SmartMaster™ 2014

BTE CORPORATION

ADMINISTRATOR
MANUAL

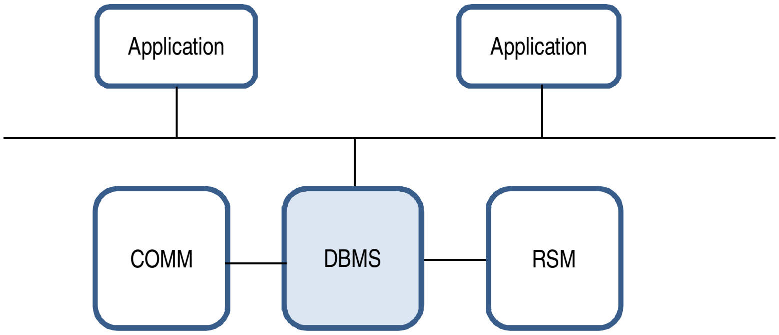
Contents

Introduction

This manual is intended for users who are able to set up and / or reconfigure SmartMaster™ (SM) so it better reflects the monitored distribution system. It is assumed that the reader has read SM User Manual.

System Functions

Below is SM block diagram depicting main system functions.



At the highest level, SM performs three functions:

1. Communications (COMM)
2. Management of remote stations (RSM)
3. Applications

Communications

The *COMM* block in above figure manages communications between SM and remote stations in the field. Its basic function is to get data from remote stations into SM database management system (DBMS), and to push data from SM to remote stations. In SM, communications are managed by *Communications* service running on the server.

Remote Stations

The *RSM* block in above figure is Remote Stations Manager. It manages remote stations in the field, such as IEDs, RTUs, switches, etc. It ensures that proper remote station parameters are defined and used, appropriate communications channels are assigned for communications between SM and respective remote stations, that communications take place at appropriate times, and that all data going to and coming from I/O points (inputs, such as analog and status readings, and outputs such as controls) is properly processed and stored. In SM, these functions are done by *RemoteStations* service running on the server.

Applications

Applications use I/O point database records. Each application also creates its own database records. These applications, such as *SCADA*, *load management*, etc. run algorithms appropriate to those applications, using above mentioned database records. In SM, each application has its own service on the server.

System Setup

To set up a functioning SM system, the following need to be set up first in the order listed below:

- All communications channels that will be used by SM. (*Communications* service)
- Remote station polling (*RemoteStations* service)
- All remote stations that will be managed by SM need to be defined and properly configured (*RemoteStations* service)
- All I/O points need to be defined and properly configured (*RemoteStations* service)
- All Evaluators (scripts of source code, authored by the Administrator, which process I/O point data) need to be defined. (*RemoteStations* service)

Above constitute a minimum set of objects that need to be defined so SM can operate. Above minimal configuration allows SM to function as a data concentrator or a small, basic SCADA master controller which can poll remote stations for data, and can dispatch control codes.

Beyond these, further system objects need to be defined to get additional functionality. They are listed below in no particular order:

- System backup schedule (*SmartMaster* service)
- Holiday list (*SmartMaster* service)
- Evaluators (*RemoteStations* service)
- RemoteStation filters (*RemoteStations* service)
- RemoteStation groups (*RemoteStations* service)
- I/O point groups (*RemoteStations* service)
- OutputManagers (*RemoteStations* service)
- Event Log Filters (*Event Viewer*)
- Data Filters (*Data Viewer*)
- Security accounts (*SystemUsers* service)
- System users (*SystemUsers* service)
- User notifications (*SystemUsers* service and *Database Mail* in SQL Server)
- User Authored Programs (*SCADA* service)
- One-Line Diagrams (*SCADA* service)
- Demand inputs (*LoadManagement* service)
- Load points (*LoadManagement* service)
- Load groups (LoadManagement service)
- Demand response (*LoadManagement* service)
- Load state reinserting (*LoadManagement* service)
- Load rotation (*LoadManagement* service)
- Reports (*Report Services* in SQL Server and *Internet Explorer*)

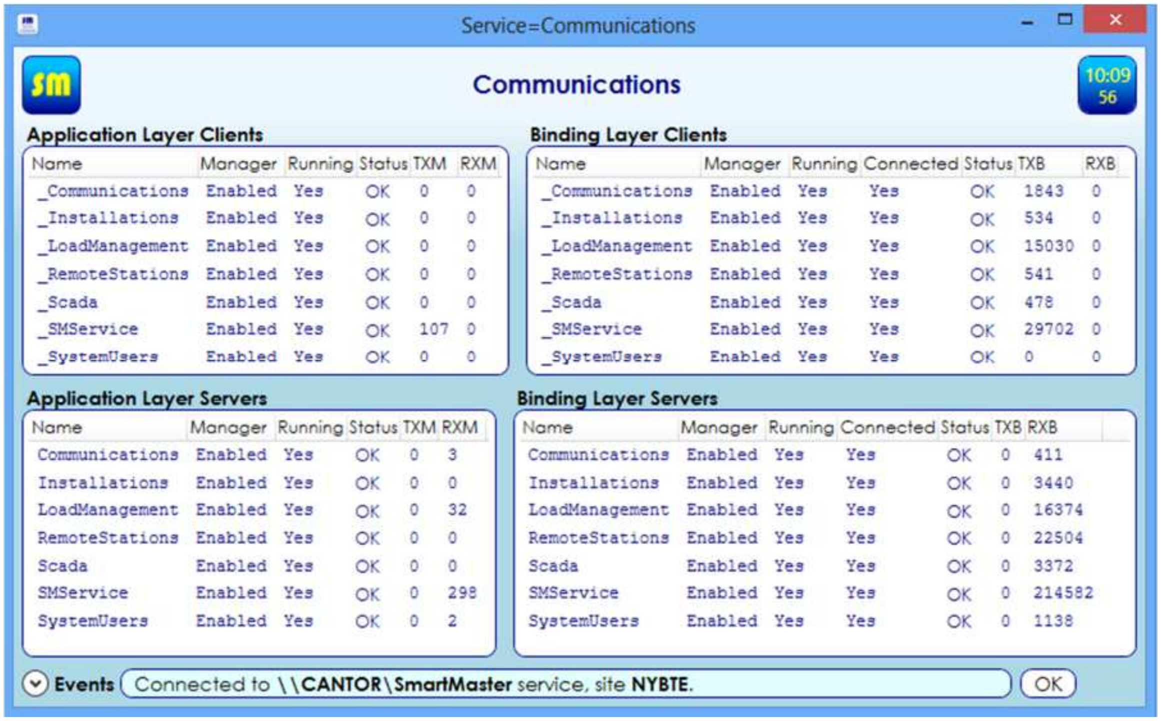
Communications

Communications service manages communications between SM and remote stations via communications chanels. In SM, each communications channel consists of two parts:

- Binding layer – moves data in and out of the computer
- Application layer – runs communications protocol layers

Communications channels can share the same binding layer. This way SM can run multiple protocols over the same physical channel.

Users can create and delete communications channels as needed. Internal, service broker channels should not be deleted as they are used by SM internally for communications between the various services and viewers.



Application Layer Clients

Name	Manager	Running	Status	TXM	RXM
_Communications	Enabled	Yes	OK	0	0
_Installations	Enabled	Yes	OK	0	0
_LoadManagement	Enabled	Yes	OK	0	0
_RemoteStations	Enabled	Yes	OK	0	0
_Scada	Enabled	Yes	OK	0	0
_SMService	Enabled	Yes	OK	107	0
_SystemUsers	Enabled	Yes	OK	0	0

Binding Layer Clients

Name	Manager	Running	Connected	Status	TXB	RXB
_Communications	Enabled	Yes	Yes	OK	1843	0
_Installations	Enabled	Yes	Yes	OK	534	0
_LoadManagement	Enabled	Yes	Yes	OK	15030	0
_RemoteStations	Enabled	Yes	Yes	OK	541	0
_Scada	Enabled	Yes	Yes	OK	478	0
_SMService	Enabled	Yes	Yes	OK	29702	0
_SystemUsers	Enabled	Yes	Yes	OK	0	0

Application Layer Servers

Name	Manager	Running	Status	TXM	RXM
Communications	Enabled	Yes	OK	0	3
Installations	Enabled	Yes	OK	0	0
LoadManagement	Enabled	Yes	OK	0	32
RemoteStations	Enabled	Yes	OK	0	0
Scada	Enabled	Yes	OK	0	0
SMService	Enabled	Yes	OK	0	298
SystemUsers	Enabled	Yes	OK	0	2

Binding Layer Servers

Name	Manager	Running	Connected	Status	TXB	RXB
Communications	Enabled	Yes	Yes	OK	0	411
Installations	Enabled	Yes	Yes	OK	0	3440
LoadManagement	Enabled	Yes	Yes	OK	0	16374
RemoteStations	Enabled	Yes	Yes	OK	0	22504
Scada	Enabled	Yes	Yes	OK	0	3372
SMService	Enabled	Yes	Yes	OK	0	214582
SystemUsers	Enabled	Yes	Yes	OK	0	1138

Events: Connected to \\CANTOR\SmartMaster service, site NYBTE.

