Information Document
Supervisory Control and Data Acquisition
ID #2012-013R

Information documents are not authoritative. Information Documents are for information purposes only and are intended to provide guidance. In the event of any discrepancy between an Information Document and any Authoritative Document(s) in effect, the Authoritative Document(s) governs.

1 Purpose

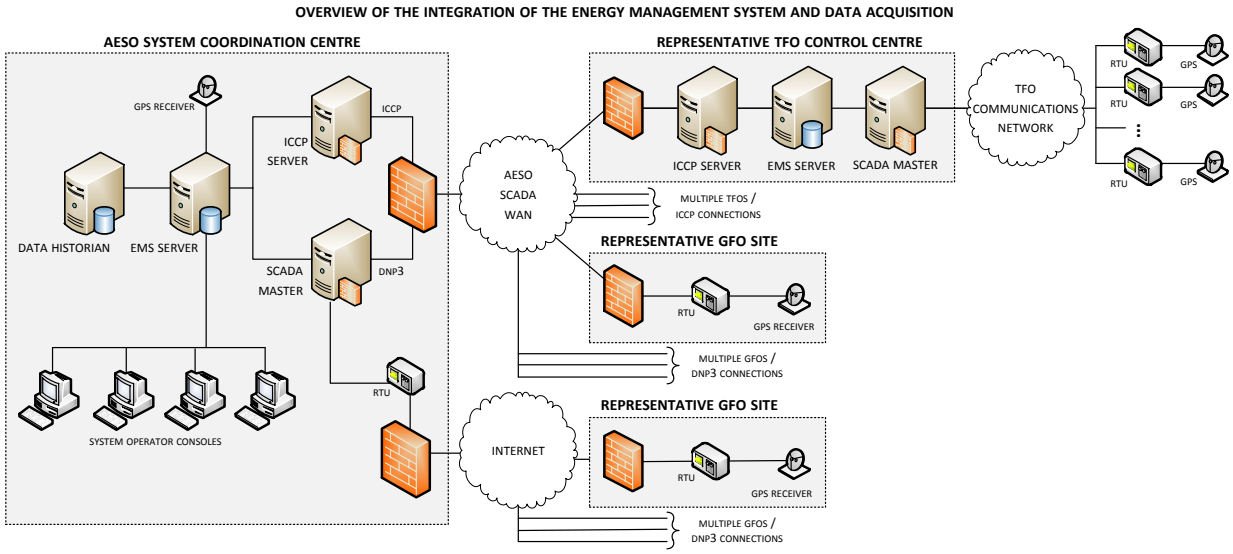
This Information Document relates to the following Authoritative Document[1]:

- Section 502.8 of the ISO rules, *Supervisory Control and Data Acquisition Technical and Operating Requirements* ("Section 502.8").

The purpose of this Information Document is to provide general information relating to supervisory control and data acquisition. Section 502.8 is focused on the design and build domain. For clarity, Section 502.8 requires that a market participant, while designing and building its facilities, design and build the facilities in accordance with the requirements and obligations set out in Section 502.8.

2 AESO Coordination Center System Overview

The AESO Energy Management System is designed to support the safe, reliable and economic operation of the interconnected electric system. It consists of several components as illustrated and described below:



Data Historian

The data historian contains a record of selected supervisory control and data acquisition data and system data for retrieval at a later date. The data historian allows the viewing of data trends over long periods of time. Some of the uses of this data are to support the review of system events, sequence of events, determination of peak loads, forecasting using load flow records, and trending.

[1] "Authoritative Documents" is the general name given by the AESO to categories of documents made by the AESO under the authority of the *Electric Utilities Act* and regulations, and that contain binding legal requirements for either market participants or the AESO, or both. AESO Authoritative Documents include: the ISO rules, the Alberta reliability standards, and the ISO tariff.

System Operator Consoles

The system operator consoles provide the AESO system controllers with the data and visual displays they require for operating the interconnected electric system. Real time data is displayed in a variety of ways to allow operating decisions to be made. A variety of applications are used to assist with dispatch of generation and ancillary services, network analysis of power flow, and system security analysis for contingencies. These applications depend on the validity of supervisory control and data acquisition data to function properly.

