TDWG – B2 ‘Communication Assessment’

May 27th 2025

TDWG Deliverables

Deliverable A – Coordination Protocols
Details transmission-distribution (T-D) coordination protocols under the Dual Participation (DP-DSO), Total Distribution System Operator (T-DSO), and Market Facilitator (MF-DSO) coordination models [**Lead: IESO**]

B1– Functional Assessment
Identify operational distributor functions, capabilities, and costs differences analyzed across several dimensions. [**Lead: Alectra & Toronto Hydro**]

B2 - Communication Assessment
Details (T-D) communication methods to support all coordination models
[**Lead: Hydro One**]

B3 - Shared Platform
Concept of Digital platform that facilitates or coordinates the procurement, trade, scheduling, and dispatch of DER (A).
[**Lead: Alectra**]

Key Components of the Report

1. Coordination Models and Architecture

- Describes three coordination models and their implications on data flow and communications.

2. Use Cases and Interaction Mapping

- Six use cases analyzed for architectural significance, based on the IESO's Deliverable A 'Communication Protocol' report:
  - Day-ahead scheduling
  - Real-time dispatch
  - DER and distribution system outages
  - Resource plan changes
  - Telemetry

3. DER Forecasting

- DER growth projections (2025–2035) based on IESO's DER Potential Study

4. Protocol Evaluation and Byte-Count Analysis

- Assesses applicability of IEEE 2030.5 and DNP3 for message exchanges.
- Quantifies daily data traffic across interfaces and DSO models

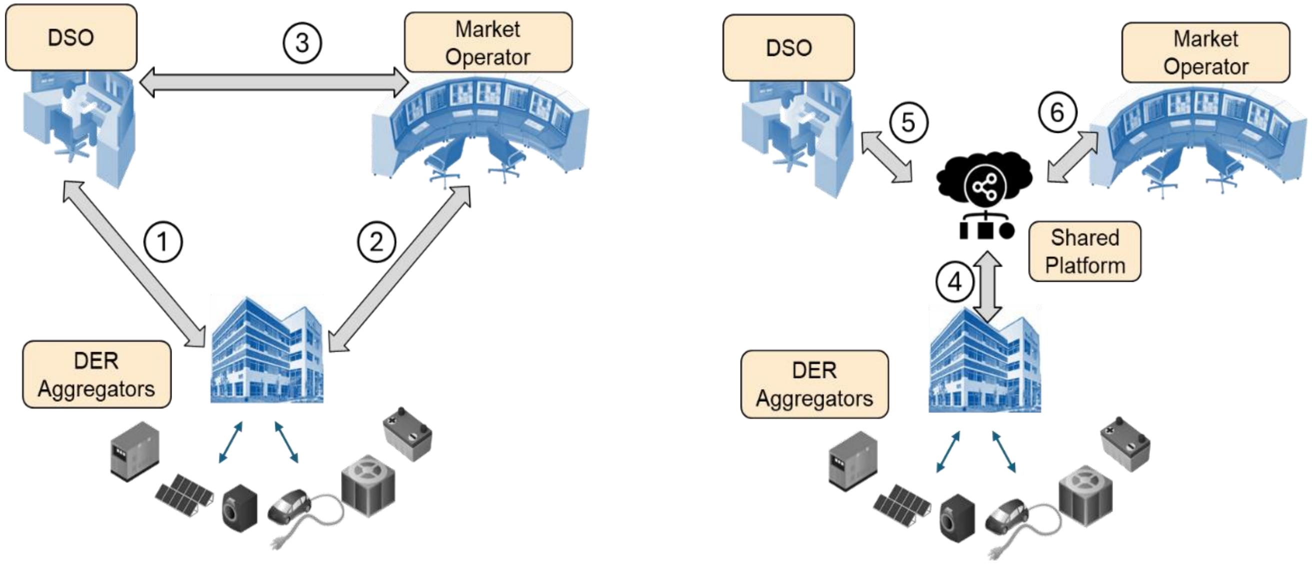
5. Telecommunication Technology Assessment

Analyzes suitability of medium based on; Data Rate, Latency, Reliability, Cost, Cybersecurity, Deployment ease Scalability.

Level of Detail – Interaction *Between* Entities

The reference architecture delivered by the IESO in Deliverable A was kept simple and at a high-level, identifying actors only down to the entity-level and not considering the specific software products or systems that might exist within each actor. Working at this level of actor detail is appropriate when the goal is to understand the communication interfaces between entities and not those within an entity.

The one exception to this is the concept of a “shared platform”. This platform is envisioned to serve as a central resource that all actors interact with directly, helping to share information and reduce the number of interfaces that each entity must support.

