
|---|---|
| *delim* | The substring of the string which to find |
| *endIndex* | Specified last index of find. Default is size() - 1 |

**Returns**

Index of first occurence of the specified substring or -1

#### 6.141.3.8 auto finds ( const std::vector< std::string > & *delims*, size_t *startIndex* = 0 ) const -> IndexPair<WeakString>

Finds first occurence in string.
Finds first occurence position of each delim in the string after startIndex and returns the minimum position of them.

**Note**

* If startIndex is not specified, then starts from 0.
* If failed to find any substring, returns -1 (npos)

**Parameters**

| | |
|---|---|
| *delims* | The substrings of target(str) which to find |
| *startIndex* | Specified starting index of find. Default is 0 |

**Returns**

pair<size_t := position, string := matched substring>

#### 6.141.3.9 auto rfinds ( const std::vector< std::string > & *delims*, size_t *endIndex* = SIZE_MAX ) const -> IndexPair<WeakString>

Finds last occurence in string.

Finds last occurence position of each delim in the string before endIndex and returns the maximum position of them.

**Note**

* If index is not specified, then starts str.size() - 1
* If failed to find any substring, returns -1 (npos)

**Parameters**

| | |
|---|---|
| *delims* | The substrings of target(str) which to find |
| *endIndex* | Specified starting index of find. Default is size() - 1 |

**Returns**

pair<size_t := position, string := matched substring>

#### 6.141.3.10 auto substr ( size_t *startIndex*, size_t *endIndex* = SIZE_MAX ) const -> WeakString

Generates a substring.

Extracts a substring consisting of the characters starts from startIndex and with a size specified size.

**Parameters**

| | |
|---|---|
| *startIndex* | |

Index of the first character.

If startIndex is greater than endIndex, those will be swapped.

**Parameters**

| | |
|---|---|
| *endIndex* | |

Number of characters to include in substring.

If the specified size is greater than last index of characeters, it will be shrinked.

**Returns**

Sub string by specified index and size

#### 6.141.3.11 auto substring ( size_t *startIndex*, size_t *size* = SIZE_MAX ) const -> WeakString

Generates a substring.

Extracts a substring consisting of the character specified by startIndex and all characters up to endIndex - 1.

* If endIndex is not specified, string::size() will be used instead.
* If endIndex is greater than startIndex, then those will be swapped

**Parameters**

| | |
|---|---|
| *startIndex* | |

Index of the first character.

If startIndex is greater than endIndex, those will be swapped.

**Parameters**

| | |
|---|---|
| *size* | |

Index of the last character - 1.

If not specified, then string::size() will be used instead.

**Returns**

Sub string by specified index(es)

#### 6.141.3.12 auto between ( const WeakString & *start* = { }, const WeakString & *end* = { } ) const -> WeakString

Generates a substring.

Extracts a substring consisting of the characters from specified start to end.

It's same with substring( ? = (str.find(start) + start.size()), find(end, ?) )

* between("ABCD[EFGH]IJK", "[", "]") => "EFGH"

**Note**

* If start is not specified, extracts from begin of the string to end
* If end is not specified, extracts from start to end of the string
* If start and end are all omitted, returns str, itself.

**Parameters**

| | |
|---|---|
| *start* | A string for separating substring at the front |
| *end* | A string for separating substring at the end |

**Returns**

substring by specified terms

#### 6.141.3.13 auto split ( const WeakString & *delim* ) const -> std::vector<WeakString>

Generates substrings.

Splits a string in to an array of substrings dividing by the specified delimiter

**Parameters**

| | |
|---|---|
| *delim* | The pattern which specifies where to split the string |

**Returns**

An array of substrings

#### 6.141.3.14 auto betweens ( const WeakString & *start* = { }, const WeakString & *end* = { } ) const -> std::vector<WeakString>

Generates substrings.

Splits a string into an array of substrings dividing by delimeters of start and end.

It's the array of substrings adjusted the between.

**Note**

* If start is omitted, it's same with the split by endStr not having last item
* If end is omitted, it's same with the split by startStr not having first item
* If start and end are all omitted, returns string, itself

**Parameters**

| | |
|---|---|
| *start* | |

A string for separating substring at the front.
If omitted, it's same with split(end) not having last item.

**Parameters**

| | |
|---|---|
| *end* | |

A string for separating substring at the end.
If omitted, it's same with split(start) not having first item.

**Returns**

An array of substrings

#### 6.141.3.15 auto trim ( const std::vector< std::string > & *delims* ) const -> WeakString

Removes all designated characters from the beginning and end of the specified string.

