Mobile Network Simulator

Generated by Doxygen 1.8.15

Chapter 1

Namespace Index

1.1 Namespace List

Here is a list of all namespaces with brief descriptions:

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 3

Class Index

3.1 Class List

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

Chapter 4

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Chapter 5

Namespace Documentation

5.1 utils Namespace Reference

Functions

- vector$<$ Point $*$ $>$ generatePoints (const Map $*$m, unsigned long n, double percentHome, unsigned seed)
- vector$<$ Point $*$ $>$ generateFixedPoints (const Map $*$m, unsigned long n, unsigned seed)
- void printPersonHeader ()
- void printAntennaHeader ()
- void printPhoneHeader ()
- void printMobileOperatorHeader ()
- double r2d (double x)
- double d2r (double x)
- XMLNode $*$ getNode (XMLElement $*$el, const char $*$name)
- XMLElement $*$ getFirstChildElement (XMLElement $*$el, const char $*$name) noexcept(false)
- double getValue (XMLElement $*$el, const char $*$name, double default_value)
- int getValue (XMLElement $*$el, const char $*$name, int default_value)
- unsigned long getValue (XMLElement $*$el, const char $*$name, unsigned long default_value)
- const char $*$ getValue (XMLElement $*$el, const char $*$name, const char $*$default_value)
- double getValue (XMLElement $*$el, const char $*$name)

Variables

- const double PI = std::atan(1.0) $*$ 4

5.1.1 Detailed Description

This namespace contains utility functions that don't belong to any class.

5.1.2 Function Documentation

5.1.2.1 d2r()

```
double utils::d2r (
              double x )  [inline]
```

Transforms a number from degrees to radians.

Parameters

x	the angle to be transformed from degrees to radians.

Returns

the value of x in radians.

5.1.2.2 generateFixedPoints()

```
vector<Point*> utils::generateFixedPoints (
            const Map * m,
            unsigned long n,
            unsigned seed )
```

Generates n random points on a map. The points have the same locations in all simulations.

Parameters

m	a pointer to a Map object where the points have to be located.
n	the number of points to generate.
seed	the seed of the random number generator used to generate the points.

Returns

a vector of pointers to Point objects.

5.1.2.3 generatePoints()

```
vector<Point*> utils::generatePoints (
            const Map * m,
            unsigned long n,
            double percentHome,
            unsigned seed )
```

Generates n random points on a map.

Parameters

m	a pointer to a Map object where the points have to be located.
n	the number of points to generate.
seed	the seed of the random number generator used to generate the points.
percentHome	a percent of the total number of points considered to be "home locations", i.e. each time they have the same values. The rest of the points differ from a simulation to another.

Returns

a vector of pointers to Point objects.

5.1.2.4 getFirstChildElement()

```
XMLElement* utils::getFirstChildElement (
             XMLElement * el,
             const char * name )  [noexcept]
```

Returns a pointer to an XMLElement which is the first child of another XMLElement. This function is used to parse the content of the configuration files.

Parameters

el	a pointer to the parent XMLElement.
name	the name of the child XMLElement.

Returns

a pointer to an XMLElement which is the first child of another XMLElement.

5.1.2.5 getNode()

```
XMLNode* utils::getNode (
             XMLElement * el,
             const char * name )
```

Returns a pointer to an XMLNode with a specific name that belongs to an XMLElement. This function is used to parse the content of the configuration files.

Parameters

el	a pointer to the the XMLElement where to search the XMLNode.
name	the name of the node.

Returns

a pointer to an XMLNode with a specific name that belongs to an XMLElement.

5.1.2.6 getValue() [1/5]

```
double utils::getValue (
             XMLElement * el,
             const char * name,
             double default_value )
```

Returns a double value obtained by converting the text in an XMLNode to a double. In case the node does not exists, this function returns a default value passed as a parameter.

Parameters

el	a pointer to the XMLElement where the XMLNode is located.
name	the name of the XMLNode.
default_value	is the value returned in case the function doesn'f find any XMLNode with the specified name under the XMLElement.

Returns

a double value obtained by converting the text in an XMLNode to a double.

5.1.2.7 getValue() [2/5]

```
int utils::getValue (
            XMLElement * el,
            const char * name,
            int default_value )
```

Returns an int value obtained by converting the text in an XMLNode to an int. In case the node does not exists, this function returns a default value passed as a parameter.

Parameters

el	a pointer to the XMLElement where the XMLNode is located.
name	the name of the XMLNode.
default_value	is the value returned in case the function doesn'f find any XMLNode with the specified name under the XMLElement.

Returns

an int value obtained by converting the text in an XMLNode to an int.

5.1.2.8 getValue() [3/5]

```
unsigned long utils::getValue (
            XMLElement * el,
            const char * name,
            unsigned long default_value )
```

Returns an unsigned long value obtained by converting the text in an XMLNode to an unsigned long. In case the node does not exists, this function returns a default value passed as a parameter.

Parameters

el	a pointer to the XMLElement where the XMLNode is located.
name	the name of the XMLNode.
default_value	is the value returned in case the function doesn'f find any XMLNode with the specified name under the XMLElement.

Returns

an unsigned long value obtained by converting the text in an XMLNode to an unsigned long.

5.1.2.9 getValue() [4/5]

```
const char* utils::getValue (
            XMLElement * el,
            const char * name,
            const char * default_value )
```

Returns a string (const char*) value obtained by converting the text in an XMLNode to a const char* pointer. In case the node does not exists, this function returns a default value passed as a parameter.

Parameters

el	a pointer to the XMLElement where the XMLNode is located.
name	the name of the XMLNode.
default_value	is the value returned in case the function doesn'f find any XMLNode with the specified name under the XMLElement.

Returns

a const char* value obtained by converting the text in an XMLNode to a const char*.

5.1.2.10 getValue() [5/5]

```
double utils::getValue (
            XMLElement * el,
            const char * name )
```

Returns a double value obtained by converting the text in an XMLNode to a double. In case the node does not exist this method throws an exection.

Parameters

el	a pointer to the XMLElement where the XMLNode is located.
name	the name of the XMLNode.

Returns

a double value obtained by converting the text in an XMLNode to a double

5.1.2.11 printAntennaHeader()

```
void utils::printAntennaHeader ( )
```

Prints out a header containing the names of the member variables from the Antenna class in a human readable format It is used together with Antenna::toString() to output the antennas set on console

5.1.2.12 printMobileOperatorHeader()

```
void utils::printMobileOperatorHeader ( )
```

Prints out a header containing the names of the member variables from the MobileOperator class in a human readable format It is used together with MobileOperator::toString() to output the mobile network operators set on console

5.1.2.13 printPersonHeader()

```
void utils::printPersonHeader ( )
```

Prints out a header containing the names of the member variables from the Person class in a human readable format. It is used together with Person::toString() to output the Persons set on console

5.1.2.14 printPhoneHeader()

```
void utils::printPhoneHeader ( )
```

Prints out a header containing the names of the member variables from the MobilePhone class in a human readable format It is used together with MobilePhone::toString() to output the mobile phones set on console

5.1.2.15 r2d()

```
double utils::r2d (
             double x )  [inline]
```

Transforms a number from radians to degrees.

Parameters

x	the angle to be transformed from radians to degrees.

Returns

the value of x in degrees.

5.1.3 Variable Documentation

5.1.3.1 PI

```
const double utils::PI = std::atan(1.0) * 4
```

Number PI.

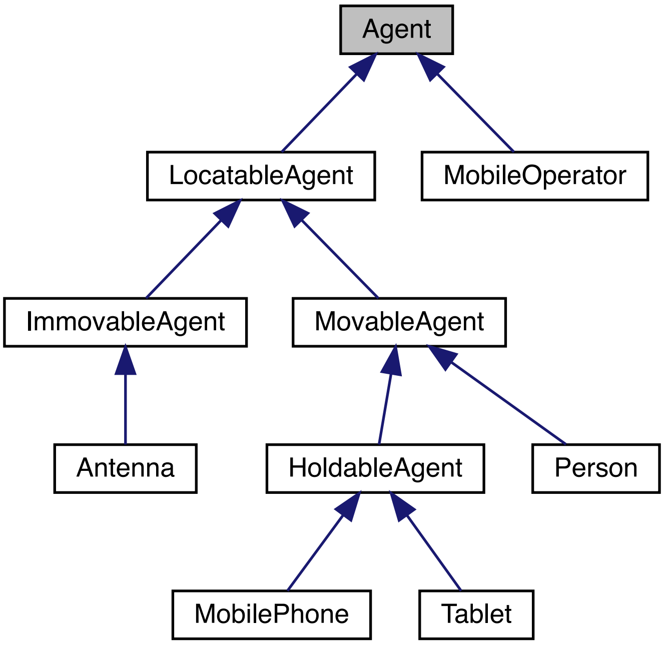
Chapter 6

Class Documentation

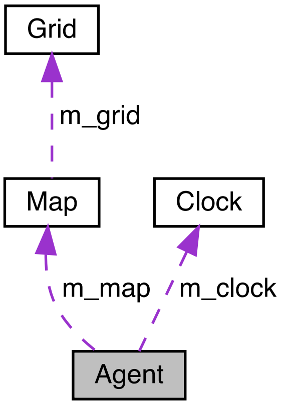
6.1 Agent Class Reference

```
#include <Agent.h>
```

Inheritance diagram for Agent:



Collaboration diagram for Agent:



Public Member Functions

- Agent (const Map ∗m, const unsigned long id, const Clock ∗clock)
- virtual ∼Agent ()
- bool operator== (const Agent &a)
- virtual const string getName () const =0
- virtual const string toString () const =0
- const Map ∗ getMap () const
- void setMap (const Map ∗map)
- const Clock ∗ getClock () const
- const unsigned long getId () const

Private Attributes

- const Map ∗ m_map
- const unsigned long m_id
- const Clock ∗ m_clock

6.1.1 Detailed Description

This is an abstract class, the base class for all agents involved in a simulation.

6.1.2 Constructor & Destructor Documentation

6.1.2.1 Agent()

```
Agent::Agent (
             const Map * m,
             const unsigned long id,
             const Clock * clock )
```

Constructor of the class. Agent is the base class for all agents used in the simulator: persons, antennas, devices, mnos. Agent is an abstract class, users should build specific subclasses.

Parameters

m	- a pointer to the Map object where the simulation take place.
id	- the id of this agent, it uniquely identifies the agent.
clock	- a pointer to a Clock object used by the simulator, the Clock is the same for all agents.

6.1.2.2 ∼Agent()

```
virtual Agent::∼Agent ( )  [virtual]
```

Default destructor of the class.

6.1.3 Member Function Documentation

6.1.3.1 getClock()

```
const Clock* Agent::getClock ( ) const
```

Returns a pointer to the Clock object used for simulation. All Agents use the same Clock object for a simulation.

Returns

6.1.3.2 getId()

```
const unsigned long Agent::getId ( ) const
```

Returns the id of the object.

Returns

the id of the object.

6.1.3.3 getMap()

```
const Map* Agent::getMap ( ) const
```

Getter that returns a pointer to the Map object passed to the constructor when an object was build.

Returns

a pointer to the Map object that was passed to the constructor. All agents use the same map for a simulation.

6.1.3.4 getName()

```
virtual const string Agent::getName ( ) const [pure virtual]
```

This function is used to obtain the name of the class. It is a pure virtual function, all subclasses implement it and return the actual name of the class.

Returns

the name of the class.

Implemented in Antenna, HoldableAgent, MobilePhone, Person, ImmovableAgent, MobileOperator, MovableAgent, LocatableAgent, and Tablet.

6.1.3.5 operator==()

```
bool Agent::operator== (
             const Agent & a )
```

The equal operator for agents.

Parameters

a	the object with which we test the equality.

Returns

true if this object is the equal to a, false otherwise. Two objects are considered to be equal if they have the same id.

6.1.3.6 setMap()

```
void Agent::setMap (
             const Map * map )
```

Sets the Map to be used by this agent during the simulation. It is not advisable to change the map during a simulation.

Parameters

map	pointer to a Map object.

6.1.3.7 toString()

```
virtual const string Agent::toString ( ) const [pure virtual]
```

Builds a string with of the relevant information of the class. It is useful to output on the console or in a file the description of concrete agents.

Returns

a string representation of the class content. The values of the members are written in this string.

Implemented in Antenna, HoldableAgent, Person, MobilePhone, MobileOperator, MovableAgent, LocatableAgent, Tablet, and ImmovableAgent.

6.1.4 Member Data Documentation

6.1.4.1 m_clock

```
const Clock* Agent::m_clock [private]
```

6.1.4.2 m_id

```
const unsigned long Agent::m_id [private]
```

6.1.4.3 m_map

```
const Map* Agent::m_map [private]
```

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

- include/Agent.h

6.2 AgentsCollection Class Reference

```
#include <AgentsCollection.h>
```

Public Member Functions

- AgentsCollection ()
- virtual ∼AgentsCollection ()
- void addAgent (Agent ∗a)
- Agent ∗ deleteAgent (Agent ∗a)
- Agent ∗ getAgent (const unsigned long id) const
- pair< um_iterator, um_iterator > getAgentListByType (const string &agentType)
- um_iterator end ()
- um_iterator begin ()
- unsigned long size ()
- void printAgents ()

Private Attributes

- unordered_multimap< string, Agent ∗ > m_agents

6.2.1 Detailed Description

This is actually a container for all the agents used for simulation. An agent could be an object of one the the derived classes of Agent. The Agents are kept in an unordered_multimap as pairs <string, Agent∗> where the first element of the pair is the name of the concrete agent (a person, a mobile device, an antenna, a mno, etc.) and the second element is a pointer to the actual object (agent).

6.2.2 Constructor & Destructor Documentation

6.2.2.1 AgentsCollection()

```
AgentsCollection::AgentsCollection ( )
```

The default constructor of the class.

6.2.2.2 ∼AgentsCollection()

```
virtual AgentsCollection::∼AgentsCollection ( )  [virtual]
```

Default destructor: it iterates through the collection of agents and frees the memory allocated for each agent in the collection.

6.2.3 Member Function Documentation

6.2.3.1 addAgent()

```
void AgentsCollection::addAgent (
             Agent * a )
```

Adds a new Agent to the collection. For performance reasons the AgentsCollection class keep only a pointer to actual agents (objects).

Parameters

a	a pointer to the object (one of the derived classes of the Agent) to be added to the collection.

6.2.3.2 begin()

```
um_iterator AgentsCollection::begin ( )
```

Iterator to the first agent of the container.

Returns

a random access iterator pointing to the first element (agent) in the container. If the container is empty, the returned iterator value shall not be dereferenced.

6.2.3.3 deleteAgent()

```
Agent* AgentsCollection::deleteAgent (
             Agent * a )
```

Removes an object from the collection.

Parameters

a	a pointer to the object to be removed from the collection.

Returns

6.2.3.4 end()

```
um_iterator AgentsCollection::end ( )
```

Iterator to the past-the-end of the collection. It does not point to any agent, and thus shall not be dereferenced.

Returns

an iterator referring to the past-the-end element in the agents container. If the container is empty, this function returns the same as AgentsColletion::begin().

6.2.3.5 getAgent()

```
Agent∗ AgentsCollection::getAgent (
            const unsigned long id ) const
```

Returns a pointer to an agent from the collection. The agent/object is identified by its id.

Parameters

id	the id of the agent to be returned.

Returns

a pointer to the agent with the id equal to the parameter id. If there is no agent with the provided id, this method returns nullptr.

6.2.3.6 getAgentListByType()

```
pair<um_iterator, um_iterator> AgentsCollection::getAgentListByType (
            const string & agentType )
```

This method is used to get a subset with a certain type of agents: persons, mobile phones etc.

Parameters

agentType	is the name of the class of agents that the user wants to retrieve from the collection of all agents.

Returns

a std::pair of iterators of type unordered_multimap<string, Agent∗>::iterator that can be used to iterate through to subset of the agents.

6.2.3.7 printAgents()

```
void AgentsCollection::printAgents ( )
```

Print out all agents in the collection.

6.2.3.8 size()

```
unsigned long AgentsCollection::size ( )
```

Returns

the number of elements in the container. This is the number of actual objects held in the container, which is not necessarily equal to its storage capacity.

6.2.4 Member Data Documentation

6.2.4.1 m_agents

```
unordered_multimap<string, Agent*> AgentsCollection::m_agents  [private]
```

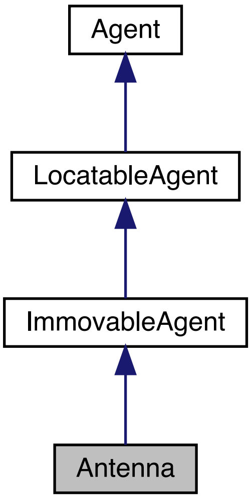
The documentation for this class was generated from the following file:

- include/AgentsCollection.h

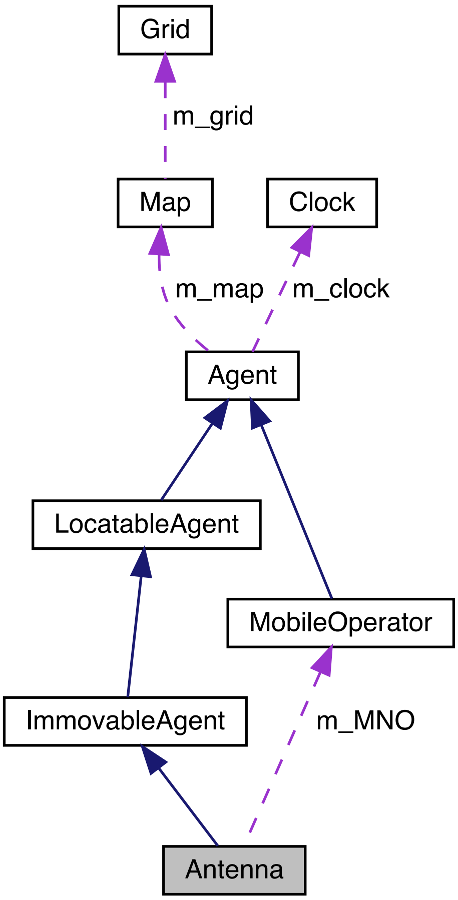
6.3 Antenna Class Reference

```
#include <Antenna.h>
```

Inheritance diagram for Antenna:



Collaboration diagram for Antenna:



Public Member Functions

- Antenna (const Map ∗m, const unsigned long id, Point ∗initPosition, const Clock ∗clock, double attenuationFactor, double power, unsigned long maxConnections, double smid, double ssteep, AntennaType type)
- Antenna (const Map ∗m, const Clock ∗clock, const unsigned long id, XMLElement ∗el, vector< MobileOperator ∗ > mnos)
- virtual ∼Antenna ()
- const string getName () const override
- const string toString () const override
- double getPLE () const
- void setPLE (double ple)
- double getPower () const
- void setPower (double power)
- unsigned long getMaxConnections () const
- void setMaxConnections (int maxConnections)
- bool tryRegisterDevice (HoldableAgent ∗device)
- void attachDevice (HoldableAgent ∗device)

- void dettachDevice (HoldableAgent ∗device)
- AntennaType getType () const
- void setType (AntennaType type)
- double S (double dist) const
- double getSmid () const
- void setSmid (double smid)
- double getSSteep () const
- void setSSteep (double sSteep)
- double computeSignalQuality (const Point ∗p) const
- double computeSignalQuality (const Coordinate c) const
- double computePower (const Point ∗p) const
- double computePower (const Coordinate c) const
- Geometry ∗ getCoverageArea ()
- MobileOperator ∗ getMNO () const
- string getAntennaOutputFileName () const
- double getRmax () const
- double getSmin () const
- string dumpCell () const
- double computeSignalStrength (const Point ∗p) const
- double computeSignalStrength (const Coordinate c) const
- double computeSignalMeasure (HoldableAgent::CONNECTION_TYPE handoverType, const Coordinate c) const
- HoldableAgent::CONNECTION_TYPE getHandoverMechanism () const
- void setHandoverMechanism (HoldableAgent::CONNECTION_TYPE handoverMechanism)

Private Member Functions

- bool alreadyRegistered (HoldableAgent ∗ag)
- void registerEvent (HoldableAgent ∗ag, const EventType event, const bool verbose)
- unsigned long getNumActiveConections ()
- double S0 () const
- double SDist (double dist) const
- double computeSignalQualityOmnidirectional (const Coordinate c) const
- double computeSignalQualityDirectional (const Coordinate c) const
- double computeSignalStrengthDirectional (const Coordinate c) const
- double computeSignalStrengthOmnidirectional (const Coordinate c) const
- void setLocationWithElevation ()
- double projectToEPlane (double b, double c, double beta) const
- vector< pair< double, double > > createMapping (double dbBack) const
- double getMin3db (double sd, double dbBack) const
- double norm_dBLoss (double angle, double dbBack, double sd) const
- double normalizeAngle (double angle) const
- double searchMin (double dg, vector< pair< double, double >> _3dBDegrees) const
- double findSD (double beamWidth, double dbBack, vector< pair< double, double >> &mapping) const
- Geometry ∗ getCoverageAreaOmnidirectional ()
- Geometry ∗ getCoverageAreaDirectional ()

Private Attributes

- double m_ple
- double m_power
- unsigned long m_maxConnections
- double m_Smid
- double m_SSteep
- Geometry ∗ m_cell
- vector< HoldableAgent ∗ > m_devices
- AntennaType m_type
- ofstream m_file
- double m_S0
- double m_height
- double m_tilt
- double m_beam_V
- double m_beam_H
- double m_azim_dB_Back
- double m_elev_dB_Back
- double m_direction
- MobileOperator ∗ m_MNO
- double m_rmax
- double m_Smin
- double m_Qmin
- vector< pair< double, double > > m_mapping_azim
- vector< pair< double, double > > m_mapping_elev
- double m_sd_azim
- double m_sd_elev
- HoldableAgent::CONNECTION_TYPE m_handoverMechanism

6.3.1 Detailed Description

This class simulates an antenna of the mobile phone network.

6.3.2 Constructor & Destructor Documentation

6.3.2.1 Antenna() [1/2]

```
Antenna::Antenna (
            const Map * m,
            const unsigned long id,
            Point * initPosition,
            const Clock * clock,
            double attenuationFactor,
            double power,
            unsigned long maxConnections,
            double smid,
            double ssteep,
            AntennaType type ) [explicit]
```

Constructor of the class. It builds an object providing directly the values for each parameter of the antenna. This constructor is used only for testing purposes. For a real simulation the other constructor of the class should be used.

Parameters

m	a pointer to the Map object used for the simulation
id	the id of the Antenna
initPosition	the position of the antenna on the map
clock	a pointer to the Clock object used for the simulation
attenuationFactor	the attenuation factor of the surrounding environment. In real life, it takes values between 2 (in open field) and 6 (inside buildings).
power	the power of the antenna in Watts.
maxConnections	the maximum number of the connections that the antenna can accept.
smid	is a parameter of an antenna. The significance of this parameter is described in mobloc R package.
ssteep	is a parameter of an antenna. The significance of this parameter is described in mobloc R package.
type	it could have two values AntennaType::OMNIDIRECTIONAL for omnidirectional antennas and AntennaType::DIRECTIONAL for directional antennas.

6.3.2.2 Antenna() [2/2]

```
Antenna::Antenna (
            const Map * m,
            const Clock * clock,
            const unsigned long id,
            XMLElement * el,
            vector< MobileOperator * > mnos )  [explicit]
```

Constructor of the class. It builds an object taking the value of the antenna' parameters from an XML Element, usually when an Antenna object is built reading the xml configuration file.

Parameters

m	a pointer to the Map object used for the simulation
clock	a pointer to the Clock object used for the simulation
id	the id of the Antenna
el	the XML Element containing the parameters of the Antenna
mnos	a vector with pointers to MobileOperator objects.

6.3.2.3 ∼Antenna()

```
virtual Antenna::∼Antenna ( )  [virtual]
```

Destructor of the class. It closes the file where the Antenna dumps the registered events during the simulation.

6.3.3 Member Function Documentation

6.3.3.1 alreadyRegistered()

```
bool Antenna::alreadyRegistered (
             HoldableAgent * ag )  [private]
```

6.3.3.2 attachDevice()

```
void Antenna::attachDevice (
             HoldableAgent * device )
```

Connects a new mobile device and outputs an event EventType::ATTACH_DEVICE in the output file. Internally, the antenna keeps a vector with all connected mobile devices. devices. When a new mobile device is connected it is added to this vector.

Parameters

device	a pointer to the object that represents the mobile device connected to this antenna.

6.3.3.3 computePower() [1/2]

```
double Antenna::computePower (
             const Point * p ) const
```

Computes the power of the signal given by an antenna in a certain location.

Parameters

p	the location where we want to compute the power of the signal.

Returns

the power of the signal in the location given by Point p.

6.3.3.4 computePower() [2/2]

```
double Antenna::computePower (
             const Coordinate c ) const
```

Computes the power of the signal given by an antenna in a certain location.

Parameters

c	the location where we want to compute the power of the signal.

Returns

the power of the signal in the location given by Coordinate c.

6.3.3.5 computeSignalMeasure()

```
double Antenna::computeSignalMeasure (
            HoldableAgent::CONNECTION_TYPE handoverType,
            const Coordinate c ) const
```

compute the signal strength, signal quality or signal power depending on the value of the handoverType parameter

Parameters

handoverType	the handover mechanism: signal quality, signal strength, signal power
c	- a pointer to a coordinate that defines the location where the signal quality/strength/power should be computed

Returns

the signal strength, signal quality or signal power depending on the value of the handoverType parameter

6.3.3.6 computeSignalQuality() [1/2]

```
double Antenna::computeSignalQuality (
            const Point * p ) const
```

Computes the signal quality given by an antenna in a certain location.

Parameters

p	the location where we want to compute the signal quality.

Returns

the signal quality.

6.3.3.7 computeSignalQuality() [2/2]

```
double Antenna::computeSignalQuality (
            const Coordinate c ) const
```

Computes the signal quality given by an antenna in a certain location.

Parameters

c	represents the coordinates of the location where we want to compute the signal quality.

Returns

the signal quality.