Binding Layer Client

To define a new binding layer client proceed as follows:

- Start the *Main Viewer*
- Open *Communications* service window
- Right-click anywhere in the *Binding Layer Clients* display
- Execute the *New Client...* command
- Enter the new client name. In SM, client names are preceded with an underscore character '_'.
- From the list of client types select the new client type

The new client appears in *Binding Layer Clients* display. To configure the new client:

- Right-click on the new client

- Execute *Configuration – Client* command
- Modify parameters as needed. At the very least one must set the value the new object *Manager* to *Enabled*.
- Select *Save+Exit*

Object modifications are logged in SM event log.

Binding Layer Server

To define a new binding layer server proceed as follows:

- Start the *Main Viewer*
- Open *Communications* service window
- Right-click anywhere in the *Binding Layer Servers* display
- Execute the *New Server…* command
- Enter the new server name.
- From the list of server types select the new server type

The new client appears in *Binding Layer Servers* display. To configure the new server:

- Right-click on the new server
- Execute *Configuration – Server* command
- Modify parameters as needed. At the very least one must set the value the new object *Manager* to *Enabled*.
- Select *Save+Exit*

Object modifications are logged in SM event log.

Application Layer Client

To define a new application layer client proceed as follows:

- Start the *Main Viewer*
- Open *Communications* service window
- Right-click anywhere in the *Application Layer Clients* display
- Execute the *New Client…* command
- Enter the new client name. In SM, client names are preceded with an underscore character '_'.
- From the list of client types select the new client type
- From the list of binding layer clients select a client

The new client appears in *Binding Layer Clients* display. The last step above associates application layer client with a binding layer counterpart. Associating clients with servers is not supported. To configure the new client:

- Right-click on the new client
- Execute *Configuration – Client* command
- Modify parameters as needed. At the very least one must set the value the new object *Manager* to *Enabled*.
- Select *Save+Exit*

Object modifications are logged in SM event log.

Application Layer Server

To define a new application layer server proceed as follows:

- Start the *Main Viewer*
- Open *Communications* service window
- Right-click anywhere in the *Application Layer Servers* display
- Execute the *New Server...* command
- Enter the new server name.
- From the list of server types select the new server type
- From the list of binding layer servers select a server

The new server appears in *Binding Layer Servers* display. The last step above associates application layer server with a binding layer counterpart. Associating servers with clients is not supported. To configure the new server:

- Right-click on the new server
- Execute *Configuration - Server* command
- Modify parameters as needed. At the very least one must set the value the new object *Manager* to *Enabled*.
- Select *Save+Exit*

Object modifications are logged in SM event log.

Remote Stations

SM sends data to remote stations, and receives data from remote stations. The latter is coordinated by *input managers* in RemoteStations service.

Input Managers / Polling

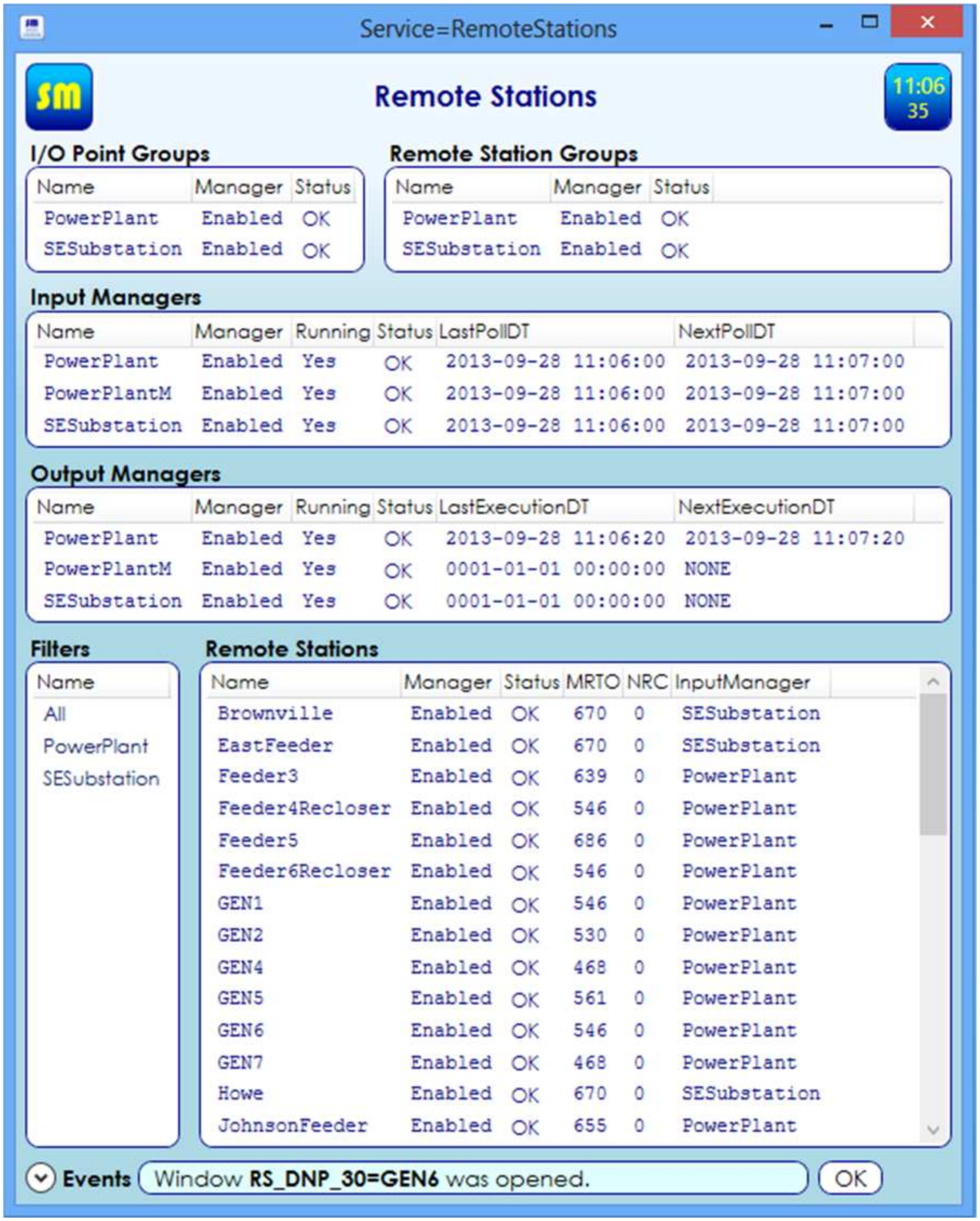
Polling remote stations for data can be manually initiated by an operator, or periodic. At the end of every poll cycle, after all data has arrived from remote stations, an evaluation cycle needs to execute. This cycle performs all calculations on the newly arrived data by executing evaluators defined by system administrator. It is important that evaluation cycle happens last, i.e. after polling cycle is complete.

Input managers execute periodic remote station polls. In addition, if so configured, a designated input manager is also a trigger for evaluation cycles. There should be at least one input manager designated as an Evaluation Cycle Trigger (ECT). If multiple input managers are defined, the one which executes (or whose execution ends) last should be designated as an ECT.

To define a new input manager:

- Start the *Main Viewer*
- Open *RemoteStations* service window
- Right-click anywhere in the *Input Managers* display
- Execute *New Input Manager…* command
- Enter new input manager's *name*

The new input manager appears in the *Input Managers* display.



Remote Stations

I/O Point Groups

Name	Manager	Status
PowerPlant	Enabled	OK
SESubstation	Enabled	OK

Remote Station Groups

Name	Manager	Status
PowerPlant	Enabled	OK
SESubstation	Enabled	OK

Input Managers

Name	Manager	Running	Status	LastPollDT	NextPollDT
PowerPlant	Enabled	Yes	OK	2013-09-28 11:06:00	2013-09-28 11:07:00
PowerPlantM	Enabled	Yes	OK	2013-09-28 11:06:00	2013-09-28 11:07:00
SESubstation	Enabled	Yes	OK	2013-09-28 11:06:00	2013-09-28 11:07:00

Output Managers

Name	Manager	Running	Status	LastExecutionDT	NextExecutionDT
PowerPlant	Enabled	Yes	OK	2013-09-28 11:06:20	2013-09-28 11:07:20
PowerPlantM	Enabled	Yes	OK	0001-01-01 00:00:00	NONE
SESubstation	Enabled	Yes	OK	0001-01-01 00:00:00	NONE

Filters

Name
All
PowerPlant
SESubstation

Remote Stations

Name	Manager	Status	MRTO	NRC	InputManager
Brownville	Enabled	OK	670	0	SESubstation
EastFeeder	Enabled	OK	670	0	SESubstation
Feeder3	Enabled	OK	639	0	PowerPlant
Feeder4Recloser	Enabled	OK	546	0	PowerPlant
Feeder5	Enabled	OK	686	0	PowerPlant
Feeder6Recloser	Enabled	OK	546	0	PowerPlant
GEN1	Enabled	OK	546	0	PowerPlant
GEN2	Enabled	OK	530	0	PowerPlant
GEN4	Enabled	OK	468	0	PowerPlant
GEN5	Enabled	OK	561	0	PowerPlant
GEN6	Enabled	OK	546	0	PowerPlant
GEN7	Enabled	OK	468	0	PowerPlant
Howe	Enabled	OK	670	0	SESubstation
JohnsonFeeder	Enabled	OK	655	0	PowerPlant

Events Window **RS_DNP_30=GEN6** was opened.