AESO Energy Management System

The AESO Energy Management System collects all the supervisory control and data acquisition data and arranges it for use by the various applications and systems that depend on the data. Data validation is done by the AESO Energy Management System to ensure that the supervisory control and data acquisition data is being received correctly and reliably. Subsystems within the AESO Energy Management System include:

- State Estimator: The state estimator calculates and evaluates power flow on the system based on supervisory control and data acquisition data and the transmission system model. The results of the state estimator are used by the AESO Energy Management System security applications, which provide real time contingency analysis and dispatcher load flows.
- Automatic Generation Control (for Regulating Reserves): The automatic generation control regulates the generation on the system to balance load, import/export, and generation. The automatic generation control also calculates the area control error and adjusts generator output to maintain the desired import or export of energy.

Inter Control Centre Protocol Server

The Inter Control Centre Protocol Server serves as the data concentrator for supervisory control and data acquisition data obtained from third party Inter Control Centre Protocol Servers via wide area network connections. These connections are depicted as the ‘Representative TFO Control Centre’ in the above diagram.

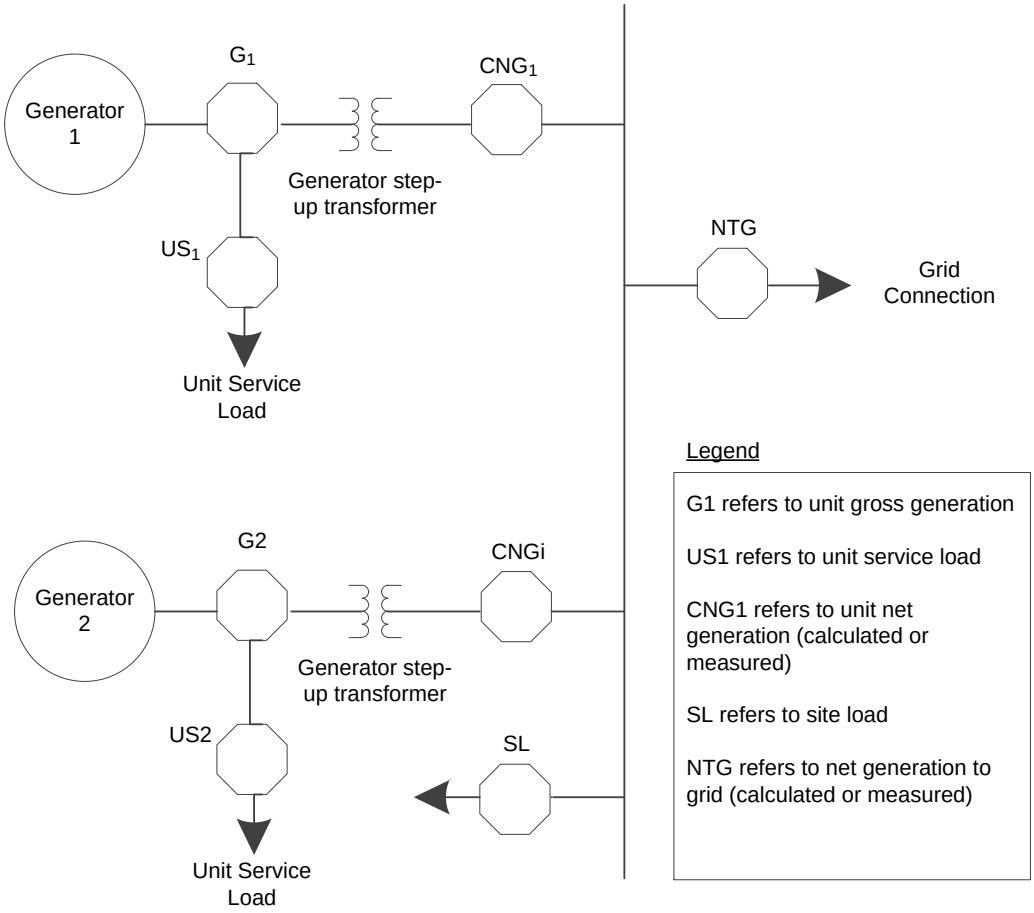
Supervisory Control and Data Acquisition Master

The Supervisory Control and Data Acquisition Master serves as a data concentrator for the supervisory control and data acquisition data collected by the AESO from remote terminal units and other intelligent electronic devices. A dedicated remote terminal unit collects data for internet-based connections. Direct communications using dedicated wide area network connectivity occur directly with the Supervisory Control and Data Acquisition Master. These connections are depicted via the ‘Representative GFO Site’ in the above diagram.