6.3.3.8 computeSignalQualityDirectional()

```
double Antenna::computeSignalQualityDirectional (
             const Coordinate c ) const  [private]
```

6.3.3.9 computeSignalQualityOmnidirectional()

```
double Antenna::computeSignalQualityOmnidirectional (
             const Coordinate c ) const  [private]
```

6.3.3.10 computeSignalStrength() [1/2]

```
double Antenna::computeSignalStrength (
             const Point * p ) const
```

Computes the signal strength given by an antenna in a certain location.

Parameters

p	the location where we want to compute the signal strength.

Returns

the signal strength.

6.3.3.11 computeSignalStrength() [2/2]

```
double Antenna::computeSignalStrength (
             const Coordinate c ) const
```

Computes the signal strength given by an antenna in a certain location.

Parameters

c	the location where we want to compute the signal strength.

Returns

the signal strength.

6.3.3.12 computeSignalStrengthDirectional()

```
double Antenna::computeSignalStrengthDirectional (
            const Coordinate c ) const  [private]
```

6.3.3.13 computeSignalStrengthOmnidirectional()

```
double Antenna::computeSignalStrengthOmnidirectional (
            const Coordinate c ) const  [private]
```

6.3.3.14 createMapping()

```
vector<pair<double, double> > Antenna::createMapping (
            double dbBack ) const  [private]
```

6.3.3.15 dettachDevice()

```
void Antenna::dettachDevice (
            HoldableAgent * device )
```

Disconnects a mobile device from the antenna and outputs an event EventType::DEATACH_DEVICE in the output file. Internally, the mobile device is removed from the vector of the connected mobile devices.

Parameters

device	

6.3.3.16 dumpCell()

```
string Antenna::dumpCell ( ) const
```

Builds a wkt string that represents the coverage area of this antenna.

Returns

a wkt string that represents the coverage area of this antenna.

6.3.3.17 findSD()

```
double Antenna::findSD (
             double beamWidth,
             double dbBack,
             vector< pair< double, double >> & mapping ) const  [private]
```

6.3.3.18 getAntennaOutputFileName()

```
string Antenna::getAntennaOutputFileName ( ) const
```

Builds the name of the output file where the events registered by this antenna during a simulation are saved.

Returns

the name of the output file where the events registered by this antenna during a simulation are saved.

6.3.3.19 getCoverageArea()

```
Geometry* Antenna::getCoverageArea ( )
```

Computes the coverage area of an antenna. It is defined as the area where the signal strength is greater than S_min

Returns

a Polygon∗ representing the coverage area of the antenna.

6.3.3.20 getCoverageAreaDirectional()

```
Geometry* Antenna::getCoverageAreaDirectional ( )  [private]
```

6.3.3.21 getCoverageAreaOmnidirectional()

```
Geometry* Antenna::getCoverageAreaOmnidirectional ( )  [private]
```

6.3.3.22 getHandoverMechanism()

```
HoldableAgent::CONNECTION_TYPE Antenna::getHandoverMechanism ( ) const
```

6.3.3.23 getMaxConnections()

```
unsigned long Antenna::getMaxConnections ( ) const
```

Returns the maximum number of mobile devices that an antenna can connect.

6.3.3.24 getMin3db()

```
double Antenna::getMin3db (
             double sd,
             double dbBack ) const  [private]
```

6.3.3.25 getMNO()

```
MobileOperator* Antenna::getMNO ( ) const
```

Returns a pointer to an MNO object representing the MNO that own this antenna.

Returns

a pointer to an MNO object representing the MNO that own this antenna.

6.3.3.26 getName()

```
const string Antenna::getName ( ) const  [override], [virtual]
```

Overrides the same method from the superclass.

Returns

the name of the class, i.e. "Antenna"

Implements Agent.

6.3.3.27 getNumActiveConections()

```
unsigned long Antenna::getNumActiveConections ( )  [private]
```

6.3.3.28 getPLE()

```
double Antenna::getPLE ( ) const
```

Returns the surrounding environment' path loss exponent of the signal.

Returns

the signals' path loss exponent of the surrounding environment. In real life, it takes values between 2 (in open field) and 6 (inside buildings).

6.3.3.29 getPower()

```
double Antenna::getPower ( ) const
```

Returns the power of an antenna in Watts at the location of antenna. This power decreases with a power of the distance from antenna.

Returns

the power of an antenna in Watts.

6.3.3.30 getRmax()

```
double Antenna::getRmax ( ) const
```

Computes the radius of the coverage area for an omnidirectional antenna. This area is a circle where the signal strength is greater than S_min.

Returns

the radius of the coverage area for an omnidirectional antenna.

6.3.3.31 getSmid()

```
double Antenna::getSmid ( ) const
```

Returns the value of the Smid antenna parameter.

Returns

the value of the Smid antenna parameter.

6.3.3.32 getSmin()

```
double Antenna::getSmin ( ) const
```

Returns the value of the minimum signal strength that defines the coverage area of this antenna.

Returns

the value of the minimum signal strength that defines the coverage area of this antenna.

6.3.3.33 getSSteep()

```
double Antenna::getSSteep ( ) const
```

Returns the value of the Ssteep antenna parameter.

Returns

the value of the Ssteep antenna parameter.

6.3.3.34 getType()

```
AntennaType Antenna::getType ( ) const
```

Returns the antenna type: omnidirectional or directional

Returns

the antenna type : AntennaType::OMNIDIRECTIONAL or AntennaType::DIRECTIONAL.

6.3.3.35 norm_dBLoss()

```
double Antenna::norm_dBLoss (
             double angle,
             double dbBack,
             double sd ) const  [private]
```

6.3.3.36 normalizeAngle()

```
double Antenna::normalizeAngle (
             double angle ) const  [private]
```

6.3.3.37 projectToEPlane()

```
double Antenna::projectToEPlane (
             double b,
             double c,
             double beta ) const  [private]
```

6.3.3.38 registerEvent()

```
void Antenna::registerEvent (
             HoldableAgent * ag,
             const EventType event,
             const bool verbose )  [private]
```

6.3.3.39 S()

```
double Antenna::S (
             double dist ) const
```

Computes the signal strength at the distance dist from antenna location.

Parameters

dist	the distance from antenna location.

Returns

the signal strength.

6.3.3.40 S0()

```
double Antenna::S0 ( ) const  [private]
```

6.3.3.41 SDist()

```
double Antenna::SDist (
            double dist ) const  [private]
```

6.3.3.42 searchMin()

```
double Antenna::searchMin (
            double dg,
            vector< pair< double, double >> _3dBDegrees ) const  [private]
```

6.3.3.43 setHandoverMechanism()

```
void Antenna::setHandoverMechanism (
            HoldableAgent::CONNECTION_TYPE handoverMechanism )
```

6.3.3.44 setLocationWithElevation()

```
void Antenna::setLocationWithElevation ( )  [private]
```

6.3.3.45 setMaxConnections()

```
void Antenna::setMaxConnections (
            int maxConnections )
```

Sets the number of mobile devices that an antenna can connect.

Parameters

maxConnections	the number of mobile devices that an antenna can connect.

6.3.3.46 setPLE()

```
void Antenna::setPLE (
            double ple )
```

Sets the surrounding environment' path loss exponent of the signal for an antenna.

Parameters

ple	the value of the surrounding environment' path loss exponent of the signal. In real life, it takes values between 2 (in open field) and 6 (inside buildings).

6.3.3.47 setPower()

```
void Antenna::setPower (
            double power )
```

Sets the power of an antenna.

Parameters

power	the value of the antenna's power.

6.3.3.48 setSmid()

```
void Antenna::setSmid (
            double smid )
```

Sets the value of the Smid antenna parameter.

Parameters

smid	the value of the Smid antenna parameter.

6.3.3.49 setSSteep()

```
void Antenna::setSSteep (
             double sSteep )
```

Sets the value of the Ssteep antenna parameter.

Parameters

sSteep	the value of the Ssteep antenna parameter.

6.3.3.50 setType()

```
void Antenna::setType (
             AntennaType type )
```

Sets the antenna type.

Parameters

type	the antenna type. It could take the following two values: AntennaType::OMNIDIRECTIONAL or AntennaType::DIRECTIONAL.

6.3.3.51 toString()

```
const string Antenna::toString ( ) const  [override], [virtual]
```

Overrides the same method from the superclass. It is used to write the characteristics of the Antenna in a file or console.

Returns

a string that describes the parameters of the Antenna.

Implements Agent.

6.3.3.52 tryRegisterDevice()

```
bool Antenna::tryRegisterDevice (
             HoldableAgent * device )
```

Tries to register a mobile device as being connected to this antenna.

Parameters

device	a pointer to the object that represents a mobile device.

Returns

true if the connection is successful, false otherwise.

6.3.4 Member Data Documentation

6.3.4.1 m_azim_dB_Back

```
double Antenna::m_azim_dB_Back  [private]
```

6.3.4.2 m_beam_H

```
double Antenna::m_beam_H  [private]
```

6.3.4.3 m_beam_V

```
double Antenna::m_beam_V  [private]
```

6.3.4.4 m_cell

```
Geometry* Antenna::m_cell  [private]
```

6.3.4.5 m_devices

```
vector<HoldableAgent*> Antenna::m_devices  [private]
```

6.3.4.6 m_direction

```
double Antenna::m_direction [private]
```

6.3.4.7 m_elev_dB_Back

```
double Antenna::m_elev_dB_Back [private]
```

6.3.4.8 m_file

```
ofstream Antenna::m_file [private]
```

6.3.4.9 m_handoverMechanism

```
HoldableAgent::CONNECTION_TYPE Antenna::m_handoverMechanism [private]
```

6.3.4.10 m_height

```
double Antenna::m_height [private]
```

6.3.4.11 m_mapping_azim

```
vector<pair<double, double> > Antenna::m_mapping_azim [private]
```

6.3.4.12 m_mapping_elev

```
vector<pair<double, double> > Antenna::m_mapping_elev [private]
```

6.3.4.13 m_maxConnections

```
unsigned long Antenna::m_maxConnections [private]
```

6.3.4.14 m_MNO

```
MobileOperator* Antenna::m_MNO  [private]
```

6.3.4.15 m_ple

```
double Antenna::m_ple  [private]
```

6.3.4.16 m_power

```
double Antenna::m_power  [private]
```

6.3.4.17 m_Qmin

```
double Antenna::m_Qmin  [private]
```

6.3.4.18 m_rmax

```
double Antenna::m_rmax  [private]
```

6.3.4.19 m_S0

```
double Antenna::m_S0  [private]
```

6.3.4.20 m_sd_azim

```
double Antenna::m_sd_azim  [private]
```

6.3.4.21 m_sd_elev

```
double Antenna::m_sd_elev  [private]
```

6.3.4.22 m_Smid

```
double Antenna::m_Smid  [private]
```

6.3.4.23 m_Smin

```
double Antenna::m_Smin  [private]
```

6.3.4.24 m_SSteep

```
double Antenna::m_SSteep  [private]
```

6.3.4.25 m_tilt

```
double Antenna::m_tilt  [private]
```

6.3.4.26 m_type

```
AntennaType Antenna::m_type  [private]
```

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

- include/Antenna.h

6.4 AntennaInfo Class Reference

```
#include <AntennaInfo.h>
```

Public Member Functions

- AntennaInfo (const unsigned long time, const unsigned long antennaId, const unsigned long event, const unsigned long deviceId, const double x, const double y)
- unsigned long getAntennaId () const
- unsigned long getDeviceId () const
- unsigned long getEventCode () const
- unsigned long getTime () const
- double getX () const
- double getY () const
- const string toString () const
- bool operator< (const AntennaInfo &ai) const

Private Attributes

- unsigned long m_time
- unsigned long m_antennaId
- unsigned long m_eventCode
- unsigned long m_deviceId
- double m_x
- double m_y

6.4.1 Detailed Description

This class is used to encapsulate all the information about an event generated by an antenna: the timestamp, antennaId, event code, the device id, the exact location of the event.

6.4.2 Constructor & Destructor Documentation

6.4.2.1 AntennaInfo()

```
AntennaInfo::AntennaInfo (
            const unsigned long time,
            const unsigned long antennaId,
            const unsigned long event,
            const unsigned long deviceId,
            const double x,
            const double y )
```

Constructor of the class, builds an object with the values of the fields provided as arguments.

Parameters

time	the timestamp of the event.
antenna↩ Id	the id of the antenna that registered an event.
event	the event code.
deviceId	the id of the device that generated the event.
x	x coordinate of the device when the event was generated.
y	y coordinate of the device when the event was generated.

6.4.3 Member Function Documentation

6.4.3.1 getAntennaId()

```
unsigned long AntennaInfo::getAntennaId ( ) const
```

Returns

the id of the antenna that registered the event.

6.4.3.2 getDeviceId()

```
unsigned long AntennaInfo::getDeviceId ( ) const
```

Returns

the id of the device that generated the event.

6.4.3.3 getEventCode()

```
unsigned long AntennaInfo::getEventCode ( ) const
```

Returns

the event code. It could take the following values: 0 - a device is connected to an antenna, 1 - a devices is disconnected from an antenna, 2 - a device is already connected to the antenna that registered the event, 3 - a device was detected in the coverage area of an antenna but the connection to the antenna failed (from different reasons).

6.4.3.4 getTime()

```
unsigned long AntennaInfo::getTime ( ) const
```

Returns

the timestamp of the event.

6.4.3.5 getX()

```
double AntennaInfo::getX ( ) const
```

Returns

x coordinate of the device that generated the event.

6.4.3.6 getY()

```
double AntennaInfo::getY ( ) const
```

Returns

y coordinate of the device that generated the event.

6.4.3.7 operator<()

```
bool AntennaInfo::operator< (
             const AntennaInfo & ai ) const
```

Overloaded operator to compare to objects

Parameters

ai	the other object to compare to.

Returns

true if this object is less than ai, false otherwise. An object is less than another object if the timestamp value of the first object is lees than the timestamp of the second one.

6.4.3.8 toString()

```
const string AntennaInfo::toString ( ) const
```

Returns

a string representation of on object of this class.

6.4.4 Member Data Documentation

6.4.4.1 m_antennaId

```
unsigned long AntennaInfo::m_antennaId  [private]
```

6.4.4.2 m_deviceId

```
unsigned long AntennaInfo::m_deviceId  [private]
```

6.4.4.3 m_eventCode

```
unsigned long AntennaInfo::m_eventCode  [private]
```

6.4.4.4 m_time

```
unsigned long AntennaInfo::m_time  [private]
```

6.4.4.5 m_x

```
double AntennaInfo::m_x  [private]
```

6.4.4.6 m_y

```
double AntennaInfo::m_y  [private]
```

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

- include/AntennaInfo.h

6.5 Clock Class Reference

```
#include <Clock.h>
```

Public Member Functions

- Clock ()
- Clock (unsigned long start, unsigned long end, unsigned long incr)
- virtual ~Clock ()
- unsigned long tick ()
- unsigned long getCurrentTime () const
- void setCurrentTime (unsigned long currentTime)
- unsigned long getIncrement () const
- void setIncrement (unsigned long increment)
- unsigned long getInitialTime () const
- void setInitialTime (unsigned long initialTime)
- time_t realTime ()
- unsigned long getFinalTime () const
- void setFinalTime (unsigned long finalTime)
- void reset ()

Private Attributes

- unsigned long m_initialTime
- unsigned long m_currentTime
- unsigned long m_increment
- unsigned long m_finalTime

6.5.1 Detailed Description

This is the clock used to synchronize the simulation. All the agents and all other objects involved in a simulation use the same Clock object. The Clock will be initialized with the value of the starting and ending time of the simulation and will keep a current time during the simulation. At each step of the simulation the current time will be increased by an increment. Starting time, ending time, current time and the time increment are only conventional units and they do not depend in any way on the real clock of the computer.

6.5.2 Constructor & Destructor Documentation

6.5.2.1 Clock() [1/2]

```
Clock::Clock ( )
```

Default constructor

6.5.2.2 Clock() [2/2]

```
Clock::Clock (
             unsigned long start,
             unsigned long end,
             unsigned long incr )
```

Constructor of the class. It takes the starting and ending time of the simulation as parameters as well as the time increment.

Parameters

start	the initial moment when the simulation starts.
end	the time when simulation ends.
incr	the time increment. At each step of the simulation the current time is incremented by this quantity.

6.5.2.3 ∼Clock()

```
virtual Clock::∼Clock ( )  [virtual]
```

Default destructor

6.5.3 Member Function Documentation

6.5.3.1 getCurrentTime()

```
unsigned long Clock::getCurrentTime ( ) const
```

Returns

the current time of the simulator.

6.5.3.2 getFinalTime()

```
unsigned long Clock::getFinalTime ( ) const
```

Returns

the ending time of the simulation.

6.5.3.3 getIncrement()

```
unsigned long Clock::getIncrement ( ) const
```

Returns

the time increment used in simulation.

6.5.3.4 getInitialTime()

```
unsigned long Clock::getInitialTime ( ) const
```

Returns

the starting time of the simulation.

6.5.3.5 realTime()

```
time_t Clock::realTime ( )
```

Returns

the real time read from the computer clock. It is used only to register the exact date and time of a simulation.

6.5.3.6 reset()

```
void Clock::reset ( )
```

Resets the current time and makes it equal to the starting time such that a new simulation can begin.

6.5.3.7 setCurrentTime()

```
void Clock::setCurrentTime (
             unsigned long currentTime )
```

Sets the current time of the simulator.

Parameters

currentTime	the value of the current time to be set.

6.5.3.8 setFinalTime()

```
void Clock::setFinalTime (
             unsigned long finalTime )
```

Sets the ending time of a simulation.

Parameters

finalTime	the value of the ending time of a simulation.

6.5.3.9 setIncrement()

```
void Clock::setIncrement (
             unsigned long increment )
```

Sets the time increment to be used in a simulation.

Parameters

increment	the value of the time increment.

6.5.3.10 setInitialTime()

```
void Clock::setInitialTime (
            unsigned long initialTime )
```

Sets the starting time of the simulation.

Parameters

initialTime	the value of the starting time of the simulation.

6.5.3.11 tick()

```
unsigned long Clock::tick ( )
```

increments the current time.

Returns

the current time after incrementation.

6.5.4 Member Data Documentation

6.5.4.1 m_currentTime

```
unsigned long Clock::m_currentTime  [private]
```

6.5.4.2 m_finalTime

```
unsigned long Clock::m_finalTime  [private]
```

6.5.4.3 m_increment

```
unsigned long Clock::m_increment  [private]
```

6.5.4.4 m_initialTime

```
unsigned long Clock::m_initialTime  [private]
```

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

- include/Clock.h

6.6 Constants Class Reference

```
#include <Constants.h>
```

Static Public Attributes

- static const double PHONE_POWER_THRESHOLD
- static const double PHONE_QUALITY_THRESHOLD
- static const double PHONE_STRENGTH_THRESHOLD
- static const double PHONE_CONNECTION_THRESHOLD
- static const double ANTENNA_POWER
- static const double ATT_FACTOR
- static const unsigned long ANTENNA_MAX_CONNECTIONS
- static const double ANTENNA_S_MID
- static const double ANTENNA_S_STEEP
- static const unsigned long SIM_NO_PERSONS
- static const unsigned long SIM_NO_ANTENNAS
- static const unsigned long SIM_NO_MOBILE_PHONES
- static const unsigned long SIM_START_TIME
- static const unsigned long SIM_END_TIME
- static const unsigned long SIM_INCREMENT_TIME
- static const unsigned long SIM_STAY_TIME
- static const unsigned long SIM_INTERVAL_BETWEEN_STAYS
- static const char sep
- static const char ∗ GRID_FILE_NAME
- static const unsigned long GRID_X_ORIG
- static const unsigned long GRID_Y_ORIG
- static const double GRID_DIM_TILE_X
- static const double GRID_DIM_TILE_Y
- static const char ∗ PROB_FILE_NAME_PREFIX
- static const char ∗ PERSONS_FILE_NAME
- static const char ∗ ANTENNAS_FILE_NAME
- static const PriorType PRIOR_PROBABILITY
- static const double ANTENNA_HEIGHT
- static const double ANTENNA_TILT

- static const double ANTENNA_AZIM_DB_BACK
- static const double ANTENNA_ELEV_DB_BACK
- static const double ANTENNA_BEAM_H
- static const double ANTENNA_BEAM_V
- static const double ANTENNA_DIRECTION
- static const unsigned int ANTENNA_MAPPING_N
- static const unsigned int ANTENNA_MIN_3_DB
- static const double ANTENNA_SMIN
- static const double ANTENNA_QMIN
- static const unsigned int SIM_NUM_MNO
- static const char ∗ SIM_DEFAULT_MNO_NAME
- static const double SIM_PROB_MOBILE_PHONE
- static const double SIM_PROB_SECOND_MOBILE_PHONE
- static const double SIM_TREND_ANGLE_1
- static const double SIM_TREND_ANGLE_2
- static const int RANDOM_SEED

6.6.1 Detailed Description

These are some constants used in the process of the simulation, most of them are only used for testing and rapid development of some methods, the real values of the parameters being read from the configuration files.

6.6.2 Member Data Documentation

6.6.2.1 ANTENNA_AZIM_DB_BACK

```
const double Constants::ANTENNA_AZIM_DB_BACK [static]
```

6.6.2.2 ANTENNA_BEAM_H

```
const double Constants::ANTENNA_BEAM_H [static]
```

6.6.2.3 ANTENNA_BEAM_V

```
const double Constants::ANTENNA_BEAM_V [static]
```

6.6.2.4 ANTENNA_DIRECTION

```
const double Constants::ANTENNA_DIRECTION  [static]
```

6.6.2.5 ANTENNA_ELEV_DB_BACK

```
const double Constants::ANTENNA_ELEV_DB_BACK  [static]
```

6.6.2.6 ANTENNA_HEIGHT

```
const double Constants::ANTENNA_HEIGHT  [static]
```

the antenna height

6.6.2.7 ANTENNA_MAPPING_N

```
const unsigned int Constants::ANTENNA_MAPPING_N  [static]
```

6.6.2.8 ANTENNA_MAX_CONNECTIONS

```
const unsigned long Constants::ANTENNA_MAX_CONNECTIONS  [static]
```

The maximum number of devices an antenna can connect.

6.6.2.9 ANTENNA_MIN_3_DB

```
const unsigned int Constants::ANTENNA_MIN_3_DB  [static]
```

6.6.2.10 ANTENNA_POWER

```
const double Constants::ANTENNA_POWER  [static]
```

Antenna power in Watts.

6.6.2.11 ANTENNA_QMIN

```
const double Constants::ANTENNA_QMIN  [static]
```

6.6.2.12 ANTENNA_S_MID

```
const double Constants::ANTENNA_S_MID [static]
```

The Smid parameter of an antenna

6.6.2.13 ANTENNA_S_STEEP

```
const double Constants::ANTENNA_S_STEEP [static]
```

The Sstepp parameter of an antenna

6.6.2.14 ANTENNA_SMIN

```
const double Constants::ANTENNA_SMIN [static]
```

6.6.2.15 ANTENNA_TILT

```
const double Constants::ANTENNA_TILT [static]
```

6.6.2.16 ANTENNAS_FILE_NAME

```
const char* Constants::ANTENNAS_FILE_NAME [static]
```

The name of the file where the exact positions of the antennas are saved during simulation. They are needed for later analysis.

6.6.2.17 ATT_FACTOR

```
const double Constants::ATT_FACTOR [static]
```

Attenuation factor of the signal. It usually takes values between 2 in open field and 6 inside buildings

6.6.2.18 GRID_DIM_TILE_X

```
const double Constants::GRID_DIM_TILE_X [static]
```

6.6.2.19 GRID_DIM_TILE_Y

```
const double Constants::GRID_DIM_TILE_Y  [static]
```

6.6.2.20 GRID_FILE_NAME

```
const char* Constants::GRID_FILE_NAME  [static]
```

The name of the file where the description of the grid is saved

6.6.2.21 GRID_X_ORIG

```
const unsigned long Constants::GRID_X_ORIG  [static]
```

6.6.2.22 GRID_Y_ORIG

```
const unsigned long Constants::GRID_Y_ORIG  [static]
```

6.6.2.23 PERSONS_FILE_NAME

```
const char* Constants::PERSONS_FILE_NAME  [static]
```

The name of the file where the exact positions of the persons are saved during simulation. They are needed for later analysis.

6.6.2.24 PHONE_CONNECTION_THRESHOLD

```
const double Constants::PHONE_CONNECTION_THRESHOLD  [static]
```

This value is interpreted according to the connection type:

- if the connection uses power it is the minimum value of the signal power received by a phone not considered as noise. Below this value the signal is unusable and the connection between a mobile phone and an antenna is not possible.
- if the connection uses signal quality it is the minimum value of the signal quality received by a phone not considered as noise. Below this value the signal is unusable and the connection between a mobile phone and an antenna is not possible.
- if the connection uses signal strength it is the minimum value of the signal strength received by a phone not considered as noise. Below this value the signal is unusable and the connection between a mobile phone and an antenna is not possible.

6.6.2.25 PHONE_POWER_THRESHOLD

```
const double Constants::PHONE_POWER_THRESHOLD  [static]
```

If the signal received by a mobile device has a power below this level, the signal is considered only noise and unusable.

6.6.2.26 PHONE_QUALITY_THRESHOLD

```
const double Constants::PHONE_QUALITY_THRESHOLD  [static]
```

If the signal received by a mobile device has a quality below this level, the signal is considered only noise and unusable.

6.6.2.27 PHONE_STRENGTH_THRESHOLD

```
const double Constants::PHONE_STRENGTH_THRESHOLD  [static]
```

If the signal received by a mobile device has a quality below this level, the signal is considered only noise and unusable.