To configure the new manager:

- Right-click on the new object
- Execute *Configuration* command
- Modify parameters as needed. At the very least one must set
  - The value the new object *Manager* to *Enabled*
  - *CommChannel* parameter – this associates one of the application layer clients with the new input manager

    - The *ECT* parameter designates the new input manager as an Evaluation Cycle Trigger (see discussion above).
- Select *Save+Exit*

Object modifications are logged in SM event log.

Output Managers

Output managers run in RemoteStations service. They perform several functions, each of which can be enabled or disabled:

- Output Value Management (OVM) – This is enforcement of computed output values. User written SCADA programs compute output values of the various outputs. Output managers send control codes to the various outputs, making sure that output states in the field are in congruence with their respective output values in the database.
- Timed Switch Management (TSM) – This is updating of timed switch states before they time out.
- Remote Station Time Synchronization (RSTS) – This is dispatching of periodic time synchronization messages to remote stations that consume such messages.

To define a new output manager:

- Start the *Main Viewer*
- Open *RemoteStations* service window
- Right-click anywhere in the *Output Managers* display
- Execute *New Output Manager…* command
- Enter new output manager's *name*

The new output manager appears in the *Output Managers* display.

To configure the new manager:

- Right-click on the new object
- Execute *Configuration* command
- Modify parameters as needed. At the very least one must set
    - The value the new object *Manager* to *Enabled*
    - *CommChannel* parameter – this associates one of the application layer clients with the new output manager
    - *ExecutionPeriod* must be set to a value greater than zero, otherwise output manager never executes. Execution period is in seconds.
    - *OVM* must be *Enabled* if output value management is to execute.
    - TSM must be *Enabled* if time switch management is to execute.
    - RSTSPeriod must be set to a value greater than zero for time synchronization of remote stations to execute.
- Select *Save+Exit*

Object modifications are logged in SM event log.

Remote Station Definition

RemoteStation managers run all activities associated with remote station management. To define new RemoteStation object:

- Start the *Main Viewer*
- Open *RemoteStations* service window
- Right-click anywhere in the *Remote Stations* display
- Execute *New Remote Station…* command
- Enter new remote station *name*
- Select remote station *type* from the *Station Type* list

Alternatively, new remote station can be created from an existing one by executing the *Copy Remote Station…* command:

- Start the *Main Viewer*
- Open *RemoteStations* service window
- Right-click anywhere in the *Remote Stations* display
- Execute *Copy Remote Station…* command
- Enter new input manager's *name*

Note that copying remote station copies all remote station parameters, as well as all associated I/O points. At the least the new remote station address needs to be changed.

The new remote station appears in the *Remote Stations* display. To configure remote station:

- Right-click on the new object
- Execute *Configuration* command
- Modify parameters as needed. At the very least one must set
  - The value the new object *Manager* to *Enabled*.
  - *InputManager* – parameter determines input channel and scheduling
  - *OutputManager* – parameter defines output channel and scheduling
  - Address – remote station address, to distinguish it from all others. Format and number of addressing parameters varies depending on remote station type (see below)
- Select *Save+Exit*

Remote Station Addressing

Remote station address parameters are self-documented, as described in the *User Manual*. Nevertheless, since some protocols have a variety of addressing options, they are documented here.

Protocols

PROTOCOL	ADDR. PARAMETER	COMMENTS
DNP 3.0	Address	Destination Address, 16 bits
Modbus	Address	Modbus Address, 8 bits
Comverge RTC	SerialNumber	Used for programming the switch
Comverge RTC	OpAddress0	Switch operational address #0
Comverge RTC	OpAddress1	Switch operational address #1
Comverge RTC	OpAddress2	Switch operational address #2
Comverge RTC	OpAddress3	Switch operational address #3
Comverge RTC	OpAddress4	Switch operational address #4
Comverge RTC	OpAddress5	Switch operational address #5

Telescada ARS Protocol

Following are the Telescada ARS protocol addressing options for the various *device types* supported by the protocol:

– Ccu7CCtl

Internal use only, do not use.

– TscRTUShortAddr

This is a Telescada RTU. Addressing is short addressing, no routing.
Address: 16 bits
Address2: Not used
RouteNo: Not used

– TscRTULongAddr

This is a Telescada RTU. Addressing is long addressing, no routing.
Address: 24 bits
Address2: Not used
RouteNo: Not used

– TscRTURelayAddr

This is a Telescada RTU. Addressing is short addressing with routing.
Address: 16 bits, RTU address
Address2: 16 bits, first repeater address
RouteNo: 8 bits, route number

– MotorolaDigital

This is a Motorola digital switch.

Address: 24 bits, PC1 = Plug Code 1, PC2 = Plug Code 2, PC3 = Plug Code 3

Bits	23 – 16	15 – 8	7 – 0
	PC1	PC2	PC3

Address2: 16 bits, FC1 = Function Code 1, FC2 = Function Code 2

Bits	15 – 8	7 – 0
	FC1	FC2

RouteNo: Not used.

– GE REMS 101/102

This is a GE REMS 101/102 protocol switch.

Address: 12 bits, A = Address Bits

Bits	11 - 8	7 - 4	3 - 0
	A	A	A

Address2: 4 bits, FC1 = Function code 1

Bits	3 - 0
	FC1

RouteNo: 4 bits, FC2 = Function code 2

Bits	3 – 0
	FC2

- **SA REMS 101/102**

This is a Scientific Atlanta REMS 101/102 protocol switch.

Address: 12 bits, A = Address Bits

Bits	11 - 8	7 - 4	3 - 0
	A	A	A

Address2: 4 bits, FC1 = Function code 1

Bits	3 - 0
	FC1

RouteNo: 4 bits, FC2 = Function code 2

Bits	3 – 0
	FC2

- **SaDigital**

This is a Scientific Atlanta digital switch.

Address: 16 bits, A = Address 1, PC2 = Address 2

Bits	15 - 8	7 - 0
	A1	A2

Address2: Not used.

RouteNo: Not used.

- **Sa206**

This is a Scientific Atlanta 206 switch.

Address: 32 bits, S = Start Bits, A = Utility Address, B = Switch Address

Bits	31 - 28	27 - 24	23 - 20	19 - 16	15 - 12	11 - 8	7 - 4	3 - 0
	0	S	0	A	0	B	B	B

Address2: 16 bits, A = Function Code 0, B = Function Code 1

Bits	15 - 12	11 - 8	7 - 4	3 - 0

	0	B	0	A

RouteNo: Not used.

I/O Points

In SM, *I/O points* are subsystems which manage data associated with corresponding data sources and data consumers in the field. Each input has two value registers: *AValue* (actual value), and *CValue* (computed value). The first holds the value found at remote data source / consumer, preserving remote register encoding. The second holds the computed value when one is needed.

There are two kinds of I/O points:

- *Inputs* – manage data associated with corresponding data sources in the field, such as voltage readings, current readings, etc.
- *Outputs* - manage data associated with corresponding data consumers in the field, such as relay coils on switches, analog outputs, etc.

Definition

To define a new I/O point:

- Start the *Main Viewer*
- Open *RemoteStations* service window
- Open *I/O Points* window
- Right-click anywhere in the *I/O Points* display
- Execute *New Input…* command to define a new input, or *New Output…* command to define a new output
- Enter new object's *name,* do not use two underscore characters (__) in point names.
- Enter new object's type
- Enter the name of I/O group that the new I/O point will belong to
- Enter new I/O point's Actual Value SQL Type (See below)
- Enter new I/O point's Computed Value SQL Type (See Below)

The new I/O point appears in the *I/O Points* display.

A new point can also be created by copying an existing one. This is useful when creating a number of points that require lots of careful configuration, but differ only in remote station association. Point *RemoteAddress* parameter can stay the same as long as points belong to different remote stations. Point LocalAddress parameters, however, need to be distinct, but these are only defined for points reported by a local communications server. To copy an existing I/O point, proceed as follows:

- Start the *Main Viewer*
- Open *RemoteStations* service window
- Open I/O points window
- Right-click on I/O point to copy
- Enter new I/O point name

The new I/O point appears in the *I/O Points* display.