**Parameters**

| | |
|---|---|
| *delims* | Designated character(s) |

**Returns**

Updated string where designated characters was removed from the beginning and end

#### 6.141.3.16 auto ltrim ( const std::vector< std::string > & *delims* ) const -> WeakString

Removes all designated characters from the beginning of the specified string.

**Parameters**

| | |
|---|---|
| *delims* | Designated character(s) |

**Returns**

Updated string where designated characters was removed from the beginning

#### 6.141.3.17 auto rtrim ( const std::vector< std::string > & *delims* ) const -> WeakString

Removes all designated characters from the end of the specified string.

**Parameters**

| | |
|---|---|
| *delims* | Designated character(s) |

**Returns**

Updated string where designated characters was removed from the end

#### 6.141.3.18 auto replace ( const WeakString & *before,* const WeakString & *after* ) const -> std::string

Replace portion of string once.

**Parameters**

| | |
|---|---|
| *before* | A specific word you want to be replaced |
| *after* | A specific word you want to replace |

**Returns**

A string specific word is replaced once

#### 6.141.3.19 auto replaceAll ( const WeakString & *before,* const WeakString & *after* ) const -> std::string

Returns a string specified word is replaced.

**Parameters**

| | |
|---|---|
| *before* | A specific word you want to be replaced |
| *after* | A specific word you want to replace |

**Returns**

A string specified word is replaced

#### 6.141.3.20 auto replaceAll ( const std::vector< std::pair< std::string, std::string >> & *pairs* ) const -> std::string

Returns a string specified words are replaced.

**Parameters**

| | |
|---|---|
| *str* | Target string to replace |
| *pairs* | A specific word's pairs you want to replace and to be replaced |

**Returns**

A string specified words are replaced

#### 6.141.3.21 auto toLowerCase ( ) const -> std::string

Convert uppercase letters to lowercase.

Returns a string that all uppercase characters are converted to lowercase.

**Parameters**

| | |
|---|---|
| *wstr* | Target string to convert uppercase to lowercase |

**Returns**

A string converted to lowercase

#### 6.141.3.22 auto toUpperCase ( ) const -> std::string

Convert uppercase letters to lowercase.

Returns a string all lowercase characters are converted to uppercase.

**Parameters**

| | |
|---|---|
| *str* | Target string to convert lowercase to uppercase |

**Returns**

A string converted to uppercase

#### 6.141.3.23 auto str ( ) const -> std::string

Get the string content.

Returns a string object with a copy of the current contents in the WeakString.

**Returns**

A new string copied from the WeakString

### 6.141.4 Member Data Documentation

#### 6.141.4.1 const size_t npos = -1 [static]

Maximum value for size_t.

npos is a static member constant value with the greatest possible value for an element of type size_t.

This value, when used as the value for a len (or sublen) parameter in string's member functions, means "until the end of the string". As a return value, it is usually used to indicate no matches.

This constant is defined with a value of -1, which because size_t is an unsigned integral type, it is the largest possible representable value for this type.

The documentation for this class was generated from the following files:

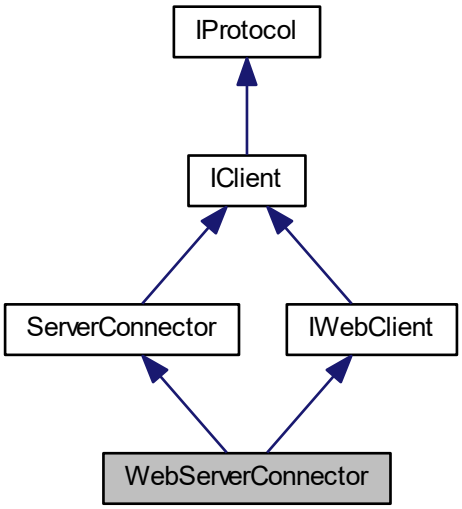
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/WeakString.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/WeakString.cpp

## 6.142 WebServerConnector Class Reference

A web-socket server connector.

