MARCH 28, 2024

Telemetry Requirements for Distributed Energy Resources

TDWG Meeting #12

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Agenda

- Introduction and Background
- Existing Telemetry Requirements for distributed energy resources (DERs)
- Proposed Changes
- Modeling DERs and DER aggregations (DER/As)
- Example Telemetry Pathways
- Feedback Questions

Introduction and Background

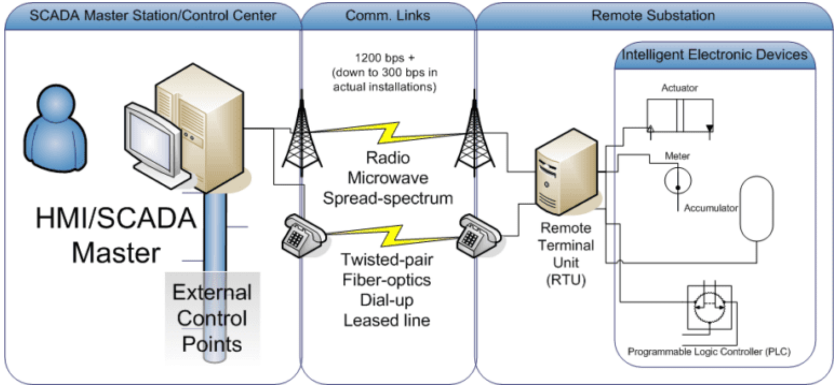
Purpose

- To inform and educate on telemetry requirements for enabling DERs/DERAs for market participation
- To start a conversation to enable collaboration with relevant entities for obtaining telemetry
- To solicit feedback on proposed telemetry requirements

Introduction

What is Telemetry?

Collection of measurements/data from remote points in the field and the automatic transmission of data to the receiving equipment for monitoring



Source: https://www.electricaltechnology.org/2015/09/scada-systems-for-electrical-distribution.html

Why is it useful?

Operational telemetered data is gathered in Supervisory Control and Data Acquisition (SCADA) for monitoring and control, e.g.,

- Situational awareness in Control Room
- Interaction & control of the remote equipment
- Recording events
- Performing state estimation – results are then passed onto downstream processes, e.g., operational planning, real-time operation, market information system, assessing security

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IESO Telemetry Performance Requirements

Market Participants (MPs) are required to satisfy certain telemetry performance requirements based on their equipment size, service offered, and location (Tx/Dx) according to Market Rules, Chapter 4. Performance specifications are given below.

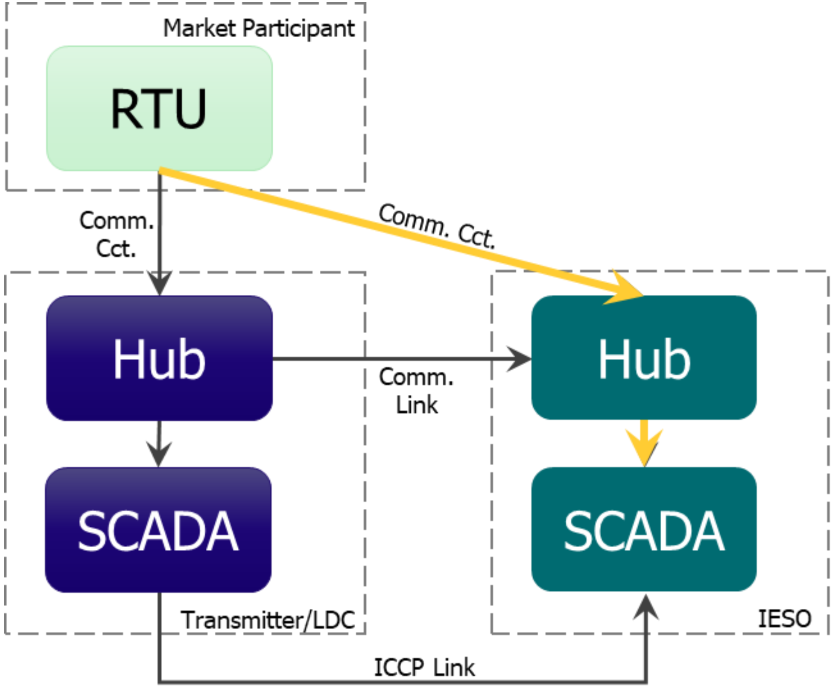
High	Medium	Low
Latency* < 2 seconds	Latency* < 10 seconds	Latency* < 1 minute
IESO scan rate ≤ 4 seconds	IESO scan rate ≥ 4 seconds	IESO scan rate ≥ 4 seconds
Data skew[+] ≤ 4 seconds	Data skew[+]: NA	Data skew[+]: NA