Configuration

To configure the new manager first assign I/O point to a remote station, unless I/O point is a stand-alone, computed point. Proceed as follows:

- Right-click on the new object
- Execute *Configuration* command
- Modify *StationName* parameter, this associates I/O point with specified remote station
- Select *Save+Exit,* this saves the re-configured I/O point and also changes its name to <Station Name>__<I/O Point Name>

Only after above association has been defined, modify other parameters:

- Right-click on the new object
- Execute *Configuration* command
- Modify parameters as needed. At the very least one must set
    - The value the new object *Manager* to *Enabled*
    - *RemoteAddress* – parameter defines point's address / index on remote station. See *Evaluation* section below
    - *LocalAddress* –parameter defined point's local address used by locally defined communications server(s). See below.
    - *VERS* – Value Encoding on Remote Station. (Unsigned Integer, Signed Integer, etc.)
    - *WORS* - Width, in bits, On Remote Station
    - *PSP* – Protocol Specific Parameter – see below.
    - *DataRecording* – must be set to *True* if SM is to record this point's values.
    - *UseCValue* –Parameter must be set to *True* if I/O point value is computed, and computed value (CValue) is to be used as I/O point value. See *Evaluation* section below
    - *Evaluator* –parameter assigns evaluator used to evaluate this point's value. See *Evaluation* section below
    - *EvaluationPriority* –parameter determines the order in which points are evaluated.
- Select *Save+Exit*

Object modifications are logged in SM event log.

PSP Parameter

This parameter is shared by all types of I/O points. It is interpreted differently, depending on communications protocol used to communicate with remote station hosting the I/O point. The table below describes parameter interpretation on a case by case basis.

	Generic DNP 3.0	Generic Modbus	Telescada NeXGen Modbus
Analog Inputs	DNP Class.		
Binary Status Inputs	DNP Class.	A single bit mask which indentifies the status bit. If that bit is 1, I/O point value = 1, else I/O point value = 0.	A single bit mask which indentifies the status bit. If that bit is 1, I/O point value = 1, else I/O point value = 0.
Multi-Val Status Inputs	DNP Class.		
Pulse Counters	DNP Class.		
Binary Control Outputs	DNP Class.	Operational bit patterns, as dictated by target device specification. Bits 0 - 15 are used to define bit pattern to set control to state 0. Bits 16 - 31 define bit pattern to set control to state 1.	Bits 0 - 15 are used to define bit pattern to set control to state 0. Bits 15 - 8 = 0; Bits 7 - 0 = 0 (See CCDC Technical Notes). Bits 16 - 31 are bits used to define bit pattern to set control to state 1. Bits 31 - 24 = 1; Bits 23 - 16 = 0 (See

			CCDC Technical Notes). PSP = 16777216, or 256 (Reverse operation logic).
Timed Control Outputs	DNP Class.	Operational bit patterns, as dictated by target device specification. Bits 0 – 15 are used to define bit pattern to set control to state 0. Bits 16 – 31 are used to define bit pattern to set control to state 1.	Bits 0 – 15 are used to define bit pattern to set control to state 0. Bits 15 – 8 = 0; Bits 7 – 0 = 1 or 2 (See CCDC Technical Notes). Bits 16 – 31 are bits used to define bit pattern to set control to state 1. Bits 31 – 24 = 1; Bits 23 – 16 = 1 or 2 (See CCDC Technical Notes).
Mom. Control Outputs	DNP Class.	Operational bit patterns, as dictated by target device specification. Bits 0 – 15 are to define bit pattern to operate control.	Bits 15 – 8 = Pulse duration, ms; Bits 7 – 0 = 0x03 or 0x04 (See CCDC Technical Notes).

Notes:

- Protocols not listed below do not use the parameter, i.e. parameter is ignored.
- In all cases, bit 0 is the least significant bit.
- CCDC Technical Notes is the NeXGen firmware technical manual available from Telescada.
- Empty table cell means parameter is ignored in that case.

Evaluation

Each I/O point manager holds two values:

- Actual value, stored in point's *AValue* register – this is unscaled value as reported by remote station, and
- Computed value, stored in point's *CValue* register, this is a value computed from point's AValue, and / or other values in the database.

Evaluators are short data conversion programs, written by SM administrators in T-SQL, which compute CValue from AValue and, possibly, from other values. Please see the section on Evaluators below.

Every poll cycle is followed by an evaluation cycle where point computed values are recalculated. The order in which this happens is dependent on values of I/O point *EvaluationPriority* parameters. For every I/O point, the lower the *EvaluationPriority* parameter value, the higher the point's evaluation priority. Evaluation order is important when results are interdependent. For example, when calculating power factor, kW and VAr numbers should be available before power factor calculation takes place.

If parameter *UseCValue* is set to True, I/O point's *CValue* is used as I/O point's value. In this case the following I/O point parameters need to be defined as follows:

- UseCValue = *True*
- RemoteAddress – see below.
- Evaluator – parameter must be defined, and not equal to *NONE*.

In the opposite case, if parameter *UseCValue* = False, I/O point's *AValue* is used as I/O point's value. In this case the following I/O point parameters need to be defined as follows:

- UseCValue = *False*
- RemoteAddress >= *0*
- Evaluator = *NONE*.

If remote station poll is to include a query for I/O point value, that I/O point value *RemoteAddress* parameter value must be >= 0. This populates I/O point's *AValue* register. One can then use *AValue* as I/O point value, or use an evaluator which uses *AValue*, and possible other values, to compute point's *CValue*.

If, on the other hand, I/O point is a purely computed one (only *CValue* is of interest), *RemoteAddress* parameter value must be -1. In this case remote station poll does not include a query for I/O point value.

Evaluators

Evaluators are short data conversion programs, written by SM administrators in T-SQL. When an evaluator is mapped to an I/O point via point's Evaluator parameter, the point's CValue is computed from point's AValue, and possibly from other values, as dictated by the said Evaluator.

To define a new Evaluator:

- Start the *Main Viewer*
- Open *RemoteStations* service window
- Open *Evaluators* window
- Right-click anywhere in the *Evaluators* display
- Execute *New Evaluator...* command
- Enter new object's *name*

The new Evaluator appears in the *Evaluators* display.

To configure the new manager:

- Right-click on the new object
- Execute *Configuration* command
- Modify parameters as needed. At the very least one must set
  - o The value the new object *Manager* to *Enabled*
  - o *SourceCode* – must be written in T-SQL language (see below)
- Select *Save+Exit*

Object modifications are logged in SM event log.

– Source Code Authoring

SM Administrators write Evaluator source code in T-SQL language. For convenience, SM generated source code provides for a number of variables which can be used by Evaluator author without declaration, including:

- @Name (varchar(64)) – Name of input executing the Evaluator
- @StationName (varchar(64)) – Name of remote station associated with I/O point
- @AValue (float) – Input current actual value
- @OldAValue (float) – Input previous value of @AValue
- @CValue (float) – Input current value of @CValue (about to be computed)
- @OldCValue (float) – Input previous value of @CValue
- @AValueDT (datetime2) – Date and time of @AValue
- @OldAValueDT (datetime2) – Date and time of @OldAValue

- @OldCValueDT (datetime2) – Date and time of @OldCValue
- @UseCValue (bit) – this variable is either true or false. When true, input CValue is used as point's value, when false input's AValue is used as point's value.
- @CanCtl – See section *Dynamic Operation Control* below.

In the simplest case the author can use @CValue to store result of his / her computation. This computation can involve variables listed above. For convenience, SM simply pre-fetches those values before calculation, and saves @CValue after calculation. In more elaborate calculations, if other variables need to be used, they have to be read from database explicitly. Also, if other variables need to be saved, they need to be written into database explicitly.

For example, to simply rescale I/O point's actual value by a factor of 10, use the following:

```
SET @CValue = @AValue * 10
```

As another example, to calculate the difference between the new and old values, proceed as follows:

```
SET @CValue = @AValue - @OldAValue
```

As a third example, suppose there are a number of remote stations each of which is reporting power on phases A, B, C via I/O points <…>__KWA, <…>__KWB, and <…>__KWB, respectively. Here, <…> stands for remote station name hosting above analog inputs. Suppose one needs to create a purely computed I/O point on each remote station which displays total power consumed on all three phases. One could write one Evaluator for each of the remote stations, in each case read in power from the three phases, and sum them up. Instead, one can use only one evaluator for all substations (lines which start with two dashes are comments ignored by compiler):

```
-- Declare local variables
DECLARE @APW float = 0
DECLARE @BPW float = 0
DECLARE @CPW float = 0
DECLARE @InputAName varchar(128)
DECLARE @InputBName varchar(128)
DECLARE @InputCName varchar(128)

-- Read in power from pahse A
SET @InputAName = @StationName + '__KWA'
SELECT @APW = AValue
  FROM [RSExec].[IOPoints]
  WHERE Name = @InputAName

-- Read in power from pahse B
SET @InputBName = @StationName + '__KWB'
SELECT @BPW = AValue
  FROM [RSExec].[IOPoints]
  WHERE Name = @InputBName

-- Read in power from pahse C
SET @InputCName = @StationName + '__KWC'
SELECT @CPW = AValue
  FROM [RSExec].[IOPoints]
  WHERE Name = @InputCName
```

```
-- Compute Total Power
SET @CValue = @APW + @BPW + @CPW
```

The author may opt to use any other variables from SM database; however those need to be read into memory explicitly by authored code.