6.6.2.28 PRIOR_PROBABILITY

```
const PriorType Constants::PRIOR_PROBABILITY  [static]
```

Indicates how the prior probability is computed: uniform, register, network

6.6.2.29 PROB_FILE_NAME_PREFIX

```
const char* Constants::PROB_FILE_NAME_PREFIX  [static]
```

The name of the file where the probabilities of mobile phones locations are saved

6.6.2.30 RANDOM_SEED

```
const int Constants::RANDOM_SEED  [static]
```

6.6.2.31 sep

```
const char Constants::sep  [static]
```

The separator used when information is saved in output files

6.6.2.32 SIM_DEFAULT_MNO_NAME

```
const char* Constants::SIM_DEFAULT_MNO_NAME  [static]
```

6.6.2.33 SIM_END_TIME

```
const unsigned long Constants::SIM_END_TIME  [static]
```

Default ending time of a simulation

6.6.2.34 SIM_INCREMENT_TIME

```
const unsigned long Constants::SIM_INCREMENT_TIME  [static]
```

Default time increment for a simulation

6.6.2.35 SIM_INTERVAL_BETWEEN_STAYS

```
const unsigned long Constants::SIM_INTERVAL_BETWEEN_STAYS  [static]
```

6.6.2.36 SIM_NO_ANTENNAS

```
const unsigned long Constants::SIM_NO_ANTENNAS  [static]
```

The number of antenna used for a simulation

6.6.2.37 SIM_NO_MOBILE_PHONES

```
const unsigned long Constants::SIM_NO_MOBILE_PHONES  [static]
```

The number of the mobile devices used for a simulation

6.6.2.38 SIM_NO_PERSONS

```
const unsigned long Constants::SIM_NO_PERSONS  [static]
```

The number of persons used for a simulation

6.6.2.39 SIM_NUM_MNO

```
const unsigned int Constants::SIM_NUM_MNO  [static]
```

6.6.2.40 SIM_PROB_MOBILE_PHONE

```
const double Constants::SIM_PROB_MOBILE_PHONE  [static]
```

6.6.2.41 SIM_PROB_SECOND_MOBILE_PHONE

```
const double Constants::SIM_PROB_SECOND_MOBILE_PHONE  [static]
```

6.6.2.42 SIM_START_TIME

```
const unsigned long Constants::SIM_START_TIME  [static]
```

Default starting time of a simulation

6.6.2.43 SIM_STAY_TIME

```
const unsigned long Constants::SIM_STAY_TIME  [static]
```

6.6.2.44 SIM_TREND_ANGLE_1

```
const double Constants::SIM_TREND_ANGLE_1  [static]
```

6.6.2.45 SIM_TREND_ANGLE_2

```
const double Constants::SIM_TREND_ANGLE_2  [static]
```

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

- include/Constants.h

6.7 CSVParser Class Reference

```
#include <CSVparser.hpp>
```

Public Member Functions

- CSVParser (const string &data, const DataType &type=eFILE, char sep=',', bool hasHeader=true)
- ∼CSVParser (void)
- Row & getRow (unsigned int row) const
- unsigned int rowCount (void) const
- unsigned int columnCount (void) const
- vector< string > getHeader (void) const
- const string getHeaderElement (unsigned int pos) const
- const string & getFileName (void) const
- bool deleteRow (unsigned int row)
- bool addRow (unsigned int pos, const vector< string > &r)
- void sync (void) const
- Row & operator[ ] (unsigned int row) const

Protected Member Functions

- void parseHeader (void)
- void parseContent (void)

Private Attributes

- string _file
- const DataType _type
- const char _sep
- vector< string > _originalFile
- vector< string > _header
- vector< Row ∗ > _content
- bool m_header

6.7.1 Detailed Description

This class is used to read and parse a csv file or to write some values as a csv file.

6.7.2 Constructor & Destructor Documentation

6.7.2.1 CSVParser()

```
CSVParser::CSVParser (
             const string & data,
             const DataType & type = eFILE,
             char sep = ',',
             bool hasHeader = true )
```

Constructor of the class. It need the name of the csv file, the file type, the separator and a boolean that indicates if the file has header or not.

Parameters

data	the name of the file
type	the file type: could be eFILE for normal text files or ePURE if the input is a string
sep	the separator of the individula values in a line of the csv file
hasHeader	true means that the csv file has a header line, false that it doesn't have a header

6.7.2.2 ∼CSVParser()

```
CSVParser::~CSVParser (
            void  )
```

Destructor

6.7.3 Member Function Documentation

6.7.3.1 addRow()

```
bool CSVParser::addRow (
            unsigned int pos,
            const vector< string > & r )
```

Inserts a Row object at a given position

Parameters

pos	the position where we want to insert the Row object
r	a vector containing the values in the Row.

Returns

> true if the insertion is successful, false otherwise (i.e. the pos parameter is outside the limits of the container that stores the Rows of the csv file.

6.7.3.2 columnCount()

```
unsigned int CSVParser::columnCount (
            void  ) const
```

Returns the number of the columns of the csv file.

Returns

the number of the columns of the csv file.

6.7.3.3 deleteRow()

```
bool CSVParser::deleteRow (
            unsigned int row )
```

Removes a row specified by its number

Parameters

row	the number of the row to be deleted

Returns

true if the removal succeeded, false otherwise

6.7.3.4 getFileName()

```
const string& CSVParser::getFileName (
            void  ) const
```

Returns the name of the csv file

Returns

the name of the csv file

6.7.3.5 getHeader()

```
vector<string> CSVParser::getHeader (
            void  ) const
```

Returns a vector containing the names of the columns as they are specified in the header line of the csv file.

Returns

a vector containing the names of the columns as they are specified in the header line of the csv file.

6.7.3.6 getHeaderElement()

```
const string CSVParser::getHeaderElement (
            unsigned int pos ) const
```

Returns the name of a specific column given by its position in the header line

Parameters

pos	the number of the column

Returns

the name of a specific column given by its position in the header line

6.7.3.7 getRow()

```
Row& CSVParser::getRow (
            unsigned int row ) const
```

Returns a Row object specified by its number in the file

Parameters

row	the number of the line that was used to build the Row object

Returns

a Row object specified by its number in the file

6.7.3.8 operator[]()

```
Row& CSVParser::operator[] (
            unsigned int row ) const
```

Overloaded operator

Parameters

row	the number of the row to be retrieved

Returns

the Row object at the position specified by row

6.7.3.9 parseContent()

```
void CSVParser::parseContent (
            void ) [protected]
```

6.7.3.10 parseHeader()

```
void CSVParser::parseHeader (
             void  )  [protected]
```

6.7.3.11 rowCount()

```
unsigned int CSVParser::rowCount (
             void  ) const
```

Returns the number of lines in the csv file without counting the header line, if it exists

Returns

the number of lines in the csv file without counting the header line, if it exists

6.7.3.12 sync()

```
void CSVParser::sync (
             void  ) const
```

Flushes the content to a file on disk and then closes the file.

6.7.4 Member Data Documentation

6.7.4.1 _content

```
vector<Row *> CSVParser::_content  [private]
```

6.7.4.2 _file

```
string CSVParser::_file  [private]
```

6.7.4.3 _header

```
vector<string> CSVParser::_header  [private]
```

6.7.4.4 _originalFile

```
vector<string> CSVParser::_originalFile [private]
```

6.7.4.5 _sep

```
const char CSVParser::_sep [private]
```

6.7.4.6 _type

```
const DataType CSVParser::_type [private]
```

6.7.4.7 m_header

```
bool CSVParser::m_header [private]
```

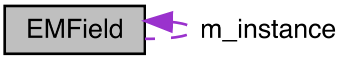
The documentation for this class was generated from the following file:

- include/CSVparser.hpp

6.8 EMField Class Reference

```
#include <EMField.h>
```

Collaboration diagram for EMField:



Public Member Functions

- virtual ∼EMField ()
- void addAntenna (Antenna ∗a)
- pair< Antenna ∗, double > computeMaxPower (const Point ∗p, const unsigned long mnoId)
- pair< Antenna ∗, double > computeMaxQuality (const Point ∗p, const unsigned long mnoId)
- pair< Antenna ∗, double > computeMaxStrength (const Point ∗p, const unsigned long mnoId)
- vector< pair< Antenna ∗, double > > getInRangeAntennas (const Point ∗p, const double threshold, const HoldableAgent::CONNECTION_TYPE connType, unsigned long mnoId)
- bool isAntennaInRange (const Point ∗p, Antenna ∗a, const double threshold, const HoldableAgent::CONNECTION_TYPE connType)
- double connectionLikelihood (Antenna ∗a, const Point ∗p)
- vector< double > sumSignalQuality (const Grid ∗grid, const unsigned long mnoID)
- double connectionLikelihoodGrid (Antenna ∗a, const Grid ∗g, unsigned long tileIndex)
- const double ∗ getAntennaMin3DbArray () const
- double ∗ getSd () const

Static Public Member Functions

- static EMField ∗ instance ()

Private Member Functions

- EMField ()
- EMField (const EMField &)
- EMField & operator= (const EMField &)

Private Attributes

- vector< Antenna ∗ > m_antennas
- map< const unsigned long, vector< double > > m_sumQuality
- double ∗ m_antennaMin3DbArray
- double ∗ m_sd

Static Private Attributes

- static EMField ∗ m_instance

6.8.1 Detailed Description

This utility singleton class is used to compute different measures of the electromagnetic field radiated by an antenna (power, signal strength etc) and it also provides methods needed to decide to which antenna a mobile device connects.

6.8.2 Constructor & Destructor Documentation

6.8.2.1 ∼EMField()

```
virtual EMField::∼EMField ( )  [virtual]
```

Default destructor.

6.8.2.2 EMField() [1/2]

```
EMField::EMField ( )  [private]
```

6.8.2.3 EMField() [2/2]

```
EMField::EMField (
            const EMField & )  [private]
```

6.8.3 Member Function Documentation

6.8.3.1 addAntenna()

```
void EMField::addAntenna (
            Antenna * a )
```

Add a pointer to an Antenna object to an internal collection needed for computations. Although these pointers are kept in an AgentCollection object they are also added to a local vector in this class for performance reasons.

Parameters

a	a pointer to the Antenna object

6.8.3.2 computeMaxPower()

```
pair<Antenna*, double> EMField::computeMaxPower (
            const Point * p,
            const unsigned long mnoId )
```

Returns a pair made of a pointer to an Antenna object and its power with the property that in the location specified by parameter p, the Antenna returned by this method provides the highest power (the power of the field is considered to decrease according a power-law).

Parameters

p	the location where we want to find which Antenna provides the highest power the of electromagnetic field.
mno↩ Id	the id of the MNO for which we compute the power. Only antennas belonging to this MNO will be considered during computations.

Returns

> a pair<Antenna∗, double> containing a pointer to the Antenna object that provides the highest power of the field in the location specified by p.

6.8.3.3 computeMaxQuality()

```
pair<Antenna*, double> EMField::computeMaxQuality (
             const Point * p,
             const unsigned long mnoId )
```

Returns a pair made of a pointer to an Antenna object and its signal quality with the property that in the location specified by p, the Antenna returned by this method provides signal with the highest quality. The signal quality in this pair is the computed in location given by p.

Parameters

p	indicates the location where we want to find which Antenna provides the highest quality of the signal.
mno↩ Id	the id of the MNO for which we compute the signal quality. Only antennas belonging to this MNO will be considered during computations.

Returns

> a pair<Antenna∗, double> containing a pointer to the Antenna object that provides a signal with the highest quality in location given by p.

6.8.3.4 computeMaxStrength()

```
pair<Antenna*, double> EMField::computeMaxStrength (
             const Point * p,
             const unsigned long mnoId )
```

Returns a pair made of a pointer to an Antenna object and its signal strength with the property that in the location specified by p, the Antenna returned by this method provides signal with the highest strength. The signal strength in this pair is the computed in location given by p.

Parameters

p	indicates the location where we want to find which Antenna provides the highest strength of the signal.
mno↩ Id	the id of the MNO for which we compute the signal strength. Only antennas belonging to this MNO will be considered during computations.

Returns

a pair<Antenna*, double> containing a pointer to the Antenna object that provides a signal with the highest strength in location given by p.

6.8.3.5 connectionLikelihood()

```
double EMField::connectionLikelihood (
            Antenna * a,
            const Point * p )
```

Computes the connection likelihood for Antenna indicated by a in a certain location given by p. The connection likelihood is computed dividing the signal quality provided by Antenna indicated through p by the sum of the signal quality provided by all antennas of an MNO.

Parameters

a	a pointer to an Antenna object.
p	a location in space.

Returns

the connection likelihood for Antenna a in location p.

6.8.3.6 connectionLikelihoodGrid()

```
double EMField::connectionLikelihoodGrid (
            Antenna * a,
            const Grid * g,
            unsigned long tileIndex )
```

Computes the connection likelihood for Antenna indicated by a in the center of the tile indicated by tileIndex

Parameters

a	a pointer to an Antenna object.
g	a pointer to the reference Grid object
tileIndex	the index of the tile where we want to compute the connection likelihood.

Returns

the connection likelihood for Antenna a in the center of the tile with the index tileIndex.

6.8.3.7 getAntennaMin3DbArray()

```
const double* EMField::getAntennaMin3DbArray ( ) const
```

6.8.3.8 getInRangeAntennas()

```
vector<pair<Antenna*, double> > EMField::getInRangeAntennas (
             const Point * p,
             const double threshold,
             const HoldableAgent::CONNECTION_TYPE connType,
             unsigned long mnoId )
```

Returns a vector of pairs made up of a pointer to an Antenna object and its power, signal quality or signal strength. All the antennas in this vector provides a signal with a power or signal quality greater than the threshold provided as threshold, i.e. this vector contains all antennas that have in their coverage area the location given by point p.

Parameters

p	the location where we want to have the list with the all antennas that covers it.
threshold	the lowest limit of the power or signal quality below which the signal is considered to be only noise, i.e. it defines the limit of the coverage area.
connType	indicates the mechanism used to set up a connection between an antenna and a mobile phone
mnoId	the id of the MNO for which we build the resulting vector. Only antennas belonging to this MNO will be considered during computations.

Returns

a vector of pairs made up of a pointer to an Antenna object and its power, signal quality or signal strength, according to the value of the connType. All the antennas in this vector provides a signal with a power, signal quality or signal strength greater than the threshold.

6.8.3.9 getSd()

```
double* EMField::getSd ( ) const
```

6.8.3.10 instance()

```
static EMField* EMField::instance ( ) [inline], [static]
```

Returns an instance of this class. This class is a singleton.

Returns

an instance of this class.

6.8.3.11 isAntennaInRange()

```
bool EMField::isAntennaInRange (
             const Point * p,
             Antenna * a,
             const double threshold,
             const HoldableAgent::CONNECTION_TYPE connType )
```

Checks if p is in the coverage area of Antenna pointed out by a. The coverage area is considered the area where the signal quality or the power of the field is greater than the value of threshold.

Parameters

p	the location that we want to check the power or the quality of the signal
a	pointer to an Antenna object for which we want to check if it covers the point p.
threshold	the lower limit of the power or signal quality below which the signal is considered only noise.
connType	indicates the mechanism used to set up a connection between an antenna and a mobile phone.

Returns

true is the Antenna object provide enough power or signal quality in the location given as p.

6.8.3.12 operator=()

```
EMField& EMField::operator= (
             const EMField & )  [private]
```

6.8.3.13 sumSignalQuality()

```
vector<double> EMField::sumSignalQuality (
             const Grid * grid,
             const unsigned long mnoID )
```

Computes the sum of the signal quality given by all antennas belonging to an MNO for all tiles in the reference grid. The signal quality is computed in the center of each tile.

Parameters

grid	the grid of tiles where this method computes the sum of the signal quality. This grid is set at the beginning of the simulation and it overlaps the Map.
mnoID	the id of the MNO for which we want to compute this sum.

Returns

a vector containing the sum of the signal quality given by all antennas of an MNO, for all tiles in the reference grid. An element of the vector corresponds to a tile in the grid. The tiles are linearized in a row-major order starting with the bottom-left corner.

6.8.4 Member Data Documentation

6.8.4.1 m_antennaMin3DbArray

```
double* EMField::m_antennaMin3DbArray  [private]
```

6.8.4.2 m_antennas

```
vector<Antenna*> EMField::m_antennas  [private]
```

6.8.4.3 m_instance

```
EMField* EMField::m_instance  [static], [private]
```

6.8.4.4 m_sd

```
double* EMField::m_sd  [private]
```

6.8.4.5 m_sumQuality

```
map<const unsigned long, vector<double> > EMField::m_sumQuality  [private]
```

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

- include/EMField.h

6.9 Grid Class Reference

```
#include <Grid.h>
```

Public Member Functions

- Grid (double xOrig, double yOrig, double xTiledim, double yTiledim, unsigned long noTilesX, unsigned long noTilesY)
- virtual ∼Grid ()
- unsigned long getNoTilesX () const
- unsigned long getNoTilesY () const
- double getXTileDim () const
- double getYTileDim () const
- double getXOrigin () const
- double getYOrigin () const
- string toString () const
- unsigned long getTileIndexX (const Point ∗p) const
- unsigned long getTileIndexY (const Point ∗p) const
- const unsigned long getNoTiles () const
- vector< double > computeProbability (unsigned long t, MobilePhone ∗m, vector< AntennaInfo > &data, pair< um_iterator, um_iterator > it, PriorType prior) const
- Coordinate getTileCenter (unsigned long tileIndex) const
- unsigned long getTileNo (const Point ∗p) const
- unsigned long getTileIndexX (double x) const
- unsigned long getTileIndexY (double y) const
- unsigned long getTileNo (double x, double y) const
- void dumpGrid (const string &gridFileName) const
- Coordinate ∗ getTileCenters () const

Private Member Functions

- Coordinate ∗ computeTileCenters ()
- vector< double > useNetworkPrior (unsigned long t, bool connected, vector< AntennaInfo >::iterator ai, pair< um_iterator, um_iterator > antennas_iterator) const
- vector< double > useUniformPrior (unsigned long t, bool connected, vector< AntennaInfo >::iterator ai, pair< um_iterator, um_iterator > antennas_iterator) const

Private Attributes

- double m_xOrigin
- double m_yOrigin
- double m_xTileDim
- double m_yTileDim
- unsigned long m_noTilesX
- unsigned long m_noTilesY
- Coordinate ∗ m_tileCenters

6.9.1 Detailed Description

This class implements a grid of rectangular tiles overlapped on the map of the simulation. This grid is used to compute the "observed" location of a mobile phone. This means that we compute the probability of a mobile device to be in a specific tile of the grid using the data recorded by each antenna during the simulation. A finer grid will give a more accurate location but the computational cost increase when the size of the tiles decrease. The tiles of the grid are indexed starting with 0 for the tile in the bottom left corner of the grid in a row-major ordering. The last tile, with the biggest index, is the tile in the upper-right corner of the grid.

6.9.2 Constructor & Destructor Documentation

6.9.2.1 Grid()

```
Grid::Grid (
            double xOrig,
            double yOrig,
            double xTiledim,
            double yTiledim,
            unsigned long noTilesX,
            unsigned long noTilesY )
```

Constructor of the class. Build a Grid object with the specified parameters.

Parameters

xOrig	the x coordinate of the origin of the grid (i.e. the x coordinate of the bottom left corner of the grid).
yOrig	the y coordinate of the origin of the grid (i.e. the y coordinate of the bottom left corner of the grid).
xTiledim	the dimension of a tile on X axis.
yTiledim	the dimension of a tile on Y axis.
noTilesX	the number of tiles on X axis.
noTilesY	the number of tiles on Y axis.

6.9.2.2 ∼Grid()

```
virtual Grid::∼Grid ( )  [virtual]
```

Default destructor.

6.9.3 Member Function Documentation

6.9.3.1 computeProbability()

```
vector<double> Grid::computeProbability (
            unsigned long t,
            MobilePhone * m,
            vector< AntennaInfo > & data,
            pair< um_iterator, um_iterator > it,
            PriorType prior ) const
```

Computes the posterior probability of a mobile device to be in a tile of the Grid according to the method described in he paper "Deriving geographic location of mobile devices from network data" by Martijn Tennekes, Yvonne A.P.M. Gootzen, Shan H. Shah.

Parameters

t	the time instant when the posterior localization probability is computed.
m	a pointer to a MobilePhone object for which the posterior localization probability is computed.
data	a vector of AntennaInfo objects generated and recorded by each antenna during the simulation. It contains the events recorder by each antenna during the simulation.
it	an iterator to access all objects of type Antenna from the AgentsCollection container.
prior	is used to set the method of computing the prior probabilities. It could take 3 values: PriorType::UNIFORM, PriorType::NETWORK or PriorType::REGISTER. Currently only UNIFORM and NETWORK methods are implemented.

Returns

> a vector with the posterior probability of the mobile phone given by m to be localized in a tile. The index of a value in this vector indicates the corresponding tile index. The size of this vector is equal to the total number of tiles in the Grid.

6.9.3.2 computeTileCenters()

```
Coordinate* Grid::computeTileCenters ( )  [private]
```

6.9.3.3 dumpGrid()

```
void Grid::dumpGrid (
             const string & gridFileName ) const
```

Writes the grid description in a .csv file for later processing.

Parameters

gridFileName	the name of the output file.

6.9.3.4 getNoTiles()

```
const unsigned long Grid::getNoTiles ( ) const
```

Computes the total number of tiles in the grid.

Returns

> the total number of tiles in the grid.

6.9.3.5 getNoTilesX()

```
unsigned long Grid::getNoTilesX ( ) const
```

Returns

the number of tiles of the grid on X axis direction.

6.9.3.6 getNoTilesY()

```
unsigned long Grid::getNoTilesY ( ) const
```

Returns

the number of tiles of the grid on Y axis direction.

6.9.3.7 getTileCenter()

```
Coordinate Grid::getTileCenter (
             unsigned long tileIndex ) const
```

Computes the coordinates of the tile center given by its index in the grid.

Parameters

tileIndex	the tile index.

Returns

the coordinates of the center of the tile.

6.9.3.8 getTileCenters()

```
Coordinate* Grid::getTileCenters ( ) const
```

Returns a vector containing the coordinates of the tile centers.

Returns

a vector containing the coordinates of the tile centers.

6.9.3.9 getTileIndexX() [1/2]

```
unsigned long Grid::getTileIndexX (
             const Point * p ) const
```

Returns the tile index on X axis that contains a given point in space, specified by p.

Parameters

p	a pointer to the point for which we need the tile index.

Returns

the tile index on X axis that contains the point specified by p, i.e. a number between 0 and getNoTilesX() - 1.

6.9.3.10 getTileIndexX() [2/2]

```
unsigned long Grid::getTileIndexX (
             double x ) const
```

6.9.3.11 getTileIndexY() [1/2]

```
unsigned long Grid::getTileIndexY (
             const Point * p ) const
```

Returns the tile index on Y axis that contains a given point in space, specified by p.

Parameters

p	the point in space for which we need the tile index.

Returns

the tile index on Y axis that contains the point specified by p, i.e. a number between 0 and getNoTilesY() - 1.

6.9.3.12 getTileIndexY() [2/2]

```
unsigned long Grid::getTileIndexY (
             double y ) const
```

6.9.3.13 getTileNo() [1/2]

```
unsigned long Grid::getTileNo (
            const Point * p ) const
```

Computes the tile index of the tile that contains the Point indicated by p.

Parameters

p	a pointer to a Point object.

Returns

the tile index of the tile that contains the Point indicated by p.

6.9.3.14 getTileNo() [2/2]

```
unsigned long Grid::getTileNo (
            double x,
            double y ) const
```

Computes the tile index of the tile that contains a point with coordinates indicated by x and y.

Parameters

x	x coordinate of a location.
y	y coordinate of a location.

Returns

the tile index of the tile that contains a point with coordinates indicated by x and y.

6.9.3.15 getXOrigin()

```
double Grid::getXOrigin ( ) const
```

Returns

the x coordinate of the origin of the grid (i.e. the x coordinate of the bottom left corner of the grid).

6.9.3.16 getXTileDim()

```
double Grid::getXTileDim ( ) const
```

Returns

the dimension of a tile on X axis direction.

6.9.3.17 getYOrigin()

```
double Grid::getYOrigin ( ) const
```

Returns

the y coordinate of the origin of the grid (i.e. the y coordinate of the bottom left corner of the grid).

6.9.3.18 getYTileDim()

```
double Grid::getYTileDim ( ) const
```

Returns

the dimension of a tile on Y axis direction.

6.9.3.19 toString()

```
string Grid::toString ( ) const
```

Returns

a string representation of an object of type Grid. This is useful to write a textual description of the grid in a file for later processing.

6.9.3.20 useNetworkPrior()

```
vector<double> Grid::useNetworkPrior (
             unsigned long t,
             bool connected,
             vector< AntennaInfo >::iterator ai,
             pair< um_iterator, um_iterator > antennas_iterator ) const  [private]
```

6.9.3.21 useUniformPrior()

```
vector<double> Grid::useUniformPrior (
            unsigned long t,
            bool connected,
            vector< AntennaInfo >::iterator ai,
            pair< um_iterator, um_iterator > antennas_iterator ) const  [private]
```

6.9.4 Member Data Documentation

6.9.4.1 m_noTilesX

```
unsigned long Grid::m_noTilesX  [private]
```

6.9.4.2 m_noTilesY

```
unsigned long Grid::m_noTilesY  [private]
```

6.9.4.3 m_tileCenters

```
Coordinate* Grid::m_tileCenters  [private]
```

6.9.4.4 m_xOrigin

```
double Grid::m_xOrigin  [private]
```

6.9.4.5 m_xTileDim

```
double Grid::m_xTileDim  [private]
```

6.9.4.6 m_yOrigin

```
double Grid::m_yOrigin  [private]
```

6.9.4.7 m_yTileDim

```
double Grid::m_yTileDim [private]
```

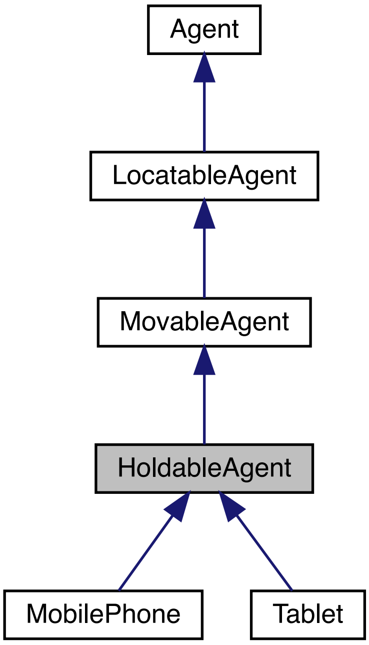
The documentation for this class was generated from the following file:

- include/Grid.h

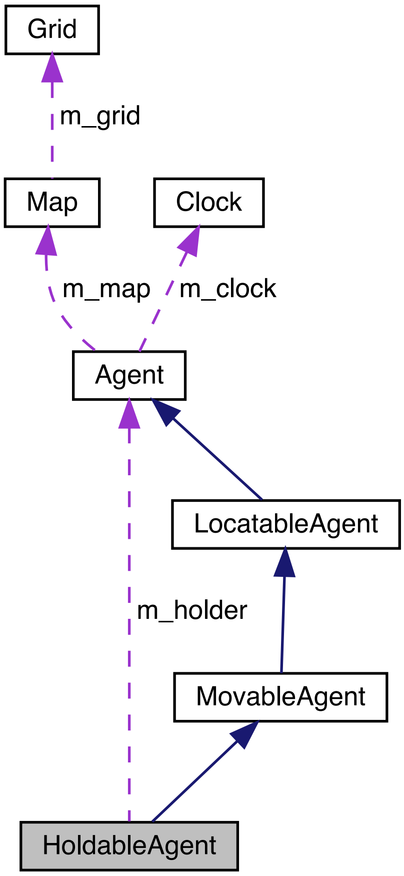
6.10 HoldableAgent Class Reference

```
#include <HoldableAgent.h>
```

Inheritance diagram for HoldableAgent:



Collaboration diagram for HoldableAgent:



Public Types

- enum CONNECTION_TYPE { USING_POWER, USING_SIGNAL_QUALITY, USING_SIGNAL_STRENGTH, UNKNOWN }

Public Member Functions

- HoldableAgent (const Map ∗m, const unsigned long id, Point ∗initPosition, Agent ∗holder, const Clock ∗clock)
- HoldableAgent (const HoldableAgent &h)
- virtual ∼HoldableAgent ()
- Agent ∗ getHolder () const
- void setHolder (Agent ∗holder)
- const string getName () const override
- const string toString () const override
- virtual bool tryConnect ()=0
- virtual bool isConnected () const
- void setLocation (Point ∗location) override
- vector< Antenna ∗ > getAntennas () const

Private Attributes

- Agent ∗ m_holder
- vector< Antenna ∗ > m_antennas

6.10.1 Detailed Description

This is the superclass for all agents that represent a device that can by held by a person.

