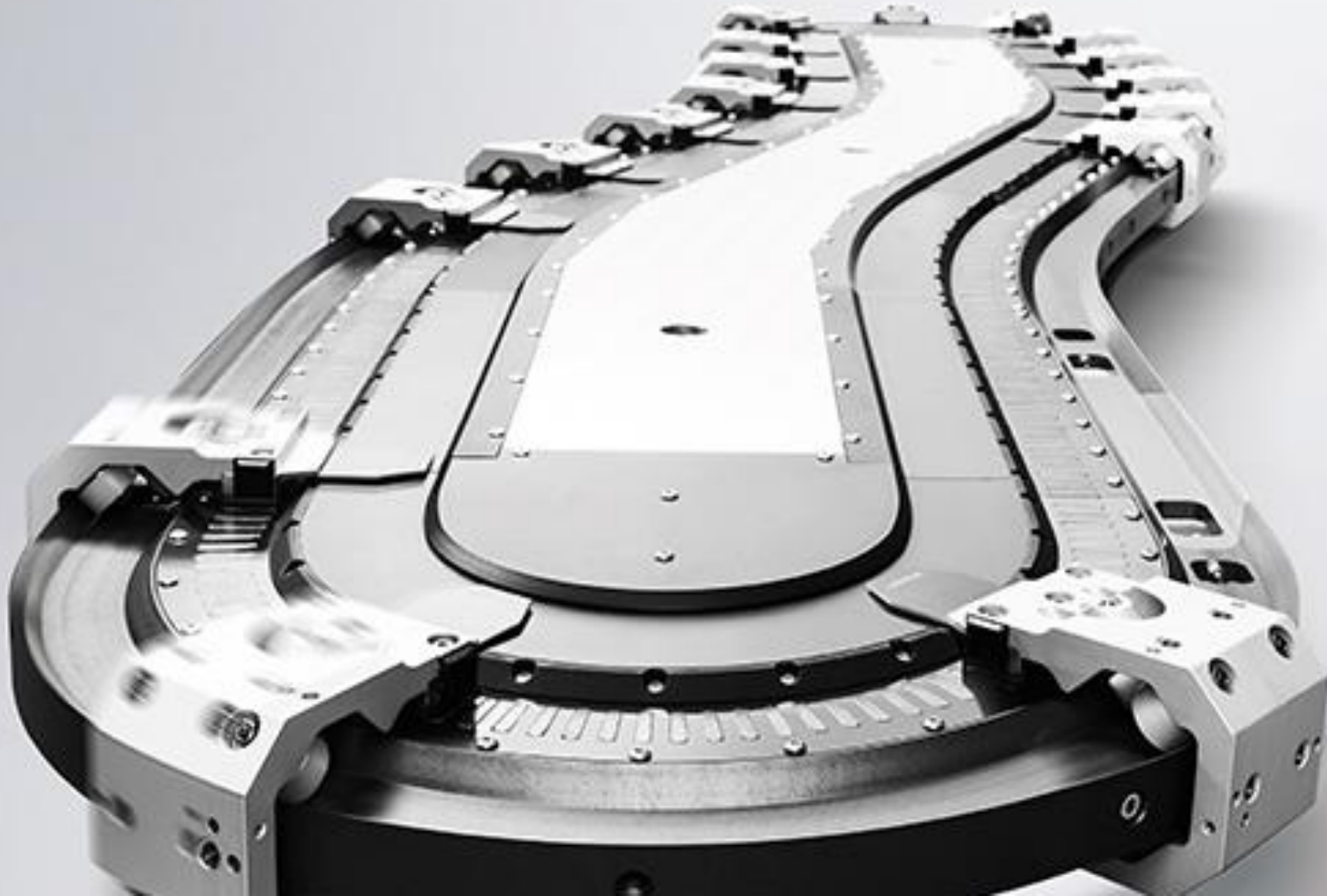


## **XTS TRANSPORT LAYER – a station based approach**

**BECKHOFF**



1. Introduction
2. Requirements
  - XtsTransport (main control)
  - Xpu (XTS Processing Unit)
  - CaGroup (Collision Avoidance)
  - Mover (MC and CA)
  - Station (process handshake)
3. Design
  - use with any cyclic runtime
  - use with non cyclic software
4. Examples
5. License

## 1. Introduction

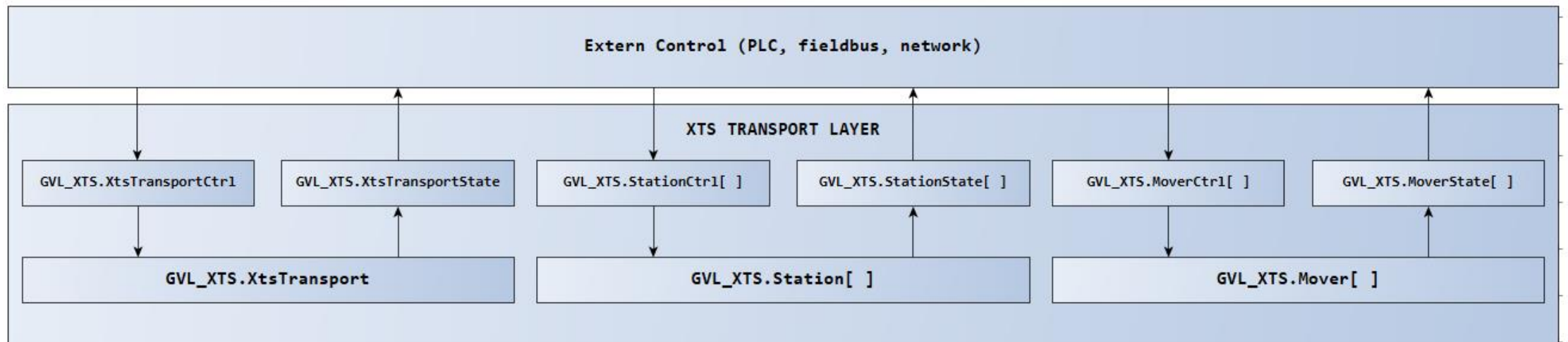
- This project collection is intended to convey the idea of a stand alone XTS transport layer to use in heterogen environments / applications.
- The main idea is that for every station a corresponding position on the xts exists.
- In order to reduce the amount of repetitive work when implementing a XTS into a machine, this project collection may help to put a transport layer in place
- A transport layer shall work a combination of discrete processes and continuous processes
- A transport layer shall have an interface for guiding a mover through a process station
- A transport layer shall have an interface to manipulate a mover
- A transport layer shall have an interface for setting-up or clearing the CollisionAvoidance Group

## 1. Introduction

- The XTS transport system enables a flexible product transport for various use cases.
- In combination with the Collision Avoidance library sending movers does not require extra monitoring of the movement. The Collision Avoidance Group is controlling the gap between movers. The gap is an input parameter of the CA motion function blocks.
- Can be used for a station based approach, in which a station class is available for interaction with your process control.
- Can be used for a mover based approach, your process control has a direct connection to every mover.
- Can be used as a combination of station based and mover based approach.
- The use of predefined datafields also enables control of XTS TRANSPORT LAYER via fieldbus or network.

## 1. Introduction

- designed for use with extern cyclic or non cyclic flow control (PLC, EtherCAT, any network)
  - Ctrl / State datafields for extern to access
- station based approach and individual manipulation of mover
- handshake in station with extern process flow (ST\_STATION\_CTRL / ST\_STATION\_STATE)
- individual cyclic mover interface with given set of movement functionalities (ST\_MOVER\_CTRL / ST\_MOVER\_STATE)



- TransportUnit
  - Access to CA group function blocks (interface pointer)
  - Access to Stations (interface pointer)
  - Access to Movers (interface pointer)
  - Commands for getting all members to defined state
  - Cyclic interface for access from extern control
    - Ctrl (write): command
    - State (read): response to command
      - information from Xpu
      - Information from CA Group

- Xpu (XTS Processing Unit)
  - Check Init Parameter
  - Check Online Parameter
  - Get Module Info Data
  - Connect TcCOM Objects to instances from XTS\_Utility.lib function blocks
  - Cyclic plausibility checks
    - Mover ID detection after init
  - Cyclic interface for access from main control
    - Ctrl (write): command
    - State (read): response to command
    - Info (read): details from cyclic checks

- CaGroup
  - Access to group function blocks
  - Access to movers for group commands
  - Get Group Info Data
  - Implements interface pointer for use in
    - TransportUnit



- Mover
  - Access to MC function blocks
  - Access to CA function blocks
  - Cyclic interface for access from extern control
    - Ctrl (write): command
    - Data (write): command parameter
    - State (read): response to command
  - Implements Interface pointer for access from:
    - TransportUnit
    - Station
    - CaGroup

- Station
  - Handshake mover transport with extern control
  - Close observation of movements in station with feedback to extern control
  - Linked List for movers in queue for infeed into station
  - Access to Linked List of target station for outfeed of mover
  - Cyclic interface for access from extern control
    - Ctrl (write): command and parameter
    - State (read): response to command and information about mover and queue
  - requires interface pointer to MC functionblocks

## ■ Namespace GVL\_XTS

### – Station

- Handshake with Process for mover transport

### – XtsTransport

- Main command interface to extern control

### – Xpu

- Access to TcCOM Objects
- Cyclic plausibility checks

### – CaGroup

- Access to CA library

### – Mover

- Access to MC and CA library

<<global>>

#### GVL\_XTS

StationStart	ST_STATION_PARAMETER
StationStartIndex	UINT
Station	ARRAY [1..MAX_STATION] OF fb_StationProcess
StationList	ARRAY [1..MAX_STATION] OF fb_Station_LinkedListCtrl
StationQueue	ARRAY [1..MAX_STATION] OF ARRAY [1..MAX_LIST_NODES] OF ST_STATION_MOVER_DATA
StationListItf	ARRAY [1..MAX_STATION] OF I_Station_LinkedList
StationCtrlItf	ARRAY [1..MAX_STATION] OF I_XtsTransport_Station
StationCtrl	ARRAY [1..MAX_STATION] OF ST_STATION_CTRL
StationState	ARRAY [1..MAX_STATION] OF ST_STATION_STATE
StationParameter	ARRAY [1..MAX_STATION] OF ST_STATION_PARAMETER
PositionOffset	ARRAY [1..MAX_STATION] OF T_NEST_OFFSET
XtsTransport	fb_TransportUnit
XtsTransportCtrl	ST_XTS_TRANSPORT_CTRL
XtsTransportState	ST_XTS_TRANSPORT_STATE
Xpu	fb_XpuCtrl
XpuCtrl	ST_XPU_CTRL
XpuState	ST_XPU_STATE
XpuInfo	ST_XPU_INFO
XpuModules	ARRAY [1..MAX_MODULE] OF Tc3_XTS_Utility.ST_InfoDataView
CaGroup	FB_CaGroup
CaGroupItf	I_XtsTransport_CaGroup
CaGroupRef	Tc3_McCoordinatedMotion.AXES_GROUP_REF
CaGroupInfo	ST_GROUP_INFO
Mover	ARRAY [1..MAX_MOVER] OF fb_MoverCtrl
MoverCtrl	ARRAY [1..MAX_MOVER] OF ST_MOVER_CTRL
MoverState	ARRAY [1..MAX_MOVER] OF ST_MOVER_STATE
MoverItf	ARRAY [1..MAX_MOVER] OF I_XtsTransport_Mover
LastPosition	ARRAY [1..MAX_MOVER] OF LREAL
LastGap	ARRAY [1..MAX_MOVER] OF LREAL
MoverInfo	ARRAY [1..MAX_MOVER] OF ST_MOVER_INFO
MoveData	ARRAY [1..MAX_MOVER] OF ST_MOVE_DATA
GearData	ARRAY [1..MAX_MOVER] OF ST_GEAR_DATA
AxisRefMover	ARRAY [1..MAX_MOVER] OF Tc2_MC2.AXIS_REF