Note also that source code can include calls to stored procedures associated with SMPrograms (see SCADA section).

- **Source Code Compilation**

Once the *SourceCode* parameter has been defined (i.e. Evaluator source code has been written), save the modified Evaluator by pressing the *Save+Exit* button. SM saves Evaluator in database and tries to compile the source code. If Evaluator compiles successfully the *Compiled* column in *Evaluators* display shows a *Yes* value, otherwise the value displayed is *No*. In addition, an appropriate event log entry is generated.

OVM (Output Value Management)

OVM is driven by administrator written program(s) in SCADA service (see SCADA section). A program computes I/O point's CValue, and *RemoteStations* service *OutputManager* subsystem whose OVM parameter is enabled, sends appropriate control code to output point in the field, so associated I/O point CValue and AValue are in congruence.

For an output point to be involved in OVM, its *OVM* parameter must be *Enabled*, and its StationName parameter must point to a valid remote station identifier.

Dynamic Operation Control

Output availability for control can be manipulated dynamically by changing the value of *@CanCtl* I/O point parameter in Evaluators. When @CanCtl value is 0 (False) output is not available for operation, manually or automatically by any of SM algorithms. Parameter value is ignored by inputs.

I/O Point Groups

I/O points can be bundled into groups. Users can filter I/O points in *I/O Points window* by groups. All I/O points in a group can also be enabled or disabled by enabling or disabling their group.

To define a new I/O point group:

- Start the *Main Viewer*
- Open *RemoteStations* service window
- Right-click anywhere in the *I/O Point Groups* display
- Execute *New I/O Group…* command
- Enter new group's *name*

The new I/O group appears in the *I/O Point Groups* display.

To reconfigure a group:

- Right-click on the group of interest
- Execute *Configuration* command
- Modify parameters as needed.
- Select *Save+Exit*

To make an I/O point a member of a group, proceed as follows:

- Right-click on I/O point of interest
- Execute *Configuration* command
- Set *IOGroup* parameter by selecting appropriate I/O group from the list of defined groups
- Select *Save+Exit*

Remote Station Groups

Remote stations can be bundled into groups. Users can filter remote stations in *Remote Stations service window* by groups. All remote stations in a group can also be enabled or disabled by enabling or disabling their group.

To define a new remote stations group:

- Start the *Main Viewer*
- Open *RemoteStations* service window
- Right-click anywhere in the *Remote Station Groups* display
- Execute *New Remote Station Group...* command
- Enter new group's *name*

The new remote stations group appears in the *Remote Stations Groups* display.

To reconfigure a group:

- Right-click on the group of interest
- Execute *Configuration* command
- Modify parameters as needed.
- Select *Save+Exit*

To make a remote station a member of a group, proceed as follows:

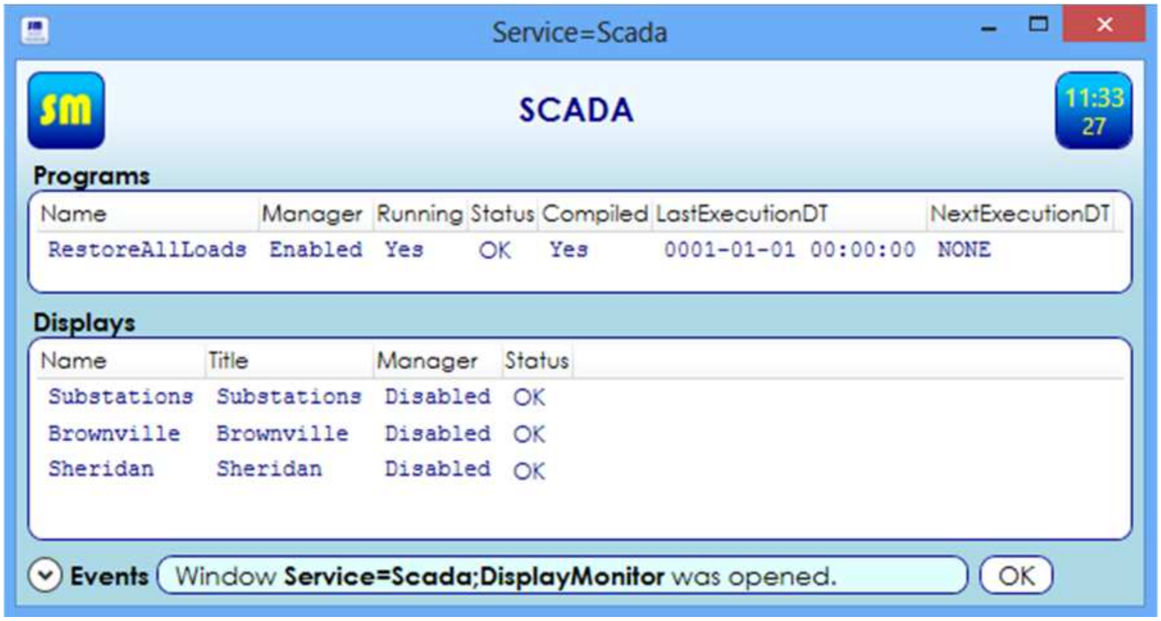
- Right-click on remote station of interest
- Execute *Configuration* command
- Set *RSGroup* parameter by selecting appropriate remote station group from the list of defined groups
- Select *Save+Exit*

SCADA

SCADA service is an application which depends on RemoteStations and Communicstion services, as well as those of DBMS. Before SCADA functions can be configured RemoteStations and Communications must be fully configured.

In SM, SCADA service provides two functions:

- Programs – Written by SM administrators
- One-Line Diagram Displays – Interactive one-line diagrams of the system managed by SM



Programs

Name	Manager	Running	Status	Compiled	LastExecutionDT	NextExecutionDT
RestoreAllLoads	Enabled	Yes	OK	Yes	0001-01-01 00:00:00	NONE

Displays

Name	Title	Manager	Status
Substations	Substations	Disabled	OK
Brownville	Brownville	Disabled	OK
Sheridan	Sheridan	Disabled	OK

Events: Window **Service=Scada;DisplayMonitor** was opened.

Programs

SCADA programs are written in T-SQL. As opposed to Evaluators, SCADA progrms are completely open, unrestricted, and provide complete freedom as to which variables are used as program inputs and outputs. With that freedom come dangers and responsibilities that program authors must be aware of. While one can use any database variables as inputs, it is strongly advised that only I/O point *CValue* registers are used for program output.

When using programs to do other tasks – such as, for example, global database value changes, it is advisable to diable all services affected by such programs. Failure to disable services increases the risk of database concurrencies.

Programs are meant to execute control algorithms and logic authored by SM administrators. It is not advisable to use programs for simple I/O point scaling & calculations – Evaluators already do that.

Program Creation

To create a new program proceed as follows:

- Open *SCADA* service window

- Right-click onto *Programs* display
- Execute *New Program...* command
- Enter new program *name*
- Select *Save+Exit*

The new program appears in the *Programs* display. To configure the new program:

- Right-click on the new program
- Execute *Configuration – Program* command
- Modify parameters as needed. At the very least one must set the value the new object *Manager* to *Enabled* and write program source code (*SourceCode* parameter).
- Select *Save+Exit*

Object modifications are logged in SM event log. If the program compiles the *Compiled* column in *Programs* display is set to *Yes*, else it is set to *No* and alarm is generated.

One should always make sure that the progrogram compiles and works as intended before it is set for automatic, scheduled execution. This should be done by first manually executing the program as diescribed in the User Manual, and observing program execution results.

Database Tables

Program input comes from parameteres in system tables. The DBMS contains many tables and other system objects. To locate SM related tables and parameters contained within proceed as follows:

- Start *Microsoft SQL Server Management Studio* (SSMS)
- Log on using your *SM account*
- Open *Object Explorer*
- Expand *Databases*
- Under Databases expand the database bearing the same name as your *system site code*
- Under the database expand *Tables*

Above lists the tables used by SM. It is strongly advised that no modifications to tables or table column values be done via SSMS.

