SMMePlus

Architecture

v.4.0

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Verificato da:		13/05/2020
Approvato da:		-

Summary

The aim of this document is to describe the architecture of SMMePlus

Index

1. Introduction

1.1. Purpose

The aim of this document is to describe the architecture of SMMePlus system.

2. Architecture

2.1. Introduction

SMMePlus system is a Service Fabric Application backed by several virtual servers that form a Service Fabric Cluster. This set of virtual machines hosts microservices and Service Fabric Runtime.

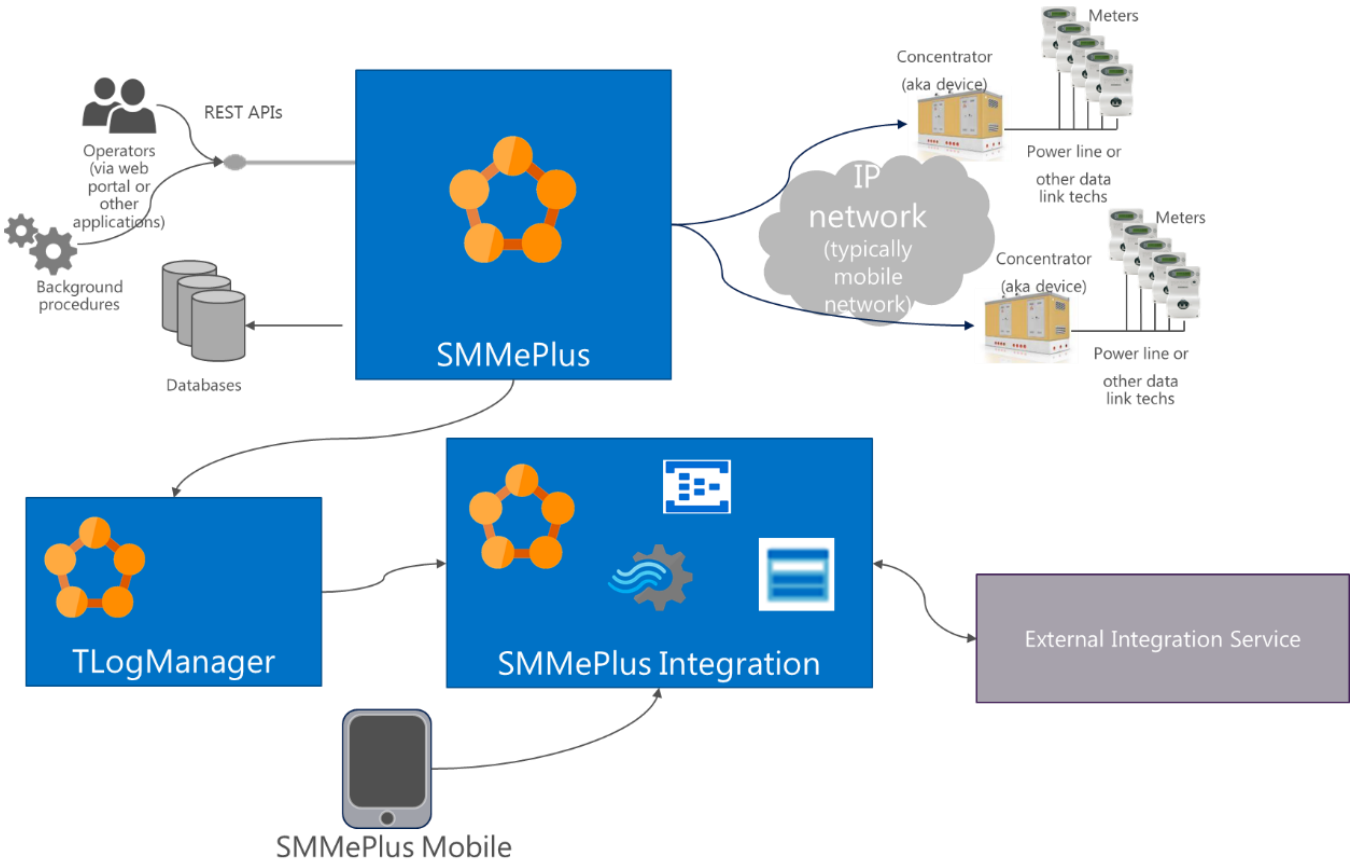
Availability and efficiency are granted by replication of service's state and distribution of replicas among different machines.

More information about Service Fabric are available at https://docs.microsoft.com/en-us/azure/service-fabric/.