`#include <WebServerConnector.hpp>`

Collaboration diagram for WebServerConnector:




### Public Member Functions

* WebServerConnector ()
  *Default Constructor.*
* virtual void connect () override
  *Connect to a server following web-socket protoocol.*

### Additional Inherited Members

### 6.142.1 Detailed Description

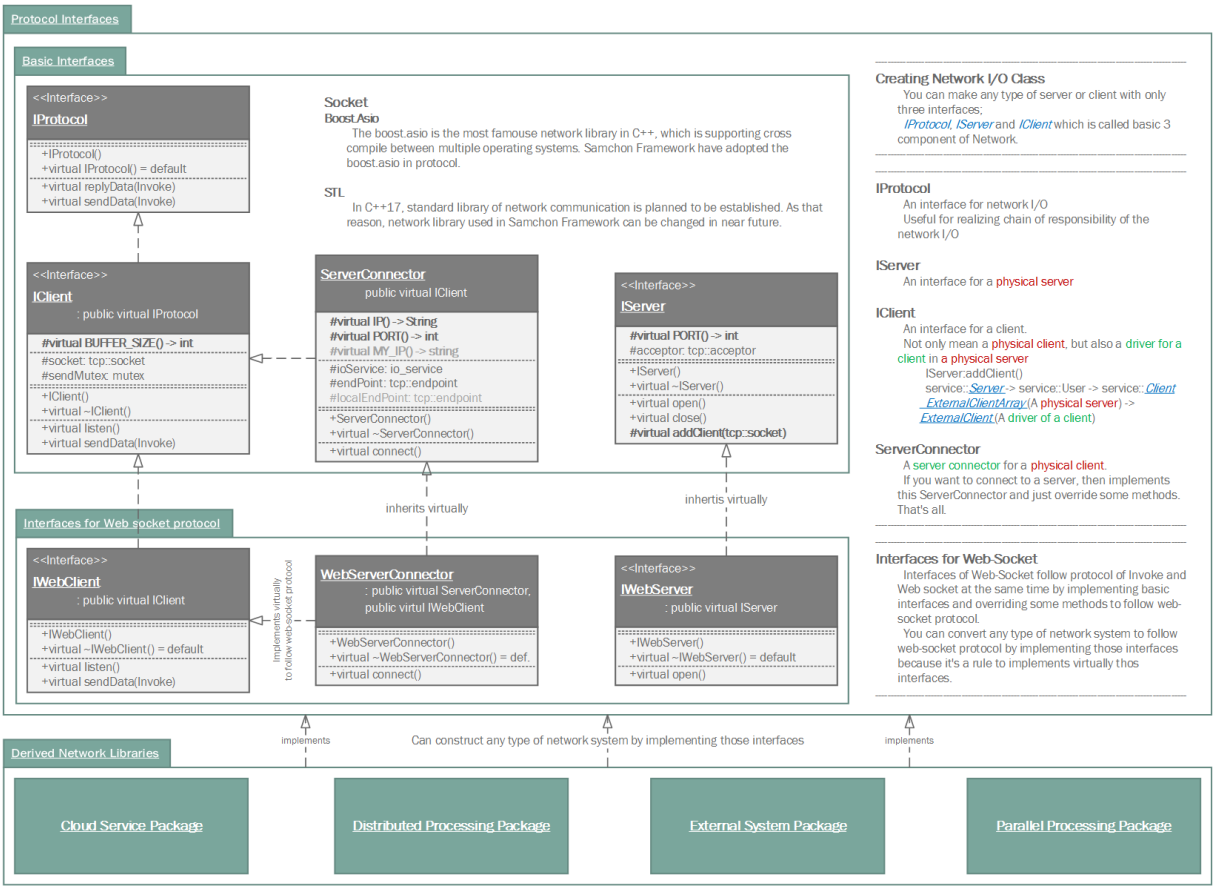
A web-socket server connector.

WebServerConnector is a ServerConnector following web-socket protocol.

**[Inherited]**

ServerConnector is a class for a physical client connecting a server. If you want to connect to a server, then implements this ServerConnector and just override some methods like getIP(), getPort() and replyData(). That's all.

In Samchon Framework, package protocol, There are basic 3 + 1 components that can make any type of network system in Samchon Framework. The basic 3 components are IProtocol, IServer and I↩ Client. The last, surplus one is the ServerConnector. Looking around classes in Samchon Framework, especially module master and slave which are designed for realizing distributed processing systems and parallel processing systems, physical client classes are all derived from this ServerConnector.




**Author**

Jeongho Nam

The documentation for this class was generated from the following file:

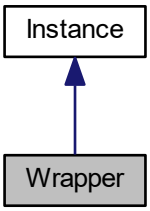
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/protocol/WebServerConnector.hpp

## 6.143 Wrapper Class Reference

A wrapper can contain products.

```
#include <Wrapper.hpp>
```

Collaboration diagram for Wrapper:




### Public Member Functions

* Wrapper (const std::string &name, int price, int volume, int weight)
  *Construct from argument of a wrapper.*
* Wrapper (const Wrapper &wrapper)
  *Copy Constructor.*
* auto tryInsert (Product *) -> bool
  *Try to insert a product into the wrapper.*
* virtual auto toString () const -> std::string override
  *Return a string represent the wrapper.*

### Additional Inherited Members

### 6.143.1 Detailed Description

A wrapper can contain products.

