

Operational Coordination Functions under Different DSO Models

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Prepared for the IESO Transmission - Distribution
Working Group (IESO TDWG)



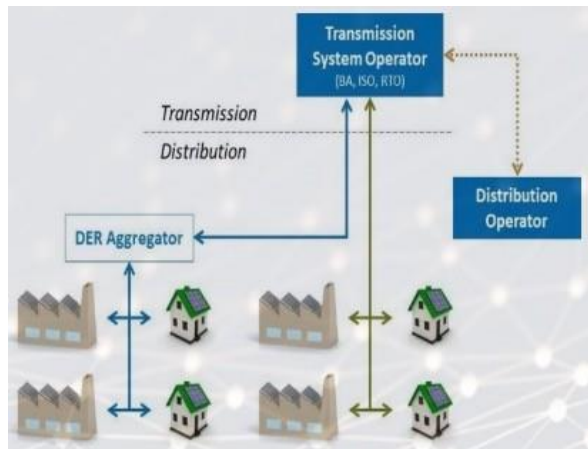
Introductory Remarks

Disclaimer: The views and perspectives presented here are those of ICF alone and do not represent the views of any other organization. The details on the following slides are intended to be a starting point for an informed discussion amongst stakeholders, and do not presuppose any specific outcome(s) regarding the implementation of T-D interoperability models in Ontario.

- The aim of this presentation is to provide a high-level description of T-D interoperability models and provide an overview of new roles and capabilities that may be required of LDCs in the future within the context of each model.
- The presentation does not define a pathway for LDCs to achieve a particular model/ end state or the individual steps required to attain a particular end state.

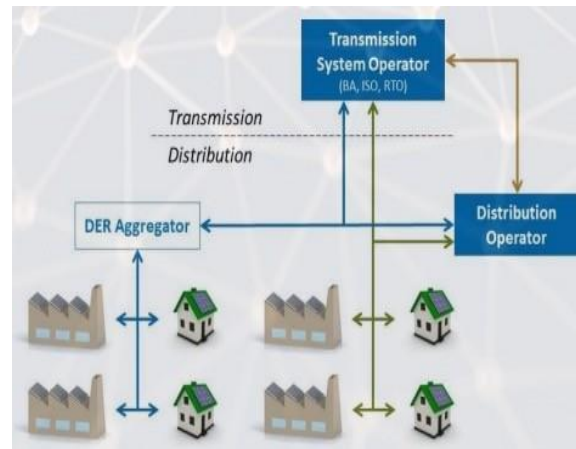
A note on terminology: This presentation distinguishes between DER(A) “penetration” versus DER(A) “participation.” There will likely be high levels of DER in the system that are “non-participating,” e.g., EVs and rooftop solar PV adopted by customers for their own purposes, where most of these DER do not participate in providing either distribution or bulk system services; i.e., high DER penetration with low DER participation. High penetrations of non-participating, non-dispatchable DER still require enhanced load forecasting capabilities by LDCs compared to low levels, even when DER participation is very low. For this working group’s effort to compare alternative DSO models, the more important factor is the level of DER(A) participation in providing distribution and/or bulk system services, so that is the focus of this presentation.

Spectrum of Future System Models



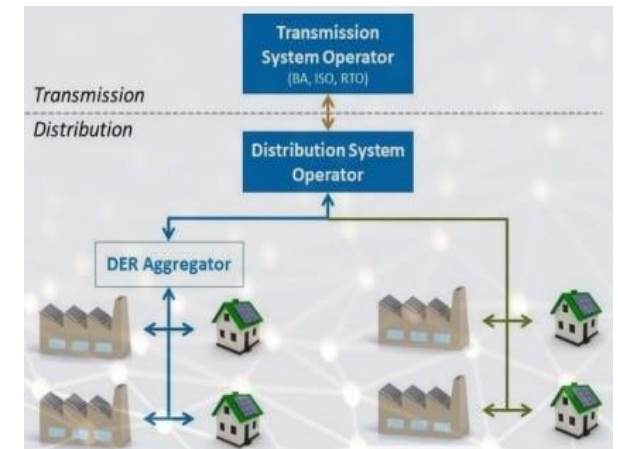
Total TSO

- TSO has full visibility into distribution system and optimizes, schedules and dispatches DER(A) for both wholesale market and distribution services
- DSO is responsible for network operations and provides network visibility to TSO
- DER(A) coordinate with DSO only for operational reliability purposes