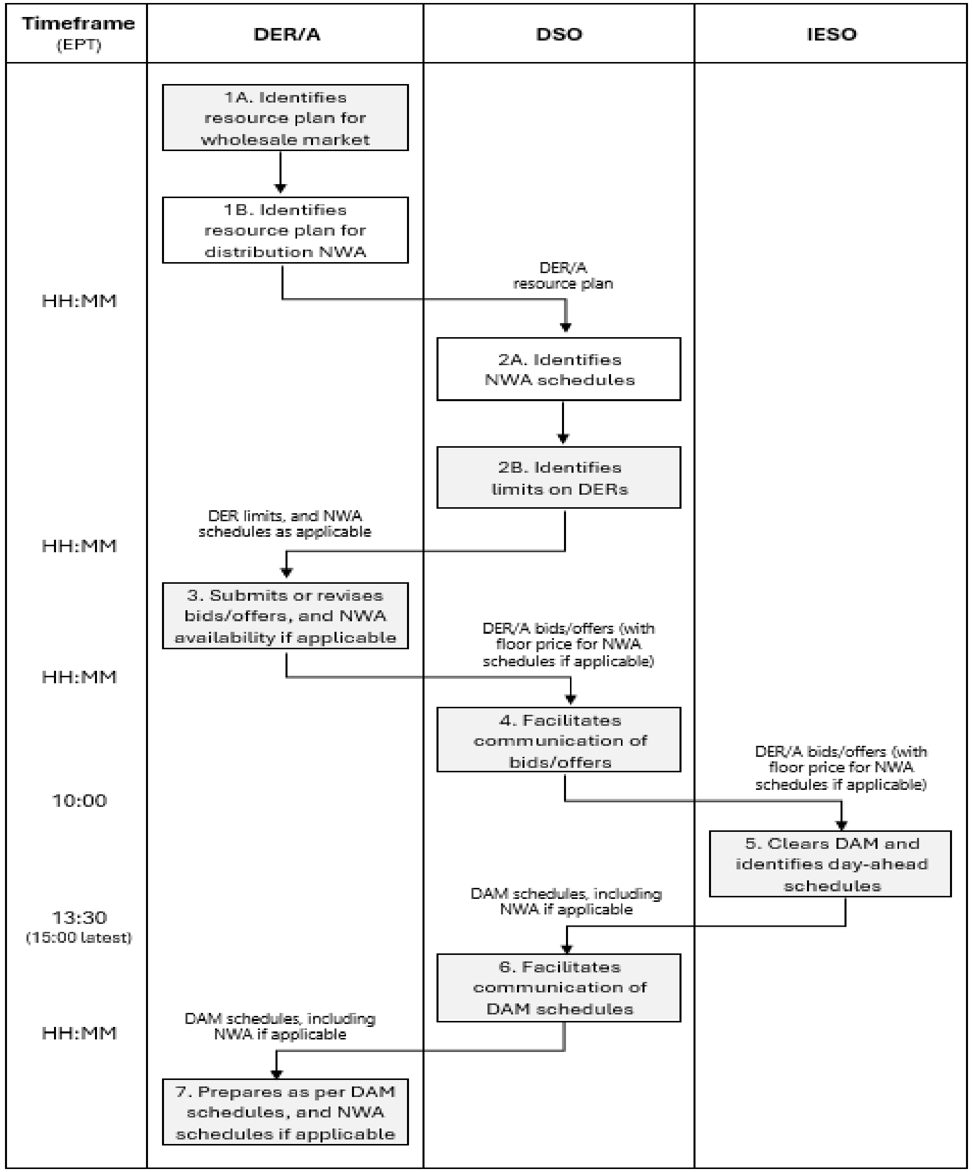


Message Identification and Mapping to DSO Models

This analysis broke down each use case into the sequence of individual messages. For example, the process swim lane diagram (right) involves several horizontal arrows, representing information exchanges between entities. The number of interactions between entities was mapped and calculated.

The table below identifies and quantifies the major data exchanges that occur between each actor / entity.