Table Columns

Table columns are SM configuration parameteres. Parameter names can be referenced by their names in SM programs. Parameter values are thus used as input for SCADA service programs. When referencing parameter name in SM programs, it is advised that their full names

Schema.Table.Column

are used, where *Schema* is DBMS security schema associated with the table, *Table* is the name of the table of interest, and *Column* is the name of the column of interest.

For example, the full name of I/O Point Cvalue register is

RSExec.IOPoints.CValue

Above, *RSExec* is the security schema name, *IOPoints* is the table name, and *Cvalue* is the column name.

To get a list of columns in a specific table proceed as follows:

- Start *Microsoft SQL Server Management Studio* (SSMS)
- Log on using your *SM account*
- Open *Object Explorer*
- Expand *Databases*
- Under Databases expand the database bearing the same name as your *system site code*
- Under the database expand *Tables*
- Under *Tables* expand the *table of interest*
- Under the table expand *Columns*

Program Execution

Programs can be executed manually as described in the User Manual. They can also be configured to run automatically by SCADA service on a periodic basis. To do that proceed as follows:

- Right-click on the program of interest
- Execute *Configuration – Program* command
- Modify parameters *ExecutionPeriod* and *OffsetFromMidnight* parameteres as needed.
- Select *Save+Exit*

Parameter *ExecutionPeriod* specifies how often the program should execute (in seconds), the value of zero disables periodic execution.

Parameter *OffsetFromMidnight* specifies the number of seconds above time grid shold be offset from last midnight.

Periodic program execution can also be disabled by setting the *Manager* parameter to *Disabled*.

Programs can also be cascaded, i.e. one program can call (execute) other programs by executing their associated stored procedures. Each program is stored in the DBMS as a stored procedure named as follows:

SMPrograms.SP_<name>

where *<name>* is the *name of the program* as listed in the SCADA service *Programs* display. Program stored procedures have no arguments.

Programs can also call Evaluators executing their associated stored procedures. Each Evaluaotr is stored in the DBMS as a stored procedure named as follows:

Evaluators.SP_<name>

where *<name>* is the *name of the Evaluator* as listed in the RemoteStations service *Evaluators* display. Evaluators are specialized programs associated with I/O points mapped to them. Consequently, evaluator stored procedures have one argument, I/O point number:

RSExec.IOPoints.Number

which is of (SQL) *bigint* type (signed 64 bit integer). This number uniquely identifes the I/O point.

Beware of circular references. A circular reference, in its simplest form, is when program A calls program B, and program B calls program A. When a program gets into circular reference endless loop, results are unpredictable.

One-Line Diagram Displays

User Manual describes how to open and view one-line diagram displays (OLDDs). This section describes how to create OLDDs.

Each OLDD is a collection of display elements (DEs) created by SM administrator. Some of those DEs are usually mapped onto respective I/O points so they display real time information and provide interactivity with SM. For example, a DE can be mapped onto a control output I/O point. That DE can show the state of that output in real time, as well as provide commands to operate the output right from the OLDD.

DEs can be atomic or composite. In the latter case the are collections of simpler DEs. To create an OLDD, a DE must be declared as such by setting DE parameter *IsDisplay* to *Yes*.

Display Designer

OLDDs are created via Display Designer (DD). To open DD proceed as follows:

- In *Main Viewer* open *SCADA service* window
- Right-click on *SCADA service* window title and execute *Display Designer* command

DD has two displays, Canvas and Library. Canvas is where display elements (DEs) are designed, and Library is where they are stored for later use in building more complex DEs. This library is a local (customer server resident) library. There exists another library on BTE server, called central library, which contains DEs designed by BTE. Those DEs can be downloaded into local library as described later in this section. Local library holds locally designed DEs and DES downloaded from central library.

Display Element Types

There are two types of DEs: atomic and composite.

- Atomic Display Elements

These are DEs which contain no children, i.e. they are not made of any other DEs. Current list of atomic DEs contains the following DE types:

Line	Straight line, two end points
Polyline	Collection of interconnected straight line segments, no limit on number of segments. Polyline start and end points are distinct (open figure)
Polygon	Collection of interconnected straight line segments, no limit on number of segments. Polyline start and end points match (closed figure)
Circle	Circle of arbitrary radius
Arc	Arbittrary open curve
Gauge	DE which changes appearance based on associated I/O point

Text	DE for displaying text.

– Composite Display Elements

These are DEs made of other DEs (children). Multiple generations of children are allowed, this allows for building of more complex DEs and, ultimately, OLDDs.

Display Element Creation

To create a new DE proceed as follows:

- Open Display Designer
- Right-click anywhere in the Canvas
- Select DE type from the list

After this procedure depends on the type of DE one is buliding.

– Line

- Click in the *Canvas* where first point is supposed to be located
- Click in the *Canvas* where second point is supposed to be located
- Drag the points to their intended final locations
- Right-click anywhere in the *Canvas*
- Execute *Attach to Grid* command
- Right-click anywhere in the *Canvas*
- *Save to Library...* command
- Enter the new DE *name*

This saves the new DE to local library.

– Polyline, Polygon

- Click in the *Canvas* where first point is supposed to be located
- Repeat above unitil all points have been defined
- Right-click anywhere in the *Canvas*
- Execute *Done Adding Points* command
- Drag the points to their intended final locations
- Right-click anywhere in the *Canvas*
- Execute *Attach to Grid* command
- Right-click anywhere in the *Canvas*
- Execute *Save to Library...* command
- Enter the new DE *name*

This saves the new DE to local library.

– Circle

- Click in the *Canvas* where first point on circle perimeter is supposed to be located

- Repeat above three more times until the cirle appears
- Drag the points to their intended final locations
- Right-click anywhere in the *Canvas*
- Execute *Attach to Grid* command
- Right-click anywhere in the *Canvas*
- Execute *Save to Library...* command
- Enter the new DE *name*

This saves the new DE to local library.

– **Arc**

- Click in the *Canvas* at three different locations
- Drag the points to their intended final locations, this manipulates arc shape
- Right-click anywhere in the *Canvas*
- Execute *Attach to Grid* command
- Right-click anywhere in the *Canvas*
- Execute *Save to Library...* command
- Enter the new DE *name*

This saves the new DE to local library.

– **Text**

- Click in the *Canvas* at where the top left text corner is supposed to be located
- Click in the *Canvas* at where the bottom right text corner is supposed to be located
- Drag the points to their intended final locations
- Right-click anywhere in the *Canvas*
- Execute *Attach to Grid* command
- Right-click anywhere in the *Canvas*
- Execute *Save to Library...* command
- Enter the new DE *name*

This saves the new DE to local library.

– **Gauge – Relay_01**

- Click in the *Canvas* at four differrent places in approxiamtely straight line. The middle line segment opens / closes when DE is mapped to a control output, matching that output state
- Drag the points to their intended final locations
- Right-click anywhere in the *Canvas*
- Execute *Attach to Grid* command
- Right-click anywhere in the *Canvas*
- Execute *Save to Library...* command
- Enter the new DE *name*

This saves the new DE to local library.

– **Composite**

- Right-Click on a DE in the library
- Execute *Add Display Element to Canvas* command – DE appears in *Canvas*
- Drag DE to desired location in *Canvas*
- Size DE to desired size (see below for procedure)
- Repeat above steps to add as many DEs to *Canvas* as desired
- Right-click anywhere in the *Canvas*
- Execute *Save to Library*… command
- Enter the new DE *name*

This saves the new DE to local library.

Change Display Element

User authored DEs can be changed in two ways: editing and reconfiguration.

– Edit Display Element

Editing DE means to change DE appearance. To edit DE proceed as follows:

- Open *Display Deigner*
- Right-Click on the DE of interest in the Library
- Execute *Edit Display Element*… command

This places the DE onto the Canvas. If DE is atomic one can drag DE points to new locations. If DE is composite one can drag DE children to new locations. In either case DE appearance changes.. When done the mofified DE can be saved as follows:

- Right-Click anywhere in *Canvas*
- Execute *Save Modifications*… command
- *Confirm* command execution

Alternatively one can save DE as a Display by excuting the *Save Modifications as Display*… command. This saves DE modifications in library and makes DE an OLDD.

DEs downloaded from central library can not be edited. They can be edited once used as children of a composite DE.

– Configure Display Element

Configuring DE means changing DE parameters. To configure DE proceed as follows:

- Open *Display Deigner*
- Right-Click on the DE of interest in the Library
- Execute *Configuration – Display Element*… command
- Change parameters of interest
- Select *Save+Exit*

DEs downloaded from central library can not be reconfigured. They can be configured once used as children of a composite DE.

Change Display Element Children

To change (edit or reconfigure) a DE child proceed as follows:

- Open *Display Deigner*
- Right-Click on the DE of interest in the Library
- Execute *Show Children* command

At this point DE children are visible in the library. They can be changed like any other DE as described in previous sections.