Dual Participation (DP)-DSO

- DP-DSO is a hybrid of the Total DSO and Total TSO models
- TSO dispatches DER(A) for wholesale market and bulk system services
- TSO has little visibility into the distribution system
- DSO dispatches/schedules DER(A) for distribution needs only and coordinates with TSO
- DER(A) coordinate with both DSO and TSO

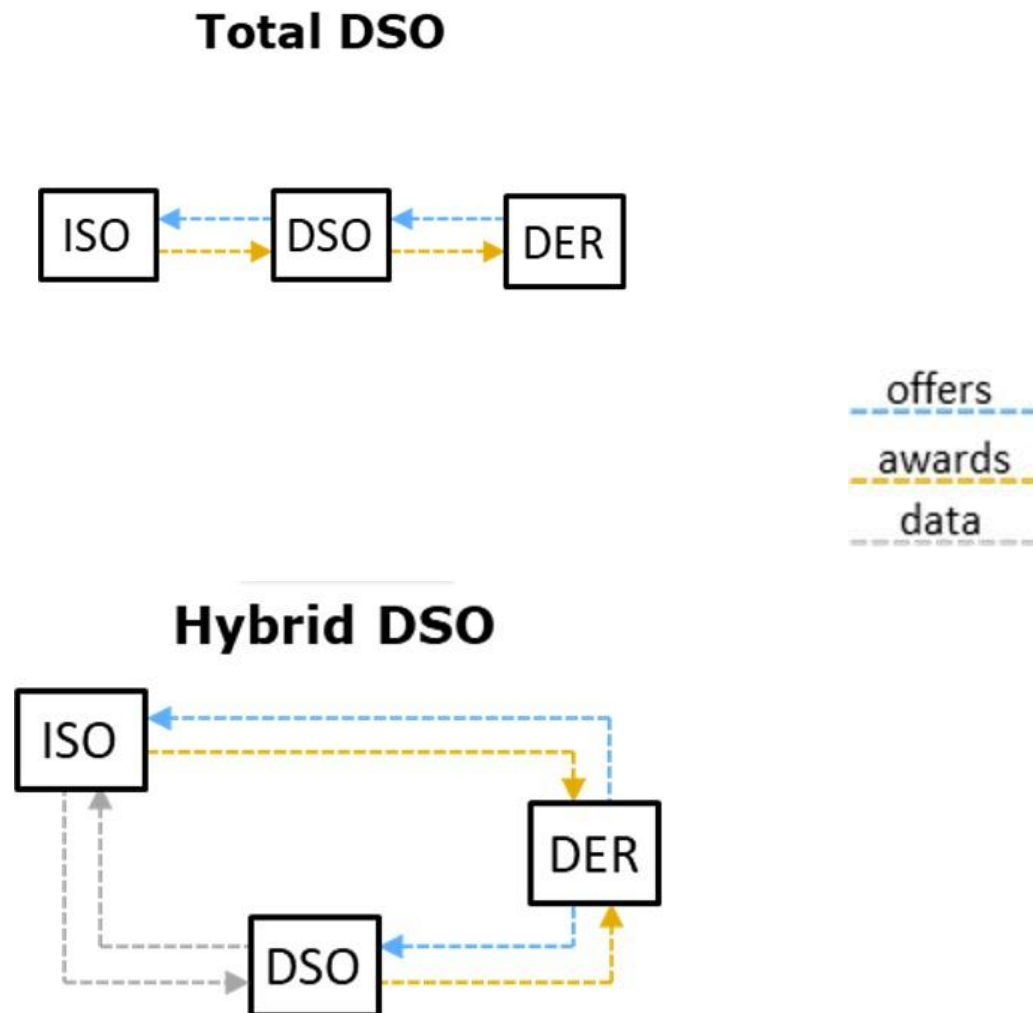


Total DSO

- TSO interacts with a single aggregate resource at each T-D interface, represented by the DSO
- DSO acts as a DSO aggregator for all DERs, offering in DER as a single resource at each T-D interface node
- DER(A) coordinate with DSO only

* The DP-DSO model can also include DSO aggregators for a subset of DERs alongside third-party DER aggregators. However, in the interest of analytical clarity, this presentation does not reflect the functionalities associated with this under the DP-DSO model.