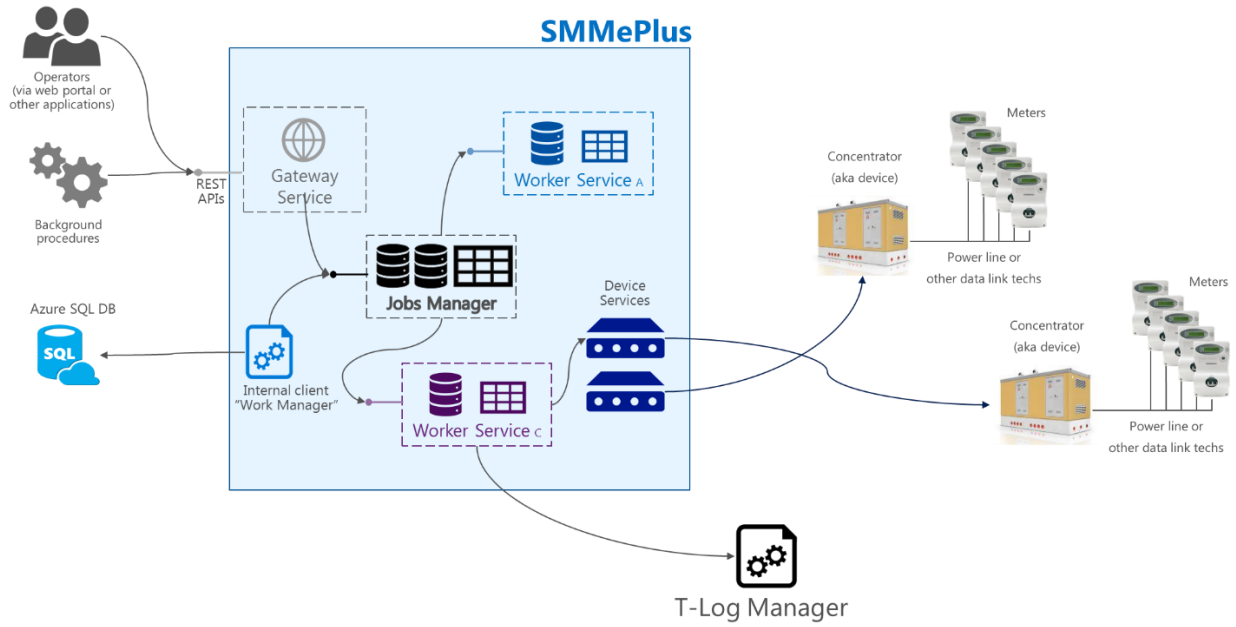
2.2. Big Picture

SMMePlus system is composed of:

- SMMePlus application
- TLogManager application
- SMMePlus Integration Service application
- SMMePlus Web site
- SMMePlus Mobile application



2.3. SMMePlus application



SMMePlus application is composed of:

1. Jobs Manager
2. Worker Services
3. Internal Clients
4. Devices

2.3.1. Jobs Manager

A dedicated service that:

1. Received jobs that have to be executed and put them in High Priority queue or Normal Priority queue.
2. Locate Worker Services and send the jobs to execute.

2.3.2. Worker Service

A dedicated service that:

1. Manages a specific kind of job (Meter Reading, N2Pload, Initialization, ...).
2. Receives jobs to execute from Jobs Manager.
3. Has all information of jobs in queue and jobs in executions in its state.
4. Sends collected information (readings, load profiles, …) to TLogManager application

2.3.3. Internal Clients

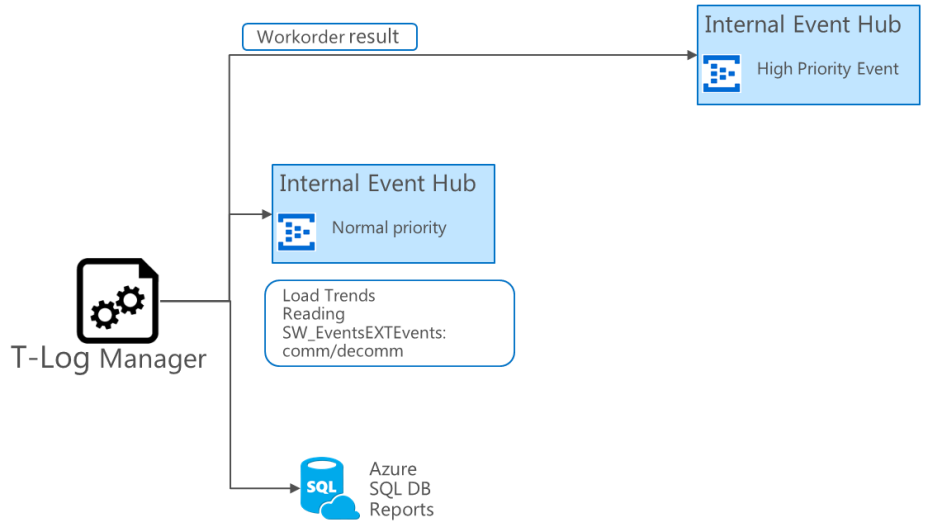
Services dedicated to a specific operation.
One of internal clients is WorkManager. This service looks on database if there are new activities to execute and send them to JobsManager.

2.3.4. Devices

Single thread execution services that are in charge of talking with concentrators.
There is 1 device for 1 concentrator.

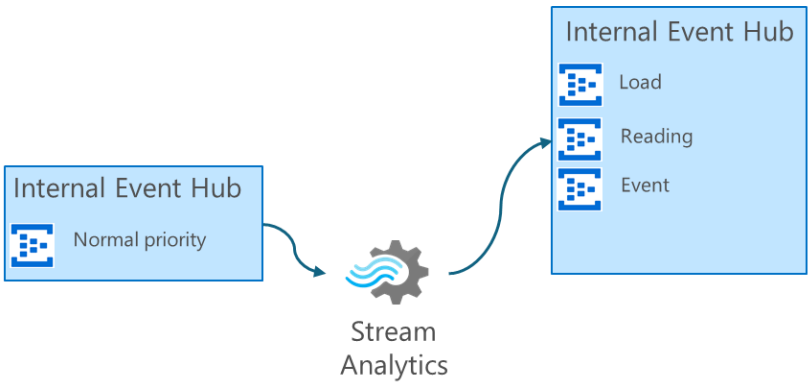
2.4. TLogManager application

TLogManager is the component in charge of saving and sharing data collected by SMMePlus application.