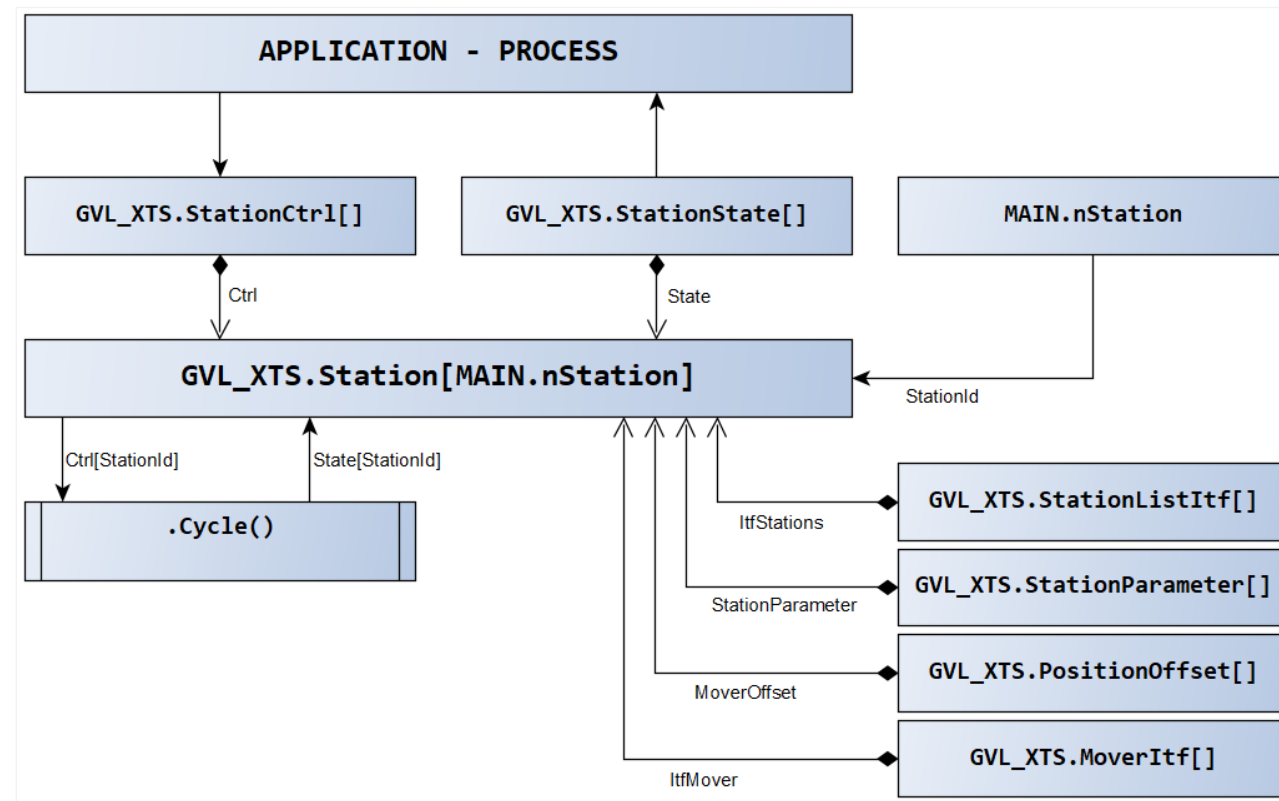
- GVL\_XTS.Station
  - **fb\_StationBase**
    - Abstract base class
    - Allowing for user defined XtsStations
    - Provides datafields and properties
    - Cycle placeholder; override with your station logic when extending this base class

<i>fb_StationBase</i>	
<i>_nStationId</i>	UINT
<i>_sState</i>	STRING(255)
<i>_eInitList</i>	E_PROGRESS
<i>_eFatalError</i>	E_STATION_STATE
<i>_stCtrl</i>	REFERENCE TO ARRAY [1..MAX_STATION] OF ST_STATION_CTRL
<i>_stState</i>	REFERENCE TO ARRAY [1..MAX_STATION] OF ST_STATION_STATE
<i>_eCmd</i>	E_STATION_CTRL
<i>_eCmdOld</i>	E_STATION_CTRL
<i>_lIfStation</i>	REFERENCE TO ARRAY [1..MAX_STATION] OF I_Station_LinkedList
<i>_lIfMover</i>	REFERENCE TO ARRAY [1..MAX_MOVER] OF I_XtsTransport_Mover
<i>_rMoverOffset</i>	REFERENCE TO ARRAY [1..MAX_STATION] OF T_NEST_OFFSET
<i>_stParameter</i>	REFERENCE TO ARRAY [1..MAX_STATION] OF ST_STATION_PARAMETER
<i>_Mover</i>	REFERENCE TO ARRAY [1..MAX_MOVER] OF AXIS_REF
<i>_stListEnter</i>	ST_STATION_LIST_RESULT
<i>_stListTarget</i>	ST_STATION_LIST_RESULT
<i>_stListDelete</i>	ST_STATION_LIST_RESULT
<i>_stMoverDataSend</i>	ST_STATION_MOVER_DATA
<i>_stMoverData</i>	ST_STATION_MOVER_DATA
<i>_stInfeed</i>	ST_MOVE_DATA
<i>_stOutfeed</i>	ST_MOVE_DATA
<i>_Result</i>	E_PROGRESS
<i>_eStateProgress</i>	E_PROGRESS
<i>_stMsg</i>	ST_Message
<i>_eMessageLevel</i>	E_MessageType
<hr/>	
+ Check()	BOOL
+ Cycle()	
+ DelBitWord(...)	WORD
+ GetBitWord(...)	BOOL
+ Init()	e_progress
+ SetBitWord(...)	WORD
+ Ctrl Set(...)	
+ lIfMover Set(...)	
+ lIfStations Set(...)	
+ MessageLevel Set(...)	
+ Mover Set(...)	
+ MoverOffset Set(...)	
+ State Set(...)	
+ StationId Set(StationId : UINT)	
+ StationId Get()	UINT
+ StationParameter Set(...)	
+ TargetWindow Set(...)	
+ TargetWindow Get()	LREAL

- GVL\_XTS.Station
  - fb\_Station[].Cycle
    - State machine for handshaking with extern control (check example pdf in [doc] folder)
    - Init (clears everything in station)
    - Enable
    - Mover Enter
    - Stop Position(s)
    - Mover Out
    - Empty
- GVL\_XTS.Station
  - fb\_Station[].Cycle
    - Control writes ticket for mover
      - MoverId
      - TargetStation
      - Mask
      - Offset

### 3. Design

- GVL\_XTS.Station
  - nStation index is passed as value from caller
  - Global datafields are passed as references (REF=) into fb\_Station properties
    - Ctrl / State: handshakes
    - ItfStations: interface pointer to linked list methods for getting and setting of mover data
    - StationParameter: Coordinates and dynamic constraint of XtsStation
    - MoverOffset: correction values for every mover in every station with every nest (StopPos[])
    - ItfMover: interface pointer to CA movements



- GVL\_XTS.Station (Planning requirements for use of fb\_Station)
  - Put the Modulo turn anywhere, **BUT NOT** within PosWait, PosStop, ReleaseDistance of a station. The code does not support crossing the modulo turn within a station.
  - Since the project is designed for stations to send movers to a flexible target, with flexible nest positions, the control struct of a station you have to use, to forward those parameters together with the mover ID
    - **ST\_STATION\_CTRL.nMask**: commands the nest count and nest position of the mover in target station
    - **ST\_STATION\_CTRL.nTargetStation**: index of station in GVL\_XTS.StationParameter[]
  - The Use of LinkedList methods (AddTail, GetHead) requires thought about when the mover is entered into the target station.
  - all coordinates are modulo values, from station to station only forward, within station: movement by use of nest offset(PosStop[]) or use of **ST\_MOVER\_CTRL**.
  - IF move backwards required you have to make sure that there is room for it
    - Check PosStop[]
    - Each PosStop[] is relative to PosWait

- **GVL\_XTS.Station** (Example)
- **ST\_STATION\_PARAMETER**: parallel Xts stations for a process with common waiting position
  - Process uses GVL\_XTS.Station[1] to GVL\_XTS.Station[4]
    - Define PosWait(Queue position)
      - **[1].rPosWait := 100**
      - **[2].rPosWait := 100**
      - **[3].rPosWait := 100**
      - **[4].rPosWait := 100**
    - Define how many rPosStop(nests) the stations may have (configured count)
      - **[1].nConfiguredStopCount := 1 (default)**
      - **[2].nConfiguredStopCount := 1**
      - **[3].nConfiguredStopCount := 1**
      - **[4].nConfiguredStopCount := 1**
  - Process uses GVL\_XTS.Station[1] to GVL\_XTS.Station[4]
    - Define the process position(s) relative to rPosWait
      - **[1].rPosStop[1] := 100**
      - **[2].rPosStop[1] := 200**
      - **[3].rPosStop[1] := 300**
      - **[4].rPosStop[1] := 400**
    - The ReleaseDistance of the last station shall be shortest, all other stations follow accordingly.
      - **[1].rReleaseDistance := 40**
      - **[2].rReleaseDistance := 30**
      - **[3].rReleaseDistance := 20**
      - **[4].rReleaseDistance := 10**



- **GVL\_XTS.Station (Example)**
- **using stations sparsely:**
  - In this case it is easiest to always handshake the stations and use the forwarding command if a station shall be skipped.
  - On Infeed state of mover, use: **E\_STATION\_CTRL.STATION\_MOVER\_SEND**.
- **deactivating stations:**
  - Make sure the queue is empty before deactivating, since the waiting mover will hold up all other, in case of required deactivation while movers are in the queue:
    - handshake mover with **E\_STATION\_CTRL.STATION\_MOVER\_SEND** to new target station if mover in queue cannot be processed
  - Handshake regular infeed if mover in queue can still be processed.
  - Do not send any new mover to the station in question
    - If queue of station is empty: **E\_STATION\_CTRL.STATION\_DISABLE**
    - preceding stations continue workflow with changed **ST\_STATION\_CTRL.nTargetStation**