*Latency is the time delay for information to be available at the IESO communication interface after a change in data measurement or equipment status.
[+]Data skew is the variation in arrival timing for different pieces of data or measurements from the same equipment

High Performance Telemetry Pathway

From Remote Terminal Unit (RTU)

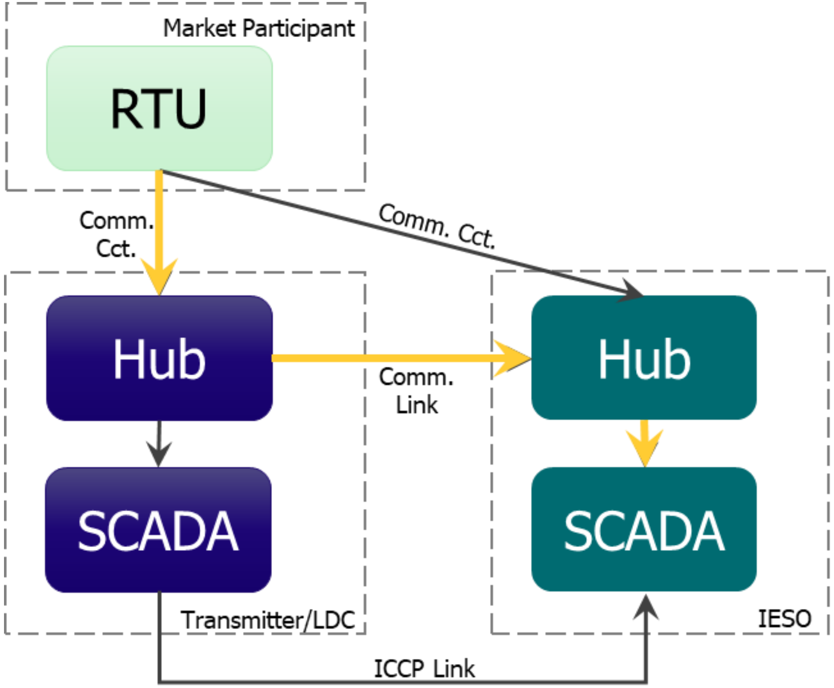
- Measurements are directly transferred from field to the IESO.
- This method is highly reliable.
- Refresh rate is typically 2 seconds.
- DNP3 (Distributed network protocol 3) is used to directly transfer data from RTU to IESO over IESO-owned communication circuits.
- RTUs gather measurements from variety of devices in the field and send them out as telemetry.