A wrapper containing products with its limitation of weight and volume.

```
D:\OneDrive\Project\Samchon\framework\cpp\x64\Release\packer.exe
$480
Category - Large
        Wrapper Large: $100, 200cm^3, 1000g
                Product Umbrella: $4000, 200cm^3, 1000g
        Wrapper Large: $100, 200cm^3, 1000g
                Product Eraser: $500, 10cm^3, 70g
                Product Pencil: $400, 30cm^3, 35g
                Product Notebook-PC: $800000, 150cm^3, 850g

Category - Medium
        Wrapper Medium: $70, 150cm^3, 500g
                Product Drink: $1000, 75cm^3, 250g
                Product Pencil: $400, 30cm^3, 35g
                Product Pencil: $400, 30cm^3, 35g
        Wrapper Medium: $70, 150cm^3, 500g
                Product Book: $8000, 150cm^3, 300g
        Wrapper Medium: $70, 150cm^3, 500g
                Product Book: $8000, 150cm^3, 300g
        Wrapper Medium: $70, 150cm^3, 500g
                Product Tablet-PC: $600000, 120cm^3, 450g

Category - Small


Press any key to continue . . .
```

**Author**

Jeongho Nam

### 6.143.2 Constructor & Destructor Documentation

#### 6.143.2.1 Wrapper ( const std::string & *name*, int *price*, int *volume*, int *weight* )

Construct from argument of a wrapper.

**Parameters**

| | |
|---|---|
| *name* | Category name of a wrapper, can be identified |
| *price* | Price of a wrapper |
| *volume* | Limited volume of a wrapper can put in. |
| *weight* | Limited weight of a wrapper can put in. |

#### 6.143.2.2 Wrapper ( const Wrapper & *wrapper* )

Copy Constructor.

Copy constructor of wrapper does not copy children items. Only copies arguments of Instance's.

### 6.143.3 Member Function Documentation

#### 6.143.3.1 auto tryInsert ( Product * *product* ) -> bool

Try to insert a product into the wrapper.

If the Wrapper has enough volume and limit of weight, inserts the Product into the Wrapper and returns *true*. If not enough, does not insert and just return *false*.

**Parameters**

| | |
|---|---|
| *product* | A product try to insert in. |

**Returns**

Whether to success put in

#### 6.143.3.2 auto toString ( ) const -> std::string [override], [virtual]

Return a string represent the wrapper.

Returns a string of the Wrapper and Product(s) packaged in.

**Returns**

A string represents the Wrapper and contained Product(s).

Reimplemented from Instance.

The documentation for this class was generated from the following files:

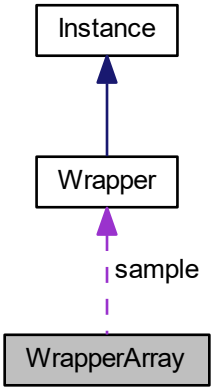
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/packer/Wrapper.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/packer/Wrapper.cpp

## 6.144 WrapperArray Class Reference

An array of wrapper with same category (name).

`#include <WrapperArray.hpp>`

Collaboration diagram for WrapperArray:




### Public Member Functions

* WrapperArray (Wrapper *)
  *Construct from a sample wrapper.*
* auto tryInsert (Product *) -> bool
  *Try to insert a product into reserved list.*
* void optimize ()
  *Optimize to retrieve the best solution.*
* auto calcPrice () const -> int
  *Calculate price of the Wrapper(s)*
* auto toString () const -> std::string
  *Return a string represents Wrapper(s) of same type.*