6.10.2 Member Enumeration Documentation

6.10.2.1 CONNECTION_TYPE

```
enum HoldableAgent::CONNECTION_TYPE
```

an enumeration of the modes used by the device to connect to an antenna: USING_POWER - connects to the antenna that provides the maximum power of the field in the location of the device. USING_SIGNAL_QUALITY - connects to the antenna that provides the maximum value of the signal quality in the location of the device. USI↩ NG_SIGNAL_STRENGTH - connects to the antenna that provides the maximum value of the signal strength in the location of the device. UNKNOWN - this should by an error.

Enumerator

USING_POWER	
USING_SIGNAL_QUALITY	
USING_SIGNAL_STRENGTH	
UNKNOWN	

6.10.3 Constructor & Destructor Documentation

6.10.3.1 HoldableAgent() [1/2]

```
HoldableAgent::HoldableAgent (
            const Map ∗ m,
            const unsigned long id,
            Point ∗ initPosition,
            Agent ∗ holder,
            const Clock ∗ clock )  [explicit]
```

Constructor of the class. It builds an HoldableAgent object with the parameters provided by user.

Parameters

m	a pointer to a Map object used for this simulation.
id	the id of the object.
initPosition	the initial location on the map of the object.
holder	a pointer to an Agent that owns this device.
clock	a pointer to a Clock object used by this simulation.

6.10.3.2 HoldableAgent() [2/2]

```
HoldableAgent::HoldableAgent (
              const HoldableAgent & h )
```

Copy constructor.

Parameters

h	another object of the same type.

6.10.3.3 ∼HoldableAgent()

```
virtual HoldableAgent::∼HoldableAgent ( ) [virtual]
```

Destructor

6.10.4 Member Function Documentation

6.10.4.1 getAntennas()

```
vector<Antenna*> HoldableAgent::getAntennas ( ) const
```

Returns

a vector with pointers to antennas where this device is connected

6.10.4.2 getHolder()

```
Agent* HoldableAgent::getHolder ( ) const
```

Returns a pointer to an Agent object that owns this device

Returns

a pointer to an Agent object that owns this device

6.10.4.3 getName()

```
const string HoldableAgent::getName ( ) const  [override], [virtual]
```

Returns the name of the class

Returns

the name of the class

Implements Agent.

Reimplemented in MobilePhone, and Tablet.

6.10.4.4 isConnected()

```
virtual bool HoldableAgent::isConnected ( ) const  [virtual]
```

check if this device is connected to an antenna

Returns

true if the device is conneted to an antenna, false otherwise.

6.10.4.5 setHolder()

```
void HoldableAgent::setHolder (
             Agent * holder )
```

Sets the owner of this device

Parameters

holder	a pointer to the owner of this device

6.10.4.6 setLocation()

```
void HoldableAgent::setLocation (
            Point * location )  [override], [virtual]
```

Sets the location of this device. After a new location is set, the device tries to connect to an antenna, i.e. the tryConnect() method is called. Since this is an abstract class and the connection type is unknown it is the responsibility of subclasses to override this method and provide the correct mode of connection.

Parameters

location	a point on the Map of the simulation

Reimplemented from LocatableAgent.

6.10.4.7 toString()

```
const string HoldableAgent::toString ( ) const  [override], [virtual]
```

Returns a string representation of this class, useful to print it to the console or in a file.

Returns

a string representation of this class, useful to print it to the console or in a file.

Implements Agent.

Reimplemented in MobilePhone, and Tablet.

6.10.4.8 tryConnect()

```
virtual bool HoldableAgent::tryConnect ( )  [pure virtual]
```

Called when a device wants to connect to an antenna

Returns

true if the connection succeeds, false otherwise.

Implemented in MobilePhone, and Tablet.

6.10.5 Member Data Documentation

6.10.5.1 m_antennas

`vector<Antenna*> HoldableAgent::m_antennas [private]`

6.10.5.2 m_holder

`Agent* HoldableAgent::m_holder [private]`

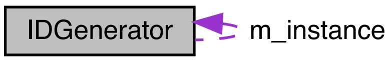
The documentation for this class was generated from the following file:

- include/HoldableAgent.h

6.11 IDGenerator Class Reference

`#include <IDGenerator.h>`

Collaboration diagram for IDGenerator:



Public Member Functions

- unsigned long next ()

Static Public Member Functions

- static IDGenerator ∗ instance ()

Private Member Functions

- IDGenerator ()

Private Attributes

- unsigned long m_id

Static Private Attributes

- static IDGenerator ∗ m_instance

6.11.1 Detailed Description

This singleton class is used to generate unique identifiers for all agents in the simulation. The ids are unsigned long integers.

6.11.2 Constructor & Destructor Documentation

6.11.2.1 IDGenerator()

```
IDGenerator::IDGenerator ( )  [inline], [private]
```

6.11.3 Member Function Documentation

6.11.3.1 instance()

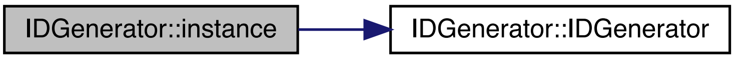
```
static IDGenerator∗ IDGenerator::instance ( )  [inline], [static]
```

Returns an instance of this class.

Returns

an instance of this class.

Here is the call graph for this function:



6.11.3.2 next()

```
unsigned long IDGenerator::next ( )  [inline]
```

Generates the next unique identifier.

Returns

a unique identifier.

6.11.4 Member Data Documentation

6.11.4.1 m_id

```
unsigned long IDGenerator::m_id  [private]
```

6.11.4.2 m_instance

```
IDGenerator* IDGenerator::m_instance  [static], [private]
```

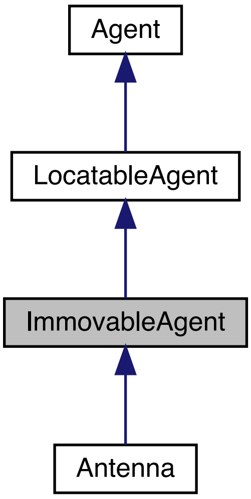
The documentation for this class was generated from the following file:

- include/IDGenerator.h

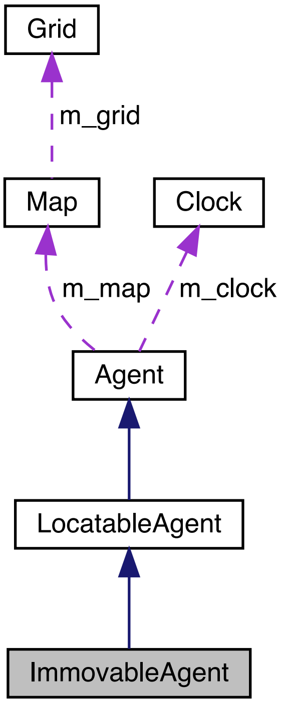
6.12 ImmovableAgent Class Reference

```
#include <ImmovableAgent.h>
```

Inheritance diagram for ImmovableAgent:



Collaboration diagram for ImmovableAgent:



Public Member Functions

- ImmovableAgent (const Map ∗m, const unsigned long id, Point ∗initialPosition, const Clock ∗clock)
- virtual ∼ImmovableAgent ()
- const string toString () const override
- const string getName () const override

6.12.1 Detailed Description

This is a class that represents an agent that can have a location on map but it cannot move. The only subclass of it is Antenna.

6.12.2 Constructor & Destructor Documentation

6.12.2.1 ImmovableAgent()

```
ImmovableAgent::ImmovableAgent (
            const Map * m,
            const unsigned long id,
            Point * initialPosition,
            const Clock * clock )  [explicit]
```

Constructor of the class. Build an ImmovableAgent object with the parameters provided by the user.

Parameters

m	a pointer to a Map object used in this simulation.
id	the id of this object.
initialPosition	the initial location on map.
clock	a pointer to a Clock object used in this simulation.

6.12.2.2 ∼ImmovableAgent()

```
virtual ImmovableAgent::∼ImmovableAgent ( )  [virtual]
```

Default destructor.

6.12.3 Member Function Documentation

6.12.3.1 getName()

```
const string ImmovableAgent::getName ( ) const  [override], [virtual]
```

Returns the name of this class.

Returns

the name of this class.

Implements Agent.

6.12.3.2 toString()

```
const string ImmovableAgent::toString ( ) const  [override], [virtual]
```

Builds a string representation of this class.

Returns

a string representation of this class. It is used to write details of the ImmovableAgent objects in a file or on console.

Implements Agent.

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

- include/ImmovableAgent.h

6.13 InputParser Class Reference

```
#include <InputParser.h>
```

Public Member Functions

- InputParser (int &argc, char ∗∗argv)
- const string & getCmdOption (const string &option) const
- bool cmdOptionExists (const string &option) const

Private Attributes

- vector< string > tokens

6.13.1 Detailed Description

Utility class used to parse the command line and extract the parameters and their values. An option is passed with a "-" sign in front of it. Example: $simulator -s simulation.xml -p persons Here -s and -p are options and simulation.xml and persons.xml are their corresponding values.

6.13.2 Constructor & Destructor Documentation

6.13.2.1 InputParser()

```
InputParser::InputParser (
             int & argc,
             char ** argv )
```

Constructor of the class.

Parameters

argc	the number of the arguments from the command line.
argv	an array with the parameters passed in the command line.

6.13.3 Member Function Documentation

6.13.3.1 cmdOptionExists()

```
bool InputParser::cmdOptionExists (
             const string & option ) const
```

Checks if an option was passed as a command line parameter.

Parameters

option	the option that we are checking.

Returns

true if the option is present in the command line, false otherwise.

6.13.3.2 getCmdOption()

```
const string& InputParser::getCmdOption (
             const string & option ) const
```

Returns the value of an option passed as a command line parameter.

Parameters

option	an option from the command line.

Returns

the value of the option passed as a command line parameter.

6.13.4 Member Data Documentation

6.13.4.1 tokens

```
vector<string> InputParser::tokens  [private]
```

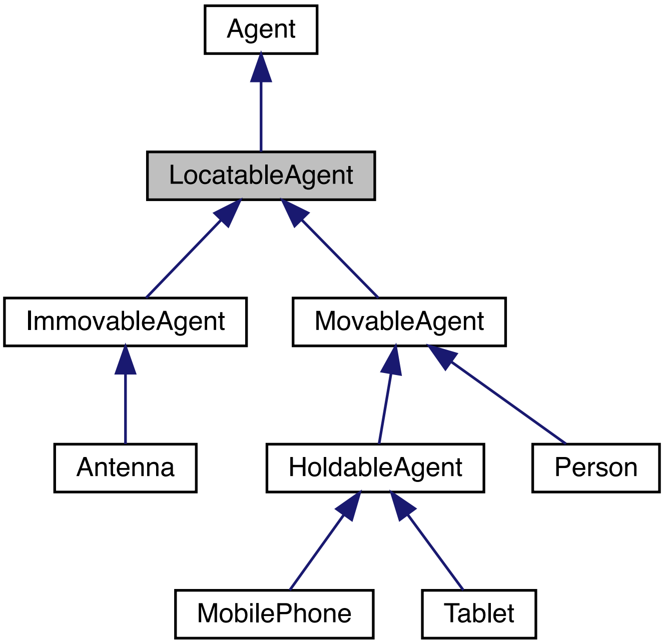
The documentation for this class was generated from the following file:

- include/InputParser.h

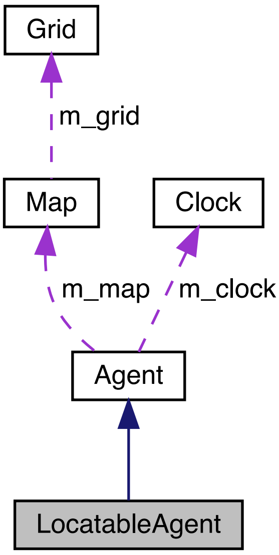
6.14 LocatableAgent Class Reference

```
#include <LocatableAgent.h>
```

Inheritance diagram for LocatableAgent:



Collaboration diagram for LocatableAgent:



Public Member Functions

- LocatableAgent (const Map ∗m, const unsigned long id, Point ∗initLocation, const Clock ∗clock)
- virtual ∼LocatableAgent ()
- const string getName () const override
- const string toString () const override
- virtual Point ∗ getLocation () const
- virtual void setLocation (Point ∗location)
- const string dumpLocation ()

Private Attributes

- Point ∗ m_location

6.14.1 Detailed Description

This class extends the Agent class and defines an object with a location on a map.

6.14.2 Constructor & Destructor Documentation

6.14.2.1 LocatableAgent()

```
LocatableAgent::LocatableAgent (
            const Map ∗ m,
            const unsigned long id,
            Point ∗ initLocation,
            const Clock ∗ clock )  [explicit]
```

Constructor of the class. Builds an object that has a location on the map of the simulation.

Parameters

m	a pointer to a Map object used in this simulation.
id	the id of the object.
initLocation	the initial location of the object.
clock	a pointer to a Clock object used in this simulation.

6.14.2.2 ∼LocatableAgent()

```
virtual LocatableAgent::∼LocatableAgent ( )  [virtual]
```

Destructor

6.14.3 Member Function Documentation

6.14.3.1 dumpLocation()

```
const string LocatableAgent::dumpLocation ( )
```

Builds a human readable string representation of the location

Returns

a human readable string representation of the location

6.14.3.2 getLocation()

```
virtual Point* LocatableAgent::getLocation ( ) const  [virtual]
```

Returns

the location on the map as a pointer to a Point object.

6.14.3.3 getName()

```
const string LocatableAgent::getName ( ) const  [override], [virtual]
```

Returns the name of this class.

Returns

the name of this class.

Implements Agent.

Reimplemented in MobilePhone, Person, MovableAgent, and Tablet.

6.14.3.4 setLocation()

```
virtual void LocatableAgent::setLocation (
             Point * location )  [virtual]
```

Sets the location of the agent on the map.

Parameters

location	the location of the agent on the map passed as a pointer to a Point object.

Reimplemented in Person, and HoldableAgent.

6.14.3.5 toString()

```
const string LocatableAgent::toString ( ) const  [override], [virtual]
```

Builds a human readable string representation of this class useful to output it to a file or on the screen.

Returns

a string representation of this class.

Implements Agent.

Reimplemented in Person, MobilePhone, MovableAgent, and Tablet.

6.14.4 Member Data Documentation

6.14.4.1 m_location

```
Point* LocatableAgent::m_location  [private]
```

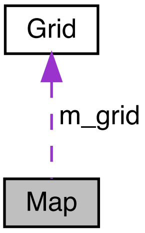
The documentation for this class was generated from the following file:

- include/LocatableAgent.h

6.15 Map Class Reference

```
#include <Map.h>
```

Collaboration diagram for Map:



Public Member Functions

- Map ()
- Map (double llX, double llY, double width, double height)
- Map (string wktFile)
- virtual ∼Map ()
- const GeometryFactory::Ptr & getGlobalFactory () const
- Geometry ∗ getBoundary () const
- void setBoundary (Geometry ∗boundary)
- const Grid ∗ getGrid () const
- void addGrid (double dimTileX, double dimTileY)

Private Member Functions

- Polygon ∗ create_rectangle (double llX, double llY, double width, double height)

Private Attributes

- GeometryFactory::Ptr m_globalFactory
- Geometry ∗ m_boundary
- Grid ∗ m_grid

6.15.1 Detailed Description

This is the map where the simulation takes place. It could be a simple rectangle or any kind of geometry object(s) read from a wkt file. The map has a boundary that is implemented as a Geometry object, a factory object of GeometryFactory type used to create other objects. All geometric and geographic features of the simulator uses the GEOS library. GEOS is an open source C++ library which is just a port to C++ of the well known Java Topology Suite.

6.15.2 Constructor & Destructor Documentation

6.15.2.1 Map() [1/3]

```
Map::Map ( )
```

Creates a map with a null boundary. The user may set the boundary later, using setBoundary() method.

6.15.2.2 Map() [2/3]

```
Map::Map (
            double llX,
            double llY,
            double width,
            double height )
```

Build a simple map of a rectangular shape.

Parameters

llX	X coordinate of the bottom left corner of the rectangle.
llY	Y coordinate of the bottom left corner of the rectangle.
width	the width of the rectangle.
height	the height of the rectangle.

6.15.2.3 Map() [3/3]

```
Map::Map (
             string wktFile )
```

Builds a map reading it from a .wkt file.

Parameters

wktFile	the name of the .wkt file that contains the description of the map. Currently, the first row of this file should contain the external boundary geometry of the map.

6.15.2.4 ∼Map()

```
virtual Map::∼Map ( )  [virtual]
```

Default destructor

6.15.3 Member Function Documentation

6.15.3.1 addGrid()

```
void Map::addGrid (
             double dimTileX,
             double dimTileY )
```

Adds a Grid that overlaps this Map objects.

Parameters

dimTileX	the dimension on OX of a tile of the Grid object.
dimTileY	the dimension on OY of a tile of the Grid object.

6.15.3.2 create_rectangle()

```
Polygon* Map::create_rectangle (
             double llX,
             double llY,
             double width,
             double height )  [private]
```

6.15.3.3 getBoundary()

```
Geometry* Map::getBoundary ( ) const
```

Returns a pointer to the Geometry object that represents the external boundary of the map.

Returns

a pointer to the Geometry object that represents the external boundary of the map.

6.15.3.4 getGlobalFactory()

```
const GeometryFactory::Ptr& Map::getGlobalFactory ( ) const
```

Returns a pointer to the GeometryFactory object which is a factory object used to create other geometric objects. The GEOS library allows users to create geometric objects only using this factory, all the constructors are made private.

Returns

a pointer to the GeometryFactory object used to create other geometric objects.

6.15.3.5 getGrid()

```
const Grid* Map::getGrid ( ) const
```

Returns a pointer to the Grid object associated with this Map. After creation of a Map the user should associate a Grid that overlaps this Map. The gird is used to compute the probability of the localization of different events during the simulation.

Returns

a pointer the Grid object associated with this Map.

6.15.3.6 setBoundary()

```
void Map::setBoundary (
             Geometry * boundary )
```

Sets the boundary of the Map object.

Parameters

boundary	the boundary of the Map object.

6.15.4 Member Data Documentation

6.15.4.1 m_boundary

```
Geometry* Map::m_boundary  [private]
```

6.15.4.2 m_globalFactory

```
GeometryFactory::Ptr Map::m_globalFactory  [private]
```

6.15.4.3 m_grid

```
Grid* Map::m_grid  [private]
```

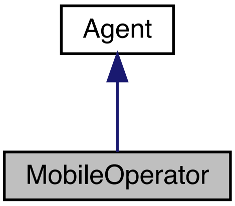
The documentation for this class was generated from the following file:

- include/Map.h

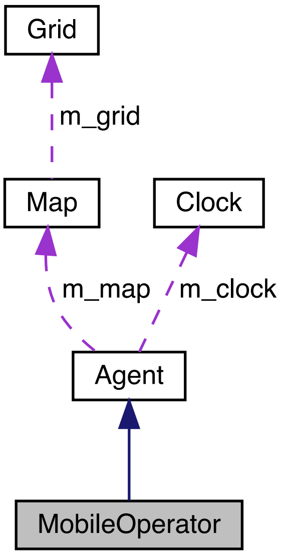
6.16 MobileOperator Class Reference

```
#include <MobileOperator.h>
```

Inheritance diagram for MobileOperator:



Collaboration diagram for MobileOperator:



Public Member Functions

- MobileOperator (const Map ∗m, const unsigned long id, const Clock ∗clock, const char ∗name, const double probMobilePhone)
- virtual ∼MobileOperator ()
- const string getName () const override
- const string toString () const override
- const string getMNOName () const
- const double getProbMobilePhone () const
- ofstream & getAntennaCellsFile ()
- ofstream & getSignalFile ()

Private Attributes

- const string m_name
- const double m_probMobilePhone
- ofstream m_antennaCellsFileName
- ofstream m_signalMeasureFileName

6.16.1 Detailed Description

This class represents a Mobile Operator company. Currently a simulation can be run with 1 or 2 mobile operators. A mobile operator own a set of antennas and has a set of mobile phone subscribed.

6.16.2 Constructor & Destructor Documentation

6.16.2.1 MobileOperator()

```
MobileOperator::MobileOperator (
            const Map * m,
            const unsigned long id,
            const Clock * clock,
            const char * name,
            const double probMobilePhone )
```

Constructor of this class. It builds a MobileOperator object with the characteristics provided by user through parameters. It builds a string representing the name of the file where the coverage area of all the antennas that belong to this MobileOperator are saved in .csv format and then open this file and writes the header of the file. The name of this file is built concatenating "AntennaCells_" with the name of the Mobile Operator. The extension of the file is ".csv". A line of this file contains the antenna id followed by a wkt text representing the coverage area of antenna. It also builds another string representing the name of a file where the signal quality values for all antennas that belong to this MobileOperator are saved. The signal quality is computed in the center of each tile of the Grid object set for a simulation. The file is opened and then it writes the header of the file. The name of this file is built concatenating "SignalQuality_" with the name of the Mobile Operator. The extension of the file is ".csv". A line of this file contains the antenna id followed by a set of values for the signal quality computed in the center of each tile of the grid.

Parameters

m	a pointer to a Map object where the simulation take place.
id	the id of the MobileOperator object.
clock	a pointer to a Clock object used for a simulation.
name	the name of the Mobile Operator.
probMobilePhone	represents the probability that a person will have a cell phone at this company.

6.16.2.2 ∼MobileOperator()

```
virtual MobileOperator::∼MobileOperator ( )  [virtual]
```

Default destructor.

6.16.3 Member Function Documentation

6.16.3.1 getAntennaCellsFile()

```
ofstream& MobileOperator::getAntennaCellsFile ( )
```

Returns

a file where the coverage area of all the antennas that belong to this MobileOperator are saved in csv format.

6.16.3.2 getMNOName()

```
const string MobileOperator::getMNOName ( ) const
```

The name of the Mobile Operator. It should be provided as a parameter to the constructor of the class.

Returns

The name of the Mobile Operator

6.16.3.3 getName()

```
const string MobileOperator::getName ( ) const  [override], [virtual]
```

Overrides the same method from the superclass.

Returns

the name of the class, i.e. "MobileOperator".

Implements Agent.

6.16.3.4 getProbMobilePhone()

```
const double MobileOperator::getProbMobilePhone ( ) const
```

The probability that a person will have a cell phone at this company. It should be provided as a parameter to the constructor of the class.

Returns

the probability that a person will have a cell phone at this company.

6.16.3.5 getSignalFile()

```
ofstream& MobileOperator::getSignalFile ( )
```

Returns

a file where the signal quality/strength/power values for all antennas belonging to this mobile Operator and all tiles of the grid are saved.

6.16.3.6 toString()

```
const string MobileOperator::toString ( ) const  [override], [virtual]
```

Overrides the same method from the superclass. It is used to write the characteristics of the Mobile Operator to a file or to console.

Returns

a string that describes the parameters of the MobieOperator.

Implements Agent.