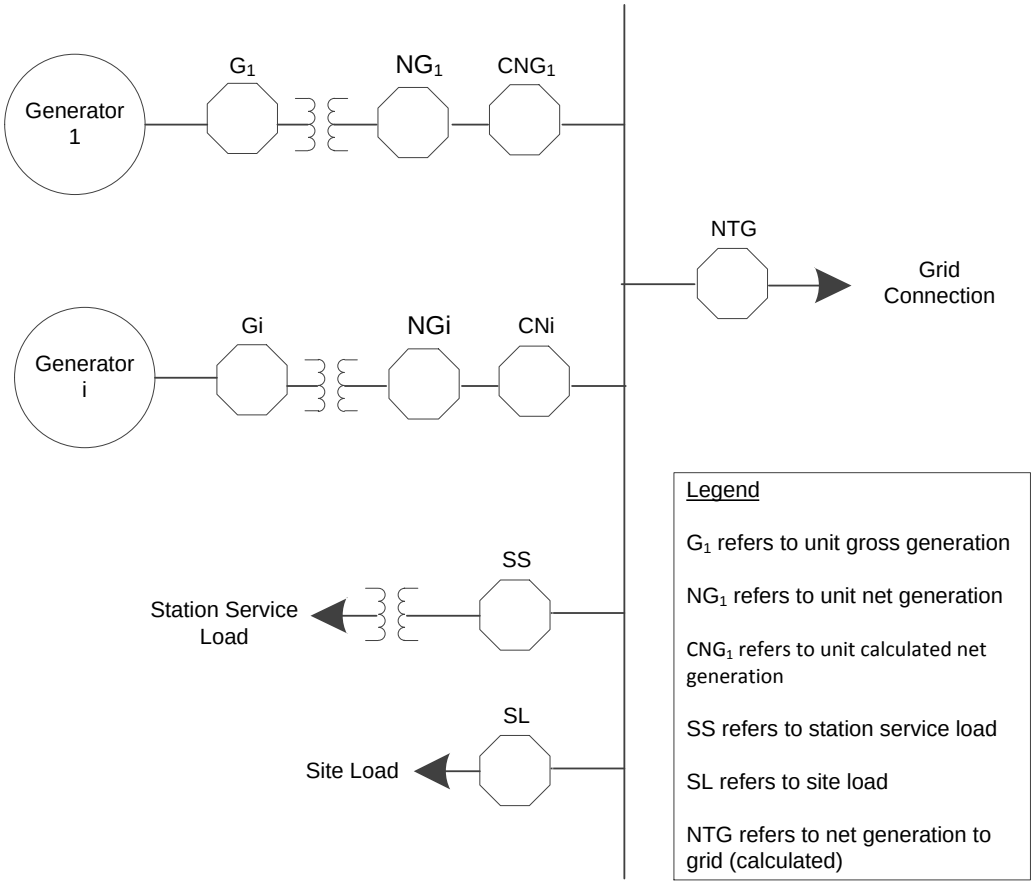
3 Facility Configurations

Below are example diagrams which illustrate common facility configurations. These diagrams are intended to help market participants understand point names as identified in the diagram legend.