### Private Attributes

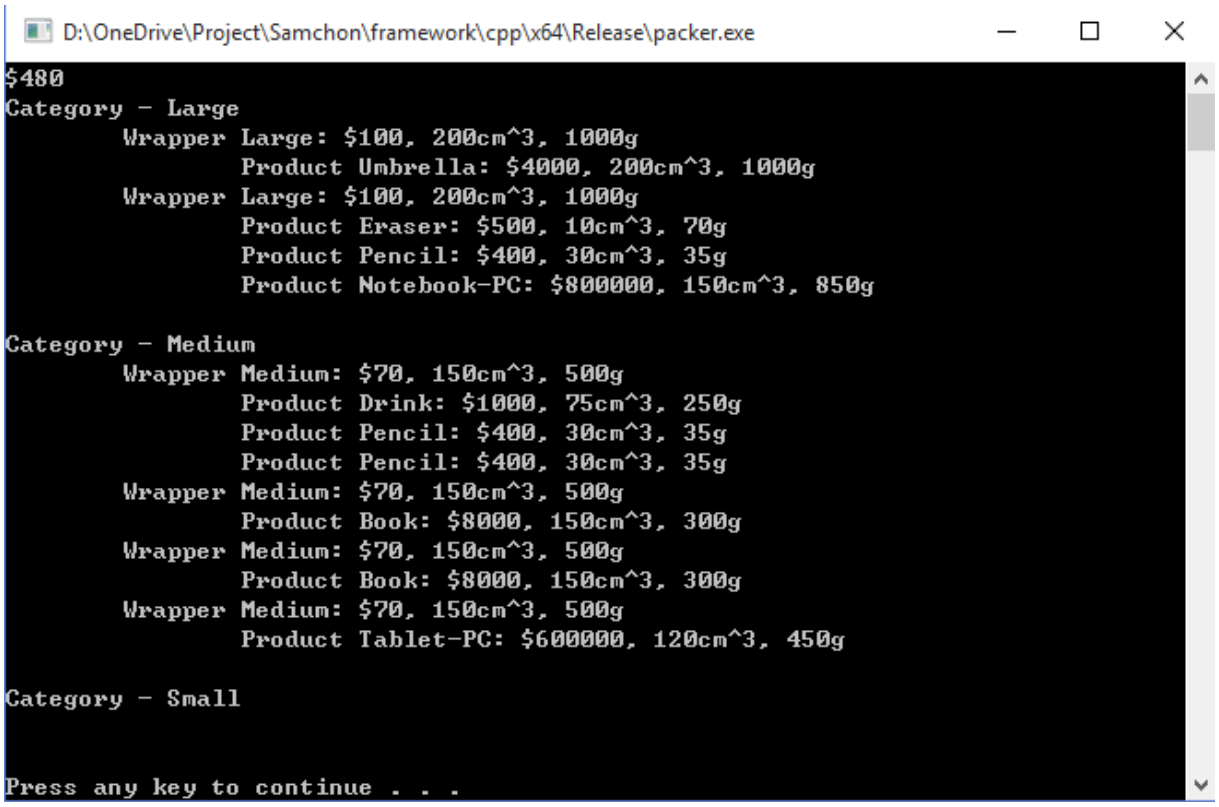
- std::vector< Product * > reserved
  *A list for reserved Product(s).*
- Wrapper * sample
  *A sample wrapper used to copy.*

## 6.144.1 Detailed Description

An array of wrapper with same category (name).

WrapperArray reserves Product(s) and generates enough number of Wrapper(s).

WrapperArray will retrieve the best arrange and packaging method for reserved Product(s).




**Author**

Jeongho Nam

## 6.144.2 Constructor & Destructor Documentation

### 6.144.2.1 WrapperArray ( Wrapper * *sample* )

Construct from a sample wrapper.

**Parameters**

| | |
|---|---|
| *sample* | A sample wrapper used to copy wrappers. |

## 6.144.3 Member Function Documentation

### 6.144.3.1 auto tryInsert ( Product * *product* ) -> bool

Try to insert a product into reserved list.

If the Product's volume and weight is equal or less than the Wrapper categorized so that enable to insert in a Wrapper, reserve the Product and returns *true*. If not, does not reserve and just return *false*.

**Returns**

Whether the Product's volume and weight is equal or less than the Wrapper.

#### 6.144.3.2 void optimize ( )

Optimize to retrieve the best solution.

Retrieve the best solution of packaging in level of WrapperArray.

Shuffles sequence of reserved Product(s) by samchon::library::FactorialGenerator and insert the reserved Products(s) following the sequence creating Wrapper(s) as needed. Between the sequences from FactorialGenerator, retrieve and determine the best solution.

**Note**

Sequence of inserting Product can affeact to numbers of Wrapper(s) to be used.

It's the reason why even WrapperArray has the optimize() method.

**See also**

samchon::library::FactorialGenerator

#### 6.144.3.3 auto calcPrice ( ) const -> int

Calculate price of the Wrapper(s)

Calculate price of all wrapppers'. The price does not contain inserted products'

The documentation for this class was generated from the following files:

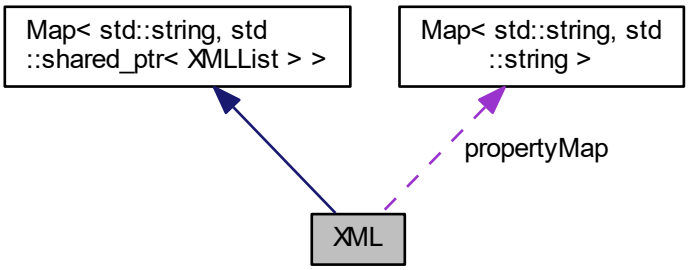
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/packer/WrapperArray.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/examples/packer/WrapperArray.cpp

## 6.145 XML Class Reference

XML is a class representing xml object.