Medium Performance Telemetry Pathway

From Intermediate Hub

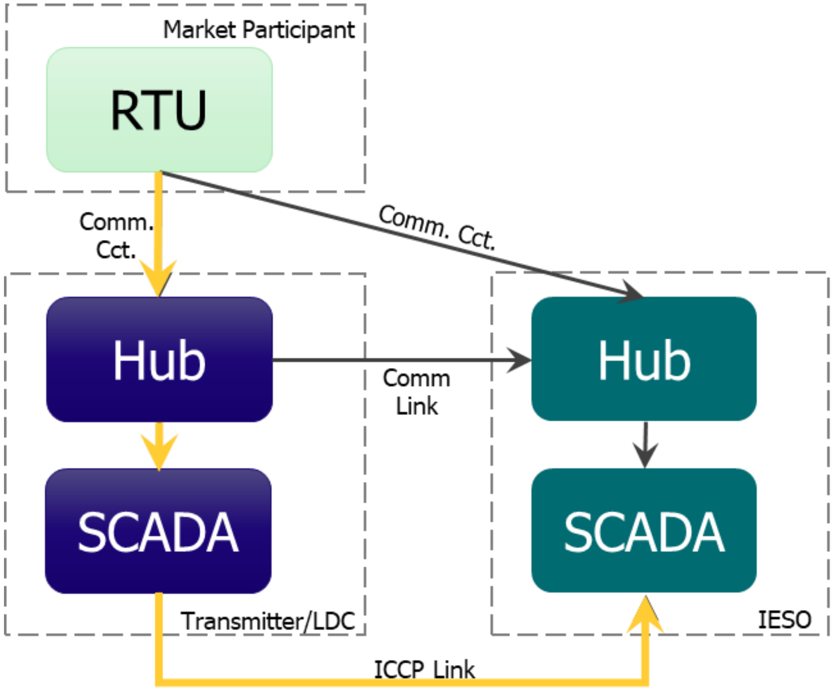
- Data is transferred from intermediate communication gateway, also known as "hub" to the IESO.
- This method provides medium reliability.
- Data is first transferred to participant's intermediate hub from RTU using DNP3, and then to the IESO.



Low/Medium Performance Telemetry Pathway

From SCADA

- Data is transferred from participant's SCADA to IESO's SCADA.
- This method provides medium/low reliability (Refresh rate is sometimes ~10 seconds).
- Inter Control center Communication Protocol (ICCP) is used to transfer information between two SCADA systems.



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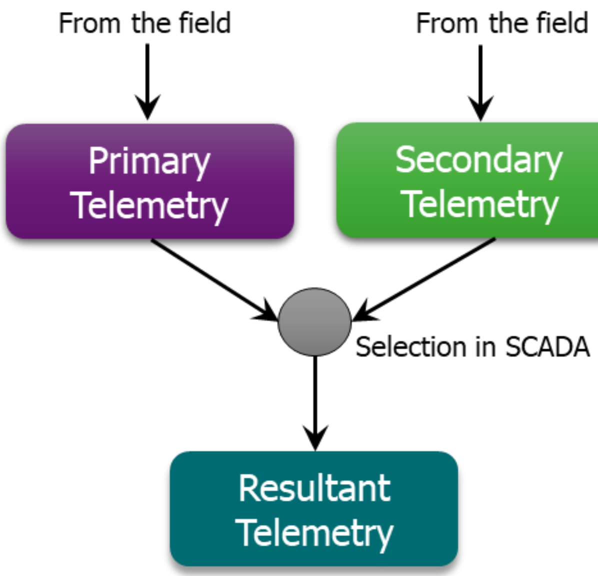
Redundant Telemetry Pathways

- A telemetered data is transferred through multiple communication pathways to the IESO, e.g., RTU and ICCP, hub & ICCP, etc.
- In all cases, the original source is always a RTU in the field.
- One pathway is designated as primary, and the other pathway is designated as secondary in SCADA.
- If primary fails, secondary is used to provide data redundancy.



Overview of Current State at the IESO

- The IESO receives two types of telemetry signals:
  - analog (e.g., Volts, Amps, Watts)
  - equipment statuses (e.g., breaker open/close)
- IESO's EMS receives ~70,000 real-time telemetry points and has a total of ~29,000 modelled equipment.
- All resources providing frequency regulation must meet high performance telemetry requirements.
- State estimation is performed every 1 minute unless triggered by an event, e.g., breaker opening.
- State estimator transfers output to market information system every 5 minutes, and using this information, multi-interval optimization (MIO) engine calculates market dispatches.
- The IESO receives telemetry from market participants, transmitter, and neighbouring jurisdictions (e.g., NYISO, MISO, Hydro Quebec).