High priority events are responses to detachment and reconnection operations. These data are sent to a dedicated Event Hub.
Normal priority data are: readings, load profile, events like meter commissioned and meter decommissioned, status word events. These data are sent to “Normal Priority” event hub.
Other information is sent directly to an Azure SQL Database for reporting aims.

Data put on “Normal Priority” Event Hub are read by a Stream Analytics Jobs that sorts data in four different Event Hubs based on their type



This is an example of data pushed on Internal Event Hubs (for daily closure readings)

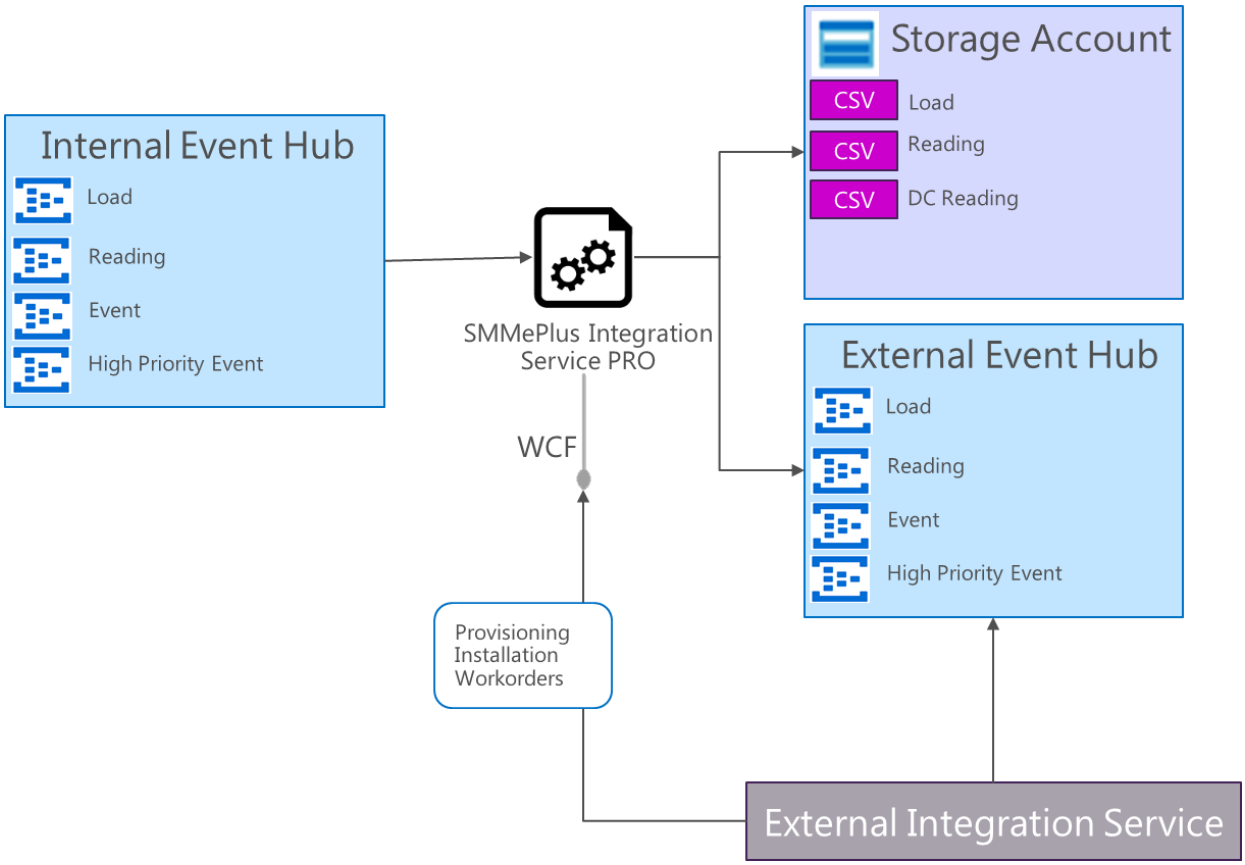
{\"ci\":\"00000000-0000-0000-0000-000000000000\", ← Correlation ID of request (if exists)
\"c\":\" 00000000-0000-0000-0000-000000000000\", ← Identifier of company
\"m\":\" UAAEEDN15200000XXX\", ← Meter serialnumber
\"p\":\"POD8\", ← POD name
\"data\":\":[
{\"cc\":\"0.0.16.1.1.1.12.0.0.0.0.0.0.0.0.0.72.0\" ← CIM Code