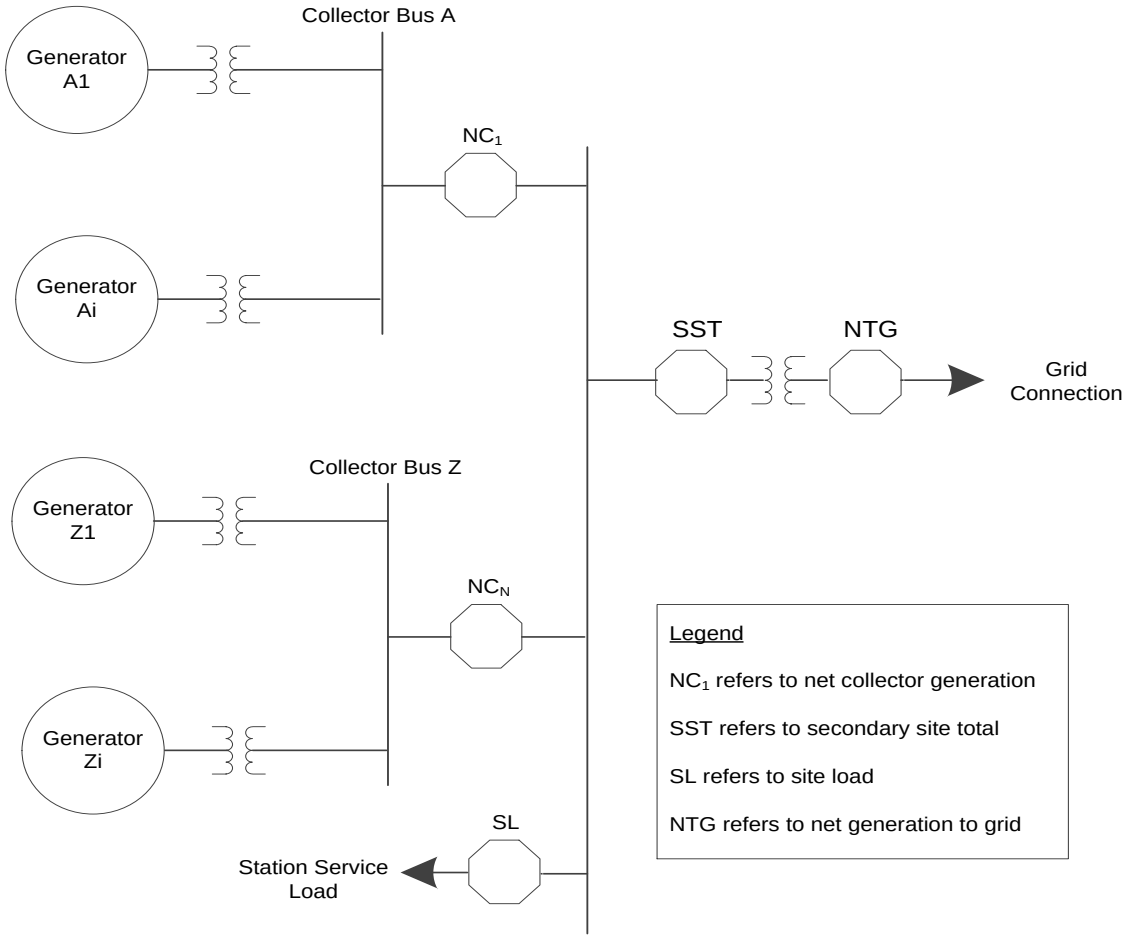
Power Plant with Separate Service for Each Generating Unit within the Power Plant



Power Plant with Single Station Service for Several Generating Units within the Power Plant



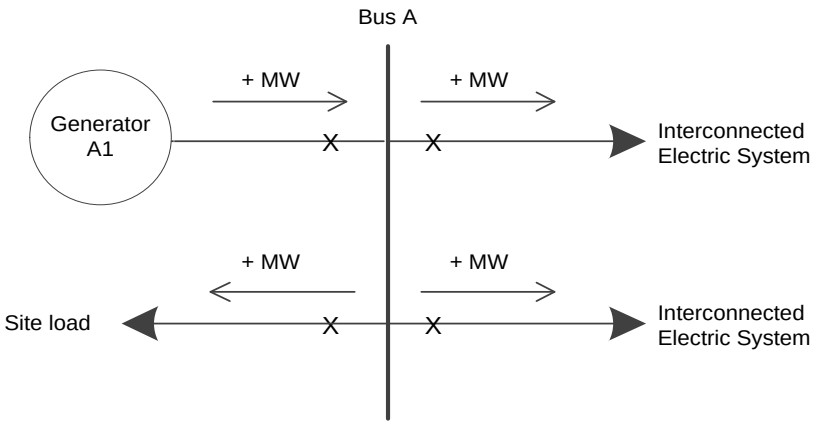
Collector System for Multiple Distributed Units



4 Polarity (Sign) Convention

Section 502.8 requires that analog values be reported with the positive sign convention of positive power flow from a bus. Refer to the examples below for additional interpretation on polarity (sign) conventions.