Existing Telemetry Requirements for DERs

Summary of Existing Telemetry Requirements for DERs

Market Rules Chapter 4 outlines telemetry performance requirements for all DERs based on size and type. Telemetry requirements for variable generators (VGs) are given in Market Manual 1.5.

High Performance	• All market participant DERs ≥ 20 MVA • All non-market participant DERs ≥ 20 MVA, if required for reliability purposes based on facility classification
Low or Medium* Performance	• All dispatchable or intermittent DERs between 1 – 20 MVA • VGs, i.e., wind and solar ≥ 5 MVA • Non-dispatchable loads ≥ 20 MVA, if directed by the IESO
No Telemetry	• Self schedulers (excluding VGs), i.e., settlement only resources < 10 MVA • All DERs < 1 MVA

VGs: Dx connected VGs are registered as program participants and provide telemetry for centralized forecasting. They are accounted in demand, not in supply.

* If required for reliability purposes only, medium performance is required for certain DERs; otherwise, meeting low performance is sufficient.

Detailed Requirements for Generators

Majority of Dx generators with ratings less than 20 MVA are required to meet low/medium performance requirements.

Generator	Information Required	Scan Rate	Permissible Latency	Accuracy
Dispatchable single/aggregated generator with 1 MVA ≤ rating < 20 MVA	Active power, reactive power, unit status (for a single unit), synchronization status	≥ 4 seconds	< 1 minute or <10 seconds if required for reliability purpose (IRFRP)	2%
VG (Wind and solar) with 5 MVA ≤ rating < 20 MVA	Active power, reactive power, unit status, synchronization status, meteorological data	≥ 4 seconds	< 1 minute or 10 seconds IRFRP ≤ 30 seconds for meteorological data	2%
Intermittent generator with 1 MVA ≤ rating < 20 MVA Self scheduler with 10 MVA ≤ rating < 20 MVA	Active power, reactive power, voltage, frequency, equipment status	≥ 4 seconds	< 1 minute or <10 seconds IRFRP	2%
All generators with ratings ≥ 20 MVA	Active power, reactive power, voltage, frequency, equipment status	≤ 4 seconds	< 2 seconds	2%
Self schedulers < 10 MW All generators < 1MVA	Telemetry is not Required			

Detailed Requirements for Dx Connected Loads

Small dispatchable loads of less than 20 MVA are required to meet low/medium performance requirements.

Loads	Information Required	Scan Rate	Permissible Latency	Accuracy
Dispatchable loads with rating ≥ 20 MVA	Active power, reactive power, phase-to-phase voltage, breaker status	≤ 4 seconds	< 2 seconds	2%
Dispatchable load with 1 MVA ≤ rating < 20 MVA Non dispatchable loads with rating ≥ 20 MVA (if directed by the IESO when the transmitter or distributor data is not sufficient)	Active power, reactive power, phase-to-phase voltage, breaker status	≥ 4 seconds	< 1 minute or <10 seconds if required for reliability purposes	2%

Detailed Requirements for Storages

Small dispatchable storages of size less than 20 MVA are required to meet low/medium performance requirements.

Storage	Information Required	Scan Rate	Permissible Latency	Accuracy
Dispatchable storage with 1 MVA ≤ size < 20 MVA Self-scheduling storage with rating < 10 MW	Active power, reactive power, unit status (for a single unit), voltage (if required for reliability), state of charge, dynamic max. and min. power, base point	≥ 4 seconds	< 1 minute or <10 seconds if required for reliability purposes	2%
All storage with size ≥ 20 MVA	Active power, reactive power, voltage, state of charge and charge limit, and dynamic max. and min. power, base point, equipment status	< 4 seconds	< 2 seconds	2%

Proposed Changes

Overview of Proposed Changes

The existing requirements continue to apply while the proposed changes address gaps for small DERs that intend to participate in the wholesale market, by lowering minimum size to 100 kVA for some DER types, as highlighted in blue.