Parameter	Result
Number of Unique Communication Interaction Types	61
Number of Unique Interaction Types by Interface	
DER/A ↔ DSO Interface	31
DER/A ↔ISO Interface	13
DSO ↔ ISO Interface	17
DER/A ↔ Shared Platform Interface	36
DSO ↔ Shared Platform Interface	42
ISO ↔ Shared Platform Interface	26
Number of Unique Interaction Types by DSO Model	
Total DSO	48
Dual Participation DSO	34
Market Facilitator DSO	48



DER Forecasts (BTM + FTM + DR)

The DER forecasts results, including the Behind the Meter (BTM), Front of the Meter (FTM), and Demand Response (DR) were obtained utilizing the following data / sources:

- IESO / Dunsky DER Potential Study
- Hydro One (DER records). This data was then pro-rated to account for rest of province.
- OEB (residential customer counts)
- IESO Peak Perks Program (for Demand Response only)

https://www.dunsky.com/wp-content/uploads/DER-potential-study-IESO-Dunsky-Vol1.pdf

Peak Perks Program Reaches Milestone Enrollment

Summary of DER potential by Scenario - Capacity

		BAU	BAU+	Accelerated
Summer 2032	**Forecasted System Needs**	**3.4 GW**	**4.6 GW**	**9.3 GW**
	Economic Potential	4.1 GW (17% of peak demand)	8.2 GW (27% of peak demand)	18.9 GW (53% of peak demand)
	Achievable Potential	1.3 GW (5% of peak demand)	2.2 GW (7% of peak demand)	4.3 GW (12% of peak demand)
Winter 2032	**Forecasted System Needs**	**1.3 GW**	**6.2 GW**	**14.6 GW**
	Economic Potential	2.8 GW (11% of peak demand)	6.8 GW (23% of peak demand)	15 GW (43% of peak demand)
	Achievable Potential	1.0 GW (4% of peak demand)	1.8 GW (6% of peak demand)	3.6 GW (10% of peak demand)

DER Forecasts (Economic & Achievable)

Below are the DER forecast numbers used in the Communication Assessment. Both High and Low values included BTM, FTM and DR DER's for the summer (peak) scenario. The Low is based on BAU (achievable) model and High value is based on BAU+ (econo).

Figure 5-12: Market-Wide Economic Potential By Scenario and Resource Type in 2032 (GW)

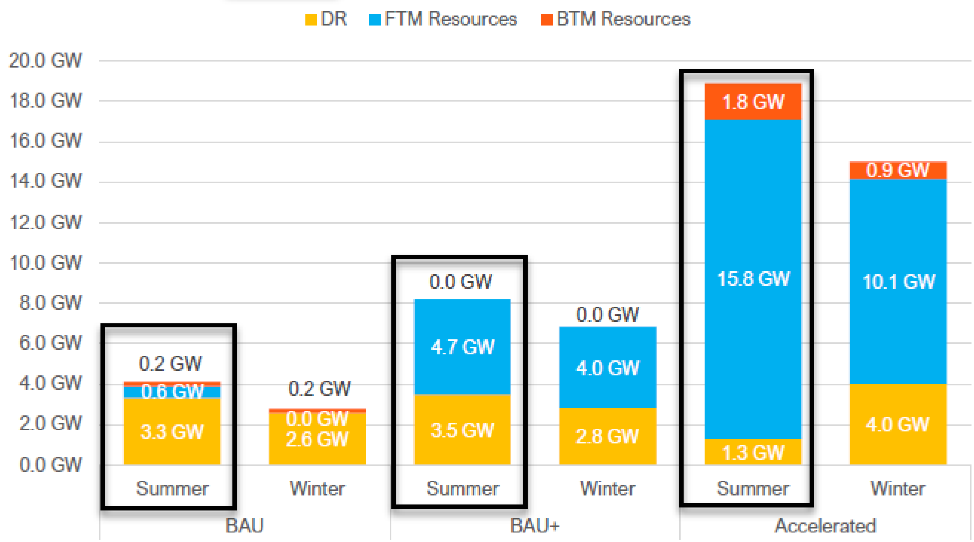
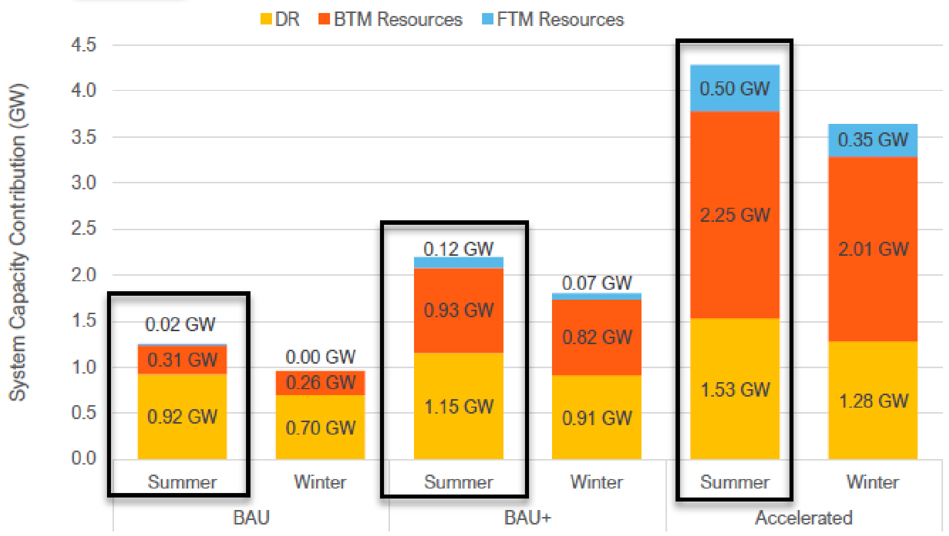