- GVL\_XTS.Station
  - Ctrl[nStation] : **ST\_STATION\_CTRL**
    - **eCmd (E\_STATION\_CTRL):**
      - enumeration for handshakes with State[nStation].eState (**E\_STATION\_STATE**)
    - **nMask (BYTE):**
      - bit mask to be used with multiple stop positions within a XtsStation.  
This mask tells the target station which StopPos[] (nest) has to be worked.
    - **nTargetStation (USINT):**
      - target to send mover to GVL\_XTS.Station[nTargetStation].rPosWait
    - **rOffset (REAL):**
      - Optional offset for mover, used in target station in addition to static offset

- GVL\_XTS.Station
  - State[nStation] : **ST\_STATION\_STATE**
    - **eState (E\_STATION\_STATE):**
      - Enumeration for active station state, Ctrl has to react to
    - **nMask (BYTE):**
      - Bitmask for active PosStop[] (nest)
    - **nMoverId (USINT):**
      - Active mover index in station
    - **rMoverModPos (LREAL):**
      - Modulo position of active mover
    - **nQueue (USINT):**
      - Count of movers, which were sent to XtsStation

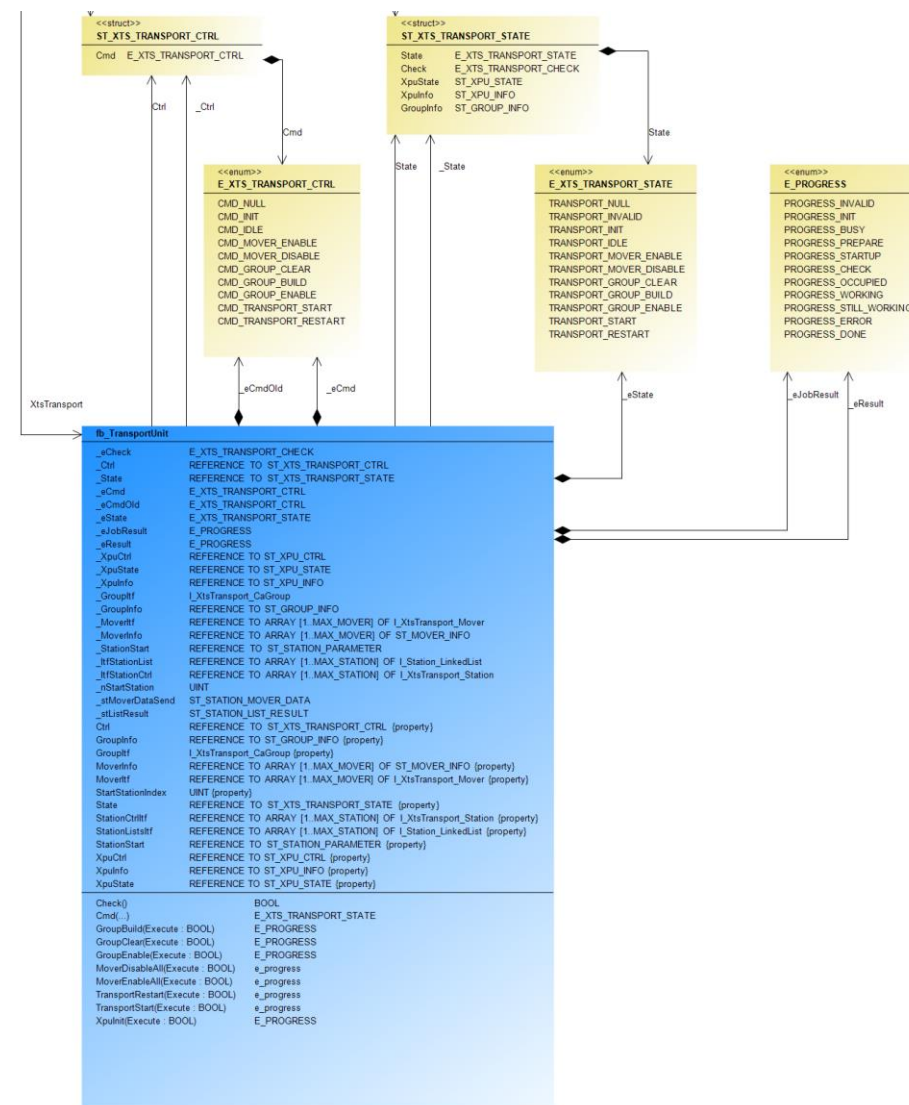
- GVL\_XTS.StationParameter
  - **sText** :
    - Description only
  - **rPosWait** :
    - start of station, a sending station is using this value to send mover to
  - **rReleaseDistance** :
    - distance mover has to travel (from ActPos) in order for station to go back to mover detection
  - **rGap** :
    - Active gap on infeed and outfeed of station
  - **rVelo** :
    - Active velocity on infeed and outfeed of station
  - **rAccDec** :
    - Active dyn constraint
  - **rJerk** :
    - Active dyn constraint
  - **nConfiguredStopCount** :
    - Count of PosStop (nests) a mover may has to stop at in XtsStation
  - **rPosStop[]** :
    - Relative to rPosWait

## 3. Design

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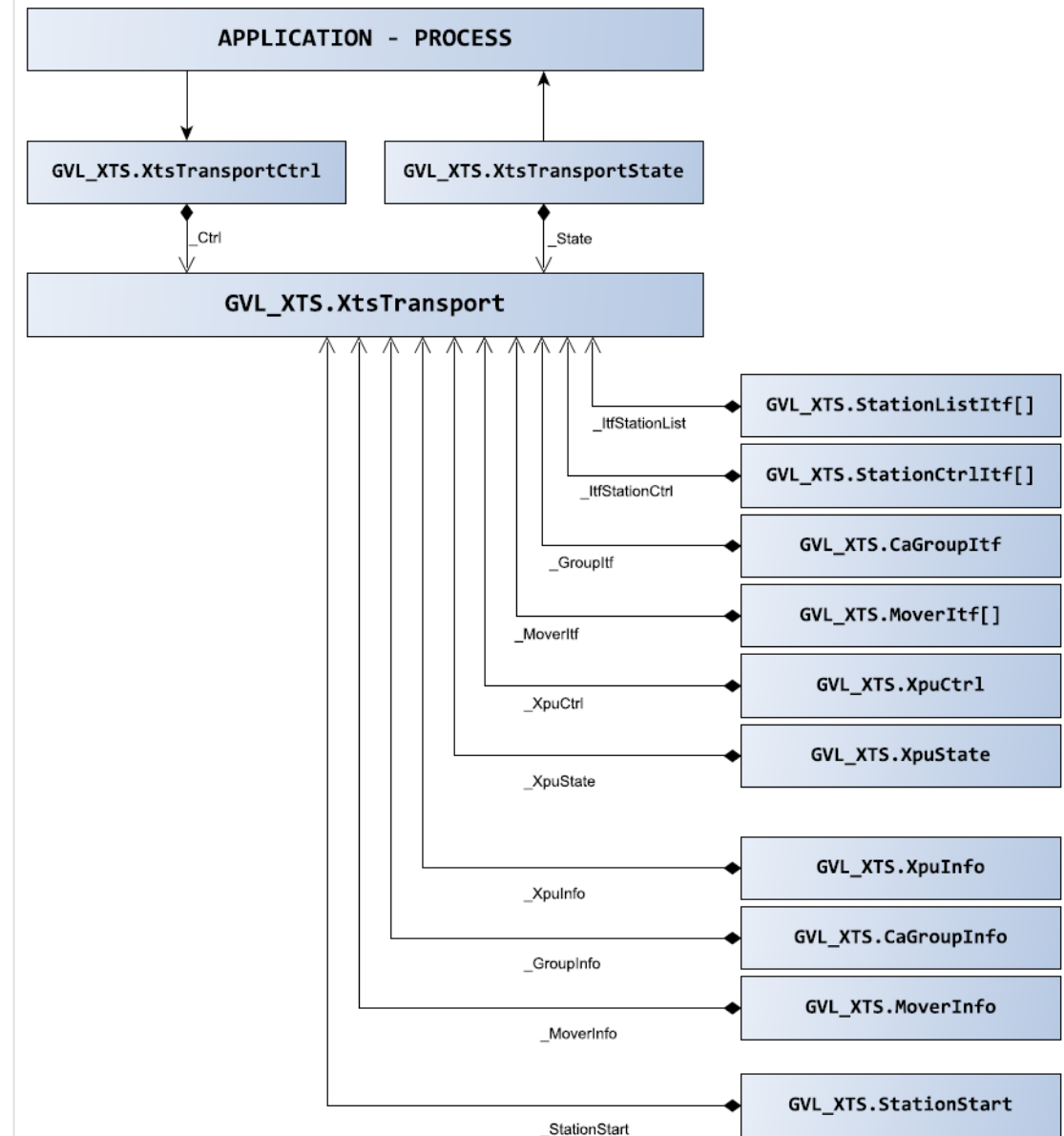
### ■ TransportUnit

- Fb\_TransportUnit():
  - Top level control of XtsTransport
  - Cycle check for change of command:
    - **E\_XTS\_TRANSPORT\_CTRL.**
      - CMD\_INIT
      - CMD\_IDLE
      - CMD\_MOVER\_ENABLE
      - CMD\_MOVER\_DISABLE
      - CMD\_GROUP\_CLEAR
      - CMD\_GROUP\_BUILD
      - CMD\_GROUP\_ENABLE
      - CMD\_TRANSPORT\_START