,\"d\":\"2018-09-20T00:00:00\", ← Timestamp of first DC
\"values\":
[{\"v\":82, \"cq\":\"1.0.0\"}]}, ← DC of timestamp
[{\"v\":84, \"cq\":\"1.0.0\"}]}, ← DC of timestamp + 1 day
{\"cc\":\"0.0.16.9.1.1.12.0.0.0.0.6.0.0.0.0.73.0\", ← CIM Code
\"d\":\"2018-09-20T00:00:00\", ← Timestamp of first DC
\"values\":
[{\"v\":0, \"cq\":\"1.0.0\"}]}, ← DC of timestamp
[{\"v\":0, \"cq\":\"1.0.0\"}]} ← DC of timestamp + 1 day
]}",

2.5. SMMePlus Integration Service application

SMMePlus Integration Service is the component in charge of integration between SMMePlus and External Systems:

- It makes collected registries available for business processes.
- It received provisioning of information and requests of workorder



SMMePlus Integration follows standard IEC 61968-9. In this way integration is simple because SMM ePlus doesn't require to know the architecture or wsdl of the External System.

2.5.1. Push of data

The service listens to the internal Event Hubs for new data and:

- creates a csv file for each day for readings, daily closures and samples
- pushes data on external Event Hubs so that external services can download them asynchronously

2.5.1.1. CSV file

Each country can access to a dedicated Azure File Storage on which SMMePlus Integration service saves the generated csv files. Storages can be accessed only using a connection string.

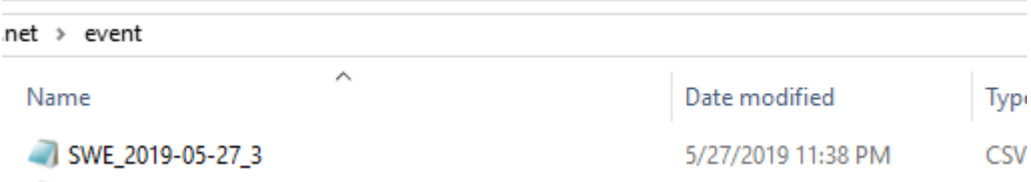
Folders are organized in the following ways:

PLOAD FOLDER

The file contains all pload registries collected the day visible in file name.
If the N2Pload process recovers data of previous days you will find them in the csv file of the day the process runs.

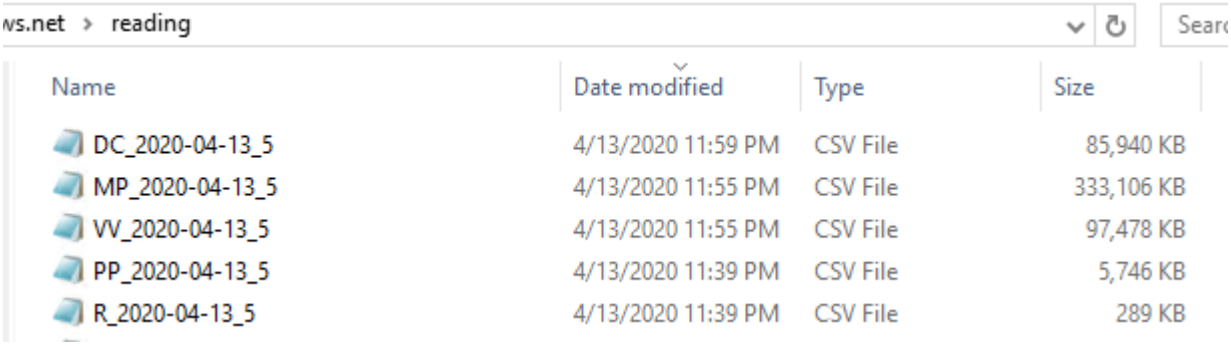
The format of the file is the following
serialnumber;pod;value;state;cimcode;sampledate
UAAEEDN15200000XXX;1251232;364;0;0.0.7.4.1.1.12.0.0.0.0.0.0.0.0.0.72.0;2018-12-16 01:00:00.000

EVENTS FOLDER



The file contains all status word alarms collected the day visible in file name.
The alarms that generate events are configurable in the system.

READING FOLDER



DC_yyyy-mm-dd_server.csv
The file contains all previous period registries collected the day visible in file name, from the server indicated.
If the DC process recovers data of previous days you will find them in the csv file of the day the process runs.

The format of the file is the following
serialnumber;t1;t2;t3;t4;t5;t6;tot;energytype;energytype_description;time
UAAEEDN15200000XXX;7743059;0;0;0;0;0;7743059;8;Active Energy Import Previous;2019-01-01 00:00:00.000

R_yyyy-mm-dd_server.csv
The file contains all current period registries collected the day visible in file name, from the server indicated.

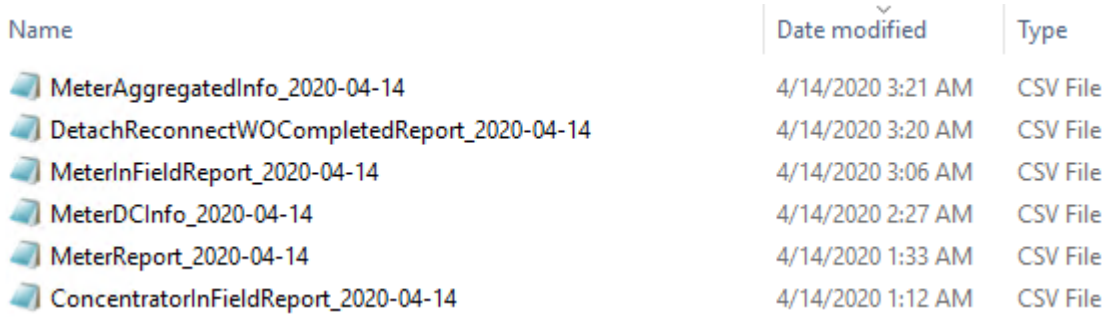
VV_yyyy-mm-dd_server.csv
The file contains information about voltage variations collected the day visible in file name.