`#include <XML.hpp>`

Collaboration diagram for XML:




### Public Member Functions

* XML ()
  *Default Constructor.*
* XML (const XML &)
  *Copy Constructor.*

* XML (XML &&)
  *Move Constructor.*
* XML (WeakString)
  *Constructor by string.*
* void push_back (const WeakString &)
  *Add children xml objects by string representing them.*
* void push_back (const std::shared_ptr< XML >)
  *Add children xml.*
* void addAllProperty (const std::shared_ptr< XML >)
  *Add all properties from another XML.*
* void setTag (const std::string &)
  *Set tag (identifier) of the XML.*
* template<typename _Ty >
  void setValue (const _Ty &val)
  *Set value of the XML.*
* template<typename _Ty >
  void setProperty (const std::string &name, const _Ty &val)
  *Set a property with its key.*
* void eraseProperty (const std::string &)
  *Erase a property by its key.*
* void clearProperties ()
  *Remove all properties in the XML.*
* auto getTag () const -> std::string
  *Get key; identifer of the XML.*
* template<class _Ty = std::string>
  auto getValue () const -> _Ty
  *Get value of the XML.*
* template<class _Ty = std::string>
  auto getProperty (const std::string &key) const -> _Ty
  *Get property.*
* auto hasProperty (const std::string &) const -> bool
  *Test wheter a property exists or not.*
* auto getPropertyMap () const -> const Map< std::string, std::string > &
  *Get propertyMap.*
* auto toString (size_t level=0) const -> std::string
  *Get the string content.*

### Private Member Functions

* XML (XML *, WeakString &)
  *Protected Constructor by string for child.*

### Private Attributes

* std::string tag
  *Tag name.*
* std::string value
  *Value of the XML.*
* Map< std::string, std::string > propertyMap
  *Properties belongs to the XML.*

### 6.145.1 Detailed Description

XML is a class representing xml object.

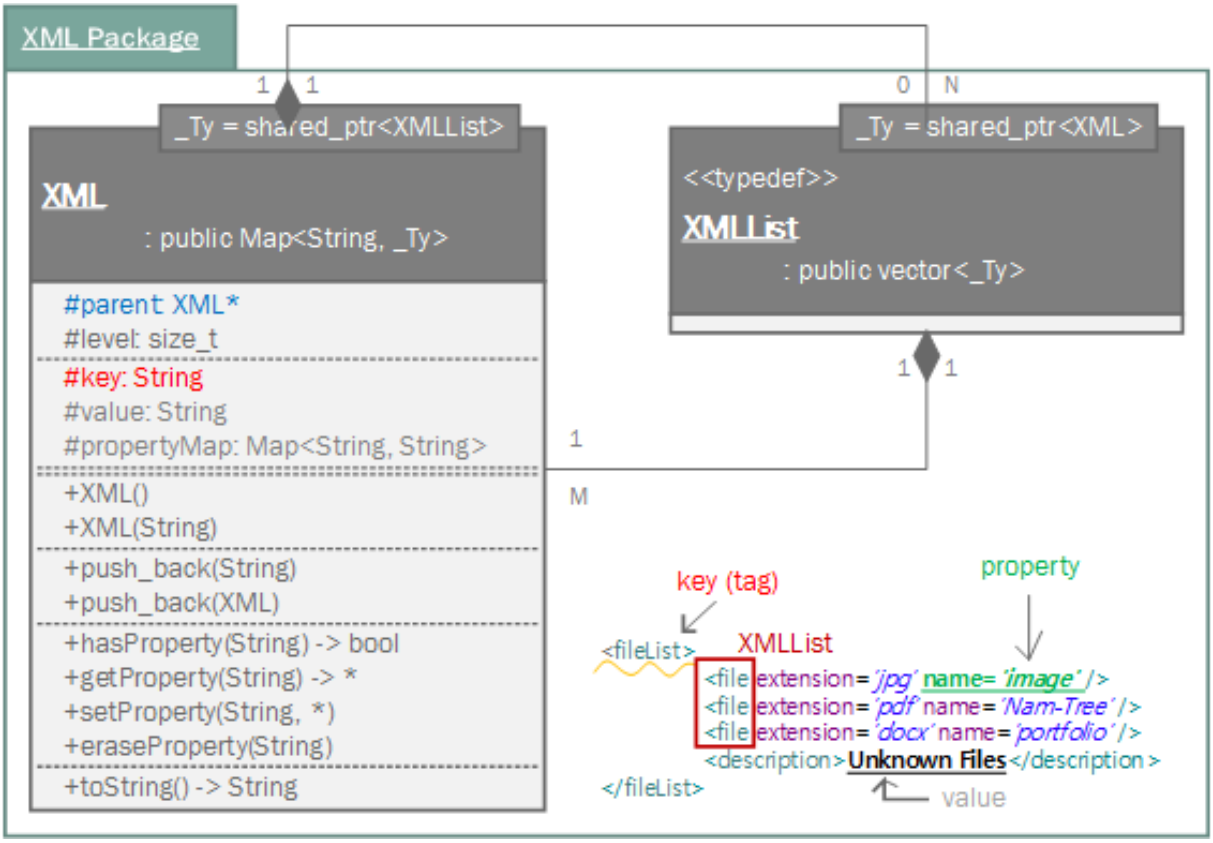
The XML class provides methods and properties for working with XML objects.