Here, the 100 kVA size is contingent upon Enabling Resources Program lowering market participation eligibility threshold to 100 kVA.

High Performance	• All market participant DERs ≥ 20 MVA
Low or Medium* Performance	• All dispatchable or intermittent DERs between 100 kVA – 20 MVA • Wind and solar generators ≥ 100 kVA • Non-dispatchable loads ≥ 20 MVA, if directed by the IESO
No Telemetry	• Self schedulers (excluding VGs), i.e., settlement only resources < 10 MVA • All DERs < 100 kVA

A similar performance requirement is expected for DER aggregations (DERAs) of the same size, type, and service.

* If required for reliability purposes only, medium performance is required for certain DERs; otherwise, meeting low performance is sufficient.

Proposed Requirements for Small Generators

Low/medium performance requirements are proposed for small generating units. A similar requirement is expected for homogenous DER aggregation (DERA) of the same total size consisting of generators.

Generator	Proposed Information Required	Scan Rate	Latency	Accuracy
Dispatchable single/aggregated generator with 100 kVA ≤ rating < 1 MVA	Active power, reactive power, unit status (for a single unit), synchronization status	≥ 4 seconds	< 1 minute or <10 seconds if required for reliability purposes (IRFRP)	2%
Wind and solar generators with 100 kVA ≤ rating < 5 MVA	Active power, reactive power, unit status (for a single unit), synchronization status, meteorological data*	≥ 4 seconds	< 1 minute or <10 seconds IRFRP ≤ 30 seconds for meteorological data*	2%
Intermittent generator with 100 kVA ≤ rating < 1 MVA	Active power, reactive power, frequency, equipment status	≥ 4 seconds	< 1 minute or <10 seconds if required for reliability purposes	2%
Self scheduling generator with 100 kVA ≤ rating < 10 MVA	No telemetry is required. It could be a settlement only generator			

* Metrological telemetry data may be required as applicable based on threshold size.

Proposed Requirements Small Loads and Storages

Low/medium performance requirements are proposed for small dispatchable loads and storages.

Load/Storage	Proposed Information Required	Scan Rate	Latency	Accuracy
Dispatchable load with 100 kVA ≤ rating < 1 MVA (Dx Connected)	Active power, apparent power, phase-to-phase voltage, breaker status	≥ 4 seconds	< 1 minute or <10 seconds if required for reliability purposes	2%
Dispatchable storage with 100 kVA ≤ size < 1 MVA	Active power, reactive power, unit status (for a single unit), voltage (if required for reliability), state of charge, dynamic max. and min. power, base point	≥ 4 seconds	< 1 minute or <10 seconds if required for reliability purposes	2%

Modeling DER/As

Importance of Modeling DERs

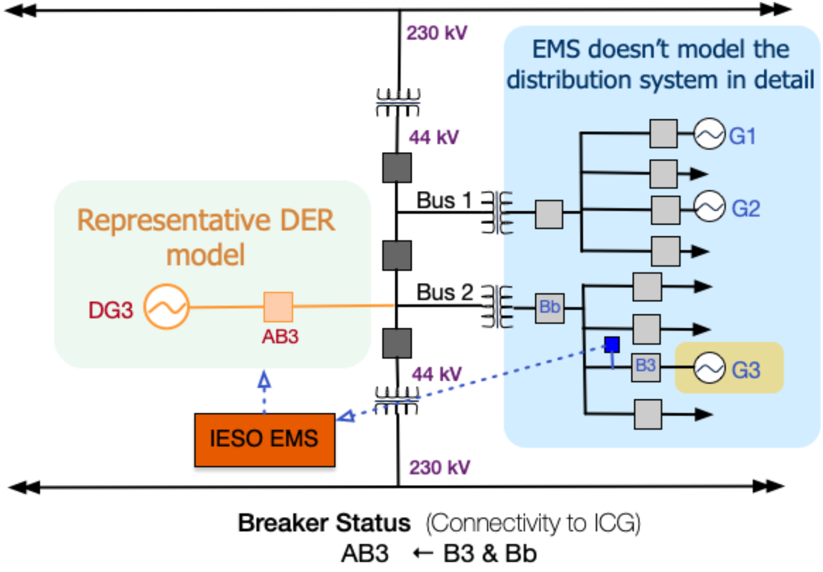
- Accurate DER/A models in Energy Management System (EMS) representing their real-time operational characteristics are important for reliable operation of the power system, especially when DER/As participate in the market, i.e., solving for power flow, checking security limits, situational awareness, and deriving accurate market dispatches.