Figure 6-3: Achievable Seasonal System Capacity Contributions by Scenario and Resource Type in 2032



	BAU (Watts)	BAU+ (Watts)	Accelerated (Watts)
Total DER Economic Potential	4,100,000,000	8,200,000,000	18,900,000,000
Total DER Achievable Potential	1,250,000,000	2,200,000,000	4,280,000,000
Total # DER (Econo)	3,320,137	**3,501,076**	1,483,616
Total # DER (Achievable)	**951,005**	1,243,027	1,755,114

Example: Demand Response (DR) Forecast

DR Forecast Calculation Based on:

- 5.01M Residential Customers in Ontario
- Average DR savings per home= 1kW (200MW / 200,000 homes) as per IESO Peak Enrollment Program)

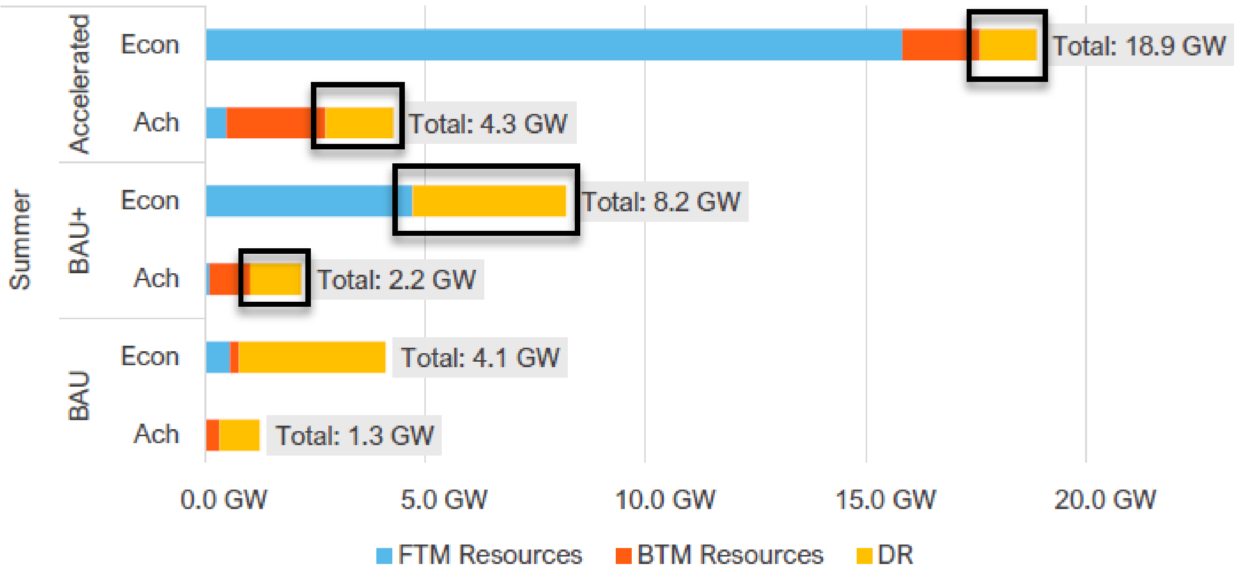
[Peak Perks Program Reaches Milestone Enrollment]

Example from BAU+ Economic:

3.5GW savings total / 1kW DR savings per home = 3.5M homes with DR

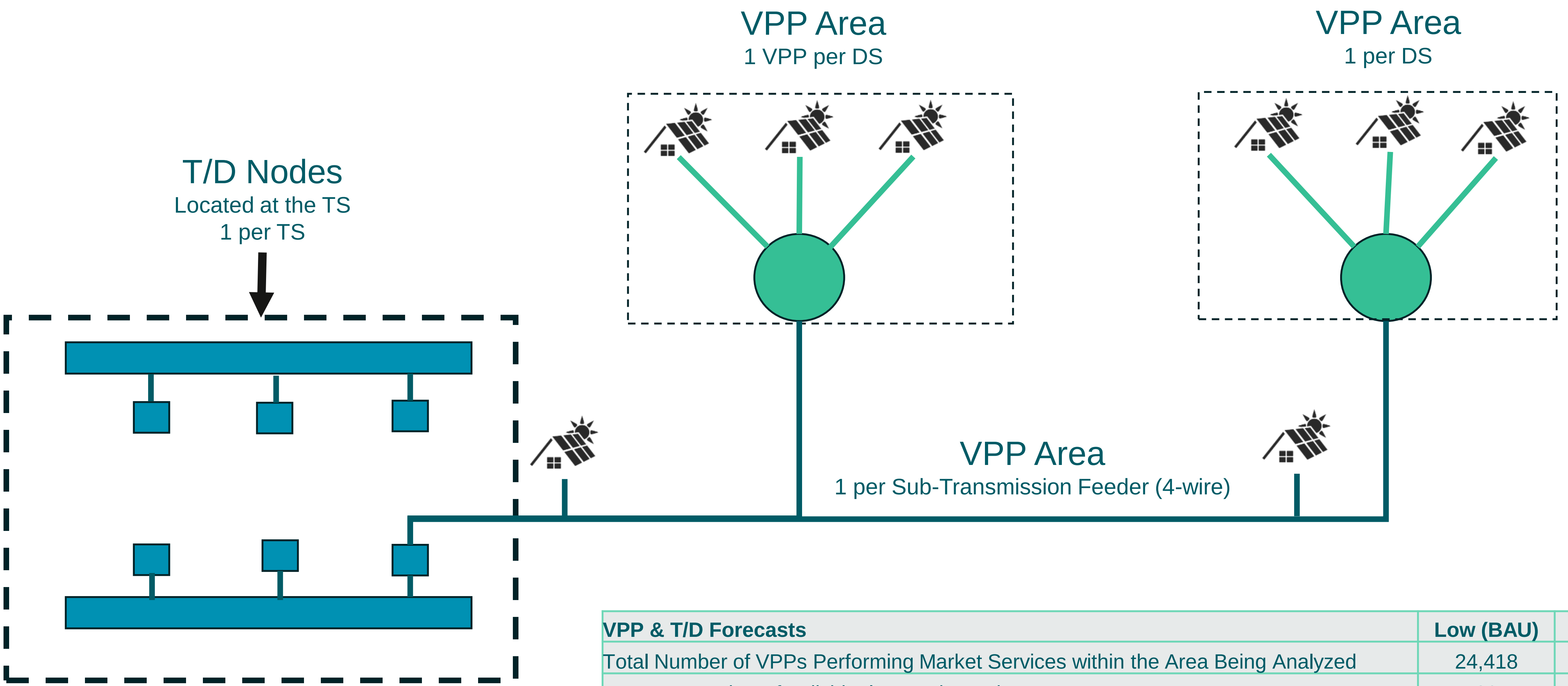
Therefore, the high estimate (BAU+ Economic) scenario indicates that there could be up to 3.5 million DR DER's interacting with a DSO.

Figure E-1: Economic and Achievable Potential Capacity Contributions by Scenario and DER Type (2032)



	BAU (watts)	BAU+ (watts)	Accelerated (watts)
Total DR Economic Potential	3,300,000,000	3,500,000,000	1,300,000,000
Total DR Achievable Potential	920,000,000	1,150,000,000	1,530,000,000
	BAU (# DR's)	**BAU+ (# DR's)**	**Accelerated (# DR's)**
Total DR (Econo)	3,300,000	3,500,000	1,300,000
Total DR (Achievable)	920,000	1,150,000	1,530,000

VPP's & T/D Nodes in Ontario



VPP & T/D Forecasts	Low (BAU)	High (BAU+)
Total Number of VPPs Performing Market Services within the Area Being Analyzed	24,418	61,046
Average Number of Individual DERs in Each VPP	39	57
Average Number of VPPs Behind a Given T/D Node	76	190
Number of T/D Nodes within the Area Being Analyzed	321	321

Aggregate Data Quantities

The total data traffic associated with each unique communication interaction type can be determined by multiplying the data size of each occurrence multiplied by the number of occurrences in a given time window. For this analysis, one day was used as the reference time window in keeping with the overall cycle of day-ahead plus real-time interactions. An excel spreadsheet tool was created and used to perform total daily data traffic for each unique interaction based on high and low projection cases (IESO DER Potential Study).