The format of the file is the following
serialnumber;pod;type;value;time
UAAEEDN15200000XXX;
UAAEEDN15200000XXX;24.12.0.3.20.1.137.0.0.0.0.0.0.0.0.0.0;1006;2019-09-24 00:00:00.000

PP_yyyy-mm-dd_server.csv
The file contains all prepayment readings collected the day visible in file name, from the server indicated.

MP_yyyy-mm-dd_server.csv
The file contains all maximum power registries collected the day visible in file name, from the server indicated.

EXTRACTION FOLDER



Name	Date modified	Type
MeterAggregatedInfo_2020-04-14	4/14/2020 3:21 AM	CSV File
DetachReconnectWOCompletedReport_2020-04-14	4/14/2020 3:20 AM	CSV File
MeterInFieldReport_2020-04-14	4/14/2020 3:06 AM	CSV File
MeterDCInfo_2020-04-14	4/14/2020 2:27 AM	CSV File
MeterReport_2020-04-14	4/14/2020 1:33 AM	CSV File
ConcentratorInFieldReport_2020-04-14	4/14/2020 1:12 AM	CSV File

MeterAggregatedInfo report contains all information about each meters:

- concentrator information (concentrator,concentratorsn,conc_nrn)
- meter manufacturing information (macaddress,metersn)
- meter status information (row,versionapp1,state,nrn)
- daily closure colelction information (lastdc_active,lastdc_reactive,lastdc_activeexport)
- load profile collection information (lastlp_active)
- last current period reading collected (lastreadingdatelocal)
- last cedata execution information (lastcedatarunlocal)

MeterInfieldReport report contains information about meters installed in field:

- Concentrator information (concentrator)
- Meter manufacturing and pod (pod,macaddress,serialnumber,metertype)
- Meter status (commissioned,processstate,nrn,reachable,statechangedateutc)
- Meter information inside concentrator
- (row,phase,ispload,isdailyclosure,primary_repeaters,secondary_repeaters, energydailyclosureprofile,energyfastploadprofile)
- Meter information (versionapp1,versionswfx,tlp)

MeterDCInfo report contains information about Daily Closure collection per each meter:

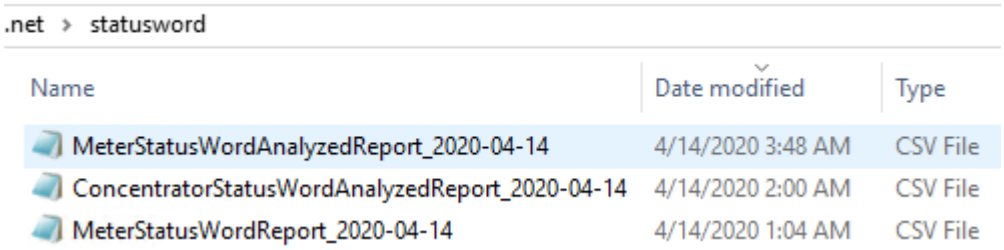
- Concentrator information (concentrator)
- Meter information (macaddress,serialnumber,versionapp1)
- Kind of energy (tabletype,description)
- DC information (lastclosuredatelocal,errordesc,isunreachable,iserror,lastupdateutc)

MeterReport report contains information about meter manufacturing:
metertype,serialnumber,serialnumberboard,macaddress,firmwareid,hardwareid,insertdateutc,lastupdateutc

ConcentratorInField report contains information about concentrator installations:

- name,
- concentrator manufacturing (concentratortype,concentrator_serialnumber)
- concentrator localization (substation,transformer,timezone)
- concentrator communication (communicationtype,module_serialnumber,ipaddress)
- concentrator configuration (procedure_profile,concentrator_spont_name)
- concentrator status (state,isconfiguring,isupdatingsw)
- concentrator information (csw,lastcswupdateut, insertdateutc,statechangedateutc,versionrom, versionmip,versionsw,versionhw,hwdiag,swdiagelm)
- concentrator reachability (nrn,isreachable)

STATUS WORD FOLDER



MeterStatusWordReport_yyyy-mm-dd.csv contains hexadecimal values of status words of meters.
MeterStatusWordAnalyzedReport_yyyy-mm-dd.csv contains the analysis of status words of meters.
ConcentratorStatusWordAnalyzedReport_yyyy-mm-dd.csv contains the analysis of status words of concentrators.

2.5.1.2. External Event Hubs

Latest version of SMMePlus Integration Service pushes collected data (DC, samples, events) on an Azure Event Hub stream that can be accessed used a private key.

The Integration service of the client “listens” to this stream in order to download new information as soon as they’re available.

The payload pushed on Event Hub follows CIM standard.