- When DER/As represent significant portion of the overall system capacity, their real-time visibility is critical to keep the system reliable. Hence, each DER/A is expected to provide accurate real-time telemetry to the IESO to participate in the market.

- The IESO's EMS only has a few individual DER models. No DERA model exists today.

Modeling a DER in EMS

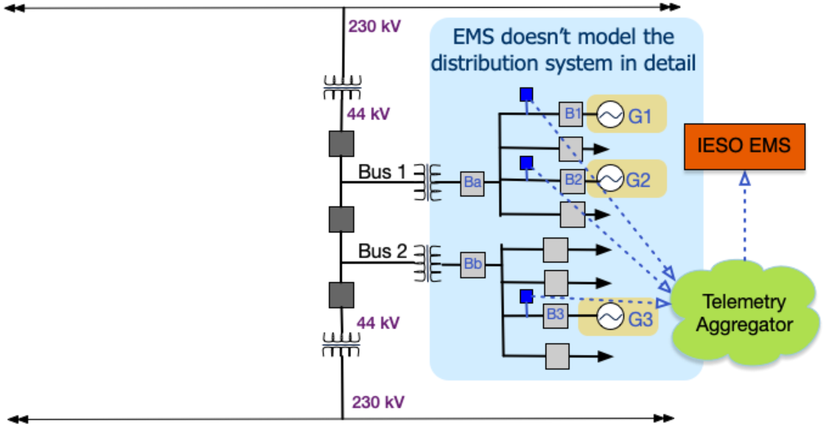
- Detailed distribution system is not modeled in the EMS. The IESO has no plans to incorporate it in the future.
- A DER is modeled at the nearest T-D interface in IESO's network model in the EMS.
- A fictitious breaker is used to represent connectivity to the IESO-controlled grid (ICG).
- Two types of telemetry information are required for representing a DER model:
  1) Connectivity status to ICG, i.e., connection status to the nearest T-D interface
  2) measurements from DER, e.g., MW, MVar.
- The **figure shows an example DER model** to represent G3 that participates in the market.



The model assumes no losses.

Modeling a DERA

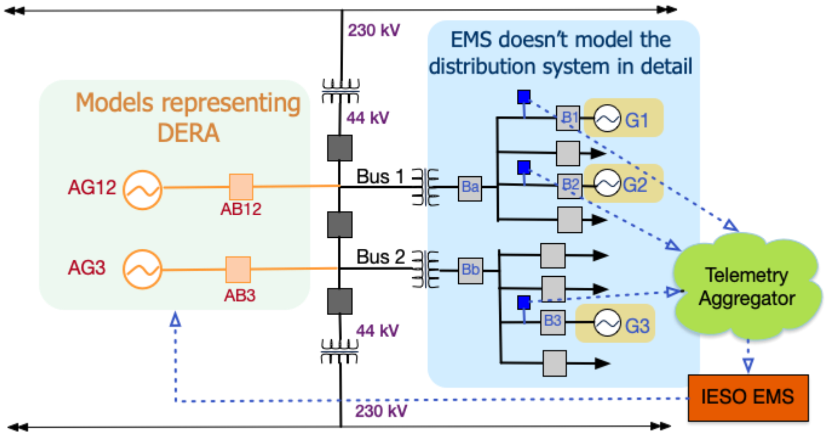
- Multiple models may be required to represent a single DERA depending on individual contributor DER locations and types.
- Contributor DERs of similar types connected to a single T-D interface or node can be aggregated and represented using a single model.
- The IESO prefers to receive aggregated telemetry points, where possible, to represent aggregate models.
- A LDC/transmitter/third-party can assume the role of a Telemetry Aggregator.
- All relevant entities, i.e., DERA, Telemetry Aggregator, host LDCs, embedded LDCs (if needed) must work together with the IESO on a case-by-case basis to identify telemetry points that can be aggregated and sent to the IESO.