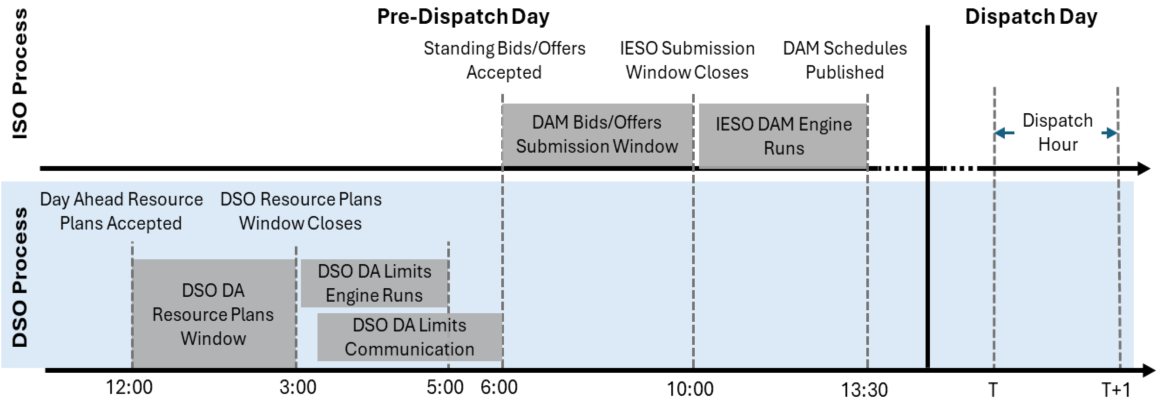
System Architecture	Interface	Daily Data (Mbytes)	
		Low Case	High Case
Direct Communication Between Actors	Aggregator to DSO Interface	31,780	112,185
	Aggregator to DSO Telemetry	124,428	320,419
	Aggregator to ISO Interface	0	0
	DSO to ISO Interface	156	211
Communication via Shared Platform	Aggregator to Shared Platform	31,780	112,185
	DSO to Shared Platform	31,936	112,396
	ISO to Shared Platform	156	211

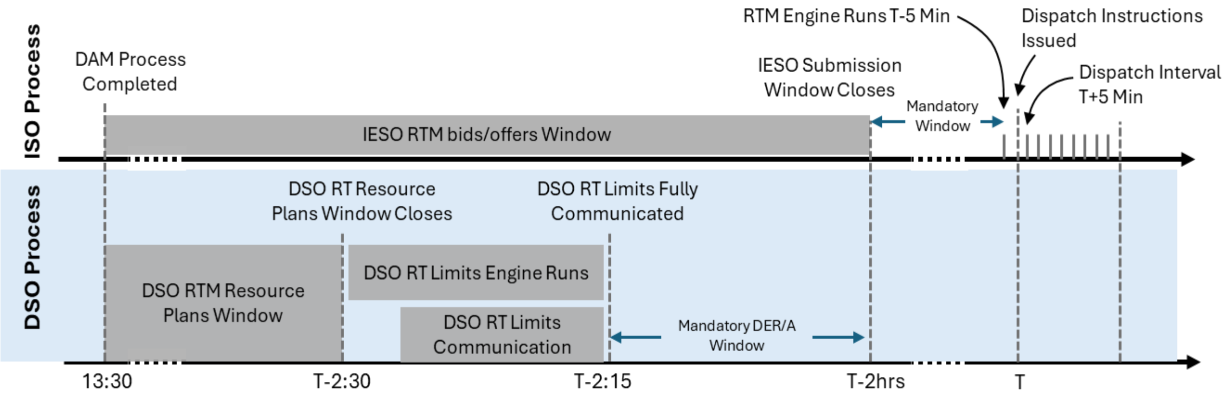
Aggregate Daily Data Quantities for the TOTAL_DSO Model

Bursty Data Traffic

This analysis identifies the total daily data traffic. However, there are certain windows of time within each day when traffic levels are higher and a given throughput (Bytes) must be transferred successfully over communication networks within the allowed windows in order to leave time for processing and computing performed by the various actors.