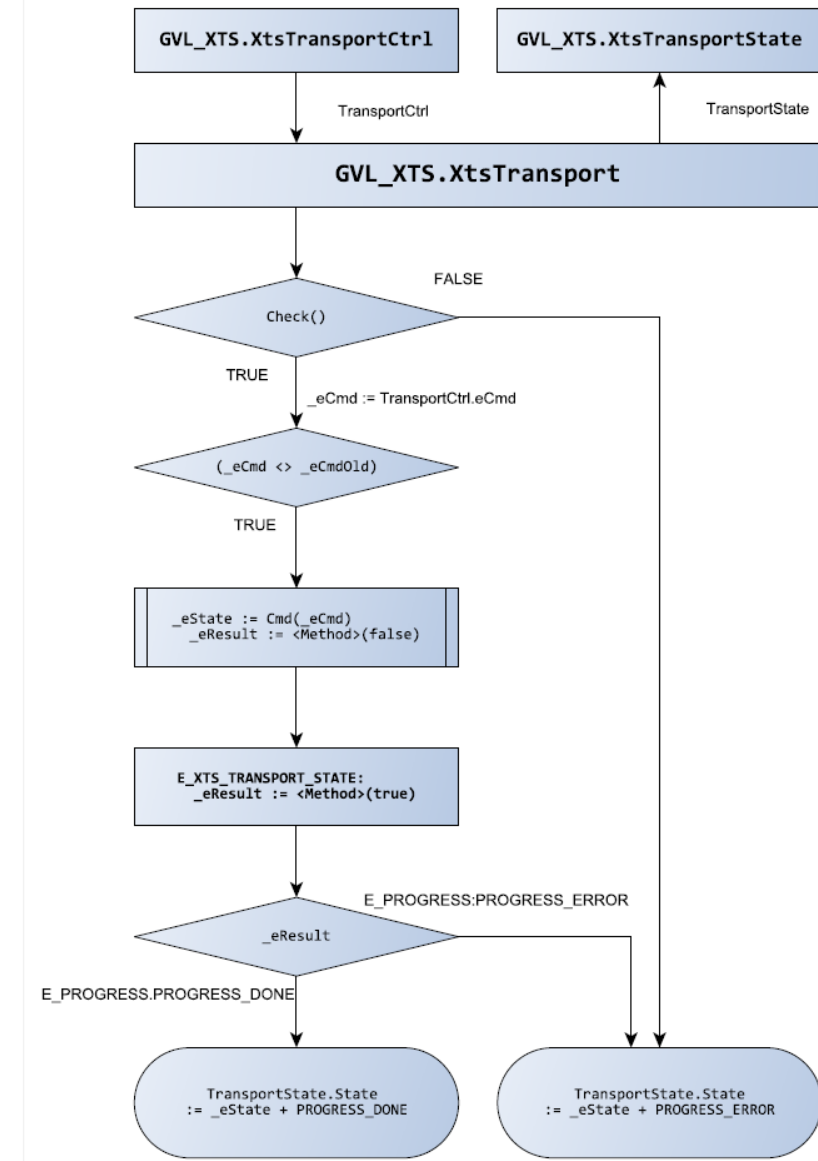
### 3. Design

- TransportUnit
  - Fb\_TransportUnit():
  - Members:



## 3. Design

- TransportUnit
  - Fb\_TransportUnit():
    - Change of command triggers execution
    - Execution result is added to state
    - Extern control needs to react to BUSY, DONE or ERROR



### 3. Design

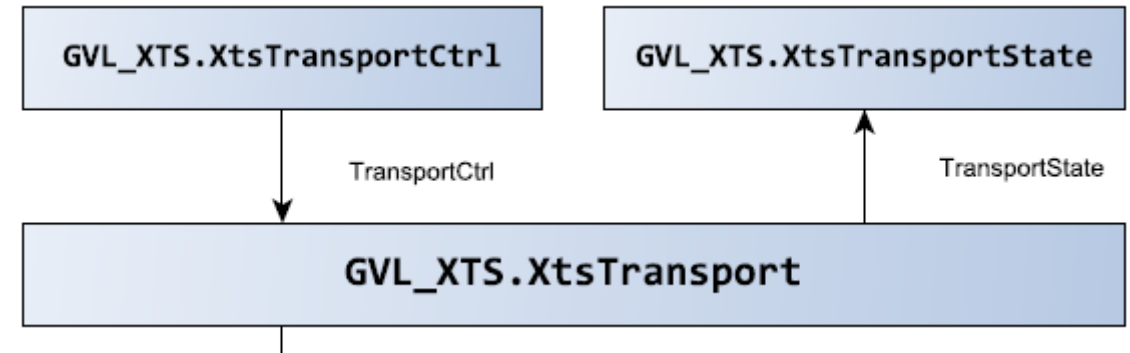
- TransportUnit

- GVL\_XTS.XtsTransportCtrl:  
**ST\_TRANSPORT\_UNIT\_CTRL**

- Struct for commanding  
FB\_TransportUnit

- eCmd : E\_XTS\_TRANSPORT\_CTRL

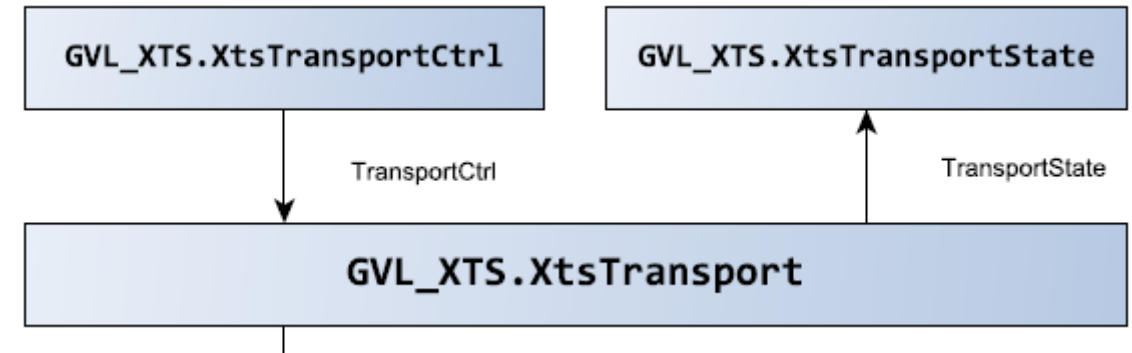
```
ST_XTS_TRANSPORT_CTRL  ▢ ×  
1  TYPE ST_XTS_TRANSPORT_CTRL :  
2  STRUCT  
3      Cmd      : E_XTS_TRANSPORT_CTRL;  
4  END_STRUCT  
5  END_TYPE  
6
```





### 3. Design

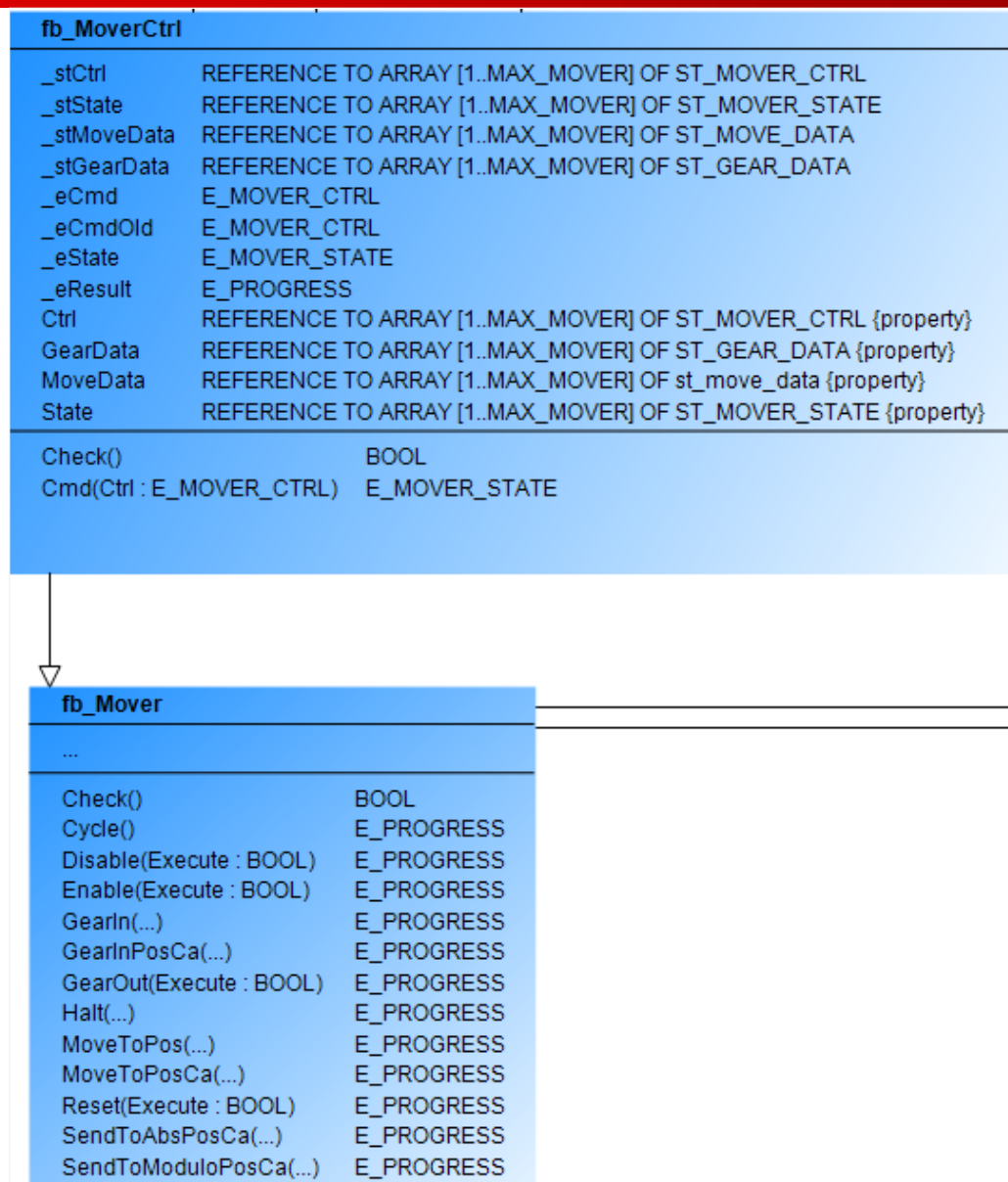
- TransportUnit
  - GVL\_XTS.XtsTransportState:  
**ST\_TRANSPORT\_UNIT\_STATE**
  - State: combines active command and result
  - Check: cyclic pointer checks
  - XpuState: state from fb\_Xpu
  - XpuInfo: cyclic plausibility checks to TcCOM Objects
  - GroupInfo: cyclic information from FB\_CaGroup



```
ST_XTS_TRANSPORT_STATE  ➤ ✕
1  {attribute 'pack_mode' := '2'}
2  TYPE ST_XTS_TRANSPORT_STATE :
3  STRUCT
4      State      : E_XTS_TRANSPORT_STATE;
5      Check      : E_XTS_TRANSPORT_CHECK;
6
7      XpuState    : ST_XPU_STATE;
8      XpuInfo     : ST_XPU_INFO;
9      GroupInfo   : ST_GROUP_INFO;
10 END_STRUCT
11 END_TYPE
12
```