The XML class (along with the XMLList and Namespace) implements the powerful XML-handling standard defined in ECMAScript for XML (E4X) specification.

XML class has a recursive, hierarchical relationship.

All XML objects're managed by shared_ptr.

* XML contains XMLList from dictionary of shared pointer<XMLList>
* XMLList contains XML from vector of shared pointer<XML>
* Even if user creates an XML object directly, it's the basic principle to use shared pointer




**Note**

Parsing comment is not supported yet.

It's not recommeded to creating an XML object which is not being managed by shared pointer.

**Warning**

Do not abuse values for expressing member variables.

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88' name='Jeongho+Nam' birthdate='1988-03-11' /><br><member id='master' name='Administartor' birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

```
#include <iostream>
#include <vector>
#include <string>

#include <samchon/library/XML.hpp>

#ifdef _WIN64
#   ifdef _DEBUG
#       pragma comment(lib, "x64/Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "x64/Release/SamchonFramework.lib")
#   endif
#else
#   ifdef _DEBUG
#       pragma comment(lib, "Debug/SamchonFramework.lib")
#   else
#       pragma comment(lib, "Release/SamchonFramework.lib")
#   endif
#endif

```

```
using namespace std;
using namespace samchon::library;

struct Member
{
    string id;
    string name;
    int age;
    int grade;

    auto toXML() const -> shared_ptr<XML>
    {
        shared_ptr<XML> xml(new XML());
        xml->setTag("member");
        xml->setProperty("id", id);
        xml->setProperty("name", name);
        xml->setProperty("age", age);
        xml->setProperty("grade", grade);

        return xml;
    };
};

void main()
{
    //DECLARE An XML WITH MEMBER_ARRAY TAG
    shared_ptr<XML> xml(new XML());
    xml->setTag("memberArray");

    //ADD MEMBER(S) TO XML
    vector<struct Member> memberArray =
    {
        {"samchon", "Jeongho Nam", 27, 1},
        {"gkyu", "Kwangkyu Ko", 25, 1},
        {"guest", "John Doe", 99, 4}
    };
    for(size_t i = 0; i < memberArray.size(); i++)
        xml->push_back( memberArray[i].toXML() );

    //ADD FILE_LIST BY STRING DIRECTLY
    xml->push_back
    (
        string("") +
        "<fileList>\n" +
            "<file extension='pdf' name='API' />" +
            "<file extension='pdf' name='Guidance+For+Developer'>Damaged</file>" +
            "<file extension='docx' name='Resume' />" +
            "<file extension='jpg' name='My+House' />" +
            "<file extension='xlsx' name='Grades' />" +
        "</fileList>"
    );

    cout << "-----------------------------------------------------------------" << endl;
    cout << " Get Properties And Values" << endl;
    cout << "-----------------------------------------------------------------" << endl;
    cout << "Age of 2nd member: " << xml->get("member")->at(1)->getProperty<int>("age") << endl;
    cout << "Age of 1st member: " << xml->get("member")->at(0)->getProperty("id") << endl << endl;

    cout << "File name and extension of 5th: "
        << xml->get("fileList")->at(0)->get("file")->at(4)->getProperty("name") << "."
        << xml->get("fileList")->at(0)->get("file")->at(4)->getProperty("extension") << endl;
    cout << "Value of 2nd file: " << xml->get("fileList")->at(0)->get("file")->at(1)->getValue() << endl << endl;

    cout << "-----------------------------------------------------------------" << endl;
    cout << " XML to String: " << endl;
    cout << "-----------------------------------------------------------------" << endl;
    cout << xml->toString() << endl;

    system("pause");
}
```

**See also**

samchon::library

**Author**

Jeongho Nam

### 6.145.2 Constructor & Destructor Documentation

#### 6.145.2.1 XML ( )

Default Constructor.