6.16.4 Member Data Documentation

6.16.4.1 m_antennaCellsFileName

```
ofstream MobileOperator::m_antennaCellsFileName  [private]
```

6.16.4.2 m_name

```
const string MobileOperator::m_name  [private]
```

6.16.4.3 m_probMobilePhone

```
const double MobileOperator::m_probMobilePhone  [private]
```

6.16.4.4 m_signalMeasureFileName

```
ofstream MobileOperator::m_signalMeasureFileName  [private]
```

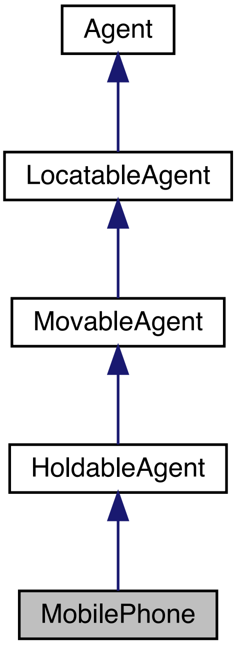
The documentation for this class was generated from the following file:

- include/MobileOperator.h

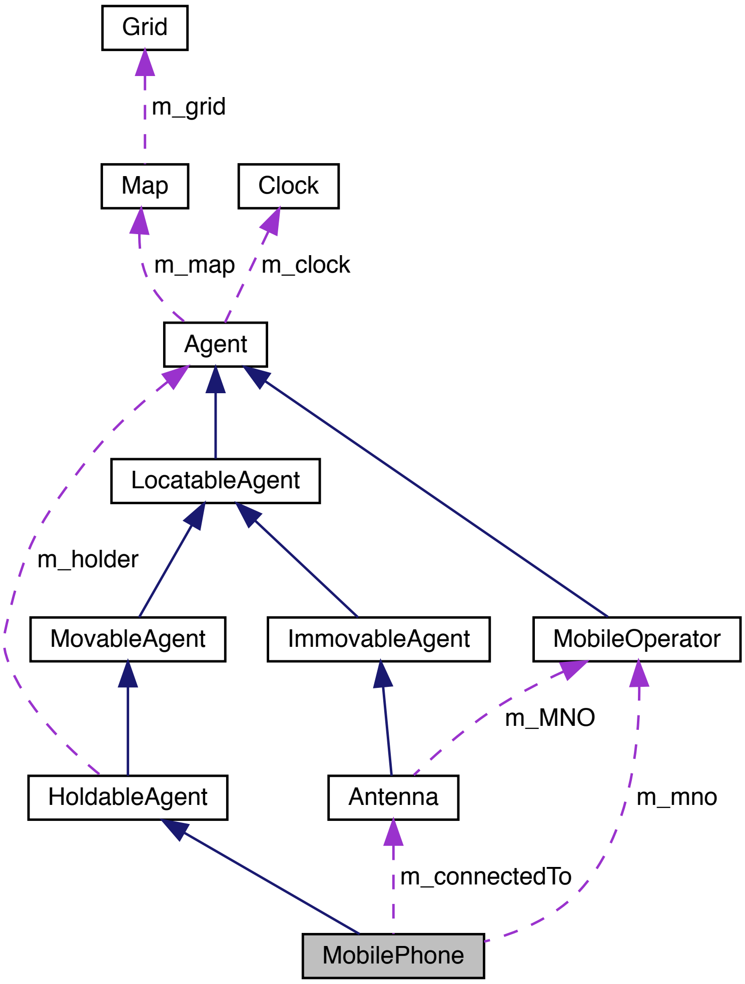
6.17 MobilePhone Class Reference

```
#include <MobilePhone.h>
```

Inheritance diagram for MobilePhone:



Collaboration diagram for MobilePhone:



Public Member Functions

- MobilePhone (const Map ∗m, const unsigned long id, Point ∗initPosition, Agent ∗holder, const Clock ∗clock, double threshold, HoldableAgent::CONNECTION_TYPE connType)
- virtual ∼MobilePhone ()
- const string getName () const override
- const string toString () const override
- Point ∗ move (MovementType mvType) override
- bool tryConnect () override
- const MobileOperator ∗ getMobileOperator () const
- void setMobileOperator (MobileOperator ∗mno)
- double getConnectionThreshold () const

Private Attributes

- double m_threshold
- Antenna ∗ m_connectedTo
- HoldableAgent::CONNECTION_TYPE m_connType
- MobileOperator ∗ m_mno

Additional Inherited Members

6.17.1 Detailed Description

This class represents a mobile phone. A mobile phone is own by a Person and it moves on the map together with its owner. While moving, at every time step it tries to connect to an antenna. The connection event is triggered by setLocation(). The connection to antenna is determined by the signal emitted by antennas. A parameter in the simulation configuration file set the criterion used to connect: the power of the signal, the signal strength or the signal quality.

6.17.2 Constructor & Destructor Documentation

6.17.2.1 MobilePhone()

```
MobilePhone::MobilePhone (
             const Map ∗ m,
             const unsigned long id,
             Point ∗ initPosition,
             Agent ∗ holder,
             const Clock ∗ clock,
             double threshold,
             HoldableAgent::CONNECTION_TYPE connType )  [explicit]
```

Builds a new MobilewPhone object with the parameters provided by the user.

Parameters

m	a pointer to the Map object where the simulation takes place.
id	the id of the mobile phone.
initPosition	the initial location of the phone on the map.
holder	a pointer to the Agent object that owns this mobile phone.
clock	a pointer to the Clock object used in this simulation.
threshold	the minimum power, signal qaulity or signal strength of the field below which the mobile phone cannot connect to an antenna.
connType	the criterion used for the connection to an antenna: based on the power of the signal or based on the signal quality. It could take three values: HoldableAgent::CONNECTION_TYPE::USING_POWER, HoldableAgent::CONNECTION_TYPE::USING_SIGNAL_QUALITY or HoldableAgent::CONNECTION_TYPE::USING_SIGNAL_STRENGTH.

6.17.2.2 ∼MobilePhone()

```
virtual MobilePhone::∼MobilePhone ( )  [virtual]
```

The default destructor.

6.17.3 Member Function Documentation

6.17.3.1 getConnectionThreshold()

```
double MobilePhone::getConnectionThreshold ( ) const
```

Returns the minimum value of the signal strength/power/quality below which the phone cannot use the signal (i.e. the signal is considered noise). The returned value is interpreted as signal strength, power or quality according to the connection type.

Returns

the minimum value of the signal strength/power/quality below which the phone cannot use the signal (i.e. the signal is considered noise).

6.17.3.2 getMobileOperator()

```
const MobileOperator* MobilePhone::getMobileOperator ( ) const
```

Returns the MobileOperator object of this mobile phone. Each MobilePhone should belong to a Mobile Operator.

Returns

the MobileOperator object of this mobile phone. Each MobilePhone should belong to a Mobile Operator.

6.17.3.3 getName()

```
const string MobilePhone::getName ( ) const  [override], [virtual]
```

Returns the name of this class.

Returns

the name of this class.

Reimplemented from HoldableAgent.

6.17.3.4 move()

```
Point* MobilePhone::move (
             MovementType mvType )  [inline], [override], [virtual]
```

Makes a step on the map according to an algorithm. The direction and the length of the step is determined by the mvType parameter and by the Person object who owns this phone.

Parameters

mvType	selects the way people and their phones are moving on the map. At this moment only RANDOM_WALK_CLOSED_MAP and RANDOM_WALK_CLOSED_MAP_WITH_DRIFT are implemented. RANDOM_WALK_CLOSED_MAP means that at each time instant the direction is generated as a uniformly distributed random value and the step length is computed multiplying the speed with the time interval set in the simulation configuration file. If a step projects it outside the map, it stops on the boundary. MovementType::RANDOM_WALK_CLOSED_MAP_WITH_DRIFT means that there is a preference in the direction of the movement. There are two constants defined, SIM_TREND_ANGLE_1 and SIM_TREND_ANGLE_2 (3PI/4 and 5PI/4), and in the first half of the simulation the direction is generated as a normal distributed random value with the mean equals to SIM_TREND_ANGLE_1 and sd = 0.1 while during the second half of the simulation it is generated as a normal distributed random value with the mean equals to SIM_TREND_ANGLE_2 and the same sd. Again, a MovableAgent can only move inside the map boundary. If a step projects it outside the map, it stops on the boundary.

Returns

the final location after the movement.

Implements MovableAgent.

6.17.3.5 setMobileOperator()

```
void MobilePhone::setMobileOperator (
            MobileOperator * mno )
```

Sets the MobileOperator object which owns this phone.

Parameters

mno	the MobileOperator object which owns this phone.

6.17.3.6 toString()

```
const string MobilePhone::toString ( ) const  [override], [virtual]
```

Returns a human readable string representation of this class useful to output it to a file or console.

Returns

a human readable string representation of this class.

Reimplemented from HoldableAgent.

6.17.3.7 tryConnect()

```
bool MobilePhone::tryConnect ( )  [override], [virtual]
```

This method is called after the phone moves (together with its owner) to a new location. It tries to connect the mobile phone to an antenna. The connection method is determined by inspecting the m_connType: using the power of the signal, using the quality of the signal or using the signal strength. The value of the m_connType is set by the constructor of the class. If the connection is successfully a pointer to the Antenna object where this mobile phone was connected is stored internally.

Returns

true if the connection succeeds, false otherwise.

Implements HoldableAgent.

6.17.4 Member Data Documentation

6.17.4.1 m_connectedTo

```
Antenna* MobilePhone::m_connectedTo  [private]
```

6.17.4.2 m_connType

```
HoldableAgent::CONNECTION_TYPE MobilePhone::m_connType  [private]
```

6.17.4.3 m_mno

```
MobileOperator* MobilePhone::m_mno  [private]
```

6.17.4.4 m_threshold

```
double MobilePhone::m_threshold  [private]
```

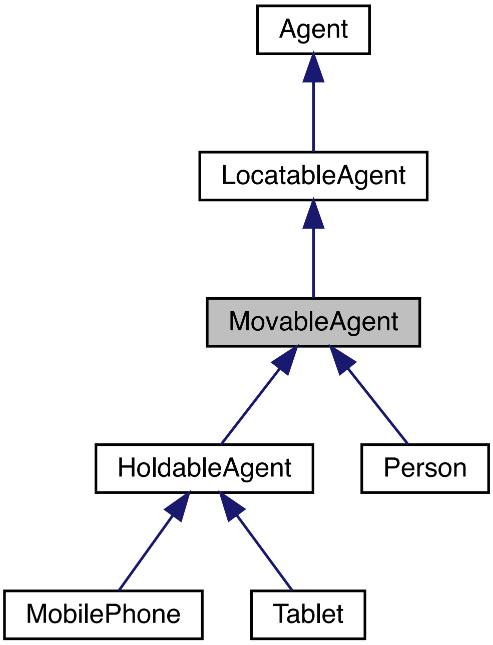
The documentation for this class was generated from the following file:

- include/MobilePhone.h

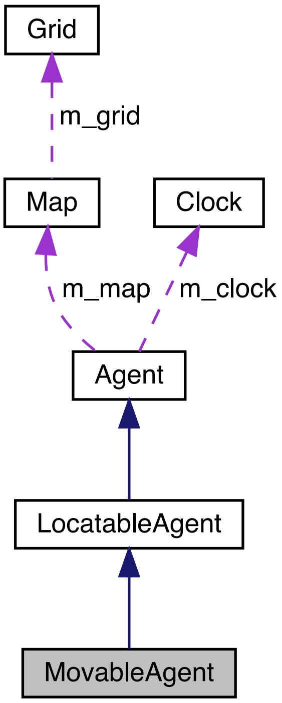
6.18 MovableAgent Class Reference

```
#include <MovableAgent.h>
```

Inheritance diagram for MovableAgent:



Collaboration diagram for MovableAgent:



Public Member Functions

- MovableAgent (const Map ∗m, const unsigned long id, Point ∗initPosition, const Clock ∗clock, double initSpeed)
- virtual ∼MovableAgent ()
- const string getName () const override
- const string toString () const override
- virtual Point ∗ move (MovementType type)=0
- double getSpeed () const
- void setSpeed (double speed)

Private Attributes

- double m_speed

6.18.1 Detailed Description

This class represents an Agent that can move inside the map. This is an abstract class. It is used as a base class for all agents that can move. Currently Person and MobilePhone classes inherits it and are already implemented.

6.18.2 Constructor & Destructor Documentation

6.18.2.1 MovableAgent()

```
MovableAgent::MovableAgent (
              const Map * m,
              const unsigned long id,
              Point * initPosition,
              const Clock * clock,
              double initSpeed )  [explicit]
```

Constructor of the class.

Parameters

m	a pointer to a Map object used by the simulation.
id	the id of the object.
initPosition	the initial location on map.
clock	a pointer to the Clock object used by this simulation.
initSpeed	the initial speed of the agent. Depending on the derived classes, this value could be read from a configuration file. For example, for the Person class, this value is specified in the persons.xml configuration file.

6.18.2.2 ∼MovableAgent()

```
virtual MovableAgent::∼MovableAgent ( )  [virtual]
```

The default destructor.

6.18.3 Member Function Documentation

6.18.3.1 getName()

```
const string MovableAgent::getName ( ) const  [override], [virtual]
```

Returns the name of the class.

Returns

the name of the class.

Reimplemented from LocatableAgent.

Reimplemented in Person, and Tablet.

6.18.3.2 getSpeed()

```
double MovableAgent::getSpeed ( ) const
```

Returns the speed of this agent.

Returns

the speed of this agent.

6.18.3.3 move()

```
virtual Point* MovableAgent::move (
             MovementType type )  [pure virtual]
```

A pure virtual method used to move the agent to a new location on the map.

Parameters

type	the type of the movement. At this moment there are two values accepted for this parameter: MovementType::RANDOM_WALK_CLOSED_MAP and MovementType::RANDOM_WALK_CLOSED_MAP_WITH_DRIFT. MovementType::RANDOM_WALK_CLOSED_MAP means that at each time instant, the direction is generated as a uniformly distributed random number and the step length is computed multiplying the speed with the time interval set in the simulation configuration file. The agent can only move inside the map boundary. If a step projects it outside the map, it stops on the boundary. MovementType::RANDOM_WALK_CLOSED_MAP_WITH_DRIFT means that there is a preference in the direction of the movement. There are two constants defined, SIM_TREND_ANGLE_1 and SIM_TREND_ANGLE_2 (3PI/4 and 5PI/4), and in the first half of the simulation the direction is generated as a normal distributed random value with the mean equals to SIM_TREND_ANGLE_1 and sd = 0.1 while during the second half of the simulation it is generated as a normal distributed random value with the mean equals to SIM_TREND_ANGLE_2 and the same sd. Again, a MovableAgent can only move inside the map boundary. If a step projects it outside the map, it stops on the boundary.

Returns

Implemented in Person, MobilePhone, and Tablet.

6.18.3.4 setSpeed()

```
void MovableAgent::setSpeed (
             double speed )
```

Sets the speed of this agent.

Parameters

speed	the speed of this agent.

6.18.3.5 toString()

```
const string MovableAgent::toString ( ) const  [override], [virtual]
```

Builds and returns a human readable string representation of the agent.

Returns

a human readable string representation of the agent.

Reimplemented from LocatableAgent.

Reimplemented in Person, and Tablet.

6.18.4 Member Data Documentation

6.18.4.1 m_speed

```
double MovableAgent::m_speed  [private]
```

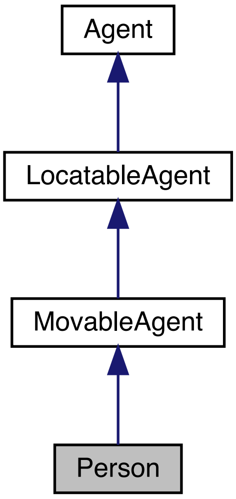
The documentation for this class was generated from the following file:

- include/MovableAgent.h

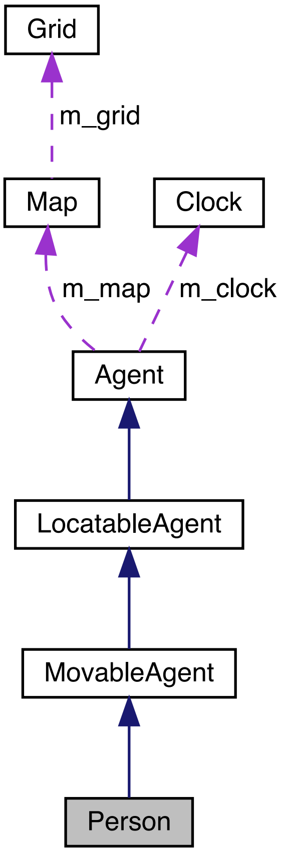
6.19 Person Class Reference

```
#include <Person.h>
```

Inheritance diagram for Person:



Collaboration diagram for Person:



Public Types

- enum Gender { MALE, FEMALE }
- enum AgeDistributions { NORMAL, UNIFORM }

Public Member Functions

- Person (const Map ∗m, const unsigned long id, Point ∗initPosition, const Clock ∗clock, double initSpeed, int age, Gender gender, unsigned long timeStay, unsigned long intervalBetweenStays)
- virtual ∼Person ()
- const string getName () const override
- const string toString () const override
- string dumpDevices ()
- bool hasDevices ()
- int getAge () const
- void setAge (int age)
- Point ∗ move (MovementType mvType) override
- virtual void setLocation (Point ∗pt) override

- void addDevice (string type, Agent ∗agent)
- Gender getGender () const
- unsigned long getAvgTimeStay () const
- unsigned long getAvgIntervalBetweenStays () const

Private Member Functions

- void randomWalkClosedMap ()
- void randomWalkClosedMapDrift ()
- Point ∗ generateNewLocation (double theta)
- void setNewLocation (Point ∗p, bool changeDirection)

Private Attributes

- int m_age
- Gender m_gender
- unordered_multimap< string, Agent ∗ > m_idDevices
- bool m_changeDirection
- unsigned long m_avgTimeStay
- unsigned long m_timeStay
- unsigned long m_avgIntervalBetweenStays
- unsigned long m_nextStay

6.19.1 Detailed Description

This class represents a person that can have 0,1 or 2 mobile phone(s). During the simulation the person move around the map, carrying his/her mobile devices.

6.19.2 Member Enumeration Documentation

6.19.2.1 AgeDistributions

```
enum Person::AgeDistributions
```

Enumerator

NORMAL	
UNIFORM	

6.19.2.2 Gender

```
enum Person::Gender
```

Enumerator

MALE	
FEMALE	

6.19.3 Constructor & Destructor Documentation

6.19.3.1 Person()

```
Person::Person (
            const Map * m,
            const unsigned long id,
            Point * initPosition,
            const Clock * clock,
            double initSpeed,
            int age,
            Gender gender,
            unsigned long timeStay,
            unsigned long intervalBetweenStays )  [explicit]
```

Builds a new Person object with the characteristics given as parameters.

Parameters

m	a pointer to the Map object where this Person move.
id	the id of the Person.
initPosition	the initial location of the person on the map.
clock	a pointer to a Clock object used for this simulation.
initSpeed	the initial speed of this person. It is provided in the configuration file.
age	the age of the person. The age is generated using a uniform or a normal distribution.
gender	the gender of the person.
timeStay	the average time of a stop
intervalBetweenStays	the average time between two consecutive stops.

6.19.3.2 ∼Person()

```
virtual Person::∼Person ( )  [virtual]
```

The default destructor.

6.19.4 Member Function Documentation

6.19.4.1 addDevice()

```
void Person::addDevice (
            string type,
            Agent * agent )
```

Add a mobile device to this person. Internally, all mobile devices are kept in an unordered_multimap as pairs <name of the device class, pointer to the device object>

Parameters

type	the name of the device's class.
agent	a pointer to the device object.

6.19.4.2 dumpDevices()

```
string Person::dumpDevices ( )
```

Builds a string containing a list with the ids of the mobile devices that this person owns.

Returns

a string containing a list with the ids of the mobile devices that this person owns.

6.19.4.3 generateNewLocation()

```
Point* Person::generateNewLocation (
            double theta )  [private]
```

6.19.4.4 getAge()

```
int Person::getAge ( ) const
```

Returns the age of the person.

Returns

the age of the person.

6.19.4.5 getAvgIntervalBetweenStays()

```
unsigned long Person::getAvgIntervalBetweenStays ( ) const
```

The average time interval between two stops. It is given in the simulation.xml configuration file.

Returns

The average time interval between two stops.

6.19.4.6 getAvgTimeStay()

```
unsigned long Person::getAvgTimeStay ( ) const
```

The average time interval a person stay in the same location. It is given in the simulation.xml configuration file.

Returns

the average time a person stay in the same location.

6.19.4.7 getGender()

```
Gender Person::getGender ( ) const
```

Returns the gender of the person.

Returns

the gender of the person.

6.19.4.8 getName()

```
const string Person::getName ( ) const [override], [virtual]
```

Returns the name of this class.

Returns

the name of this class.

Reimplemented from MovableAgent.

6.19.4.9 hasDevices()

```
bool Person::hasDevices ( )
```

returns true if this person has at least a mobile device, false otherwise.

Returns

6.19.4.10 move()

```
Point* Person::move (
            MovementType mvType )  [override], [virtual]
```

Move the person to another location. Computes the coordinates of the new location and then call setLocation() with this new coordinates.

Parameters

mvType	specifies the method used to compute the new position of the person, i.e. how the direction and the length of the step are computed. It can have the following values: RANDOM_WALK_CLOSED_MAP - the agent moves randomly inside the map boundary. The direction is generated as a random value at each time step and the step length is computed multiplying the speed with the time interval. RANDOM_WALK_CLOSED_MAP_WITH_DRIFT: the agent moves in a preferential direction. There are two constants defining these directions: SIM_TREND_ANGLE_1 and SIM_TREND_ANGLE_2 (3PI/4 and 5PI/4). The actual direction is generated as a normally distributed random value with means equals to these constants and sad = 0.1. In both cases, a Person makes several steps then a stop. The average time length of a stop is given is the simulation configuration file while the actual values are generated as normal distributed random values with the mean read from the configuration file and and sd = 20% from mean. The average time interval elapsed between two stop is read from the simulation configuration file and the actual values are generated as exponential distributed random values.

Returns

a pointer to a Point object that represents the new location.

Implements MovableAgent.

6.19.4.11 randomWalkClosedMap()

```
void Person::randomWalkClosedMap ( )  [private]
```

6.19.4.12 randomWalkClosedMapDrift()

```
void Person::randomWalkClosedMapDrift ( )  [private]
```

6.19.4.13 setAge()

```
void Person::setAge (
            int age )
```

Sets the age of the person.

Parameters

age	the age of the person.

6.19.4.14 setLocation()

```
virtual void Person::setLocation (
            Point * pt )  [override], [virtual]
```

Sets the location of the person on the map.

Parameters

pt	a pointer to a Point object that represent the location of the person on the map. If the person has mobile devices (phone, tablets) this function calls setLocation() for all mobile devices too.

Reimplemented from LocatableAgent.

6.19.4.15 setNewLocation()

```
void Person::setNewLocation (
            Point * p,
            bool changeDirection )  [private]
```

6.19.4.16 toString()

```
const string Person::toString ( ) const  [override], [virtual]
```

Builds and returns a human readable string representation of the person.

Returns

a human readable string representation of the person.

Reimplemented from MovableAgent.

6.19.5 Member Data Documentation

6.19.5.1 m_age

```
int Person::m_age  [private]
```

6.19.5.2 m_avgIntervalBetweenStays

```
unsigned long Person::m_avgIntervalBetweenStays  [private]
```

6.19.5.3 m_avgTimeStay

```
unsigned long Person::m_avgTimeStay  [private]
```

6.19.5.4 m_changeDirection

```
bool Person::m_changeDirection  [private]
```

6.19.5.5 m_gender

```
Gender Person::m_gender  [private]
```

6.19.5.6 m_idDevices

```
unordered_multimap<string, Agent*> Person::m_idDevices  [private]
```

6.19.5.7 m_nextStay

```
unsigned long Person::m_nextStay  [private]
```

6.19.5.8 m_timeStay

```
unsigned long Person::m_timeStay [private]
```

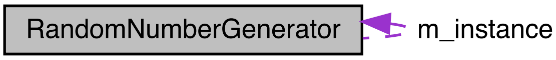
The documentation for this class was generated from the following file:

- include/Person.h

6.20 RandomNumberGenerator Class Reference

```
#include <RandomNumberGenerator.h>
```

Collaboration diagram for RandomNumberGenerator:



Public Member Functions

- double ∗ generateNormal2Double (const double m1, const double sd1, const double m2, const double sd2, int n)
- double generateNormalDouble (const double m, const double sd)
- double ∗ generateNormalDouble (const double m, const double sd, const int n)
- double ∗ generateTruncatedNormalDouble (const double a, const double b, const double m, const double sd, const unsigned long n)
- double generateUniformDouble (const double min, const double max)
- double ∗ generateUniformDouble (const double min, const double max, const int n)
- double generateExponentialDouble (const double lambda)
- int generateUniformInt (const int min, const int max)
- int ∗ generateUniformInt (const int min, const int max, const int n)
- int generateBinomialInt (const int max, const double p)
- int generateBernoulliInt (const double p)
- int ∗ generateBinomialInt (const int max, const double p, const int n)
- int ∗ generateBernoulliInt (const double p, const int n)
- double normal_pdf (double x, double m, double s)
- void setSeed (unsigned seed)

Static Public Member Functions

- static RandomNumberGenerator ∗ instance ()
- static RandomNumberGenerator ∗ instance (unsigned seed)

Private Member Functions

- RandomNumberGenerator ()
- RandomNumberGenerator (unsigned seed)
- RandomNumberGenerator (const RandomNumberGenerator &)
- RandomNumberGenerator & operator= (const RandomNumberGenerator &)

Private Attributes

- uniform_int_distribution< int > m_unif_int_distribution
- uniform_real_distribution< double > m_unif_double_distribution
- normal_distribution< double > m_normal_double_distribution
- exponential_distribution< double > m_exponential_double_distribution
- binomial_distribution< int > m_binomial_distribution
- bernoulli_distribution m_bernoulli_distribution
- std::mt19937 m_generator

Static Private Attributes

- static RandomNumberGenerator ∗ m_instance

6.20.1 Detailed Description

Utility singleton class to generate random numbers according to different distributions.

6.20.2 Constructor & Destructor Documentation

6.20.2.1 RandomNumberGenerator() [1/3]

```
RandomNumberGenerator::RandomNumberGenerator ( )  [private]
```

6.20.2.2 RandomNumberGenerator() [2/3]

```
RandomNumberGenerator::RandomNumberGenerator (
                unsigned seed )  [private]
```

6.20.2.3 RandomNumberGenerator() [3/3]

```
RandomNumberGenerator::RandomNumberGenerator (
                const RandomNumberGenerator &  )  [private]
```

6.20.3 Member Function Documentation

6.20.3.1 generateBernoulliInt() [1/2]

```
int RandomNumberGenerator::generateBernoulliInt (
            const double p )
```

Generates an int random value from a Bernoulli distribution.

Parameters

p	the parameter of the Bernoulli distribution.

Returns

an int random value from a Bernoulii distribution.

6.20.3.2 generateBernoulliInt() [2/2]

```
int* RandomNumberGenerator::generateBernoulliInt (
            const double p,
            const int n )
```

Generates n int random values from a Bernoulli distribution.