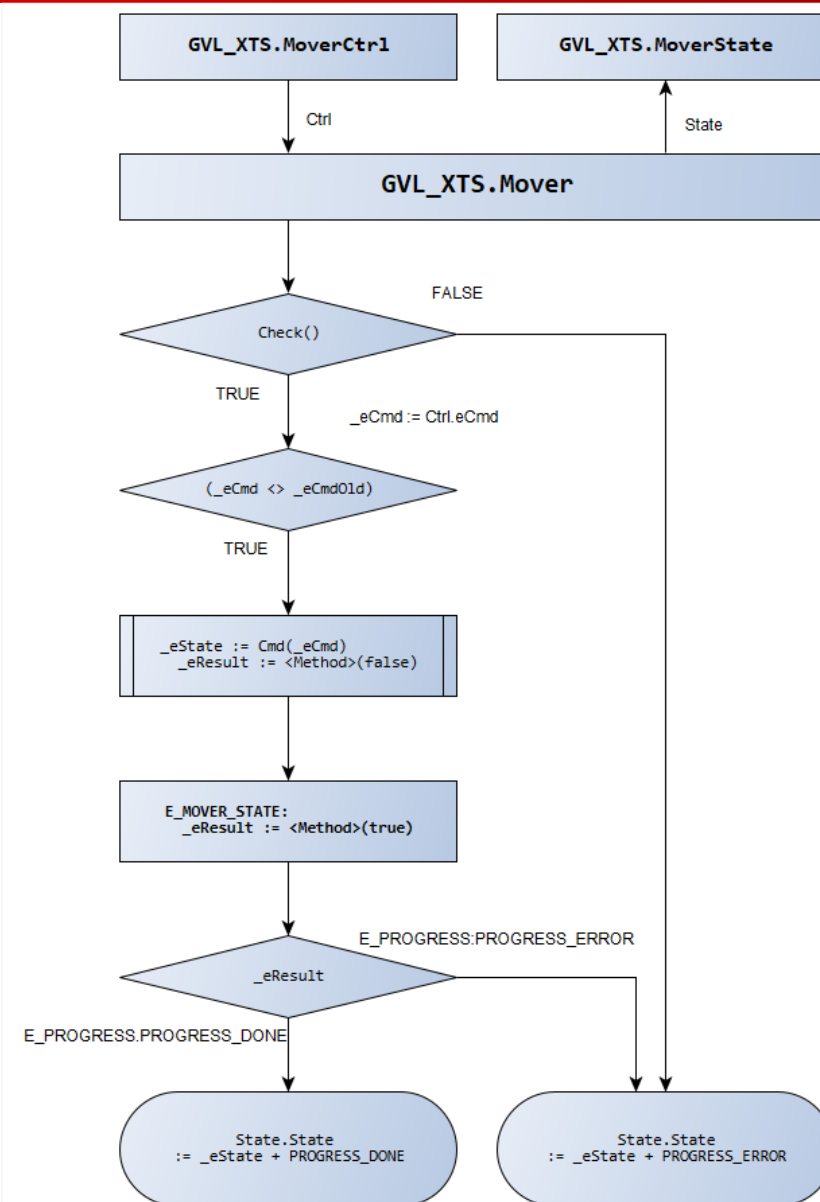
### 3. Design

- GVL\_XTS.Mover[] (**fb\_MoverCtrl**)
  - Inherits **fb\_Mover**
    - Access to MC function blocks in library
    - Implements Interface for use in other classes
  - Contains cyclic interface
    - OnChange check of command
    - Ctrl datafield for setting commands
    - State data field for checking responses
    - Parameter datafields for using motion functions



## 3. Design

- fb\_MoverCtrl:
  - Mover index is passed as value from caller
  - Global datafields are passed as references (**REF=**) into fb\_MoverCtrl properties
    - OnChange Ctrl / State: handshakes
      - standard return value for method (**E\_PROGRESS**)
    - OnExec log LastPosition of CA/MC function
    - OnExec log LastGap on CA function



### 3. Design

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- fb\_CaGroup:
  - Collision Avoidance class wrapper
  - Implements I\_Transport\_CaGroup
  - Cyclic information from **AXES\_GROUP\_REF**
  - Mover commands via interface **I\_XtsTransport\_Mover**

FB_CaGroup	
GROUP_HALT_JERK	LREAL
GROUP_HALT_DEC	LREAL
_eCheck	E_GROUP_CHECK
_bError	BOOL
_GroupRef	REFERENCE TO Tc3_McCoordinatedMotion.AXES_GROUP_REF
_GroupCommon	MCTOPLC_GROUP_COMMON_PART
_AxisRefMover	REFERENCE TO ARRAY [1..MAX_MOVER] OF Tc2_MC2.AXIS_REF
_MoverItf	REFERENCE TO ARRAY [1..MAX_MOVER] OF I_XtsTransport_Mover
_stMoveData	ST_MOVE_DATA
_fbAddAxisGroup	ARRAY [1..MAX_MOVER] OF Tc3_McCoordinatedMotion.MC_AddAxisToGroup
_fbRemoveAxisGroup	ARRAY [1..MAX_MOVER] OF Tc3_McCoordinatedMotion.MC_RemoveAxisFromGroup
_fbGroupDisable	Tc3_McCoordinatedMotion.MC_GroupDisable
_fbGroupEnable	Tc3_McCoordinatedMotion.MC_GroupEnable
_fbGroupErrorRead	Tc3_McCoordinatedMotion.MC_GroupReadError
_fbGroupStatusRead	Tc3_McCoordinatedMotion.MC_GroupReadStatus
_fbGroupReset	Tc3_McCoordinatedMotion.MC_GroupReset
_stGroupInfo	ST_GROUP_INFO
_rtrigGroupStatusRead	Tc2_Standard.R_TRIG
_rtrigGroupErrorRead	Tc2_Standard.R_TRIG
_stMsg	ST_Message
_eMessageLevel	E_MessageType
AxisRef	REFERENCE TO ARRAY [1..MAX_MOVER] OF Tc2_MC2.AXIS_REF {property}
GroupInfo	REFERENCE TO ST_GROUP_INFO {property}
GroupRef	REFERENCE TO Tc3_McCoordinatedMotion.AXES_GROUP_REF {property}
MessageLevel	e_messagetype {property}
MoverItf	REFERENCE TO ARRAY [1..MAX_MOVER] OF I_XtsTransport_Mover {property}

...

- fb\_CaGroup:
  - Implements **I\_Transport\_CaGroup**
  - Used in fb\_TransportUnit

<<interface>>

**I\_XtsTransport\_CaGroup**

AddAll(Execute : BOOL)	E_PROGRESS
Disable(Execute : BOOL)	E_PROGRESS
Enable(Execute : BOOL)	E_PROGRESS
McHaltAll(Execute : BOOL)	E_PROGRESS
McResetAll(Execute : BOOL)	E_PROGRESS
RemoveAll(Execute : BOOL)	E_PROGRESS
Reset(Execute : BOOL)	E_PROGRESS

- fb\_CaGroup:
  - Cyclic information to **ST\_GROUP\_INFO**

CaGroupInfo	→	<<struct>>
		<b>ST_GROUP_INFO</b>
_stGroupInfo	→	
		GroupStatusValid BIT
		GroupStatusBusy BIT
		GroupMoving BIT
		GroupHoming BIT
		GroupErrorStop BIT
		GroupNotReady BIT
		GroupStandby BIT
		GroupStopping BIT
		GroupDisabled BIT
		AllAxesStanding BIT
		ConstantVelocity BIT
		Accelerating BIT
		Decelerating BIT
		InPosition BIT
		GroupError BIT
		GroupErrorId UDINT
		AxisCount UDINT
		AxisCountEnabled UDINT
		CaGroupOID OTCID
		CaGroupState E_CA_GROUP_STATE



- GVL\_XTS.Xpu (**fb\_XpuCtrl**)
  - Inherits **fb\_Xpu**:
    - Class for interacting with XTS ProcessingUnit
    - Xpulnit()
      - Connects to OTCIDs of XTS TcCOM Objects
    - Cycle
      - Plausibility checks, get module info data
    - ModuleInfoData, used in Cycle

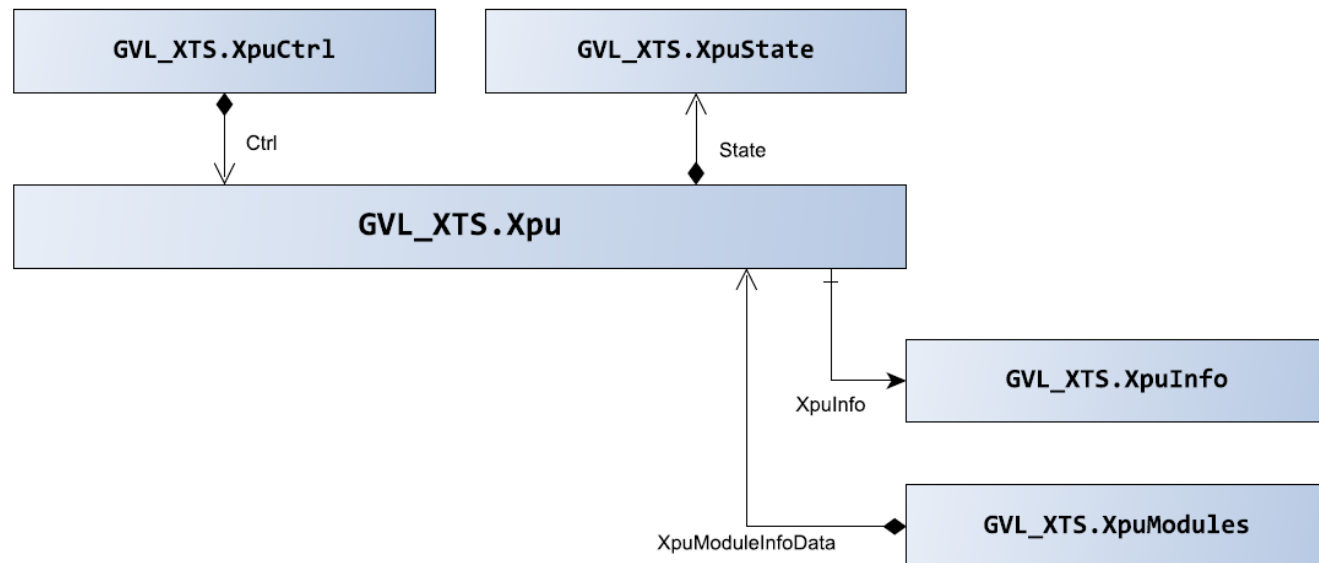
fb_XpuCtrl	
_Ctrl	REFERENCE TO ST_XPU_CTRL
_State	REFERENCE TO ST_XPU_STATE
_eCmd	E_XPU_CTRL
_eCmdOld	E_XPU_CTRL
_eResult	E_PROGRESS
_eState	E_XPU_STATE
Ctrl	REFERENCE TO ST_XPU_CTRL {property}
State	REFERENCE TO ST_XPU_STATE {property}
Check()	BOOL
Cmd(Ctrl : E_XPU_CTRL)	E_XPU_STATE
DetectMoverId(Enable : BOOL)	E_XPU_CHECK

fb_Xpu	
...	
Cycle(...)	E_PROGRESS
GetEnvironment()	I_TcXtsEnvironment
IdDetectionModeToString()	STRING(20)
ModuleInfoData(Enable : BOOL)	E_PROGRESS
MoverPositionAssignmentToString()	STRING(20)
OpModeToString()	STRING(20)
Xpulnit(...)	E_XPU_INIT