G1, G2, and G3 represent a DERA

An Example of DERA Modeling

- In the figure, generators G1, G2, and G3 of the same type constitute a DERA.
- Both G1 and G2 are connected to Bus 1, they are aggregated and represented using a single AG12 model at Bus 1 in the EMS.
- Since G3 is connected to a different node/bus, it is represented using a separate model AG3 at Bus 2.
- Both AG12 and AG3 models use aggregated telemetry points to represent relevant real and reactive power injections.
- Both AB12 and AB3 breaker statuses represent connectivity statuses to the ICG.



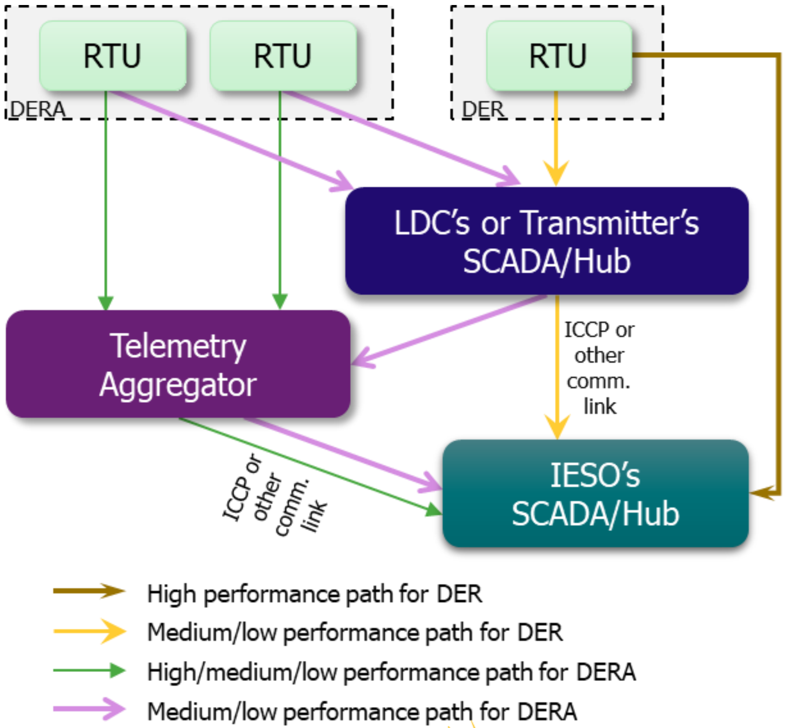
Breaker Status (Connectivity to ICG)
AB12 ← (B1 | B2) & Ba
AB3 ← B3 & Bb

Real & Reactive Power injections of DERA
$P_{AG12} = P_{G1}.\ B1 + P_{G2}.\ B2$, $P_{AG3} = P_{G3}$
$Q_{AG12} = Q_{G1}.\ B1 + Q_{G2}.\ B2$, $Q_{AG3} = Q_{G3}$

Example Telemetry Pathways

Example Telemetry Pathways for DER/As

- An individual DER can send its telemetry directly to the IESO to meet high performance requirements, or through LDC/Transmitter to meet low/medium performance requirements
- A DERA is recommended to use a Telemetry Aggregator, where possible, to aggregate telemetry points before sending them to the IESO.
- An LDC/Transmitter may assume the role of a Telemetry Aggregator for DERAs.