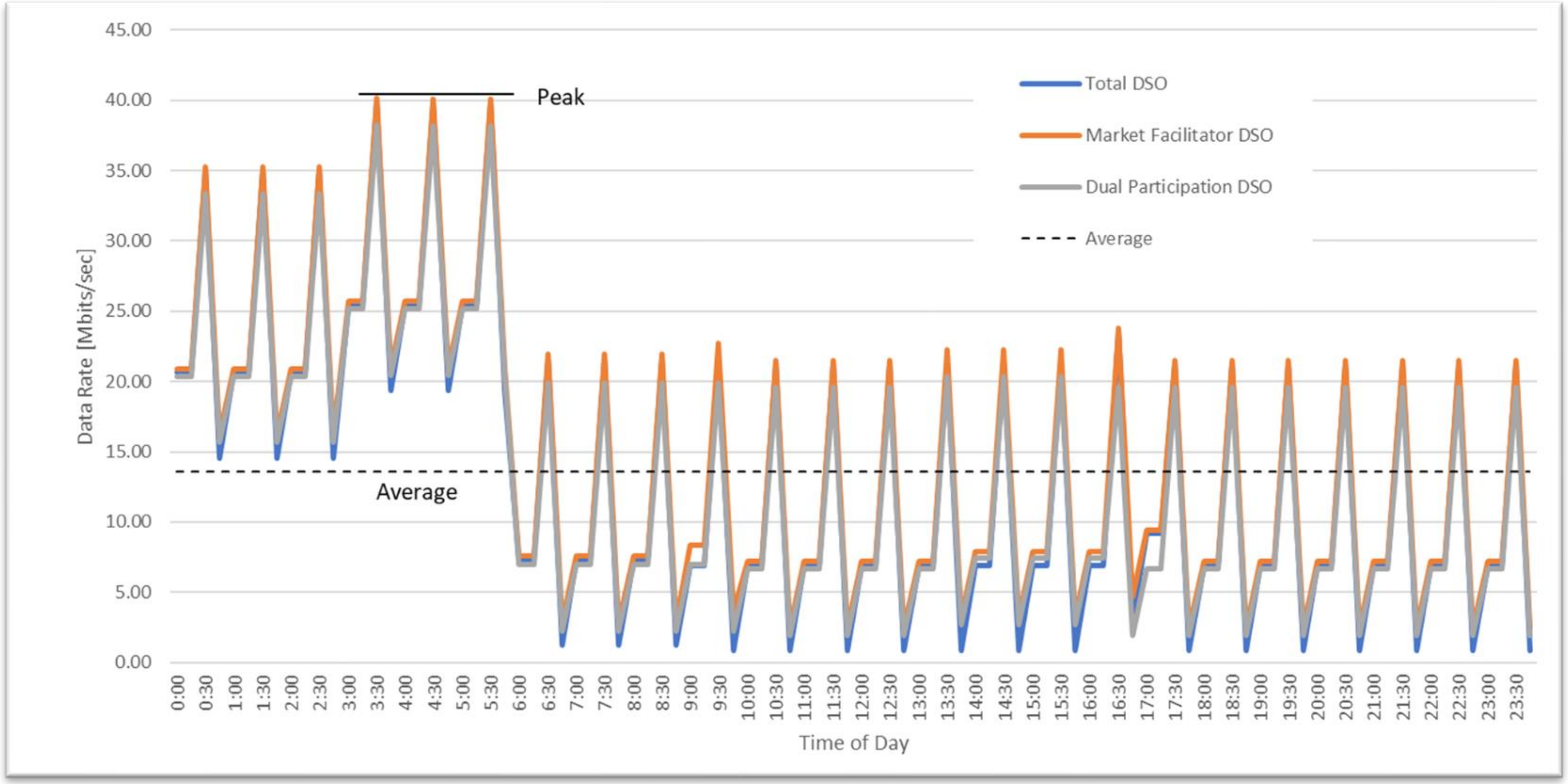
The figures below show example timelines of DSO and DER/A interactions in coordination with ISO day ahead and real time markets.





Bursty Data Traffic Results

Putting these day-ahead and real time scenarios together, the peak loading occurs during the once-per-day period when the day-ahead and real time processes overlap and specifically within that period, the window when day-ahead constraints/limits and the RT processes overlap. These bursty data periods result in the effective data throughput rates shown below.