Download Display Elements from Central Library

To download or update DEs from central library proceed as follows:

- Open *Display Deigner*
- Right-Click onto DD title
- Execute *Update Local Library...* command
- *Confirm* command execution

Above updates DEs in local library downloaded from central library. It does not affect locally authored DEs.

Display Element Colors

Each DE is assigned default colors. Colors can be changed by reconfiguring DE. Each DE has six color parameteres: Two stroke colors (Parameters SC0 and SC1), and four fill colors (FC0 – FC3).

– Stroke Colors

Stroke colors are used to color line elements and text letters. All DEs are colored using stroke color SC0 when DE is *unmapped* or is mapped to an object in *normal* state, and SC1 when DE is mapped to an object in *alarm* state.

– Fill Colors

Fill colors are used to color DEs which form two dimensional areas bordered by stroke colored line elements.

All DEs are colored using fill color FC0 when unmapped, or when mapped to I/O point of unknown type or state.

All DEs are colored using standard alarm brush (alternating red / yellow) when mapped to objects in alarm state.

When mapped to binary *status* or any of the *control* outputs, fill colors FC1 and FC2 are used for the two possible I/O point states.

When mapped to a multi-valued *status* point, Fill color FC1 is used when status point is in state 0, and FC2 is used when in any of the other possible states.

When mapped to an *analog* point, fill colors are used as follows:

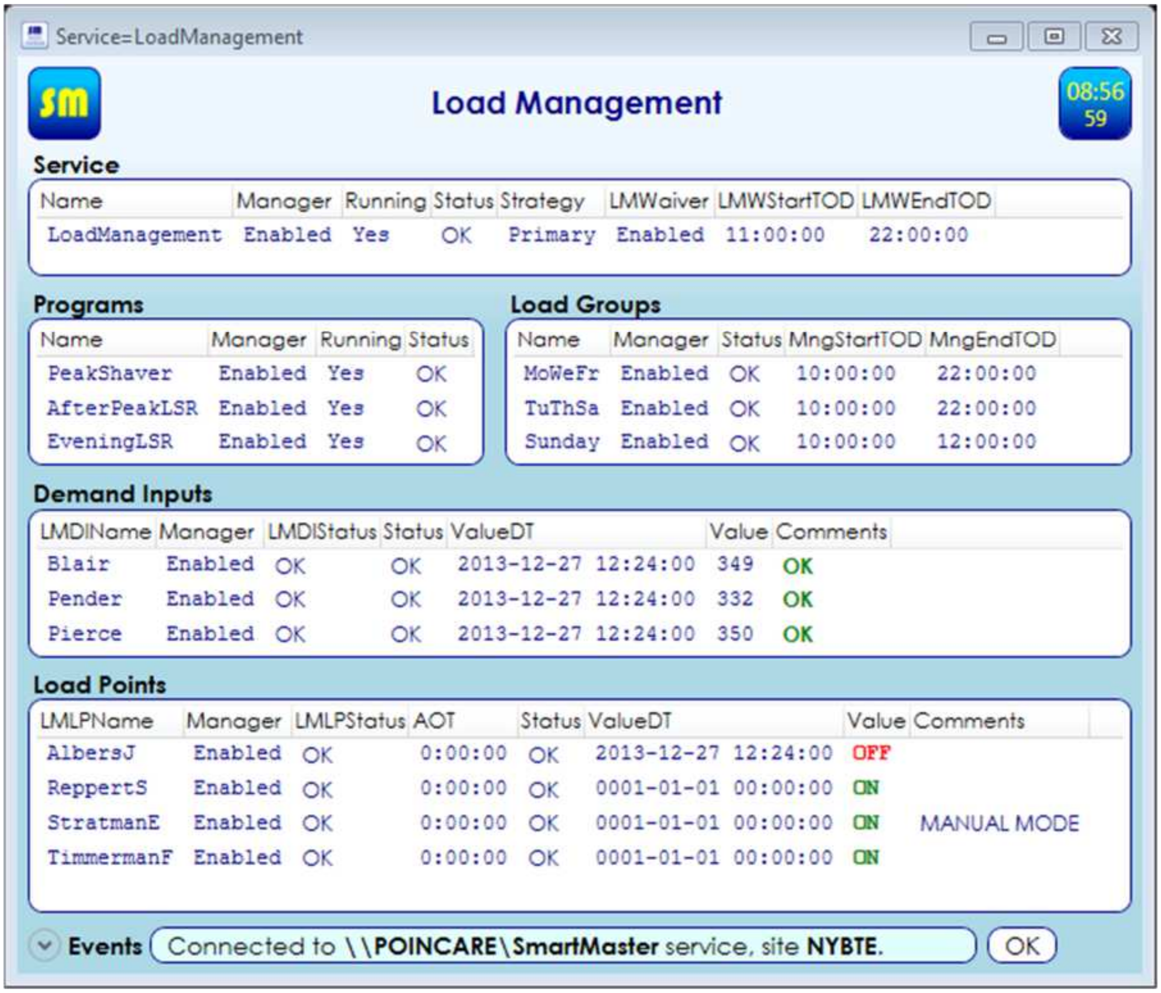
FC1	Analog point in *low* or *very low* region
FC2	Analog point in *normal* region
FC3	Analog point in *high* or *very high* region

Load Management

LoadManagement service is an application which depends on RemoteStations and Communicstion services, as well as those of DBMS. Before LoadManagement functions can be configured RemoteStations and Communications must be fully configured.

In SM, LoadManagement service provides the following functions:

- Peak shaving
- Load state reinserting
- Load rotation



Load Management

Service

Name	Manager	Running	Status	Strategy	LMWaiver	LMWStartTOD	LMWEndTOD
LoadManagement	Enabled	Yes	OK	Primary	Enabled	11:00:00	22:00:00

Programs

Name	Manager	Running	Status
PeakShaver	Enabled	Yes	OK
AfterPeakLSR	Enabled	Yes	OK
EveningLSR	Enabled	Yes	OK

Load Groups

Name	Manager	Status	MngStartTOD	MngEndTOD
MoWeFr	Enabled	OK	10:00:00	22:00:00
TuThSa	Enabled	OK	10:00:00	22:00:00
Sunday	Enabled	OK	10:00:00	12:00:00

Demand Inputs

LMDIName	Manager	LMDIStatus	Status	ValueDT	Value	Comments
Blair	Enabled	OK	OK	2013-12-27 12:24:00	349	OK
Pender	Enabled	OK	OK	2013-12-27 12:24:00	332	OK
Pierce	Enabled	OK	OK	2013-12-27 12:24:00	350	OK

Load Points

LMLPName	Manager	LMLPStatus	AOT	Status	ValueDT	Value	Comments
AlbersJ	Enabled	OK	0:00:00	OK	2013-12-27 12:24:00	OFF	
ReppertS	Enabled	OK	0:00:00	OK	0001-01-01 00:00:00	ON	
StratmanE	Enabled	OK	0:00:00	OK	0001-01-01 00:00:00	ON	MANUAL MODE
TimmermanF	Enabled	OK	0:00:00	OK	0001-01-01 00:00:00	ON	

Events: Connected to \\POINCARE\SmartMaster service, site NYBTE.

The service uses *demand inputs* to account for managed system power demand, and *load points* to manage demand response. Each load point can be used to connect / disconnect one or more power consumers. Load point operations can be manually initiated by an operator, or automatically executed by SM based on *program* settings. One can create as many programs as necessary. Three types of program managers are available: *peak shavers*, *load state reinserting* managers, and *load rotation* managers. Finally, load points can be grouped in *load groups* for group management.

Ton configure *LoadManagement* service proceed as follows:

- Start the *Main Viewer*
- Right-click on LoadManagement
- Execute *Configuration – Service* command
- Modify parameters as needed. At the very least one must set
    - *Manager* to *Enabled*.
- Select *Save+Exit*

Alternatively, with LoadManagement service window already open, proceed as follows:

- Right-click on window title
- Execute *Configuration – LoadManagement* command
- Modify parameters as needed.
- Select *Save+Exit*

Strategies

The service allows for three possible strategies: *Primary*, *Secondary*, and *Emergency*. One can define a set of load groups for each strategy, and assign each load point to appropriate laod group for each strategy as described in *Load Points* section. Switching between strategies can only be manually initiated by an operator.

Single strategy load management is possible – one can leave *Strategy* parameter set to *Primary* and never change it. In this case load point parameters *Group2* and *GroupE* can remain undefined.

Demand Inputs

Demand inputs are used to account for managed system power demand. To crate a new demand input proceed as follows:

- Start the *Main Viewer*
- Open *LoadManagement* service window
- Right-click anywhere in the *Demand Inputs* display
- Execute the *New Demand Input…* command
- Enter the new demand input *name*

The new demand input appears in *Demand Inputs* display. To configure the new demand input:

- Right-click on the new demand input
- Execute *Configuration – Demand Input* command
- Modify parameters as needed. At the very least one must set
    - *Manager* to *Enabled*.
    - *AnalogInput* to appropriate analog input reading demand at the point of interest
- Select *Save+Exit*

Object modifications are logged in SM event log.