2.5.1.2.1. Reading xml

Below, it’s visible an example for readings:

```
<?xml version="1.0" encoding="utf-16"?>
<EventMessage xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://iec.ch/TC57/2011/schema/message">
	<Header>
		<Verb>created</Verb>
		<Noun>MeterReadings</Noun>
		<Revision>2.0</Revision>
		<Timestamp>2019-10-02T10:41:24.626415Z</Timestamp>
		<Source>2ac73910-46b3-4fff-8056-8a2a98c10b0b</Source>
		<MessageID>83344b05-755b-4c6b-bd1f-eef737e20e2d</MessageID>
		<Property>
			<Name>EventSource</Name>
			<Value>f1c44343-61d8-4867-908e-c8f67432399f</Value>
		</Property>
	</Header>
	<Payload>
		<MeterReadings>
			<MeterReading xmlns="http://iec.ch/TC57/2011/MeterReadings#">
				<Meter>
					<Names>
						<name>UAAEEDN17204606196</name>
					</Names>
				</Meter>
				<UsagePoint>
					<Names>
						<name>827323</name>
					</Names>
				</UsagePoint>
				<Readings>
					<timeStamp>2019-10-02T00:00:00</timeStamp>
					<value>14631051</value>
					<ReadingQualities>
						<ReadingQualityType ref="1.0.0" />
					</ReadingQualities>
					<ReadingType ref="0.0.16.1.1.1.12.0.0.0.0.0.0.0.0.72.0" />
				</Readings>
				<Readings>
```

<timeStamp>2019-10-02T00:00:00</timeStamp>
<value>14631051</value>
<ReadingQualities>
<ReadingQualityType ref="1.0.0" />
</ReadingQualities>
<ReadingType ref="0.0.16.9.1.1.12.0.0.0.0.1.0.0.0.0.72.0" />
</Readings>
<Readings>
<timeStamp>2019-10-02T00:00:00</timeStamp>
<value>0</value>
<ReadingQualities>
<ReadingQualityType ref="1.0.0" />
</ReadingQualities>
<ReadingType ref="0.0.16.9.1.1.12.0.0.0.0.2.0.0.0.0.72.0" />
</Readings>
<Readings>
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<value>0</value>
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</Readings>
<Readings>
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</ReadingQualities>
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</Readings>
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<value>0</value>
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</ReadingQualities>
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</Readings>
</MeterReading>
</MeterReadings>
</Payload>
</EventMessage>

2.5.1.2.2. Load profile xml

Below, it's visible an example for load profile:

```
<?xml version="1.0" encoding="utf-16"?>
<EventMessage xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://iec.ch/TC57/2011/schema/message">
	<Header>
		<Verb>created</Verb>
		<Noun>MeterReadings</Noun>
		<Revision>2.0</Revision>
		<Timestamp>2019-10-02T09:21:35.7220351Z</Timestamp>
		<Source>2ac73910-46b3-4fff-8056-8a2a98c10b0b</Source>
		<MessageID>a0595074-fd63-44ac-95ca-1c884cc2aa9c</MessageID>
		<Property>
			<Name>EventSource</Name>
			<Value>f1c44343-61d8-4867-908e-c8f67432399f</Value>
		</Property>
	</Header>
	<Payload>
		<MeterReadings>
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						</ReadingQualities>
					</IntervalReadings>
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				</IntervalBlocks>
				<Meter>
					<Names>
						<name>UAAEEDN18700723562</name>
					</Names>
				</Meter>
				<UsagePoint>
					<Names>
						<name>1249846</name>
					</Names>
				</UsagePoint>
			</MeterReading>
			<MeterReading xmlns="http://iec.ch/TC57/2011/MeterReadings#">
				<IntervalBlocks>
					<IntervalReadings>
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						<value>152</value>
						<ReadingQualities>
							<ReadingQualityType ref="1.0.0" />
						</ReadingQualities>
					</IntervalReadings>
```

```
                <ReadingType ref="0.0.7.4.1.1.12.0.0.0.0.0.0.0.0.0.72.0" />
            </IntervalBlocks>
            <Meter>
                <Names>
                    <name>UAAEEDN18700718702</name>
                </Names>
            </Meter>
            <UsagePoint>
                <Names>
                    <name>1249878</name>
                </Names>
            </UsagePoint>
        </MeterReading>
        <MeterReading xmlns="http://iec.ch/TC57/2011/MeterReadings#">
            <IntervalBlocks>
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                    <value>177</value>
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                    </ReadingQualities>
                </IntervalReadings>
                <IntervalReadings>
                    <timeStamp>2019-10-01T18:00:00</timeStamp>
                    <value>380</value>
                    <ReadingQualities>
                        <ReadingQualityType ref="1.0.0" />
                    </ReadingQualities>
                </IntervalReadings>
                <IntervalReadings>
                    <timeStamp>2019-10-01T19:00:00</timeStamp>
                    <value>292</value>
                    <ReadingQualities>
                        <ReadingQualityType ref="1.0.0" />
                    </ReadingQualities>
                </IntervalReadings>
                <IntervalReadings>
                    <timeStamp>2019-10-01T20:00:00</timeStamp>
                    <value>340</value>
                    <ReadingQualities>
                        <ReadingQualityType ref="1.0.0" />
                    </ReadingQualities>
                </IntervalReadings>
                <IntervalReadings>
                    <timeStamp>2019-10-01T21:00:00</timeStamp>
                    <value>388</value>
                    <ReadingQualities>
                        <ReadingQualityType ref="1.0.0" />
                    </ReadingQualities>
                </IntervalReadings>
                <IntervalReadings>
                    <timeStamp>2019-10-01T22:00:00</timeStamp>
                    <value>383</value>
```