Example Daily Data Traffic Pattern

Communication Technology Analysis

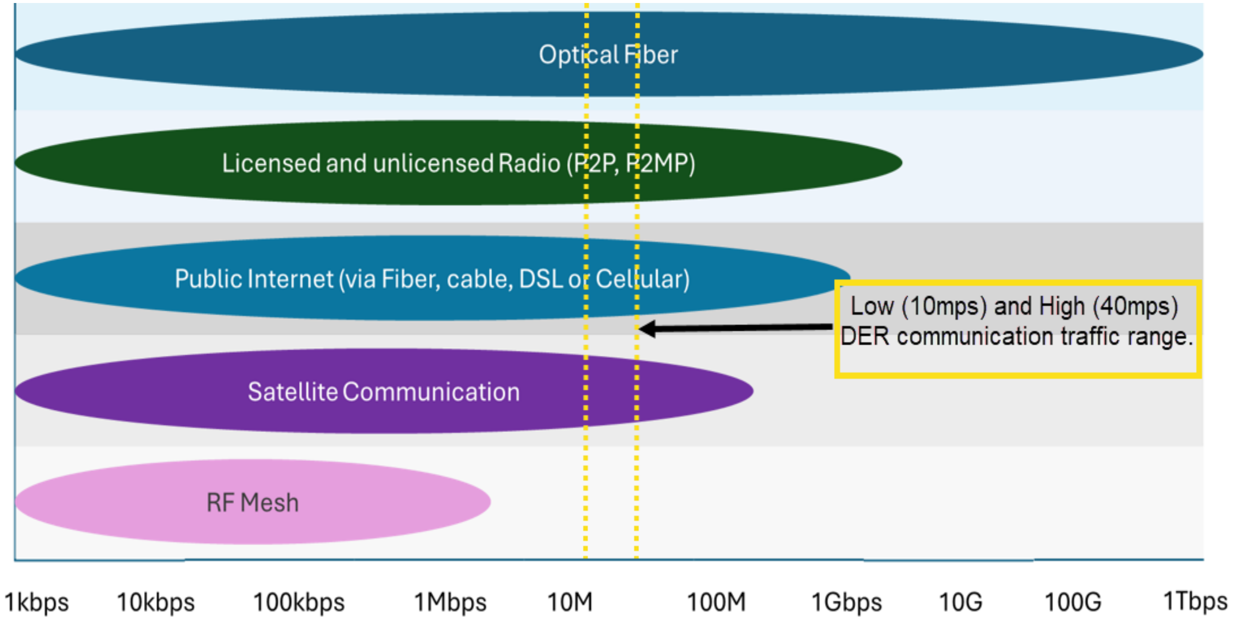
Evaluation Criteria	
Data Rate	• Different types of media support different data rates. It is a primary factor used in telecom technology evaluation.
Latency	• While the latency requirements of each model under consideration are not that stringent (i.e., in milliseconds), it is still valuable to evaluate latency performance, as these requirements may change with the grid's evolution.
Reliability	• Typically the most important factor for utilities. Multiple metrics available to evaluate this, key amongst them for telecom technologies is network availability.
Cost	• Different technology options incur different capital and operational expenditures. The industry goal to affordably modernize the grid makes this an important criterion.
Life Span	• Scheduling resources to upgrade/replace infrastructure is always a challenge in the utility industry, hence technology life span is an important consideration.
Cyber Security	• Exchanging digital information across a distance introduces major cyber security risks, which are different for different technologies, hence important to understand.
Ease of Deployment	• Deployment effort and time required is different for different technologies. This has the potential to increase the complexity of grid modernization projects, hence this is also an important factor to evaluate.
Scalability & Flexibility	• While the information available today is significantly limited, it is not irrational to assume that the future grid will continue to grow and evolve for the foreseeable future. Hence it is important to also understand the scalability and flexibility telecom technologies offer.

Conclusions

1. **All three DSO models can** be supported with current telecommunications options.
2. **A hybrid communication strategy**—mixing fiber, microwave, cellular, and satellite—will be essential for scalable and cost-effective deployment. Further evaluation should incorporate additional criteria including geographic location, reliability requirements, and DER density.

The assessment provides a foundational framework to inform future investment, standardization, and policy direction for Ontario's evolving power grid and DER market integration. Further evaluation is required considering geographic location, reliability requirements, and DER density for each DSO.

Communication Medium Vs Performance		
	Data Rate Requirements	Latency Requirements
Optical Fiber	Significantly Exceeds	Exceeds
Licensed P2P Microwave	Exceeds	Exceeds
Unlicensed P2P Radio	Meets and potentially exceeds	Meets and potentially exceeds
Private Cellular	Meets and potentially exceeds	Meets and potentially exceeds
Leased (Wireline)	Meets and potentially exceeds	Meets and potentially exceeds
Public Cellular	May Meet (location dependent)	Meets
Satellite (LEO)	Meets	Meets
RF Mesh	Likely Does Not Meet	May Meet



Feedback Questions

1. What could be some network reliability requirements when using DERs for mission critical grid services?

2. Have all the interactions, that will drive high data levels and are architecturally impactful, been identified?

3. From a DER aggregator perspective, what are some potential impacts to the DER aggregators when having to communicate with two entities, i.e., both the TSO (IESO) and DSO in the Dual Participation coordination model? To note, the T-DSO and MF-DSO models only require DER aggregators to communicate with the DSO, and not the TSO.

Thank you

For more information, please contact me at james.mcgowan@hydroone.com