It is advisable to configure associated RemoteStations *demand input* configured so it's value is never more than input's *very high* threshold, and never less than input's *very low* threshold. This way out of range values are still reported via alarms when demand input value is either *high* or *low*, but are never so far out of range as to cause inapropriate peak shaver demand response. This behavior can be accomplished by computing demand input value using appropriate evaluator.

Load Points

Load points are objects used by *LoadManagement* service to connect and disconnect power users from the power grid. To crate a new demand input proceed as follows:

- Start the *Main Viewer*
- Open *LoadManagement* service window
- Right-click anywhere in the *Load Points* display
- Execute the *New Load Point…* command
- Enter the new load point *name*

The new load point appears in *Load Points* display. To configure the new load point:

- Right-click on the new load point
- Execute *Configuration – Load Point* command
- Modify parameters as needed. At the very least one must set
  - *Manager* to *Enabled*.
  - *ControlOutput* to appropriate control output of interest
- Select *Save+Exit*

Object modifications are logged in SM event log.

Above minimum configuration is enough so the new load point can be used to manually operate associated control output. For automatic operations a few more load point parameteres need to be defined:

- *PowerRating* – parameter needs to be defined for all load points that are managed by a peak shaving program.
- *LoadType* – must be set to *Primary* for load point to be managed by any of the programs. See the section on *Secondary Loads* below.
- *Group1* – parameter must be defined for load points involved in *Primary* strategy load management.
- *Group2* – parameter must be defined for load points involved in *Secondary* strategy load management.
- *GroupE* – parameter must be defined for load points involved in *Emergency* strategy load management.
- *DemandResponder* – every load that is to be managed by a demand responder type program must specify that program.
- *LSR* – every load point whose state is to be automatically reinserted by any *LSR* type program must have this parameter set to *Enabled*.

To configure associated *RemoteStations* service control point click on load point *ControlOutputConfiguration* parameter. Control point *ManualMode* parameter must be set to *False*, otherwise LoadManagement servoice programs ignore (do not operate) that load point.

Load Groups

Load groups are objects for grouping load points. They contain parameters shared by associated load points. A group can also be used to operate all loads assigned to that group. To crate a new load group proceed as follows:

- Start the *Main Viewer*
- Open *LoadManagement* service window

- Right-click anywhere in the *Load Groups* display
- Execute the *New Load Group...* command
- Enter the new load group *name*

The new load group appears in *Load Groups* display. To configure the new load group:

- Right-click on the new load group
- Execute *Configuration – Load Group* command
- Modify parameters as needed. At the very least one must set
  - *Manager* to *Enabled*.
- Select *Save+Exit*

Object modifications are logged in SM event log.

Above minimum configuration is enough to run group default settings. Usually one will want to set up days of week when load managamant is allowed, AOTBaseDT, and AOTMode. The latter parameter can have one of the following values:

- CurrentDay – Current day of week Accumulated Off Time (AOT) only is used
- EnabledDays – AOT sum of all management enabled days of week is used

Manual Load Point Operation

To operate load point manually proceed as follows:

- Right-Click on the load point of interest in the *LoadManagement* service window
- Execute *Operate Load Point*... command
- *Confirm* command execution

To operate a number of load points simultaneously:

- Select load points of interest in the *LoadManagement* service window
- Right-Click on any of the selected load points
- Execute *Operate Load Point*... command
- *Confirm* command execution

To operate all load points assigned to the same load group:

- Right-Click on the load group of interest in the *LoadManagement* service window
- Execute *Operate Load Points*... command
- *Confirm* command execution

Load Point Operation Priority

Load point disconnect priority is computed in the following order:

- Associated load group DisconnectPriority parameter values are compared. Load points with lower parameter value have higher disconnect priority.
- Load point DisconnectPriority parameter values are compared. Load points with lower parameter value have higher disconnect priority.
- Load point AOT values are compared. Load points with lower AOT value have higher disconnect priority.

Load point reconnect priority is computed in the following order:

- Associated load group ReconnectPriority parameter values are compared. Load points with lower parameter value have higher reconnect priority.
- Load point ResconnectPriority parameter values are compared. Load points with lower parameter value have higher reconnect priority.
- Load point AOT values are compared. Load points with higher AOT value have higher reconnect priority.

Secondary Loads

Secondary loads are load points which operate only when associated primary load operates. Secondary loads are not operated directly by any LoadManagement program. A load point is a primary load point when parameter *LoadType* is set to *Primary*. A load point is secondary when parameter *LoadType* is set to identify associated primary load. Beware of circular references. For example, when load A is secondary to load B and vice versa, neither load point will operate automatically under any LoadManagement program.

Programs

LoadManagement service offers three types of programs: demand responder, load state reinserting (LSR) manager, and load rotation (LR) manager.

Demand Response

Demand response is done by *DemandResponder* type program(s). One can create and run as many programs as necessary. *DemandResponder* type programs run a peak shaving algorithm which attempts to keep power demand below operator specified high threshold.

To crate a new program proceed as follows:

- Start the *Main Viewer*
- Open *LoadManagement* service window
- Right-click anywhere in the *Programs* display
- Execute the *New Program...* command
- Enter the new program *name*
- Select *DemandResponder* for program type

The new program appears in the *Programs* display. To configure the new program:

- Right-click on the new program
- Execute *Configuration – Program* command
- Modify parameters as needed. For the program to run correctly all parameteres need to be defined properly.
- Select *Save+Exit*

Object modifications are logged in SM event log.

Parameter *TDAI* (Total Demand Analog Input) must be set to identify *RemoteStations* service analog input responsible for reporting total demand managed by the program. TDAI threshold parameter values must satisfy the following condition for the program to be able to function:

VlowThr <= LowThr < HighThr <= VhighThr

TDAI Low threshold (*LowThr*) and high threshold (*HighThr*) parameter values are used for load management. When TDAI demand reading is higher than *HighThr* setting enough load points are disconnected to bring demand below *HighThr* setting if possible. When TDAI demand reading is lower than *LowThr* setting enough load points are reconnected to bring demand just below *HighThr* setting if possible. TDAI VlowAlarm, LowAlarm, NormalAlarm, and HighAlarm parameteres should be set to False to avoid unnecessary alarms.

TDAIConfiguration parameter can be used to configure TDAI. By clicking on *TDAIConfiguration* one goes straight to TDAI configuration window.

InputManagerName must identify RemoteStations service input manager responsible for polling analog inputs which serve as LoadManagement service demand inputs. This way the program executes automatically right after every poll initiated by the input manager completes. If *InputManagerName* is set to *NONE*, the program never executes, except when executed manually. To execute a program manually:

- Right-click on the program in the *Programs* display
- Select *Execute management Cycle*... command

It is not advisable to execute *DemandResponder* type program manually more than once in a row. When program execution completes demand readings are still the same as they were before program execution. The readings change only after a poll. Repeated program execution may disconnect too many customers from the power grid.

Load State Reinserting

Load state reinserting (LSR) is done by *LSRManager* type program(s). One can create and run as many programs as necessary. *LSRManager* type programs run an algorithm which attempts to reinsert load states by dispatching appropriate control messages. If a load point is thought to be ON at the time of LSRManager execution, an ON command is sent to that load. If a load point is thought to be OFF at the time of LSRManager execution, an OFF command is sent to that load.

To crate a new program proceed as follows:

- Start the *Main Viewer*
- Open *LoadManagement* service window
- Right-click anywhere in the *Programs* display
- Execute the *New Program...* command
- Enter the new program *name*
- Select *LSRManager* for program type

The new program appears in the *Programs* display. To configure the new program:

- Right-click on the new program
- Execute *Configuration – Program* command
- Modify parameters as needed. For the program to run correctly all parameteres need to be defined properly.
- Select *Save+Exit*

Object modifications are logged in SM event log.

Program parameter *SchedulingMethod* must be set to *MngStartTOD* if the program is to execute daily at the time of day specified by *MngStartTOD* parameter.

Program parameter *SchedulingMethod* must be set to *MinAfterEndOfPP* if the program is to execute daily *MinAfterEndOfPP* minutes after peak period.

Program parameter *OperationMode* must be defined appropriately to specify which load points are to be issued LSR commands. The table below lists available options:

OffAndOn	All load points are issued LSR commands
OffOnly	Only loads in OFF state are issued LSR commands
OnOnly	Only loads in ON state are issued LSR commands
OffAndOnOperatedToday	Only loads operated previously on the day of program execution are issued LSR commands
OffOnlyOperatedToday	Only loads in OFF state operated previously on the day of program execution are issued LSR commands
OnOnlyOperatedToday	Only loads in ON state operated previously on the day of program execution are issued LSR commands