The example below depicts the direction of power flow. Power flows in the opposite direction are to be reported as negative numbers.



5 Generic Communication Block Diagrams

Understanding the communication path between a market participant's facility and the AESO's coordination center can help both the AESO and the market participant understand communication issues and develop an action plan to resolve those issues.

Prior to energizing and connecting new facilities it is important for the market participant to select the communication block diagram that represents the communication path between the market participant's facility and the AESO's coordination center.

Rather than have each market participant depict its own communication path the AESO has developed two generic communication block diagrams which represent the typical communication paths. Please refer to Appendix 1 to review these diagrams. A market participant will be expected to inform the AESO which diagram represents the communication path for its facilities with amendments if necessary.

6 Notification of Unplanned Availability, Suspected Failure or Erroneous Data

Each market participant must, in accordance with Section 502.8, notify the AESO system controller if the legal owner experiences an unplanned outage to its supervisory control and data acquisition system or any component of the supervisory control and data acquisition system.Each market participant must notify the AESO system controller if the legal owner suspects the remote terminal unit has failed or is providing erroneous data to the AESO.

The AESO monitors the DNP/ICCP application communication status alarms between the AESO Energy Management System and a market participant's supervisory control and data acquisition system, and will contact the market participant when it identifies a communication connection issue. Market participants are encouraged to notify the AESO at EMS_SCADA@aeso.ca of their appropriate contact information for addressing SCADA matters.

For the purposes of the availability requirements in the appendices to Section 508.2, connection availability is calculated on an annual calendar basis (i.e., 98% availability * 365 days = 357.7 days available and 7.3 days unavailable per annum). The corresponding "mean time to repair" is representative of the AESO's expectations for re-establishing communications after an unplanned unavailability event is discovered. The AESO recommends that if a market participant's resolution plan (submitted in accordance with subsection 9 of Section 502.8) exceeds this value, that the plan submitted to the AESO provide sufficient explanation for why the repairs will exceed the "mean time to repair" value. If a MP makes a request pursuant to subsection 11 of Section 502.8 and the plan and expected date for repair is reasonable and acceptable to the AESO then the unavailability during the repair period is not included in the availability calculation.

If a market participant wishes to set up real time monitoring through the AESO Energy Management System such that the market participant can directly monitor the entire communication path to the AESO, the AESO will give consideration to such a request on a case-by-case basis. Requests for real time monitoring may be sent to EMS_SCADA@aeso.ca.

7 Positive Polarity Example

Normal convention for polarity at substations is, "positive out of the bus". However, measurements representing an injection of real or reactive power into the system, such as from a generator or capacitor bank, are represented with positive magnitudes into a bus.

8 Full Scale Example

A field device is monitoring a line voltage with a nominal (i.e. designed operating range) rating of 138 kV. The transducer is providing an analog value based on a 4-20 mA input signal, where 20 mA indicates the full scale value (i.e. the upper limit of the input).

By the ISO rules, the line rating must have a maximum value of 120% of the nominal rating.
Ergo: 138 kV * 120% = 165.6 kV

This means that the input signal should be calibrated so that the transducer reports a “full scale” value of 165.6 kV when at its maximum of 20 mA.

9 Analog Accuracy Example

In the table, AESO has asked that value be +/- 2% of a “full scale” value. Using the above example:

i. A 138 kV measurement has a “full scale” value of 165.6 kV. 2% of this value is 165.5 kV * 2% = 3.3 kV.

ii. A generator has a nominal equipment rating to produce 50 MW of real power. As per subsection 7(6) of Section 502.8, the full scale value must be within 120% to 200% of the nominal equipment rating; the generator owner has decided to implement a 200% rating. The minimum acceptable accuracy of the unit is:

Full scale value = 50 MW * 200% = 100 MW

2% Accuracy = 100 MW * 2% = +/-2 MW of actual output power

10 Time Stamped Data

Where the legal owner is required to install a global positioning system clock under subsection 7(11) of Section 502.8, subsection 7(12) requires all supervisory control and data acquisition data provided to the AESO pursuant to subsections 5 and 7 to be time stamped.