### 3. Design

- GVL\_XTS.Xpu (fb\_XpuCtrl)
  - Wraps cyclic execution of fb\_Xpu
  - Cyclic check for command change (ST\_XPU\_CTRL.Cmd)

```
E_XPU_CTRL  ➦ ✕  
1 {attribute 'strict'}  
2 TYPE E_XPU_CTRL :  
3 (  
4   XTS_CMD_NULL,  
5   XTS_CMD_INIT           := 10,  
6   //XTS_CMD_READ_STN_CONFIG := 20,  
7   XTS_IDLE               := 30  
8 )UINT;  
9 END_TYPE
```



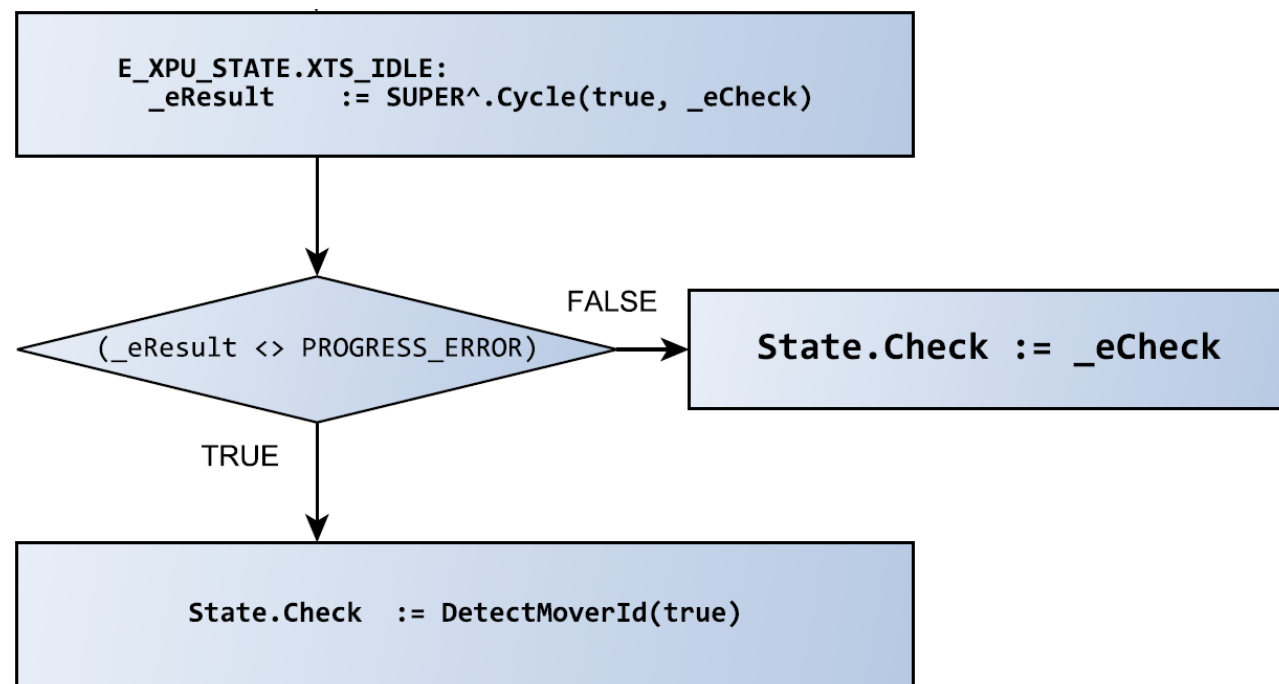


### ▪ fb\_XpuCtrl cyclic data:

- **SUPER^.Cycle():**
  - Cyclic plausibility checks
  - Cyclic update motor modules data

### – Cyclic data **ST\_XPU\_INFO**:

```
ST_XPU_INFO  ▢ ×
1 {attribute 'pack_mode' := '2'}
2 TYPE ST_XPU_INFO :
3 STRUCT
4   AllPositionsValid  : BIT;
5   IdDetectionError   : BIT;
6   IdDetectionValid   : BIT;
7   IdDetectionActive  : BIT;
8
9   OperationMode      : UINT;
10
11   IdDetectionMode     : UINT;
12   MoverPositionAssignment : UINT;
13
14   nDetectedAxisCount  : UINT;
15   nExpectedAxisCount : UINT;
16
17
18 END_STRUCT
19 END_TYPE
~
```



- fb\_XpuCtrl:
  - Cyclic motor module data:

Tc3\_XTS\_Utility = Tc3\_XTS\_Utility, 4.0.10.0 (Beckhoff Automation GmbH) Tc3\_XTS\_Utility 4.0.10.0

- Diagnostic
- Motor
  - ST\_XtsMotorMemoryData
  - ST\_XtsMotorModule
  - CoE
    - ST\_XtsCoE
    - SubItem
      - AmplifierSetting
      - DiagData
      - DiagHistory
      - I2tDiagData
      - Identity
      - InfoData
        - ST\_InfoData
        - View
          - ST\_InfoDataView
      - VendorData
- Motion
- XTS IO

Inputs/Outputs Documentation

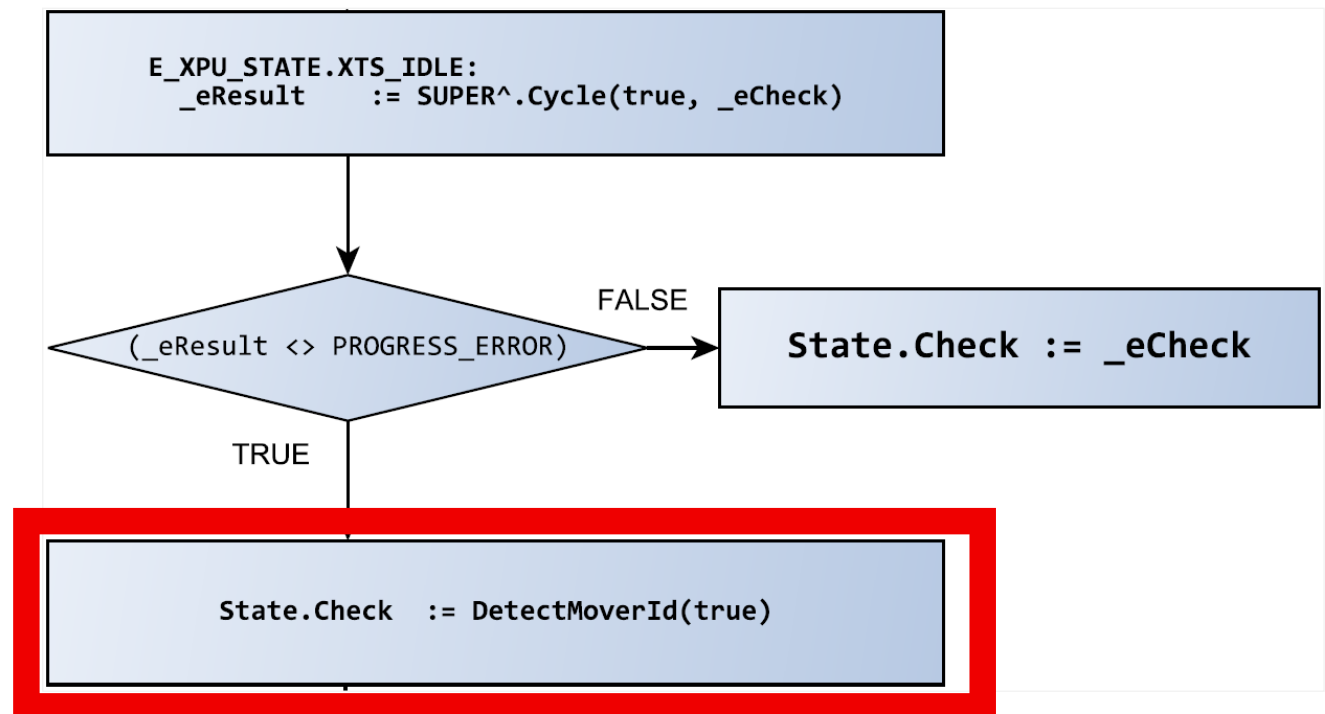
**STRUCT ST\_InfoDataView**

Name	Type	Inherited from	Address	Initial
byInfoData	BYTE			
fAuxiliaryVoltage_5V	LREAL			
fAuxiliaryVoltage_10V	LREAL			
fAuxiliaryVoltage_24V	LREAL			
fDcLinkVoltage	LREAL			
nCurrentScaling	INT			
nDeviceInfo	UDINT			
fPcbTemp_0	LREAL			
fPcbTemp_1	LREAL			
fPcbTemp_2	LREAL			
fPcbTemp_3	LREAL			
fAverageTemp	LREAL			
fOverallCurrent	LREAL			
fMaxDCLinkVoltageLast500ms	LREAL			
fMaxOverallCurrentLast500ms	LREAL			

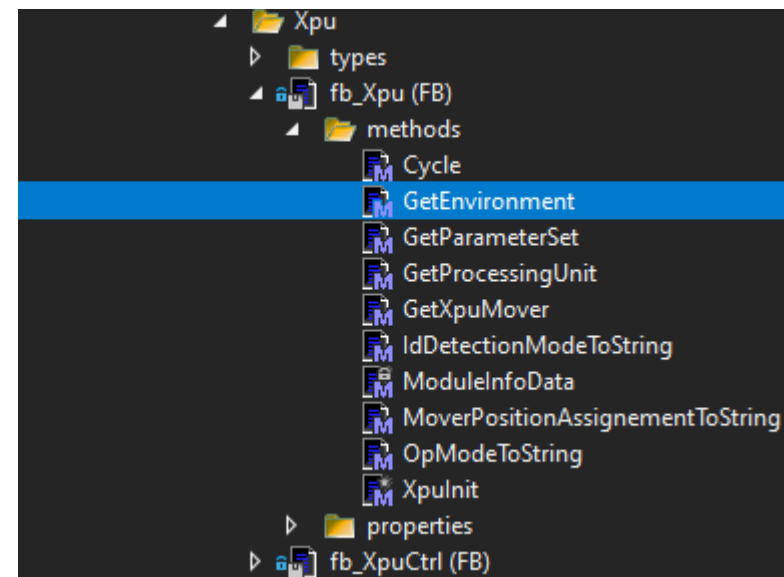
- fb\_XpuCtrl:

- **DetectMoverId:**

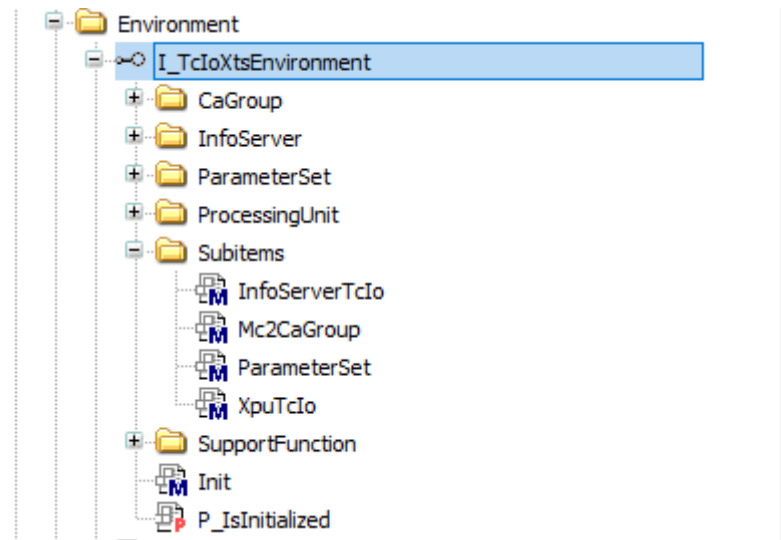
- Cyclic checks for valid Mover ID Detection
    - Check pdf flowchart in [doc] folder of project



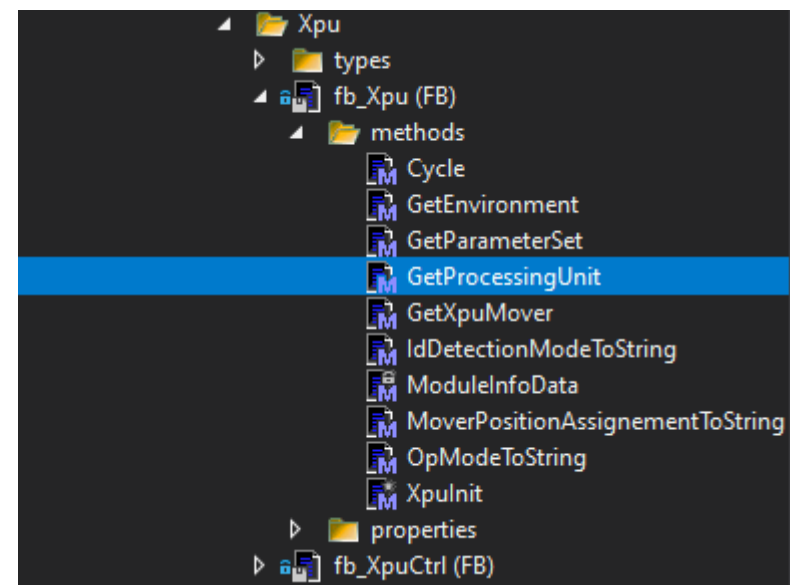
- `fb_Xpu.GetEnvironment()`:
  - **Interface methods to Tc3\_XTS\_Utility.lib:**
    - `GetEnvironment()` : `I_TcloXtsEnvironment`
      - Startup initialization of `_fbEnvironment` is done by `fb_Xpu.Init()`
    - Top level interface
      - See interface structure (Library Manager) in order to reach lower level interfaces



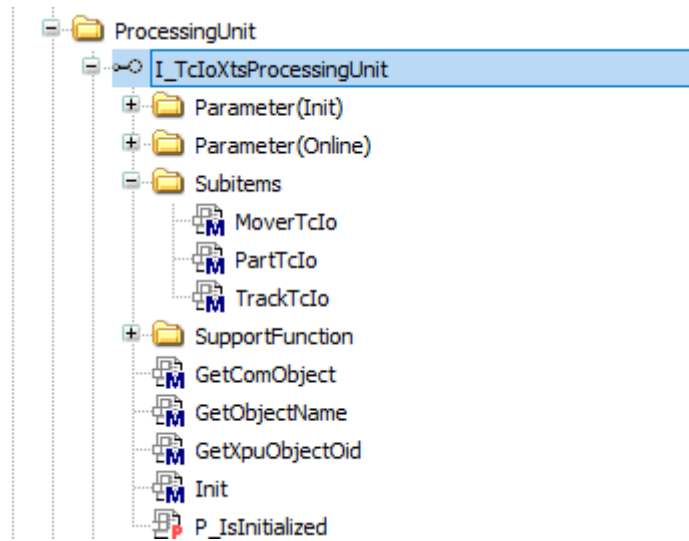
- `fb_Xpu.GetEnvironment():`
  - **I\_TcIoXtsEnvironment:**
    - See LibraryManager
    - Provides access to members



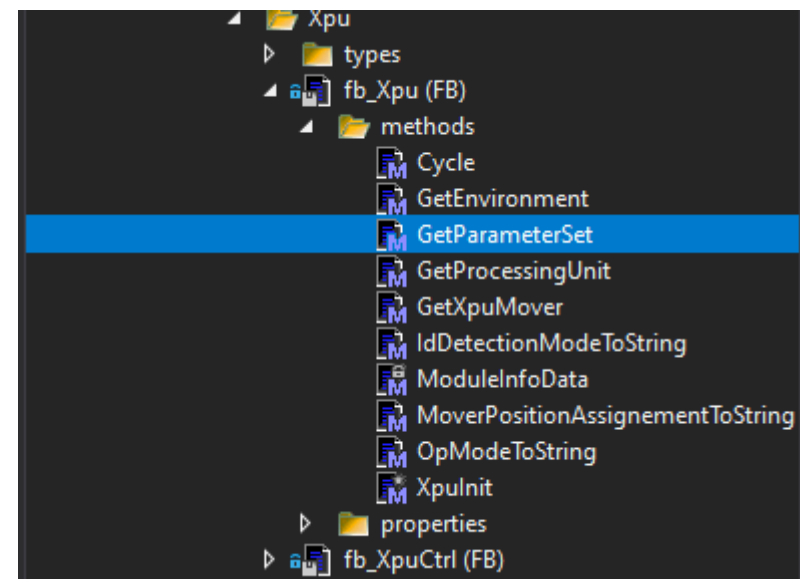
- `fb_Xpu.GetProcessingUnit()`:
  - **Interface methods to Tc3\_XTS\_Utility.lib:**
    - `GetProcessingUnit : I_TcloXtsProcessingUnit`
      - Startup initialization of `_fbProcessingUnit` is done by `fb_Xpu.Init()`
    - Interface for `ParameterSets`
      - See interface structure (Library Manager) in order to reach lower level interfaces



- fb\_Xpu.GetProcessingUnit():
  - **I\_TcIoXtsProcessingUnit:**
    - See LibraryManager
    - Provides access to members

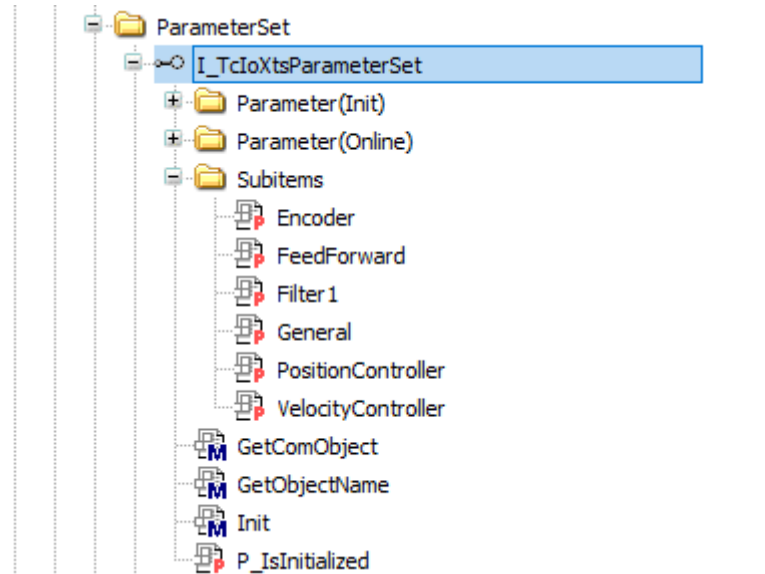


- fb\_Xpu.GetParameterSet(Index):
  - **Interface methods to Tc3\_XTS\_Utility.lib:**
    - GetParameterSet(Index) : I\_TcloXtsParameterSet
      - Startup initialization of \_fbParameterSet[ ] is done by fb\_Xpu.Init()
  - Interface for ParameterSets
    - See interface structure (Library Manager) in order to reach lower level interfaces

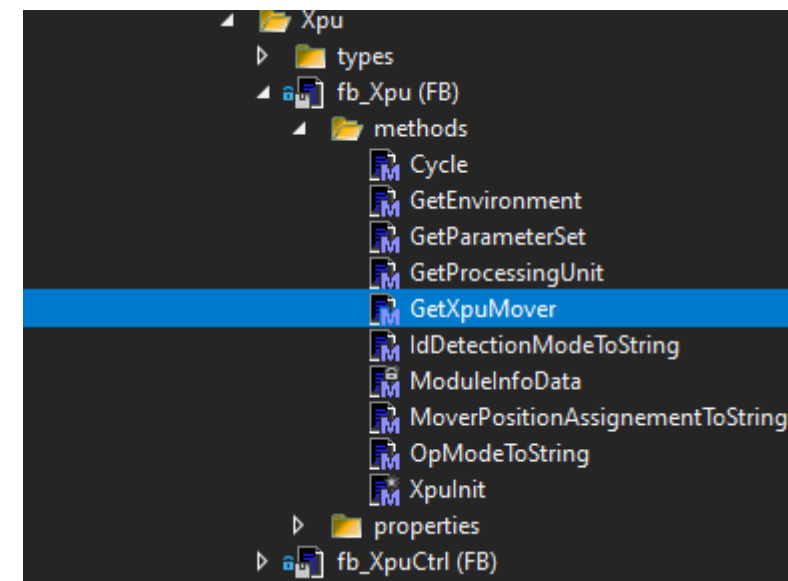




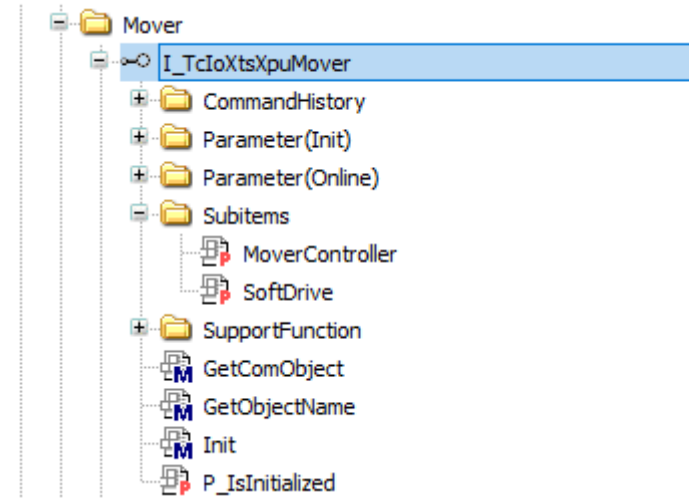
- `fb_Xpu.GetParameterSet(Index):`
  - **`I_TcIoXtsParameterSet:`**
  - See LibraryManager
  - Provides access to members