Parameters

p	the parameter of the Bernoulli distribution.
n	the number of values to be generated.

Returns

array with n int values from a Bernoulli distribution.

6.20.3.3 generateBinomialInt() [1/2]

```
int RandomNumberGenerator::generateBinomialInt (
            const int max,
            const double p )
```

Generates a int random value from a binomial distribution inside the interval [0, max].

Parameters

max	the upper limit of the value.
p	the parameter of the binomial distribution.

Returns

a int random value from a binomial distribution inside the interval [0, max].

6.20.3.4 generateBinomialInt() [2/2]

```
int* RandomNumberGenerator::generateBinomialInt (
            const int max,
            const double p,
            const int n )
```

Generates n int random values from a binomial distribution inside the interval [0, max].

Parameters

max	the upper limit of the value.
p	the parameter of the binomial distribution.
n	the number of values to be generated.

Returns

array with n int values from a binomial distribution.

6.20.3.5 generateExponentialDouble()

```
double RandomNumberGenerator::generateExponentialDouble (
            const double lambda )
```

Generates a random value distributed according to an exponential distribution with parameter lambda.

Parameters

lambda	the parameter of the exponential distribution.

Returns

a random value distributed according to an exponential distribution with parameter lambda.

6.20.3.6 generateNormal2Double()

```
double* RandomNumberGenerator::generateNormal2Double (
            const double m1,
            const double sd1,
            const double m2,
            const double sd2,
            int n )
```

Generates n random numbers with a normal distribution. Half of them are N(m1,sd1), the other half N(m2,sd2).

Parameters

m1	the mean of the first normal distribution.
sd1	the standard deviation of the first normal distribution.
m2	the mean of the second normal distribution.
sd2	the standard deviation of the second normal distribution.
n	the total number of values to be generated.

Returns

an array with random numbers according to two normal distributions.

6.20.3.7 generateNormalDouble() [1/2]

```
double RandomNumberGenerator::generateNormalDouble (
             const double m,
             const double sd )
```

Generates a random value, normally distributed with mean m and standard distribution sd

Parameters

m	the mean of the normal distribution.
sd	the standard deviation of the normal distribution.

Returns

a random value, normally distributed with mean m and standard distribution sd.

6.20.3.8 generateNormalDouble() [2/2]

```
double* RandomNumberGenerator::generateNormalDouble (
             const double m,
             const double sd,
             const int n )
```

Generates an array with n double values normally distributed with mean m and standard deviation sd.

Parameters

m	the mean of the normal distribution.
sd	the standard deviation of the normal distribution.
n	the number of values to be generated.

Returns

an array with n double values normally distributed with mean m and standard deviation sd.

6.20.3.9 generateTruncatedNormalDouble()

```
double* RandomNumberGenerator::generateTruncatedNormalDouble (
            const double a,
            const double b,
            const double m,
            const double sd,
            const unsigned long n )
```

Generates n double values from a truncated normal distribution. All values will be in [a, b].

Parameters

a	the inferior limit of the truncated normal distribution.
b	the superior limit of the truncated normal distribution.
m	the mean of the normal distribution.
sd	the standard deviation of the normal distribution.
n	the number of values to be generated.

Returns

an array with n double values from a truncated normal distribution.

6.20.3.10 generateUniformDouble() [1/2]

```
double RandomNumberGenerator::generateUniformDouble (
            const double min,
            const double max )
```

Generates a random double value from a uniform distribution which lies inside [min, max].

Parameters

min	the lower limit of the value.
max	the upper limit of the value.

Returns

a double value, uniformly distributed in [min, max].

6.20.3.11 generateUniformDouble() [2/2]

```
double* RandomNumberGenerator::generateUniformDouble (
            const double min,
            const double max,
            const int n )
```

Generates n uniform distributed random values which lie inside [min, max].

Parameters

min	the lower limit of the values.
max	the upper limit of the values.
n	the number of values to be generated.

Returns

n array with n double values from a uniform distribution.

6.20.3.12 generateUniformInt() [1/2]

```
int RandomNumberGenerator::generateUniformInt (
            const int min,
            const int max )
```

Generates a random int value from a uniform distribution which lies inside [min, max].

Parameters

min	the lower limit of the value.
max	the upper limit of the value.

Returns

an int value, uniformly distributed in [min, max].

6.20.3.13 generateUniformInt() [2/2]

```
int* RandomNumberGenerator::generateUniformInt (
            const int min,
            const int max,
            const int n )
```

Generates n uniform distributed random values which lie inside [min, max].

Parameters

min	the lower limit of the values.
max	the upper limit of the values.
n	the number of values to be generated.

Returns

an array with n int values from a uniform distribution.

6.20.3.14 instance() [1/2]

```
static RandomNumberGenerator* RandomNumberGenerator::instance ( )  [inline], [static]
```

Returns an instance of this class.

Returns

n instance of this class.

6.20.3.15 instance() [2/2]

```
static RandomNumberGenerator* RandomNumberGenerator::instance (
              unsigned seed )  [inline], [static]
```

Returns an instance of this class and also sets the seed of the random number generator.

Returns

n instance of this class.

6.20.3.16 normal_pdf()

```
double RandomNumberGenerator::normal_pdf (
              double x,
              double m,
              double s )
```

The value of the PDF of the normal distribution for x.

Parameters

x	the value for which we need the PDF.
m	the mean of the normal distribution.
s	the standard deviation of the normal distribution.

Returns

The value of the PDF of the normal distribution for x.

6.20.3.17 operator=()

```
RandomNumberGenerator& RandomNumberGenerator::operator= (
             const RandomNumberGenerator &  )  [private]
```

6.20.3.18 setSeed()

```
void RandomNumberGenerator::setSeed (
             unsigned seed )
```

Sets the seed of the random number generator.

Parameters

seed	

6.20.4 Member Data Documentation

6.20.4.1 m_bernoulli_distribution

```
bernoulli_distribution RandomNumberGenerator::m_bernoulli_distribution  [private]
```

6.20.4.2 m_binomial_distribution

```
binomial_distribution<int> RandomNumberGenerator::m_binomial_distribution  [private]
```

6.20.4.3 m_exponential_double_distribution

```
exponential_distribution<double> RandomNumberGenerator::m_exponential_double_distribution
[private]
```

6.20.4.4 m_generator

```
std::mt19937 RandomNumberGenerator::m_generator  [private]
```

6.20.4.5 m_instance

```
RandomNumberGenerator* RandomNumberGenerator::m_instance  [static], [private]
```

6.20.4.6 m_normal_double_distribution

```
normal_distribution<double> RandomNumberGenerator::m_normal_double_distribution  [private]
```

6.20.4.7 m_unif_double_distribution

```
uniform_real_distribution<double> RandomNumberGenerator::m_unif_double_distribution  [private]
```

6.20.4.8 m_unif_int_distribution

```
uniform_int_distribution<int> RandomNumberGenerator::m_unif_int_distribution  [private]
```

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

- include/RandomNumberGenerator.h

6.21 Row Class Reference

```
#include <CSVparser.hpp>
```

Public Member Functions

- Row (const vector< string > &header)
- ∼Row (void)
- unsigned int size (void) const
- void push (const string &value)
- bool set (const string &key, const string &value)
- template<typename T >
  const T getValue (unsigned int pos) const
- const string operator[ ] (unsigned int i) const
- const string operator[ ] (const string &valueName) const

Private Attributes

- const vector< string > _header
- vector< string > _values

Friends

- ostream & operator<< (ostream &os, const Row &row)
- ofstream & operator<< (ofstream &os, const Row &row)

6.21.1 Detailed Description

This class is used to represent a line from a .csv file. It is a container of the values from a line of text.

6.21.2 Constructor & Destructor Documentation

6.21.2.1 Row()

```
Row::Row (
            const vector< string > & header )
```

Constructor. It takes a a line of text representing the header of the csv file.

Parameters

header	the header line

6.21.2.2 ∼Row()

```
Row::∼Row (
            void )
```

Destructor.

6.21.3 Member Function Documentation

6.21.3.1 getValue()

```
template<typename T >
const T Row::getValue (
            unsigned int pos ) const  [inline]
```

Returns the value of an element from a row

Parameters

pos	the number of the element in row

Returns

the value

6.21.3.2 operator[]() [1/2]

```
const string Row::operator[] (
            unsigned int i ) const
```

Overloaded operator

Parameters

i	the position of the value that we want to extract

Returns

the value from position i

6.21.3.3 operator[]() [2/2]

```
const string Row::operator[] (
            const string & valueName ) const
```

Overloaded operator

Parameters

valueName	the name of the column from which we want to extract a the value

Returns

the value from the column specified by its name

6.21.3.4 push()

```
void Row::push (
            const string & value )
```

Add a new value on a row

Parameters

value	to be added

6.21.3.5 set()

```
bool Row::set (
            const string & key,
            const string & value )
```

Sets the value of a specific element in a row. The element is specified by the column name.

Parameters

key	the name of the column (given in the header of the file)
value	the value to be set

Returns

6.21.3.6 size()

```
unsigned int Row::size (
            void ) const
```

Returns the number of values on a row.

Returns

the number of values on a row.

6.21.4 Friends And Related Function Documentation

6.21.4.1 operator<< [1/2]

```
ostream& operator<< (
             ostream & os,
             const Row & row )  [friend]
```

Overloaded operator outputs the content of a row in a stream

Parameters

os	the stream where we want to send the content of the row.
row	the row that we want to output

Returns

the same output stream

6.21.4.2 operator<< [2/2]

```
ofstream& operator<< (
             ofstream & os,
             const Row & row )  [friend]
```

Overloaded operator outputs the content of a row in a file stream

Parameters

os	the file stream where we want to send the content of the row.
row	the row that we want to output

Returns

the same output file stream

6.21.5 Member Data Documentation

6.21.5.1 _header

```
const vector<string> Row::_header  [private]
```

6.21.5.2 _values

```
vector<string> Row::_values  [private]
```

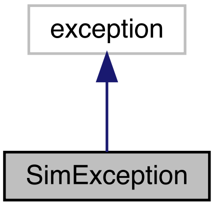
The documentation for this class was generated from the following file:

- include/CSVparser.hpp

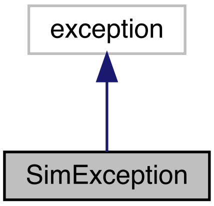
6.22 SimException Class Reference

```
#include <SimException.h>
```

Inheritance diagram for SimException:



Collaboration diagram for SimException:



Public Member Functions

- SimException (const char ∗msg)
- virtual const char ∗ what () const throw ()
- virtual ∼SimException ()

Private Attributes

- const char ∗ msg

6.22.1 Constructor & Destructor Documentation

6.22.1.1 SimException()

```
SimException::SimException (
             const char ∗ msg )
```

6.22.1.2 ∼SimException()

```
virtual SimException::∼SimException ( )  [virtual]
```

6.22.2 Member Function Documentation

6.22.2.1 what()

```
virtual const char∗ SimException::what ( ) const throw ( )   [virtual]
```

6.22.3 Member Data Documentation

6.22.3.1 msg

```
const char∗ SimException::msg  [private]
```

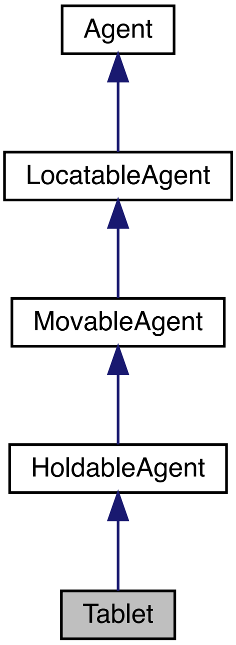
The documentation for this class was generated from the following file:

- include/SimException.h

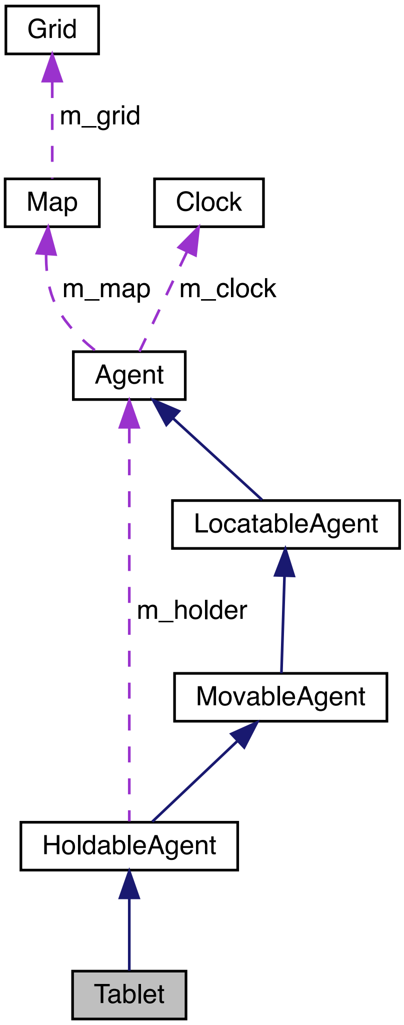
6.23 Tablet Class Reference

```
#include <Tablet.h>
```

Inheritance diagram for Tablet:



Collaboration diagram for Tablet:



Public Member Functions

- Tablet (const Map ∗m, const unsigned long id, Point ∗initPosition, const Clock ∗clock)
- virtual ∼Tablet ()
- const string getName () const override
- const string toString () const override
- Point ∗ move (MovementType type) override
- bool tryConnect () override

Additional Inherited Members

6.23.1 Constructor & Destructor Documentation

6.23.1.1 Tablet()

```
Tablet::Tablet (
            const Map * m,
            const unsigned long id,
            Point * initPosition,
            const Clock * clock ) [explicit]
```

Builds a new Tablet object with the parameters provided by the user.

Parameters

m	a pointer to a Map object used for simulation.
id	the id of the tablet.
initPosition	the initial location on map.
clock	a pointer to a Clock object used for simulation..

6.23.1.2 ∼Tablet()

```
virtual Tablet::∼Tablet ( ) [virtual]
```

The default destructor.

6.23.2 Member Function Documentation

6.23.2.1 getName()

```
const string Tablet::getName ( ) const [override], [virtual]
```

Returns the name of this class.

Returns

the name of this class.

Reimplemented from HoldableAgent.

6.23.2.2 move()

```
Point* Tablet::move (
            MovementType type ) [inline], [override], [virtual]
```

This method is called to move the tablet (actually the person who own this tablet move) to another location on the map.

Parameters

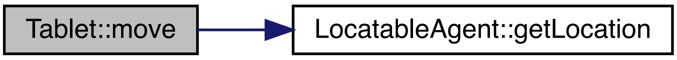
type	the method used to compute the new location. For details see MovableAgent::move() and Person::move().

Returns

a pointer to a Point object representing the new location on the map.

Implements MovableAgent.

Here is the call graph for this function:



6.23.2.3 toString()

```
const string Tablet::toString ( ) const  [override], [virtual]
```

Builds a human readable representation of this class.

Returns

a human readable representation of this class.

Reimplemented from HoldableAgent.

6.23.2.4 tryConnect()

```
bool Tablet::tryConnect ( )  [override], [virtual]
```

Called after the tablet changes location on the map, tries to connect to an antenna.

Returns

true if the connection succeeds, false otherwise.

Implements HoldableAgent.

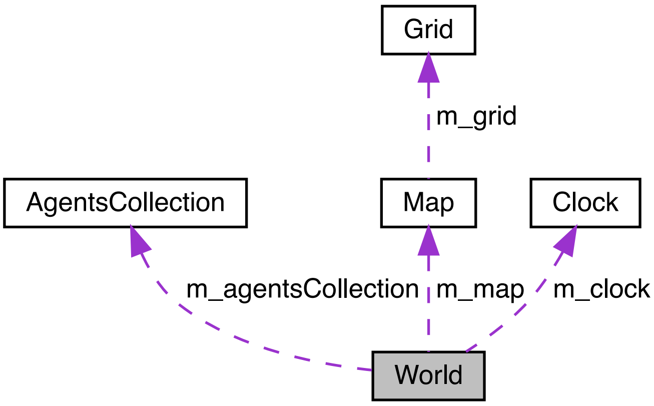
The documentation for this class was generated from the following file:

- include/Tablet.h

6.24 World Class Reference

```
#include <World.h>
```

Collaboration diagram for World:



Public Member Functions

- World (Map ∗map, int numPersons, int numAntennas, int numMobilePhones)
- World (Map ∗map, const string &configPersonsFileName, const string &configAntennasFileName, const string &configSimulationFileName, const string &probabilitiesFileName) noexcept(false)
- virtual ∼World ()
- void runSimulation () noexcept(false)
- AgentsCollection ∗ getAgents () const
- void setAgents (AgentsCollection ∗agents)
- Clock ∗ getClock () const
- void setClock (Clock ∗clock)
- const Map ∗ getMap () const
- void setMap (Map ∗map)
- const string & getGridFilename () const
- map< const unsigned long, const string > getProbFilenames () const
- const string & getAntennasFilename () const
- const string & getPersonsFilename () const
- double getGridDimTileX () const
- double getGridDimTileY () const
- PriorType getPrior () const
- HoldableAgent::CONNECTION_TYPE getConnectionType () const

Private Member Functions

- vector< Person * > generatePopulation (unsigned long numPersons, double percentHome)
- vector< Person * > generatePopulation (const unsigned long numPersons, vector< double > params, Person::AgeDistributions age_distribution, double male_share, vector< MobileOperator * > mnos, double speed_walk, double speed_car, double percentHome)
- vector< Antenna * > generateAntennas (unsigned long numAntennas)
- vector< Antenna * > parseAntennas (const string &configAntennasFile, vector< MobileOperator * > mnos) noexcept(false)
- vector< Person * > parsePersons (const string &personsFileName, vector< MobileOperator * > mnos) noexcept(false)
- vector< MobilePhone * > generateMobilePhones (int numMobilePhones, HoldableAgent::CONNECTION_TYPE connType)
- vector< MobileOperator * > parseSimulationFile (const string &configSimulationFileName) noexcept(false)
- int whichMNO (vector< pair< string, double >> probs, vector< MobileOperator * > mnos)
- string parseProbabilities (const string &probabilitiesFileName)
- double getDefaultConnectionThreshold (HoldableAgent::CONNECTION_TYPE connType)

Private Attributes

- Map * m_map
- AgentsCollection * m_agentsCollection
- Clock * m_clock
- unsigned long m_startTime
- unsigned long m_endTime
- unsigned long m_timeIncrement
- double m_GridDimTileX
- double m_GridDimTileY
- PriorType m_prior
- unsigned m_seed
- unsigned long m_stay
- unsigned m_intevalBetweenStays
- double m_connThreshold
- HoldableAgent::CONNECTION_TYPE m_connType
- MovementType m_mvType
- string m_gridFilename
- map< const unsigned long, const string > m_probFilenames
- string m_personsFilename
- string m_antennasFilename
- double m_probSecMobilePhone

6.24.1 Detailed Description

This is the class where the simulation process takes place. A World object has a Map, a Clock, a set of Agents than can be persons, mobile phones, antennas, mobile operators etc. After generating all the required objects for simulation by reading the parameters from the input configuration files runSimulation() method is called to perform the actual simulation. The output of the simulation process is written in several files. Antenna objects output their registered events in a .csv file and after the simulation ends, these files are merged in a single file that is used to compute the posterior localization probabilities for each mobile device. These probabilities are computed using a Grid that is overlapped on the Map, i.e. we compute the probability of a mobile phone to be in a tile of the grid. A finer the grid means more accurate localization but this come with an important computational cost.

6.24.2 Constructor & Destructor Documentation

6.24.2.1 World() [1/2]

```
World::World (
            Map * map,
            int numPersons,
            int numAntennas,
            int numMobilePhones )
```

Builds a new World object, randomly generating a set of persons, antennas and mobile devices with the default parameters. This class is used only for testing and developing new features. For a real simulation the user should build the Wolrd object using the other constructor that takes the name of the input files as params.

Parameters

map	a pointer to a Map object where the simulation takes place.
numPersons	the number of persons to be generated.
numAntennas	the number of antennas to be generated.
numMobilePhones	the number of mobile phones to be generated. These phones are randomly given to persons.

6.24.2.2 World() [2/2]

```
World::World (
            Map * map,
            const string & configPersonsFileName,
            const string & configAntennasFileName,
            const string & configSimulationFileName,
            const string & probabilitiesFileName )  [noexcept]
```

Builds a new World object, reading the parameters for the Persons, Antennas and Mobile Phones from configuration files. The configuration files are in XML format and they should be provided as command line parameters. The general parameters of the simulation (duration, how people move around the map, how mobile phone try to connect to antennas, etc. are also read from a configuration file:

- the persons configuration file is provided through the -p parameter in the command line.
- the antennas configuration file is provided through the -a parameter in the command line.
- the simulation configuration file is provided through the -s parameter in the command line.
- the posterior probabilities configuration file is provided through the -pb parameter in the command line.

Parameters

map	a pointer to a Map object where the simulation takes place
configPersonsFileName	the configuration file name for the persons objects.
configAntennasFileName	the configuration file name for antenna objects.
configSimulationFileName	the general configuration file for a simulation.
probabilitiesFileName	the config file for the posterior location probabilites.

6.24.2.3 ∼World()

```
virtual World::∼World ( )  [virtual]
```

Destructor It releases the memory allocated for the agents collection and the Clock object.

6.24.3 Member Function Documentation

6.24.3.1 generateAntennas()

```
vector<Antenna*> World::generateAntennas (
             unsigned long numAntennas )  [private]
```

6.24.3.2 generateMobilePhones()

```
vector<MobilePhone*> World::generateMobilePhones (
             int numMobilePhones,
             HoldableAgent::CONNECTION_TYPE connType )  [private]
```

6.24.3.3 generatePopulation() [1/2]

```
vector<Person*> World::generatePopulation (
             unsigned long numPersons,
             double percentHome )  [private]
```

6.24.3.4 generatePopulation() [2/2]

```
vector<Person*> World::generatePopulation (
             const unsigned long numPersons,
             vector< double > params,
             Person::AgeDistributions age_distribution,
             double male_share,
             vector< MobileOperator * > mnos,
             double speed_walk,
             double speed_car,
             double percentHome )  [private]
```

6.24.3.5 getAgents()

```
AgentsCollection* World::getAgents ( ) const
```

Returns the AgentsCollection used in simulation.

Returns

a pointer to AgentsCollection object.

6.24.3.6 getAntennasFilename()

```
const string& World::getAntennasFilename ( ) const
```

Returns the name of the file where the antennas exact locations are saved for later analysis.

Returns

the name of the file where the antennas exact locations are saved for later analysis.

6.24.3.7 getClock()

```
Clock* World::getClock ( ) const
```

Returns a pointer to a Clock object used for simulation.

Returns

a pointer to a Clock object used for simulation.

6.24.3.8 getConnectionType()

```
HoldableAgent::CONNECTION_TYPE World::getConnectionType ( ) const
```

Returns the type of the handover mechanism

Returns

the type of the handover mechanism: HoldableAgent::CONNECTION_TYPE::USING_SIGNAL_QUALI↩ TY, HoldableAgent::CONNECTION_TYPE::USING_SIGNAL_STRENGTH, HoldableAgent::CONNECTION↩ _TYPE::USING_POWER

6.24.3.9 getDefaultConnectionThreshold()

```
double World::getDefaultConnectionThreshold (
             HoldableAgent::CONNECTION_TYPE connType )  [private]
```

6.24.3.10 getGridDimTileX()

```
double World::getGridDimTileX ( ) const
```

Returns the dimension of tiles on OX, this number is read from simulation configuration file.

Returns

the dimension of tiles on OX, this number is read from simulation configuration file.

6.24.3.11 getGridDimTileY()

```
double World::getGridDimTileY ( ) const
```

Returns the dimension of tiles on OY, this number is read from simulation configuration file.

Returns

the dimension of tiles on OY, this number is read from simulation configuration file.

6.24.3.12 getGridFilename()

```
const string& World::getGridFilename ( ) const
```

Returns the file name where the grid parameters are saved. They are needed for the visualization software.

Returns

the file name where the grid parameters are saved.

6.24.3.13 getMap()

```
const Map* World::getMap ( ) const
```

Returns a pointer to a Map object where the simulation takes place.

Returns

a pointer to a Map object where the simulation takes place.

6.24.3.14 getPersonsFilename()

```
const string& World::getPersonsFilename ( ) const
```

Returns the name of the file where the persons exact locations are saved for later analysis.

Returns

the name of the file where the persons exact locations are saved for later analysis.

6.24.3.15 getPrior()

```
PriorType World::getPrior ( ) const
```

Returns the type of the prior probability used to compute the posterior localization probability.

Returns

the type of the prior probability used to compute the posterior localization probability.

6.24.3.16 getProbFilenames()

```
map<const unsigned long, const string> World::getProbFilenames ( ) const
```

Returns the name of the file where the probabilities of mobile phones locations are saved.

Returns

the name of the file where the probabilities of mobile phones locations are saved.

6.24.3.17 parseAntennas()

```
vector<Antenna*> World::parseAntennas (
            const string & configAntennasFile,
            vector< MobileOperator * > mnos )  [private], [noexcept]
```

6.24.3.18 parsePersons()

```
vector<Person*> World::parsePersons (
            const string & personsFileName,
            vector< MobileOperator * > mnos )  [private], [noexcept]
```

6.24.3.19 parseProbabilities()

```
string World::parseProbabilities (
            const string & probabilitiesFileName )  [private]
```

6.24.3.20 parseSimulationFile()

```
vector<MobileOperator*> World::parseSimulationFile (
            const string & configSimulationFileName )  [private], [noexcept]
```

6.24.3.21 runSimulation()

```
void World::runSimulation ( )  [noexcept]
```

This method is called to perform the actual simulation. During the simulation it outputs the exact positions of all persons in a .csv file and the positions of antennas at the starting time of the simulation. A simulation means a number of time steps, at each step every person move to another position and after arriving at their new positions the mobile phones that they carry try to connect to one of the available antennas. The antennas record these events and output them in a file.

6.24.3.22 setAgents()

```
void World::setAgents (
            AgentsCollection * agents )
```

Sets the AgentsCollection to be used for simulation.

Parameters

agents	a pointer to AgentsCollection object.