11 Internet Connections

An internet based connection is an option for facilities that have a specific latency time requirement as defined in subsection 9(1) of Section 502.8. The latency time requirement is prescribed in either the applicable appendix of Section 502.8 or a functional specification.

12 Virtual Private Network

The AESO has virtual private network (“VPN”) encryption capabilities available as a connection option for the purposes of Section 502.8. The AESO will facilitate configuring a VPN tunnel for internet based connections if it is requested by the connecting party. Requests to set up a connection can be sent to EMS_SCADA@aeso.ca.

Revision History

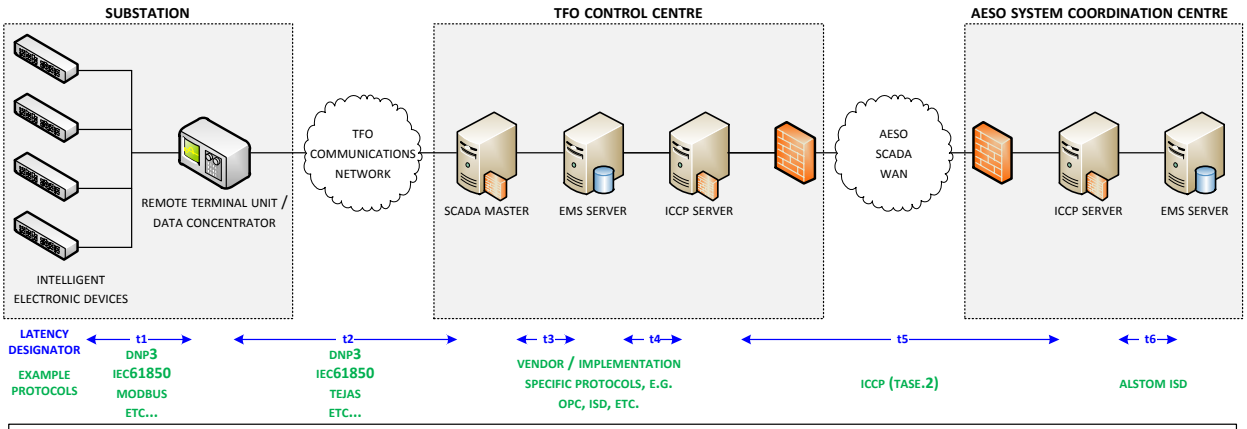
2019-06-27	Addition of sections 11 and 12 Addition to section 6
2017-04-06	Amendment to section 9, section reference changed
2017-02-09	Addition of Section 10 - Time Stamped Data. Administrative Amendments
2013-02-28	Initial Release

Appendix 1 – Generic Communication Block Diagrams

Below are two generic communication block diagrams depicting the typical communication paths.

ISO Communications Block Diagram 1

The first diagram depicts the communication path where the market participant is using a transmission facilities owner's communications network for transmitting the supervisory control and data acquisition data between its facility and the AESO's coordination center.



Notes:

1. Substation Communications Schematic
Intended to be a simplified representation of data collection devices located at the substation (or other field facility). Should be provided on a project-by-project basis (or indicate that follows a specific template). Desired information includes:
- protocol(s) used
- scan rate from RTU to IED (**t1**)

2. TFO Control Centre Schematic
Intended to represent all intermediate data collection/processing devices and the information transfer rates between them. Note this is a generic representation; actual flow of data will need to be provided by the operating entity. It is expected that this information will be relatively static and only need to updated when a significant change occurs to the TFO's SCADA/EMS systems, but may be inclusive of several different data streams with unique configurations.
- protocol(s) used
- scan rate from SCADA master or front-end processor (FEP) to RTU (**t2**)
- data transfer rate from SCADA master to primary EMS server (**t3**).
(NB: It is expected that any communication device (e.g. modem, router, firewall, switch multiplexor, etc.) processing delays are minimal. Please indicate if this is not the case.)
- data transfer rate from the EMS server to ICCP server (**t4**)