- `fb_Xpu.GetXpuMover(Index)`:
  - **Interface methods to Tc3\_XTS\_Utility.lib:**
    - `GetXpuMover(Index) : I_TcloXtsXpuMover`
      - Startup initialization of `_fbMoverXpu[ ]` is done by `fb_Xpu.Init()`
    - Interface for Mover
      - See interface structure (Library Manager) in order to reach lower level interfaces



- `fb_Xpu.GetXpuMover(Index):`
  - **I\_TcIoXtsXpuMover:**
    - See LibraryManager
    - Provides access to members



- **Transport Logic can be easy**

- All examples consider one specific aspect of the XTS transport system
  - Work as simple IndexTable
  - Work as Index Table where processes may host a number of XtsStations, working in parallel.
  - Complex, lot based decisions in order to achieve maximum production flexibility in one machine
  - Fast and precise for high speed packaging machines
  - Fast, synchronuous and precise for high end sorting and/or assembly machines

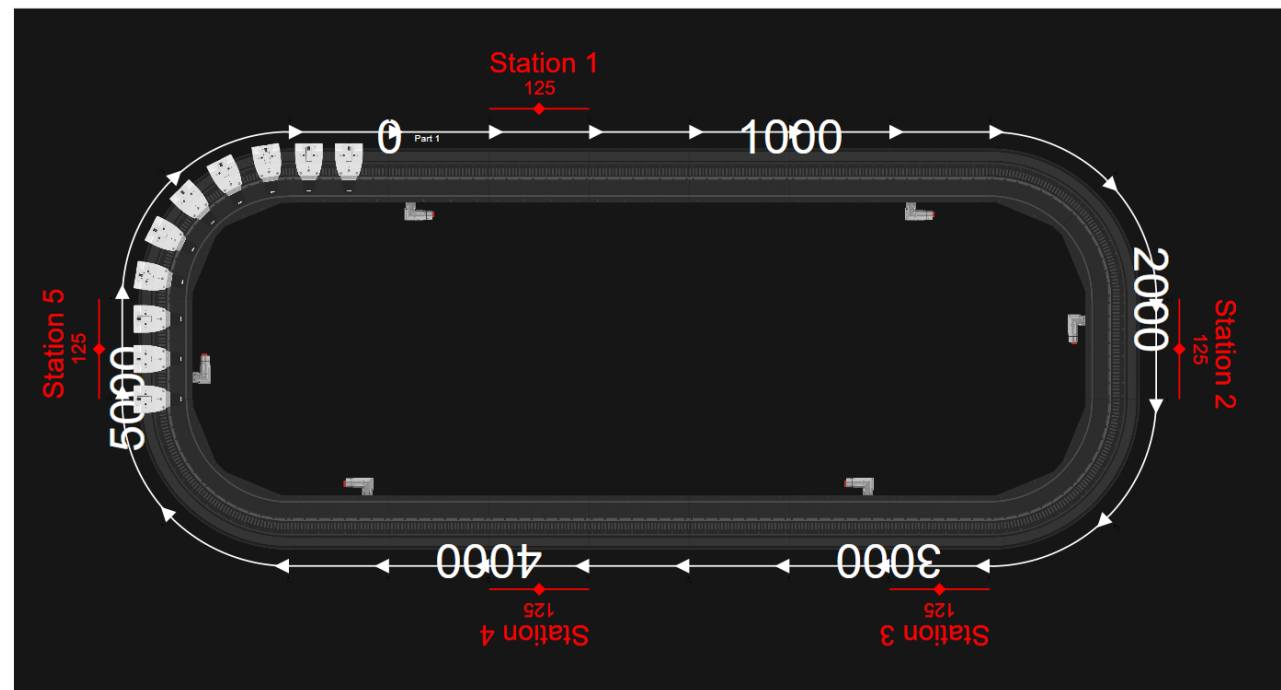
### 3. Examples

BECKHOFF

#### ■ XTS\_DEMO\_11

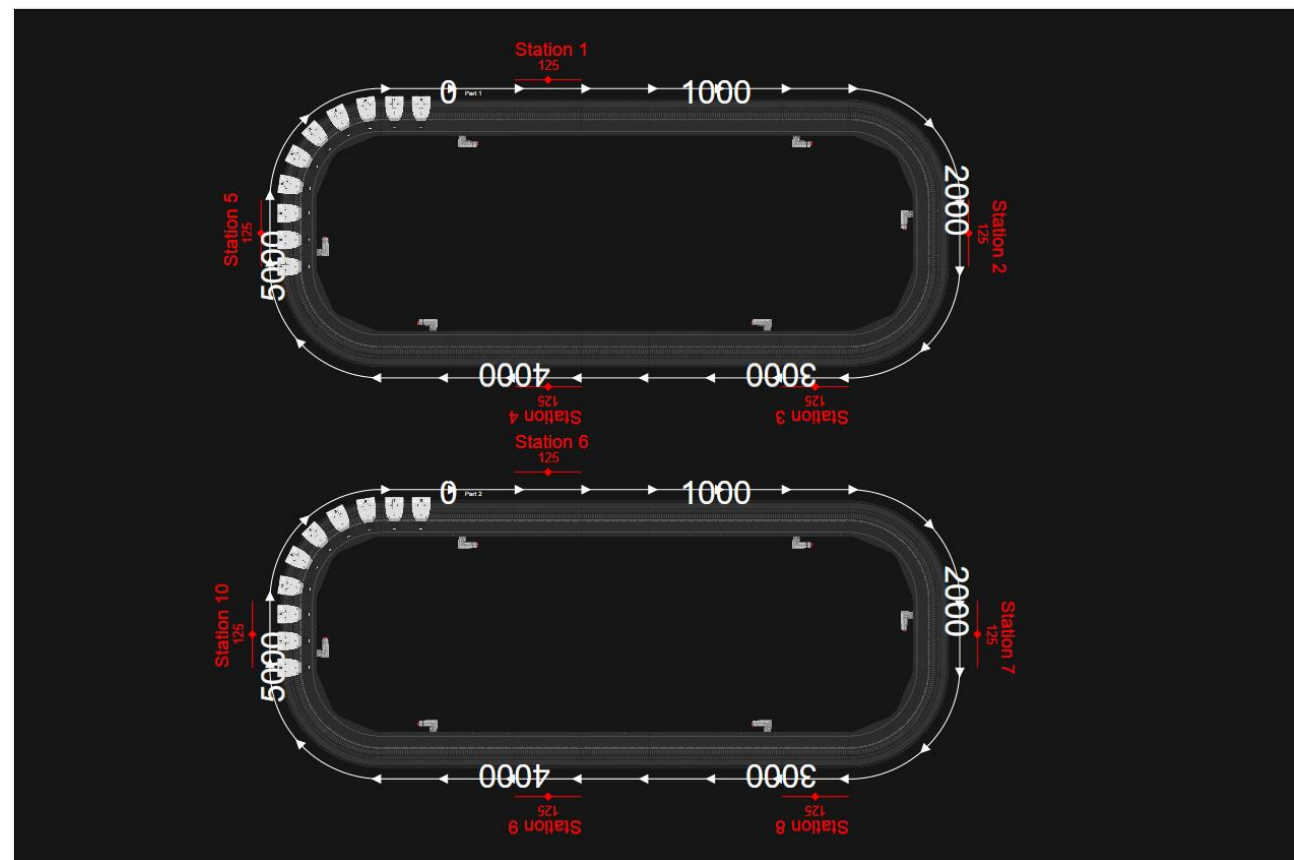
- Single Station, Single Nest
- Easy example for a XTS transport which requires only stations in which a mover stops once.
- Easy transport logic;

Target[n] := n+1; n+1 > MAX; n+1 := 1



### 3. Examples

- XTS\_DEMO\_22
  - Multiple XPU
    - 2 ProcessingUnits in one PLC
  - Single Station, Single Nest
  - Easy example for an XTS transport requiring only stations in which a mover stops once.
  - Easy transport logic:  
 $\text{Target}[n] := n+1; n+1 > \text{MAX}; n+1 := 1$



### 3. Examples

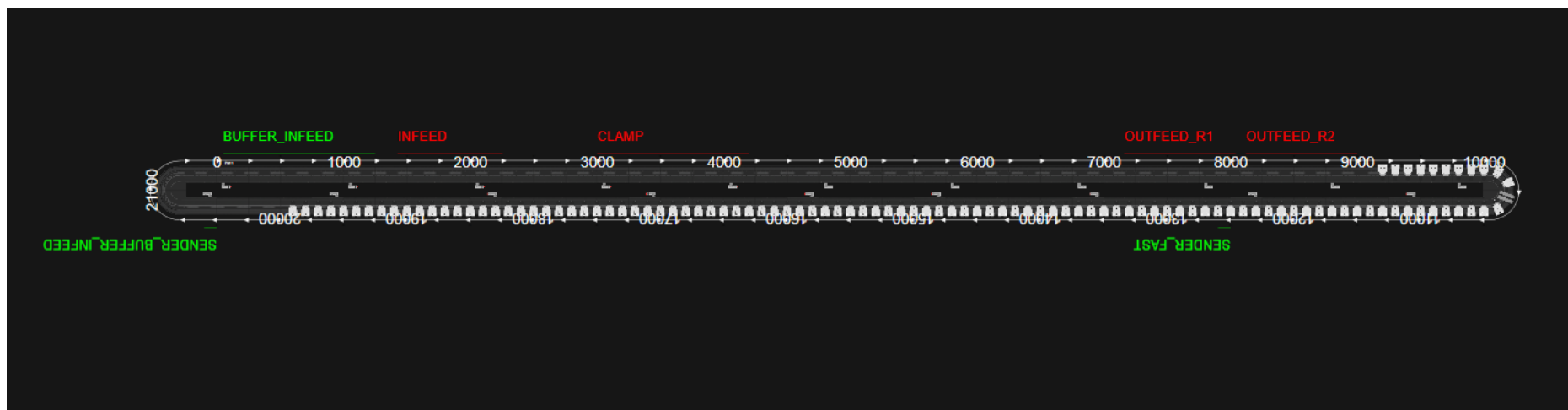
BECKHOFF

- XTS\_DEMO\_APPLICATION\_108

- High volume packaging application
- 450 – 500 Mover/Minute
- INFEED with gaps [1..12] possible
- Any OUTFEED without gaps
  - 12 Movers per outfeed
- 4 OUTFEED scenarios
  - software switch (PLC)
  - R1 or R2
  - R1 and R2
  - R1 xor R2
  - CLAMP

- 

- Complex transport logic:
  - fb\_ProcessCollector: grouping of XtsStations
  - fb\_Instance: base class for logic implementation
  - Process\_Instances: extending fb\_Instance with transport details



### XTS\_TRANSPORT\_LAYER project

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