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Feedback Questions

Feedback Questions

- Are the proposed telemetry requirements for DER/As reasonable? Please explain any challenges and suggest solutions to overcome them.
- Are there any telemetry pathways, other than those mentioned in the deck, that can be utilized to meet the telemetry requirements for DER/As?
- What entity is best positioned to serve as a Telemetry Aggregator and why?
- What data is required to represent losses or electrical distances of DER/As in EMS, and where should the data come from? Please suggest possible approaches.

Appendix

Jurisdictional Scan

Overview of Other Jurisdictional Telemetry Requirements

- All DERAs must provide aggregated telemetry
- High frequency scan rate is required for frequency regulation (2-6 s)
- PJM requires meteorological telemetry for solar DERA of more than 3 MW in size data (radiance & back panel temperature) in 5-minute resolution.

Jurisdictional Scan – Telemetry Requirements for DERAs

Jurisdiction	NYISO	PJM	SPP	ISO-NE	MISO	CAISO	IESO
Telemetry for DERAs	Require aggregated real-time telemetry						Aggregated, where possible
Telemetry Details	Mostly scan rate is 6s Permissible latency is <10 s for one-way and <20s for round trip.	Regulation: 2s for Reg-D 10s for Reg-A 1-min for DERAs providing reserves & capacity 1-min for energy for DERAs > 10 MW DERA solar > 3 MW require met telemetry at 5-min	DERA aggregated realtime MW telemetry via ICCP	SODERA: no telemetry GEN, BSF, CSF: 10 s or 2s (if providing regulation) DR,DRDERA: individual DER telemetry at 1- or 5-min	2s for all dispatchable DERAs; relax to 10-30s for non-regulation DERs < 5 MW	Telemetry is required only if the DERA size is larger than 10 MW or provides AS. Mostly 4s telemetry	Scan rate ≤ 4s for all DERAs ≥ 20 MVA; ≥ 4s for all DERAs < 20 MVA 2s latency for all DERAs ≥ 20 MVA; 1-min or 10s for all DERAs <20 MW for energy

Source: DER Aggregation Participation in Electricity Markets EPRI Collaborative Forum Final Report and FERC Order 2222 Roadmap

Requirements for Market Participation (Includes Tx Resources)

Product	ISO-NE	NYISO	PJM	MISO	ERCOT	CAISO	SPP	IESO	AESO
Regulation	4 seconds for DR, same for Generator	6 second resolution (ICCP)	2-4 second resolution (ICCP)	2 second resolution (ICCP)	2 seconds (DNP 3)	4 second	4 second	No DR	4 second
10 Minute Spin	1 minute for DR, 10 sec for Generator	6 second resolution (ICCP)	N/A	10 second resolution (ICCP)	2 seconds (DNP 3)	4 second	4 second	2-10 second	4 second
10 Minute Non-Spin	1 minute for DR, 10 sec for Generator	6 second resolution (ICCP)		10 second resolution (ICCP) (Exception: For DRR Type I after-the fact metering with 5 min. resolution suffices)		4 second (1-min scan for PDR, 4-sec scan for NGR)	4 second	2-10 second	4 second
30 Minute Non-Spin	5 minute for DR, 10 sec for Generator	6 second resolution (ICCP)			2 seconds (DNP 3)			2-10 second	
RT Energy	5 minutes for DR, 10 sec for Generator	N/A (Except for RT energy dispatched from AS Capacity as stated above)	N/A	4 second resolution (ICCP) (Exception: For DRR Type I after-the fact metering with 1 min. resolution suffices)	N/A	4 second (5-min scan)	4 second	2-10 second	4 second
DA Energy	5 minutes for DR, 10 sec for Generator	N/A	N/A	N/A	N/A	N/A	4 second	2-10 second	4 second
Capacity Market	5 minutes for DR, 10 sec for Generator	N/A	N/A	N/A		N/A	N/A	N/A	4 second

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