<ReadingQualities>
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</ReadingQualities>
</IntervalReadings>
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<ReadingQualityType ref="1.0.0" />
</ReadingQualities>
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</ReadingQualities>
</IntervalReadings>
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</IntervalBlocks>
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</Names>
</Meter>
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</Names>
</UsagePoint>
</MeterReading>
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<IntervalReadings>
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</ReadingQualities>
</IntervalReadings>
<IntervalReadings>
<timeStamp>2019-10-01T18:00:00</timeStamp>
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</ReadingQualities>
</IntervalReadings>
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<ReadingQualities>
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</ReadingQualities>

```
                                    </IntervalReadings>
                                    <IntervalReadings>
                                        <timeStamp>2019-10-01T20:00:00</timeStamp>
                                        <value>453</value>
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                                            <ReadingQualityType ref="1.0.0" />
                                        </ReadingQualities>
                                    </IntervalReadings>
                                    <IntervalReadings>
                                        <timeStamp>2019-10-01T21:00:00</timeStamp>
                                        <value>477</value>
                                        <ReadingQualities>
                                            <ReadingQualityType ref="1.0.0" />
                                        </ReadingQualities>
                                    </IntervalReadings>
                                    <IntervalReadings>
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                                    <IntervalReadings>
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                                        <value>499</value>
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                                    </Names>
                                </Meter>
                                <UsagePoint>
                                    <Names>
                                        <name>1249846</name>
                                    </Names>
                                </UsagePoint>
                            </MeterReading>
                        </MeterReadings>
                    </Payload>
                </EventMessage>
```

2.5.1.2.3. Event xml

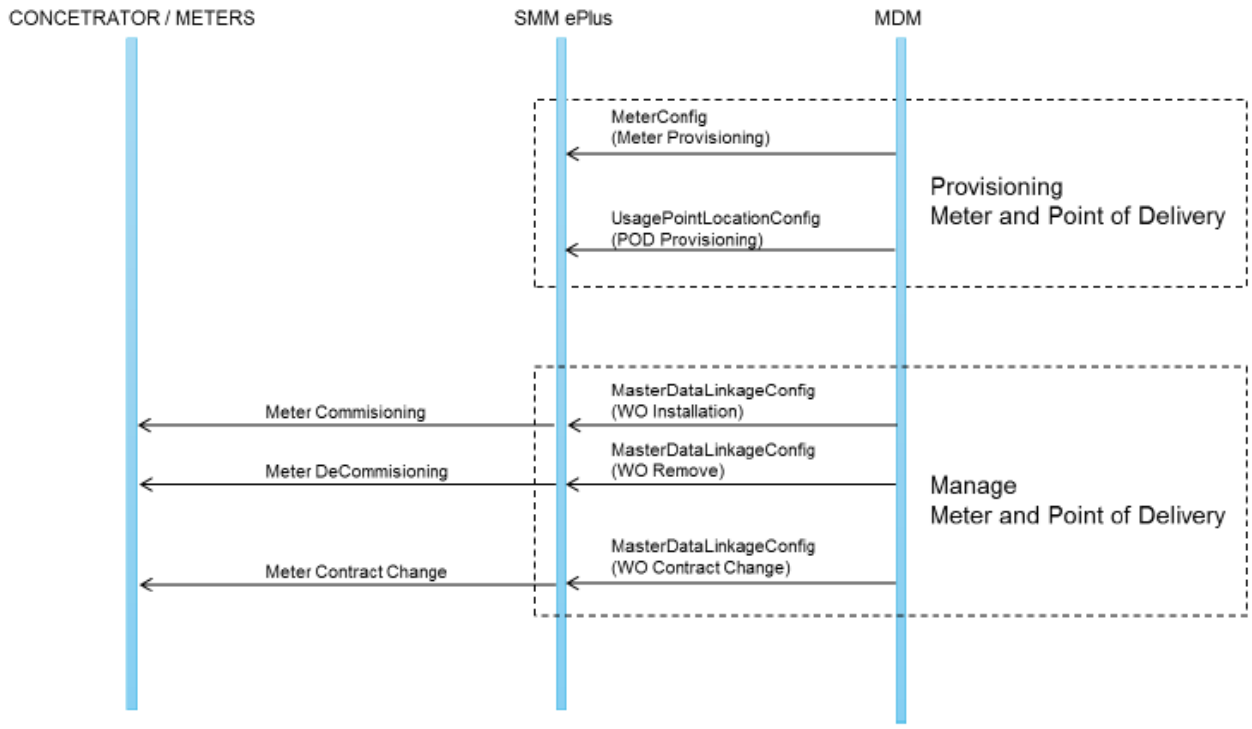
Below, it's visible an example for event:

```
<?xml version="1.0" encoding="utf-16"?>
<EventMessage xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://iec.ch/TC57/2011/schema/message">
	<Header>
		<Verb>created</Verb>
		<Noun>EndDeviceEvents</Noun>
		<Revision>2.0</Revision>
		<Timestamp>2019-10-04T00:07:01.0337877Z</Timestamp>
		<Source>2ac73910-46b3-4fff-8056-8a2a98c10b0b</Source>
		<MessageID>f31f75b2-031d-4b73-882c-27e3d8e5cfd2</MessageID>
		<CorrelationID>03102019093557034-WSCONSULTASMT</CorrelationID>
		<Property>
			<Name>EventSource</Name>
			<Value>f1c44343-61d8-4867-908e-c8f67432399f</Value>
		</Property>
	</Header>
	<Payload>
		<EndDeviceEvents>
			<EndDeviceEvent xmlns="http://iec.ch/TC57/2011/EndDeviceEvents#">
				<createdDateTime>2019-10-03T21:07:00.3306019Z</createdDateTime>
				<severity>0</severity>
				<Assets>
					<Names>
						<name>UAAEEDN18700817770</name>
					</Names>
				</Assets>
				<EndDeviceEventDetails>
					<name>CONCENTRATOR</name>
					<value>TD-105525</value>
				</EndDeviceEventDetails>
				<EndDeviceEventDetails>
					<name>DESCRIPTION</name>
					<value>Concentrator is unreachable [Open socket error]</value>
				</EndDeviceEventDetails>
				<EndDeviceEventDetails>
					<name>EXTERNALREQUEST</name>
					<value>True</value>
				</EndDeviceEventDetails>
				<EndDeviceEventType ref="3.21.87.85" />
				<UsagePoint>
					<Names>
						<name>3373159</name>
					</Names>
				</UsagePoint>
			</EndDeviceEvent>
		</EndDeviceEvents>
	</Payload>
</EventMessage>
```