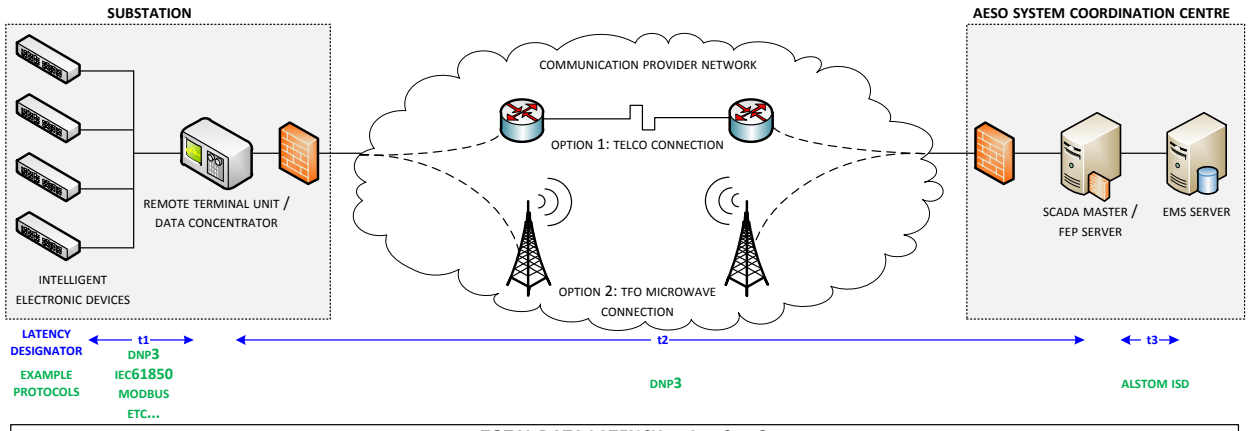
3. AESO System Coordination Centre
The AESO configures its ICCP data sets to meet the latency rates specified in the SCADA standard; these are typically sampled at twice the latency rate. This representation is for information only.
t5 = 2s, 7s, or 15s (as required)
t6 = 1s (data transfer between the AESO's ICCP and EMS servers)

4. For applicable facilities, it is expected that data is time-stamped from a GPS source at the source of the data (or applicable sampling device) and transmitted to the AESO.

5. Note that data connections are required to both the AESO System Coordination Centre (SCC) and Backup Coordination Centre (BUCC). Circuit redundancy may be required based on facility size and criticality.

ISO Communications Block Diagram 2

The second diagram depicts the communication path where the market participant is using either an independent network provider or the transmission facilities owner's microwave connection for transmitting the supervisory control and data acquisition data between its facility and the AESO's coordination center.



Notes:

1. Substation Communications Schematic
Intended to be a simplified representation of data collection devices located at the substation (or other field facility). Should be provided on a project-by-project basis (or indicate that follows a specific template). Desired information includes:
- protocol(s) used
- scan rate from RTU to IED (**t1**)

2. Communication Provider Network
This is intended to be a generic representation of possible communication paths where SCADA data is acquired directly form site. Current options include use of:
A) Commercial telecommunications provider (e.g. Telus)
B) TFO (transmission facility owner) microwave communications system

The AESO will configure the scan rate from SCADA master or front-end processor (FEP) to RTU (**t2** = 2s, 7s, or 15s as required) using the DNP3 protocol
(NB: It is expected that any communication device (e.g. modem, router, firewall, switch multiplexor, etc.) processing delays are minimal. Please indicate if this is not the case.)

3. AESO System Coordination Centre
This representation is for information only. **t3** = 1s (data transfer between the AESO's FEP and EMS servers)

4. For applicable facilities, it is expected that data is time-stamped from a GPS source at the source of the data (or applicable sampling device) and transmitted to the AESO.

5. Note that data connections are required to both the AESO System Coordination Centre (SCC) and Backup Coordination Centre (BUCC). Circuit redundancy may be required based on facility size and criticality.