**Warning**

Declare XML to managed by shared pointer

#### 6.145.2.2 XML ( const XML & *xml* )

Copy Constructor.
Not copying (shared) pointer of children xml objects, but copying the real objects of children xml

#### 6.145.2.3 XML ( WeakString *wStr* )

Constructor by string.
Parses a string so that constructs an XML object
**Parameters**

| | |
|---|---|
| *str* | A string representing xml object |

**Warning**

Declare XML to managed by shared pointer

#### 6.145.2.4 XML ( XML * *parent*, WeakString & *str* ) [private]

Protected Constructor by string for child.
Parses a string so that creates an XML object It is called for creating children XML objects from parent XML object.
**Parameters**

| | |
|---|---|
| *parent* | Parent object who will contains this XML object |
| *str* | A string to be parsed |

### 6.145.3 Member Function Documentation

#### 6.145.3.1 void push_back ( const WeakString & *str* )

Add children xml objects by string representing them.
**Parameters**

| | |
|---|---|
| *str* | A string representing xml objects whould be belonged to this XML |

#### 6.145.3.2 void push_back ( const std::shared_ptr< XML > )

Add children xml.
**Parameters**

| | |
|---|---|
| *xml* | An xml object you want to add |

#### 6.145.3.3 void addAllProperty ( const std::shared_ptr< XML > )

Add all properties from another XML.
**Copies all properties from target to here.**

**Warning**

Not a category of assign, but an insert.

**Parameters**

| | |
|---|---|
| *xml* | Target xml object to deliver its properties |

#### 6.145.3.4 void setTag ( const std::string & *tag* )

Set tag (identifier) of the XML.

**See also**

XML::tag

#### 6.145.3.5 void setValue ( const _Ty & *val* ) [inline]

Set value of the XML.

**Template Parameters**

| | |
|---|---|
| *_Ty* | Type of the value |

**Parameters**

| | |
|---|---|
| *val* | The value to set |

**Warning**

Do not abuse values for expressing member variables

| Standard Usage | Non-standard usage abusing value |
|---|---|
| <memberList><br><member id='jhnam88'<br>name='Jeongho+Nam'<br>birthdate='1988-03-11' /><br><member id='master' name='Administartor'<br>birthdate='2011-07-28' /><br></memberList> | <member><br><id>jhnam88</id><br><name>Jeongho+Nam</name><br><birthdate>1988-03-11</birthdate><br></member> |

#### 6.145.3.6 void eraseProperty ( const std::string & *tag* )

Erase a property by its key.

**Parameters**

| | |
|---|---|
| *key* | The key of the property to erase |

**Exceptions**

| | |
|---|---|
| *exception* | Unable to find the element |

#### 6.145.3.7 auto getTag ( ) const -> std::string

Get key; identifer of the XML.

**Returns**

tag, identifer of the XML

**See also**

XML::tag

#### 6.145.3.8 auto toString ( size_t *level* = 0 ) const -> std::string

Get the string content.

Returns a string representation of the XML and its all children

**Returns**

A string representing the xml

### 6.145.4 Member Data Documentation

#### 6.145.4.1 std::string tag [private]

Tag name.

* <**tag** label='property' />: tag => "tag"
* <**price** high='1500' low='1300' open='1450' close='1320' />: tag => "price"

#### 6.145.4.2 std::string value [private]

Value of the XML.

* <parameter name='age' type='int'>**26**</parameter>: value => 26
* <price high='1500' low='1300' open='1450' close='1320' />: tag => null

#### 6.145.4.3 Map<std::string, std::string> propertyMap [private]

Properties belongs to the XML.

A Dictionary of properties accessing each property by its key.

* <price **high='1500' low='1300' open='1450' close='1320'** />: propertyMap => {{"high": 1500}, {"low": 1300}, {"open": 1450}, {"close", 1320}}
* <member **id='jhnam88' name='Jeongho+Nam' comment='Hello.+My+name+is+Jeongho+Nam'** >: propertyMap => {{"id", "jhnam88"}, {"name", "Jeongho Nam"}, {"comment", "Hello. My name is Jeongho Nam"}}

The documentation for this class was generated from the following files:

* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/XML.hpp
* D:/OneDrive/Project/Samchon/framework/cpp/samchon/library/XML.cpp

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