6.24.3.23 setClock()

```
void World::setClock (
             Clock * clock )
```

Sets the Clock of the simulation.

Parameters

clock	a pointer to a Clock object used for simulation.

6.24.3.24 setMap()

```
void World::setMap (
             Map * map )
```

Sets the map where the simulation takes place.

Parameters

map	a pointer to a Map object where the simulation takes place.

6.24.3.25 whichMNO()

```
int World::whichMNO (
             vector< pair< string, double >> probs,
             vector< MobileOperator * > mnos )  [private]
```

6.24.4 Member Data Documentation

6.24.4.1 m_agentsCollection

```
AgentsCollection* World::m_agentsCollection  [private]
```

6.24.4.2 m_antennasFilename

```
string World::m_antennasFilename [private]
```

6.24.4.3 m_clock

```
Clock* World::m_clock [private]
```

6.24.4.4 m_connThreshold

```
double World::m_connThreshold [private]
```

6.24.4.5 m_connType

```
HoldableAgent::CONNECTION_TYPE World::m_connType [private]
```

6.24.4.6 m_endTime

```
unsigned long World::m_endTime [private]
```

6.24.4.7 m_GridDimTileX

```
double World::m_GridDimTileX [private]
```

6.24.4.8 m_GridDimTileY

```
double World::m_GridDimTileY [private]
```

6.24.4.9 m_gridFilename

```
string World::m_gridFilename [private]
```

6.24.4.10 m_intevalBetweenStays

```
unsigned World::m_intevalBetweenStays  [private]
```

6.24.4.11 m_map

```
Map* World::m_map  [private]
```

6.24.4.12 m_mvType

```
MovementType World::m_mvType  [private]
```

6.24.4.13 m_personsFilename

```
string World::m_personsFilename  [private]
```

6.24.4.14 m_prior

```
PriorType World::m_prior  [private]
```

6.24.4.15 m_probFilenames

```
map<const unsigned long, const string> World::m_probFilenames  [private]
```

6.24.4.16 m_probSecMobilePhone

```
double World::m_probSecMobilePhone  [private]
```

6.24.4.17 m_seed

```
unsigned World::m_seed  [private]
```

6.24.4.18 m_startTime

```
unsigned long World::m_startTime  [private]
```

6.24.4.19 m_stay

```
unsigned long World::m_stay  [private]
```

6.24.4.20 m_timeIncrement

```
unsigned long World::m_timeIncrement  [private]
```

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

- include/World.h

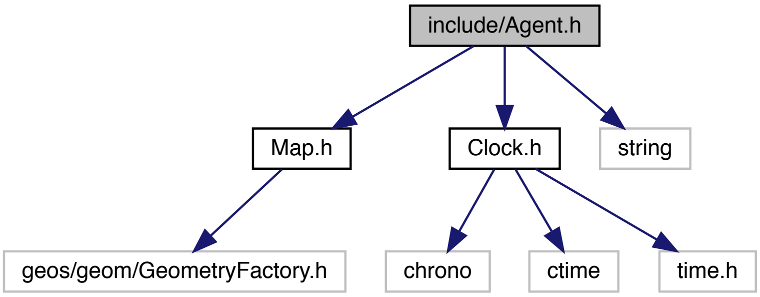
Chapter 7

File Documentation

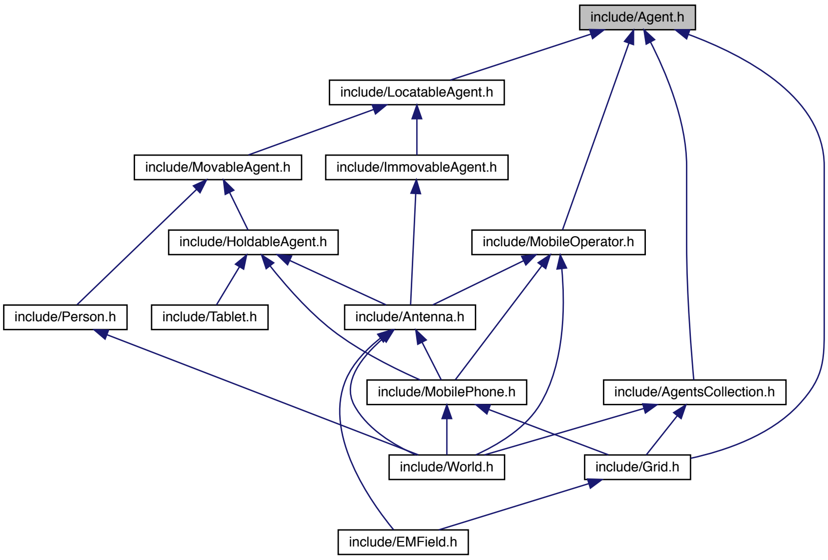
7.1 include/Agent.h File Reference

```
#include <Map.h>
#include <Clock.h>
#include <string>
```

Include dependency graph for Agent.h:



This graph shows which files directly or indirectly include this file:



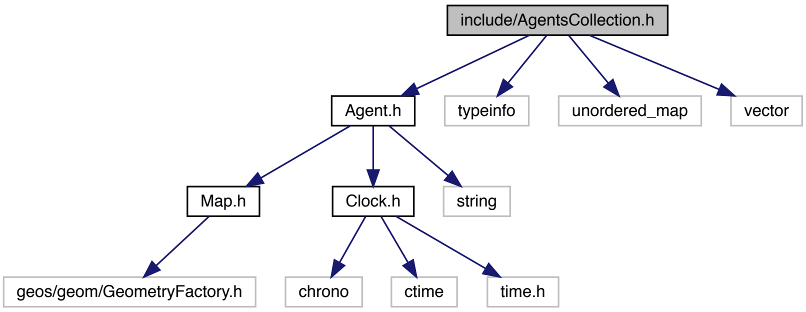
Classes

- class Agent

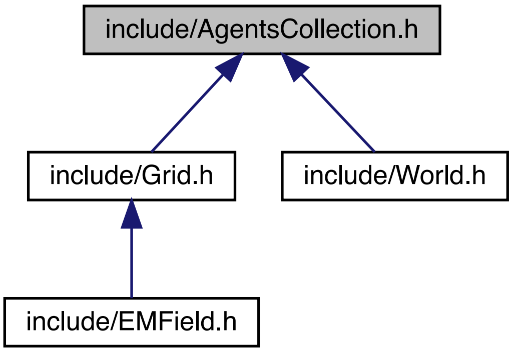
7.2 include/AgentsCollection.h File Reference

```
#include <Agent.h>
#include <typeinfo>
#include <unordered_map>
#include <vector>
```

Include dependency graph for AgentsCollection.h:



This graph shows which files directly or indirectly include this file:



Classes

- class AgentsCollection

Typedefs

- typedef unordered_multimap< string, Agent ∗ >::iterator um_iterator

7.2.1 Typedef Documentation

7.2.1.1 um_iterator

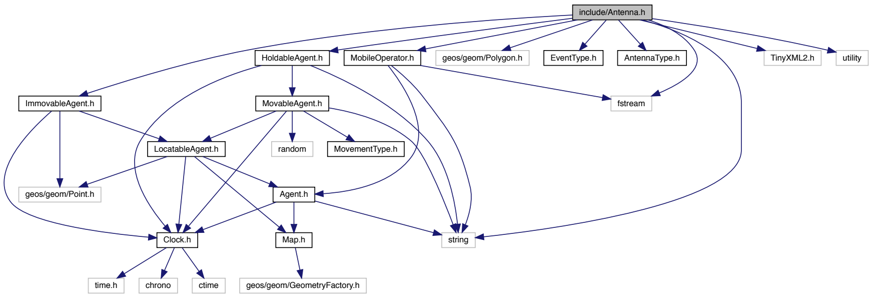
```
typedef unordered_multimap<string, Agent*>::iterator um_iterator
```

7.3 include/Antenna.h File Reference

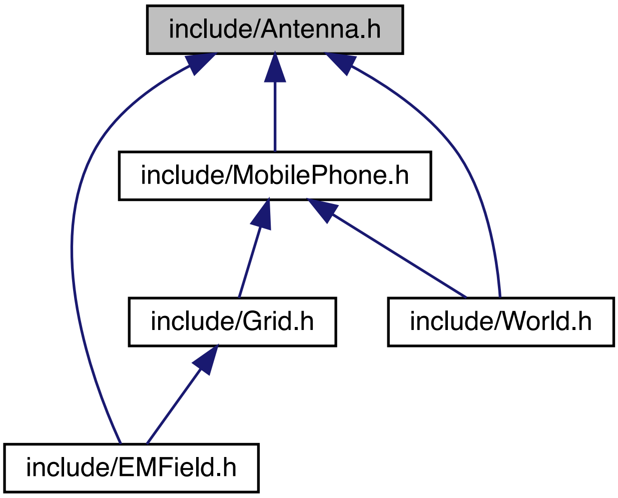
```
#include <ImmovableAgent.h>
#include <HoldableAgent.h>
#include <geos/geom/Polygon.h>
#include <EventType.h>
#include <AntennaType.h>
#include <MobileOperator.h>
#include <TinyXML2.h>
#include <string>
#include <fstream>
```

```
#include <utility>
```

Include dependency graph for Antenna.h:



This graph shows which files directly or indirectly include this file:



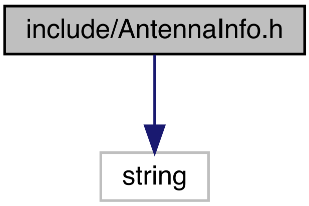
Classes

- class Antenna

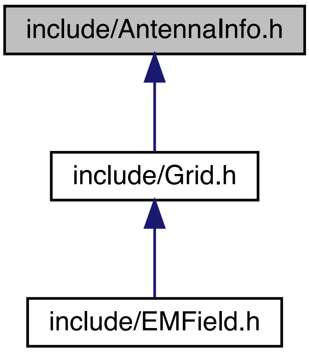
7.4 include/AntennaInfo.h File Reference

```
#include <string>
```

Include dependency graph for AntennaInfo.h:



This graph shows which files directly or indirectly include this file:

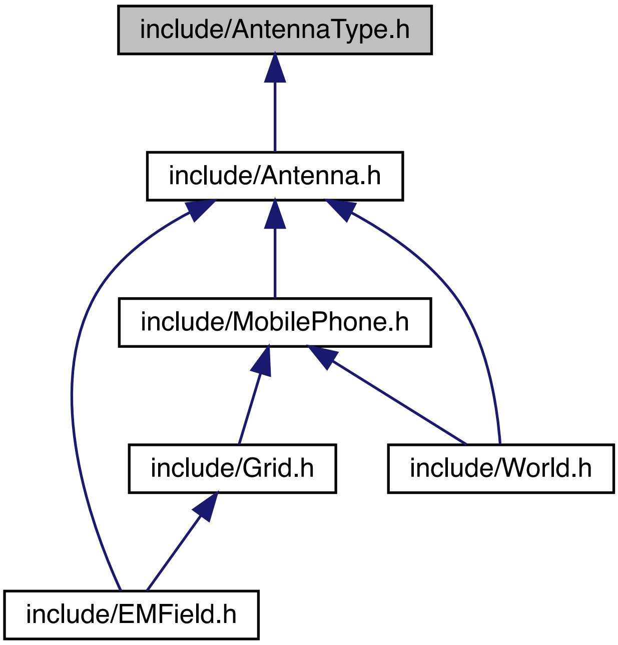


Classes

- class AntennaInfo

7.5 include/AntennaType.h File Reference

This graph shows which files directly or indirectly include this file:



Enumerations

- enum AntennaType { AntennaType::OMNIDIRECTIONAL, AntennaType::DIRECTIONAL }

7.5.1 Enumeration Type Documentation

7.5.1.1 AntennaType

```
enum AntennaType  [strong]
```

An enum class that is used to represent the type of an antenna. There are two types of antennas supported: omnidirectional and directional.

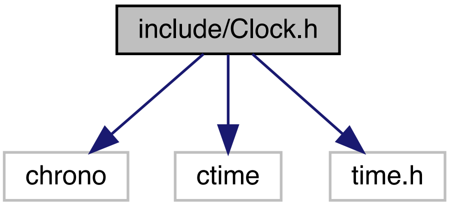
Enumerator

OMNIDIRECTIONAL	
DIRECTIONAL	

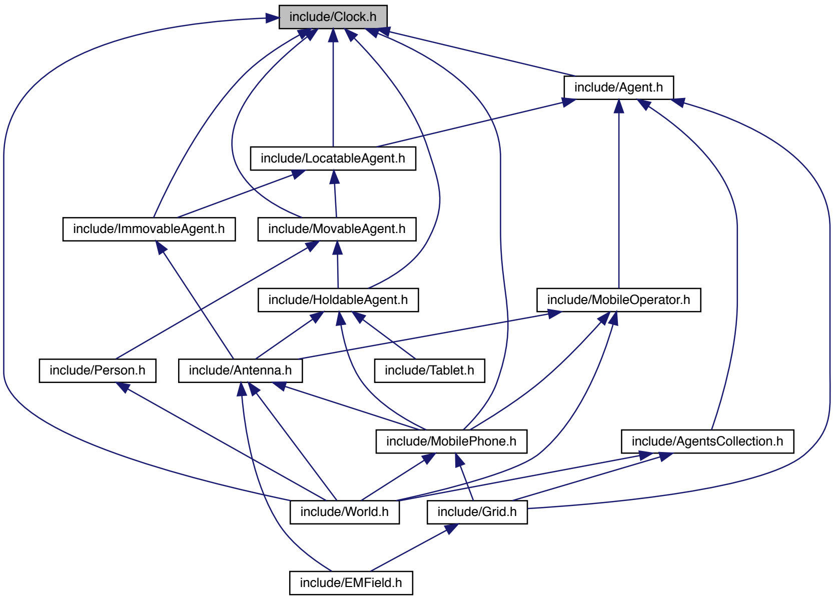
7.6 include/Clock.h File Reference

```
#include <chrono>
#include <ctime>
#include <time.h>
```

Include dependency graph for Clock.h:



This graph shows which files directly or indirectly include this file:



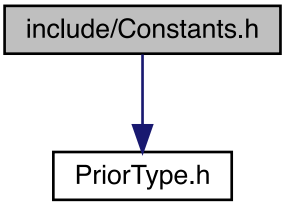
Classes

- class Clock

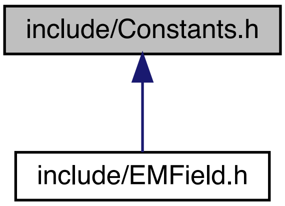
7.7 include/Constants.h File Reference

```
#include <PriorType.h>
```

Include dependency graph for Constants.h:



This graph shows which files directly or indirectly include this file:



Classes

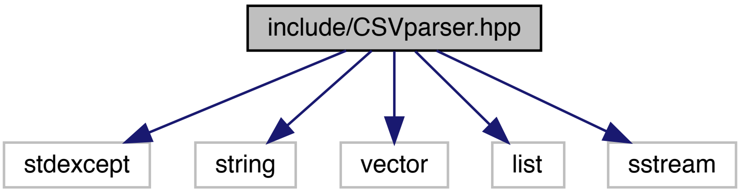
- class Constants

7.8 include/CSVparser.hpp File Reference

```
#include <stdexcept>
#include <string>
#include <vector>
#include <list>
```

```
#include <sstream>
```

Include dependency graph for CSVparser.hpp:



Classes

- class Row
- class CSVParser

Enumerations

- enum DataType { eFILE = 0, ePURE = 1 }

7.8.1 Enumeration Type Documentation

7.8.1.1 DataType

```
enum DataType
```

Enumerator

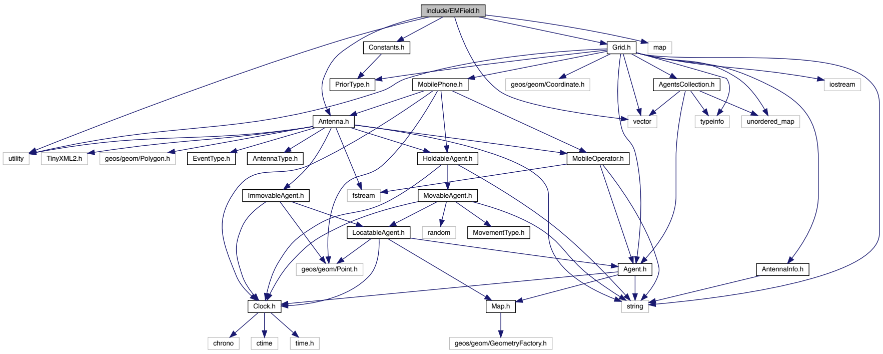
eFILE	
ePURE	

7.9 include/EMField.h File Reference

```
#include <Antenna.h>
#include <Constants.h>
#include <Grid.h>
#include <utility>
#include <vector>
```

```
#include <map>
```

Include dependency graph for EMField.h:

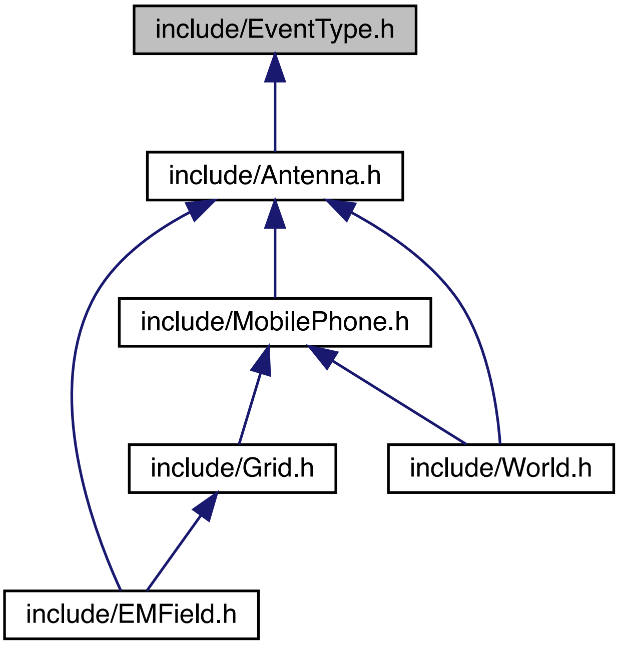


Classes

- class EMField

7.10 include/EventType.h File Reference

This graph shows which files directly or indirectly include this file:



Enumerations

- enum EventType { EventType::ATTACH_DEVICE, EventType::DETACH_DEVICE, EventType::ALREADY_ATTACHED_DEVIC
  EventType::IN_RANGE_NOT_ATTACHED_DEVICE }

7.10.1 Enumeration Type Documentation

7.10.1.1 EventType

```
enum EventType  [strong]
```

This class is an enumeration of network events currently registered: ATTACH_DEVICE - means that an antenna connects a new mobile device. DETACH_DEVICE - means that an antenna disconnects a mobile device, i.e. this mobile device is no longer connected to that antenna. ALREADY_ATTACHED_DEVICE - means that an antenna is connected with a mobile device and that mobile was connected to the same antenna in the previous time step too. IN_RANGE_NOT_ATTACHED_DEVICE - means that a mobile device tried to connect to an antenna, the antenna provided enough signal power/quality but the connection was not successful (for example antenna is at its maximum capacity and cannot connect any new devices).

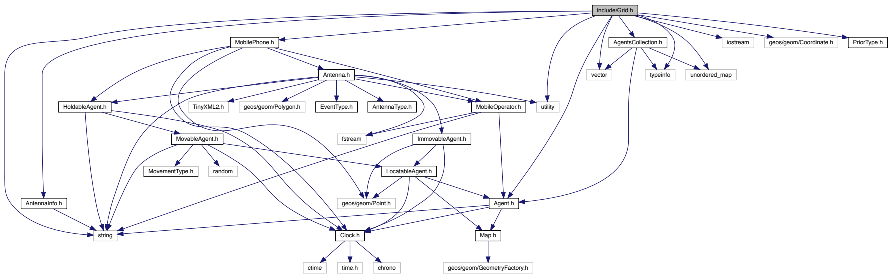
Enumerator

ATTACH_DEVICE	
DETACH_DEVICE	
ALREADY_ATTACHED_DEVICE	
IN_RANGE_NOT_ATTACHED_DEVICE	

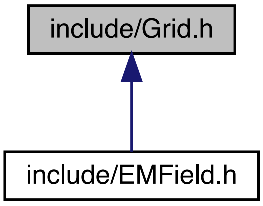
7.11 include/Grid.h File Reference

```
#include <string>
#include <iostream>
#include <vector>
#include <geos/geom/Coordinate.h>
#include <MobilePhone.h>
#include <AntennaInfo.h>
#include <Agent.h>
#include <AgentsCollection.h>
#include <typeinfo>
#include <unordered_map>
#include <utility>
#include <PriorType.h>
```

Include dependency graph for Grid.h:



This graph shows which files directly or indirectly include this file:



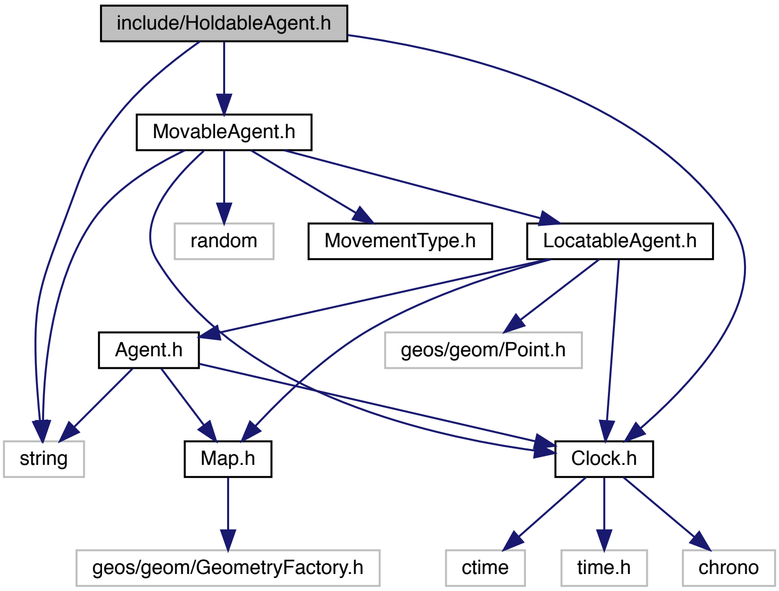
Classes

- class Grid

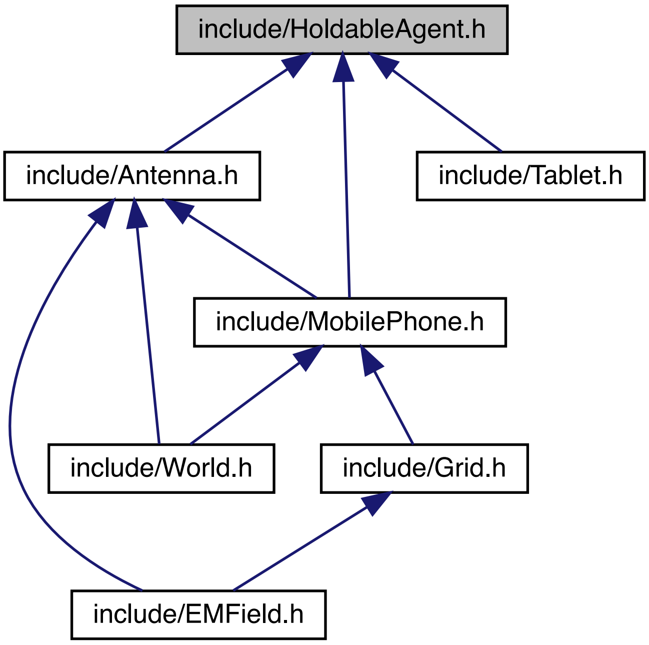
7.12 include/HoldableAgent.h File Reference

```
#include <MovableAgent.h>
#include <Clock.h>
#include <string>
```

Include dependency graph for HoldableAgent.h:



This graph shows which files directly or indirectly include this file:



Classes

- class HoldableAgent

7.13 include/IDGenerator.h File Reference

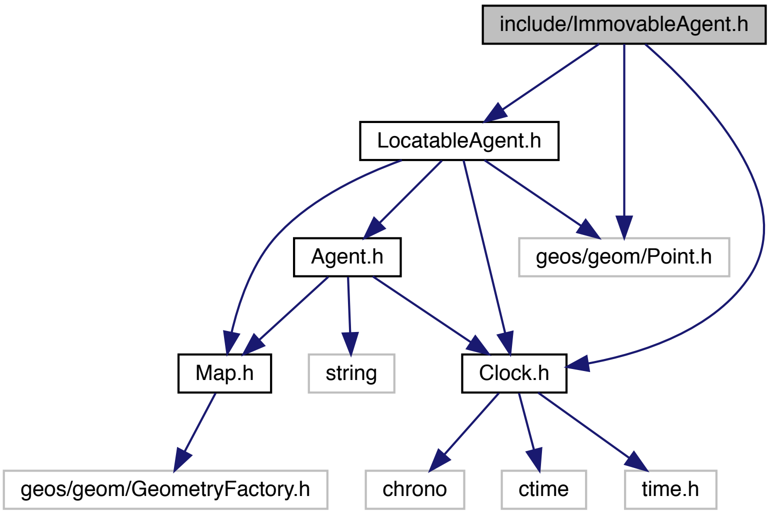
Classes

- class IDGenerator

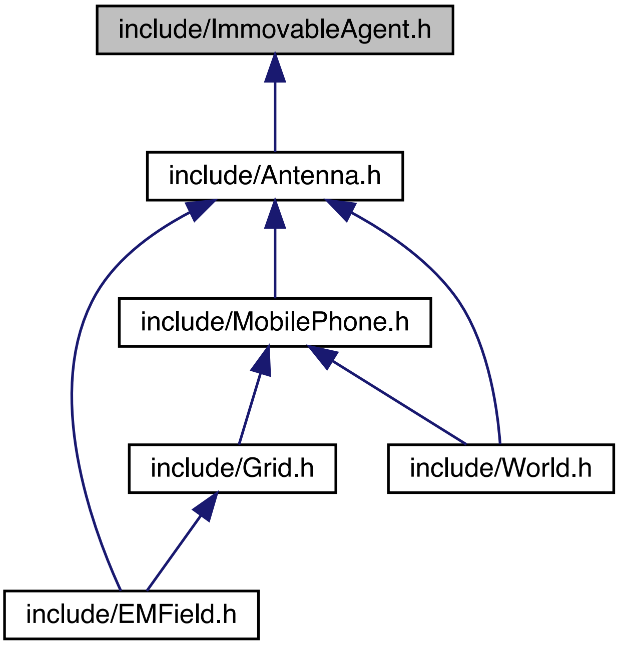
7.14 include/ImmovableAgent.h File Reference

```
#include "LocatableAgent.h"
#include <Clock.h>
#include <geos/geom/Point.h>
```