2.5.2. Receive provisioning and requests

SMMePlus Integration service exposes a WCF service that is called from external systems to provision information about manufacturing and installations and to request detachments, reconnections and readings.

The diagram below shows provisioning and devices management.



2.5.2.1. Provisioning

The method involved are:

- MeterConfig: it is used to provision meters
- UsagePointLocationConfig: it is used to provision usagepoints (pods)

Installation

The method involved is MasterDataLinkageConfig.
It is used to communicate the association or disassociation between Meter and UsagePoint using the related identifiers

2.5.2.2. Work Orders

The methods involved are:

- MasterDataLinkageConfig: it is used to communicate the association or disassociation between Meter and Contract Profile, Contract State and Tariff Profile. (Contract Change Work Order)
- OnDemandMeterReadings: it is used to request a synchronous spot reading to the meter. (Reading Work Order)
- EndDeviceControl: it used to request a disconnection, connection or power reduction to the meter. (Disconnection, Connection, Reduction Work Orders)

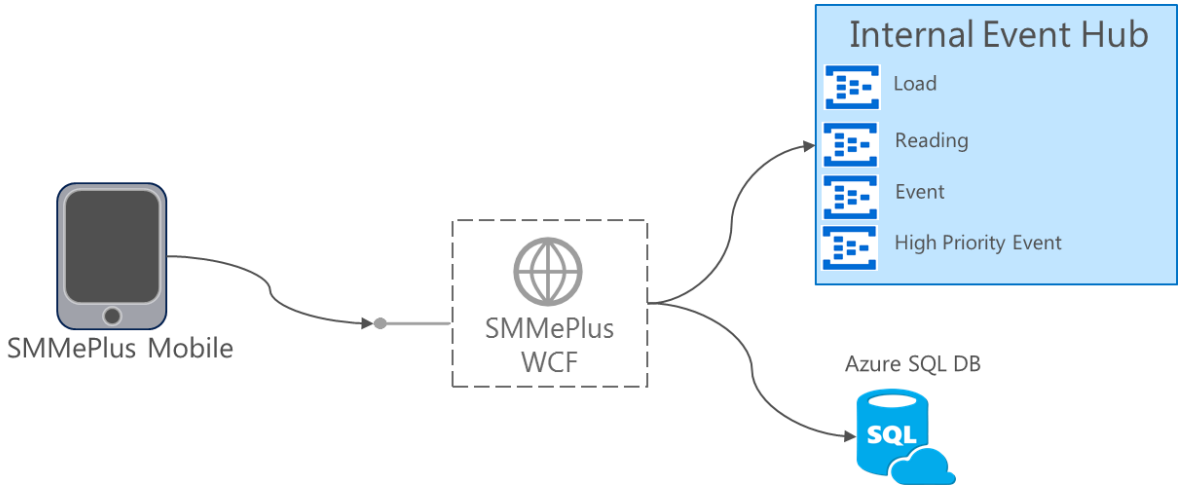
When requested workders are completed, a High Priority event is pushed on High Priority Event Hub.

2.6. SMMePlus Web Site

SMMePlus websites are hosted inside App Service Environment provided by Azure.
This Azure service lives inside a virtual network reachable from Enel network and provides a dedicated environment that can be easily managed and scaled.

2.7. SMMePlus Mobile

SMMePlus Mobile is an easy and light android application that enabled the user to perform detachments, reconnections and readings.



When the local activity is completed, SMMePlus Mobile applications sends the result to a dedicated WCF service. The WCF services updated database and send collected readings and activity events to internal Event Hubs.