Include dependency graph for ImmovableAgent.h:



This graph shows which files directly or indirectly include this file:



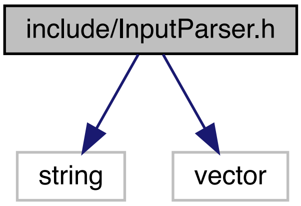
Classes

- class ImmovableAgent

7.15 include/InputParser.h File Reference

```
#include <string>
#include <vector>
```

Include dependency graph for InputParser.h:



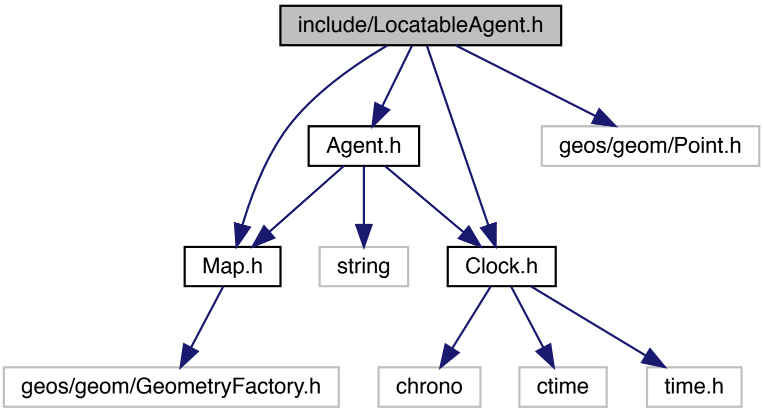
Classes

- class InputParser

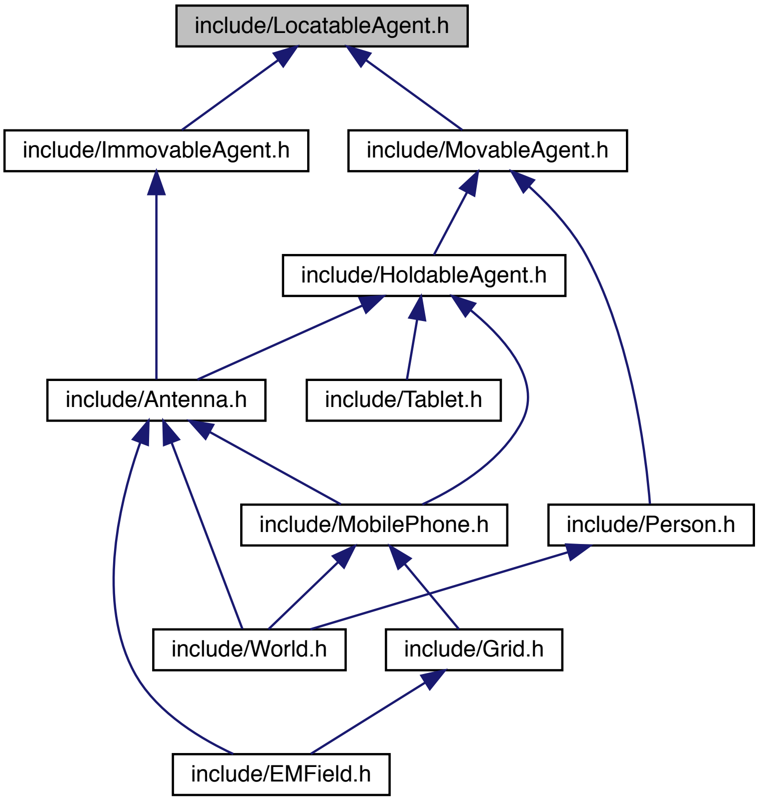
7.16 include/LocatableAgent.h File Reference

```
#include <Agent.h>
#include <Clock.h>
#include <Map.h>
#include <geos/geom/Point.h>
```

Include dependency graph for LocatableAgent.h:



This graph shows which files directly or indirectly include this file:



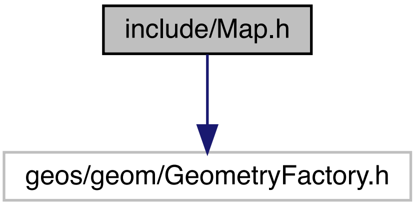
Classes

- class LocatableAgent

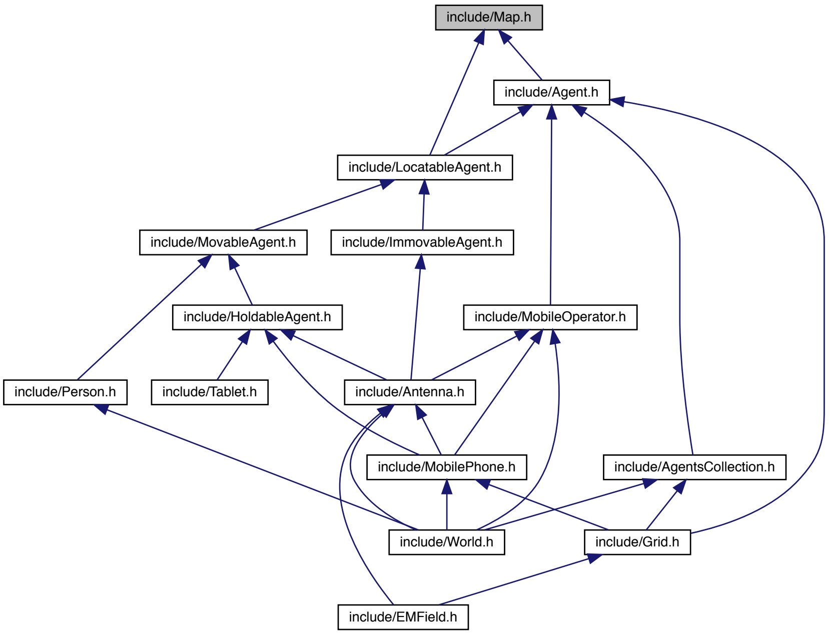
7.17 include/Map.h File Reference

```
#include <geos/geom/GeometryFactory.h>
```

Include dependency graph for Map.h:



This graph shows which files directly or indirectly include this file:



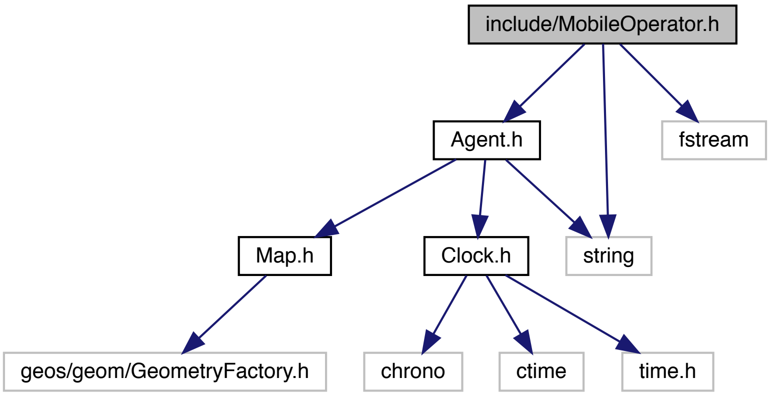
Classes

- class Map

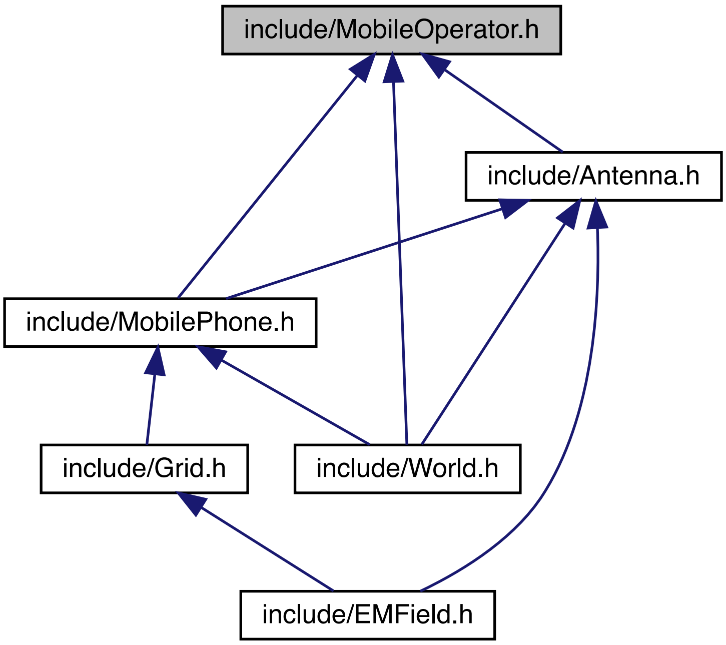
7.18 include/MobileOperator.h File Reference

```
#include <Agent.h>
#include <string>
#include <fstream>
```

Include dependency graph for MobileOperator.h:



This graph shows which files directly or indirectly include this file:



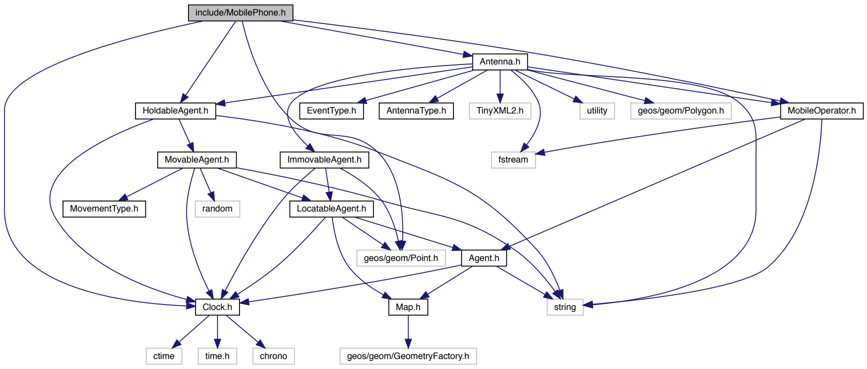
Classes

- class MobileOperator

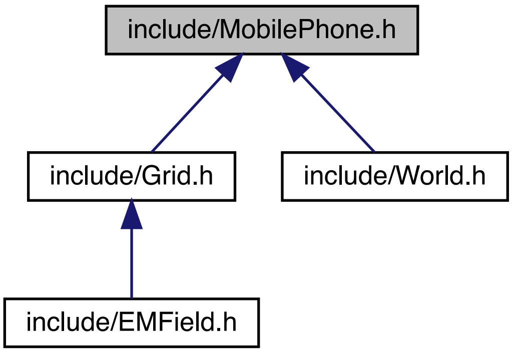
7.19 include/MobilePhone.h File Reference

```
#include <HoldableAgent.h>
#include <MobileOperator.h>
#include <Antenna.h>
#include <Clock.h>
#include <geos/geom/Point.h>
```

Include dependency graph for MobilePhone.h:



This graph shows which files directly or indirectly include this file:



Classes

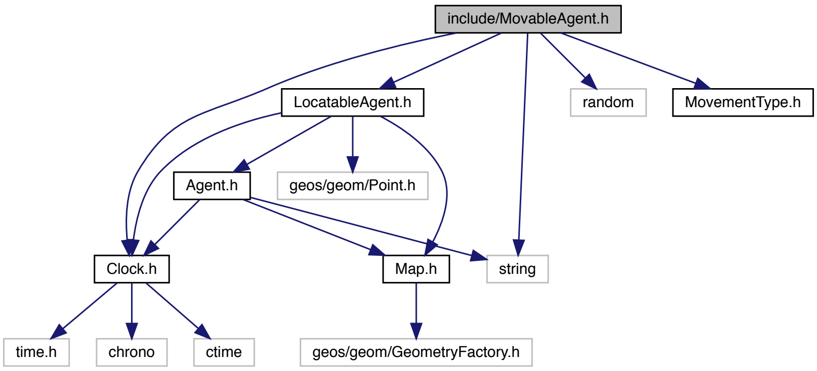
- class MobilePhone

7.20 include/MovableAgent.h File Reference

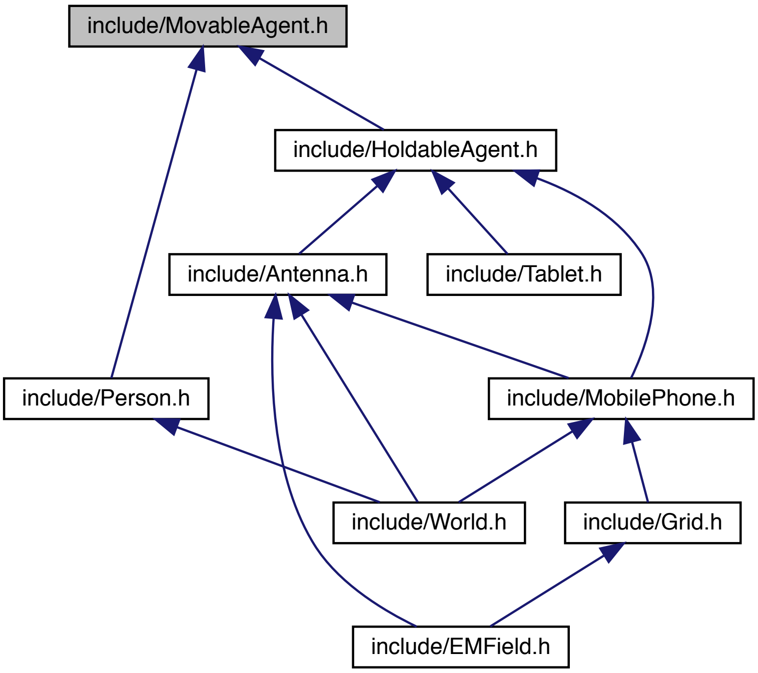
```
#include <LocatableAgent.h>
#include <Clock.h>
#include <random>
#include <MovementType.h>
```

```
#include <string>
```

Include dependency graph for MovableAgent.h:



This graph shows which files directly or indirectly include this file:

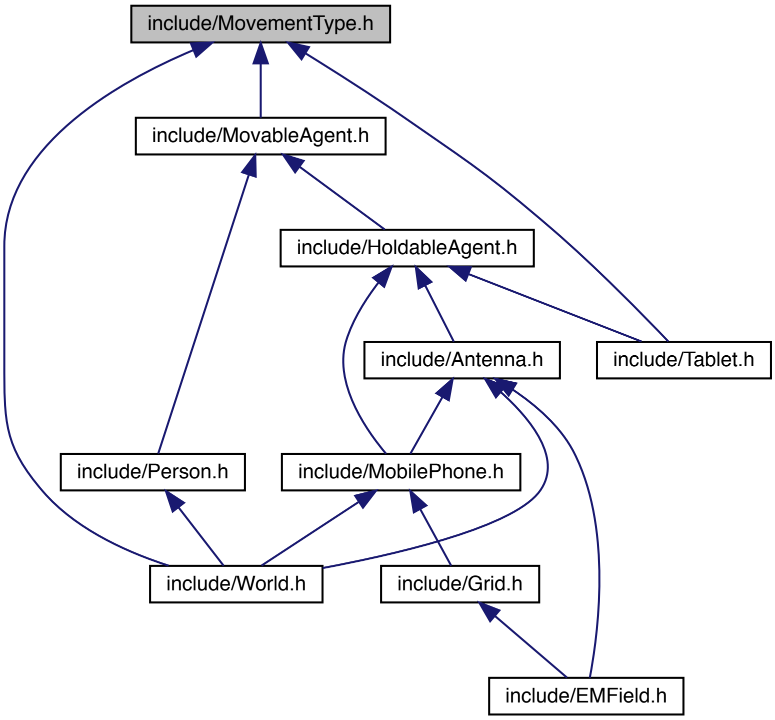


Classes

- class MovableAgent

7.21 include/MovementType.h File Reference

This graph shows which files directly or indirectly include this file:



Enumerations

- enum MovementType { MovementType::RANDOM_WALK_CLOSED_MAP, MovementType::RANDOM_WALK_CLOSED_MAP
MovementType::UNKNOWN }

7.21.1 Enumeration Type Documentation

7.21.1.1 MovementType

```
enum MovementType  [strong]
```

An enum class that enumerates the types of the methods used to move the people on the map. RANDOM_WA↩ LK_CLOSED_MAP - the agent moves randomly inside the map boundary. The direction is generated as a random value at each time step and the step length is computed multiplying the speed with the time interval. RANDOM_↩ WALK_CLOSED_MAP_WITH_DRIFT: the agent moves in a preferential direction. There are two constants defining these directions: SIM_TREND_ANGLE_1 and SIM_TREND_ANGLE_2 (3PI/4 and 5PI/4). The actual direction is generated as a normally distributed random value with means equals to these constants and sad = 0.1.

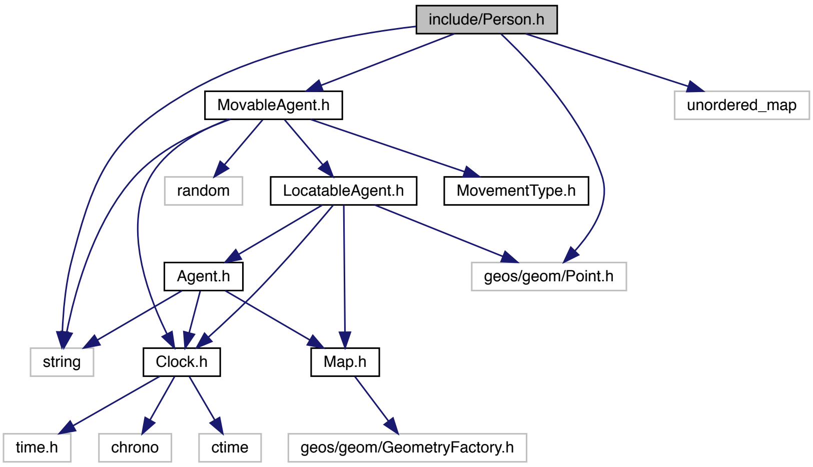
Enumerator

RANDOM_WALK_CLOSED_MAP	
RANDOM_WALK_CLOSED_MAP_WITH_DRIFT	
UNKNOWN	

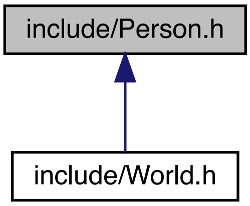
7.22 include/Person.h File Reference

```
#include <MovableAgent.h>
#include <geos/geom/Point.h>
#include <string>
#include <unordered_map>
```

Include dependency graph for Person.h:



This graph shows which files directly or indirectly include this file:

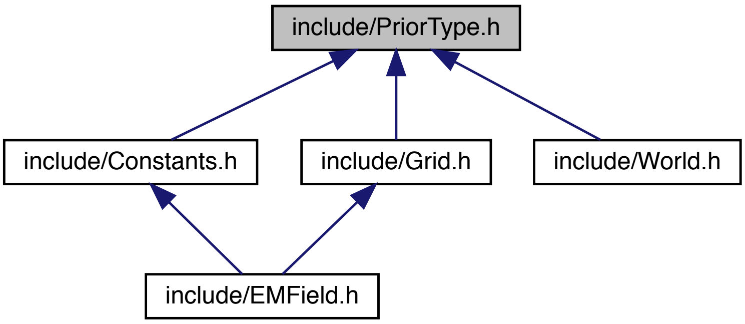


Classes

- class Person

7.23 include/PriorType.h File Reference

This graph shows which files directly or indirectly include this file:



Enumerations

- enum PriorType { PriorType::UNIFORM, PriorType::REGISTER, PriorType::NETWORK }

7.23.1 Enumeration Type Documentation

7.23.1.1 PriorType

```
enum PriorType  [strong]
```

An enum class that enumerates the types of the prior used to computed the posterior localization probability. UN↩ IFORM : the prior is an uniform probability, i.e. each object is equally located in each tile of the map. REGISTER: the prior probability is given by an administrative register. NETWORK: the prior probability is given by the mobile network - it is computed as the ratio between the signal quality given by Antenna a in tile t and the sum of the signal quality given by all antennas in all tiles of the grid.

Enumerator

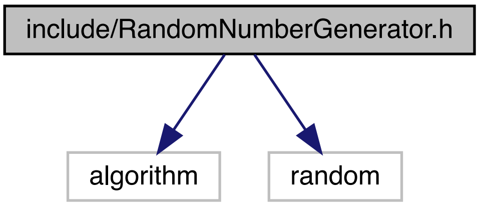
UNIFORM	
REGISTER	
NETWORK	

7.24 include/RandomNumberGenerator.h File Reference

```
#include <algorithm>
```

```
#include <random>
```

Include dependency graph for RandomNumberGenerator.h:



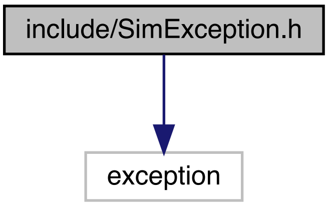
Classes

- class RandomNumberGenerator

7.25 include/SimException.h File Reference

```
#include <exception>
```

Include dependency graph for SimException.h:



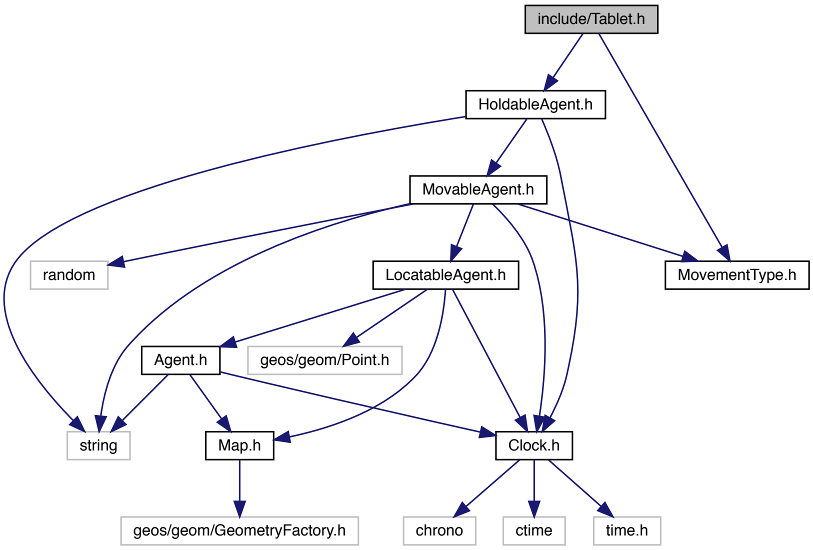
Classes

- class SimException

7.26 include/Tablet.h File Reference

```
#include <HoldableAgent.h>
#include <MovementType.h>
```

Include dependency graph for Tablet.h:



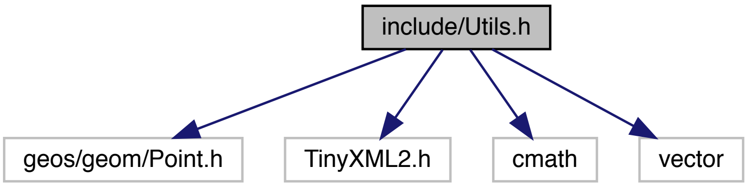
Classes

- class Tablet

7.27 include/Utils.h File Reference

```
#include <geos/geom/Point.h>
#include <TinyXML2.h>
#include <cmath>
#include <vector>
```

Include dependency graph for Utils.h:



Namespaces

- utils

Functions

- vector< Point ∗ > utils::generatePoints (const Map ∗m, unsigned long n, double percentHome, unsigned seed)
- vector< Point ∗ > utils::generateFixedPoints (const Map ∗m, unsigned long n, unsigned seed)
- void utils::printPersonHeader ()
- void utils::printAntennaHeader ()
- void utils::printPhoneHeader ()
- void utils::printMobileOperatorHeader ()
- double utils::r2d (double x)
- double utils::d2r (double x)
- XMLNode ∗ utils::getNode (XMLElement ∗el, const char ∗name)
- XMLElement ∗ utils::getFirstChildElement (XMLElement ∗el, const char ∗name) noexcept(false)
- double utils::getValue (XMLElement ∗el, const char ∗name, double default_value)
- int utils::getValue (XMLElement ∗el, const char ∗name, int default_value)
- unsigned long utils::getValue (XMLElement ∗el, const char ∗name, unsigned long default_value)
- const char ∗ utils::getValue (XMLElement ∗el, const char ∗name, const char ∗default_value)
- double utils::getValue (XMLElement ∗el, const char ∗name)

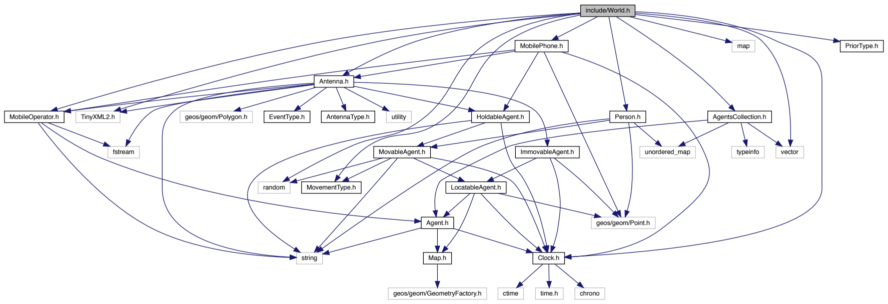
Variables

- const double utils::PI = std::atan(1.0) ∗ 4

7.28 include/World.h File Reference

```
#include <Antenna.h>
#include <Person.h>
#include <random>
#include <vector>
#include <map>
#include <AgentsCollection.h>
#include <Clock.h>
#include <MobilePhone.h>
#include <MovementType.h>
#include <TinyXML2.h>
#include <PriorType.h>
#include <MobileOperator.h>
```

Include dependency graph for World.h:



Classes

- class World

Index