The DP-DSO and Total DSO Models Have Commonalities...



In both models*:

- LDC owns, maintains, and operates physical distribution system assets
- LDC creates and directs switching plans to accommodate planned and emergency work and monitors the grid for power quality requirements
- LDC coordinates with DER(A) and overrides wholesale market dispatch if necessary to maintain system safety and reliability
- LDC may procure distribution grid services from DER(A), for example as non-wires alternatives (NWAs)
- LDC clears and settles transactions related to distribution grid services
- High levels of non-participating DER require enhanced load and DER forecasting methods; e.g., probabilistic methods that consider a range of operating scenarios

* LDCs possess some of these capabilities already, while other capabilities (especially related to DER dispatch) may be acquired over time.

For example, the LDC currently informs IESO of large unexpected deviations in load (20 MW or higher). This threshold may be lowered at higher penetrations of participating DER.

... And a Few Key Differences

Total DSO



Hybrid DSO



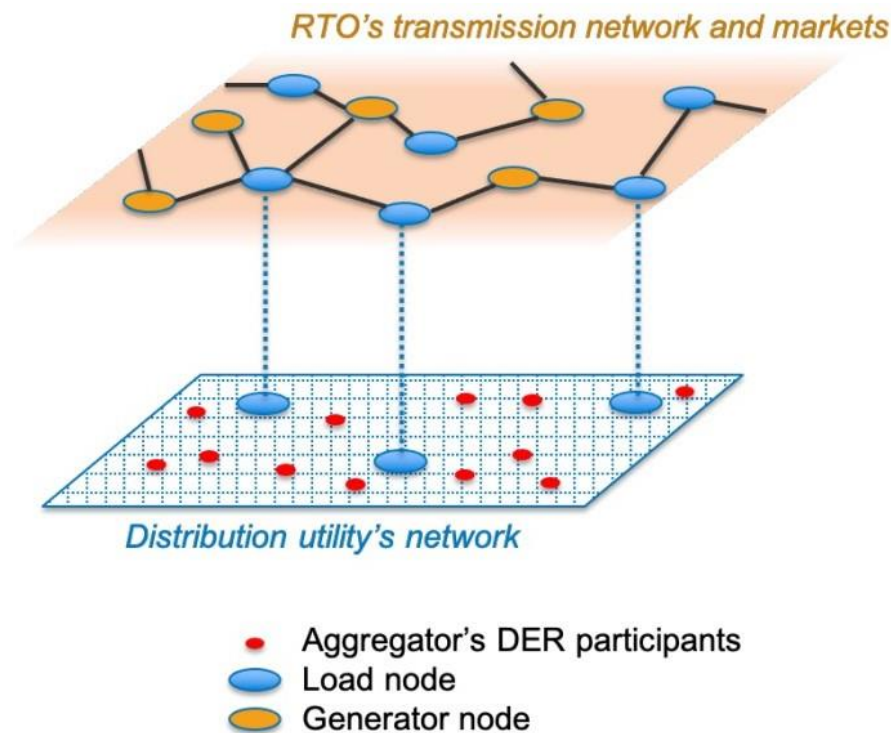
Total DSO

- LDC acts as DSO aggregator and submits a single offer to IESO at each T-D interface incorporating offers of all participating DER(A)
- LDC is responsible for complying with IESO day-ahead (DAM) and real-time market (RTM) 5-minute dispatches at each T-D interface and communicates IESO instructions to participating DER(A)
- LDC meters DER(A) performance, performs clearing and settlement functions for all DER(A), and settles with IESO for energy and ancillary services at each T-D interface

DP-DSO

- DER(A) participating in wholesale markets submit offers directly to IESO and receive wholesale market clearing results and dispatches
- DER(A) are responsible for reporting to IESO any changes in capacity or ability to comply with IESO dispatches due to changing system conditions
- DER(A) that participate in wholesale markets settle directly with IESO for wholesale market transactions
- LDCs, IESO and participating DER(A) coordinate to manage DER(A) that provide services to both distribution and bulk systems

Additional LDC Functions to Coordinate with IESO



Dual Participation DSO

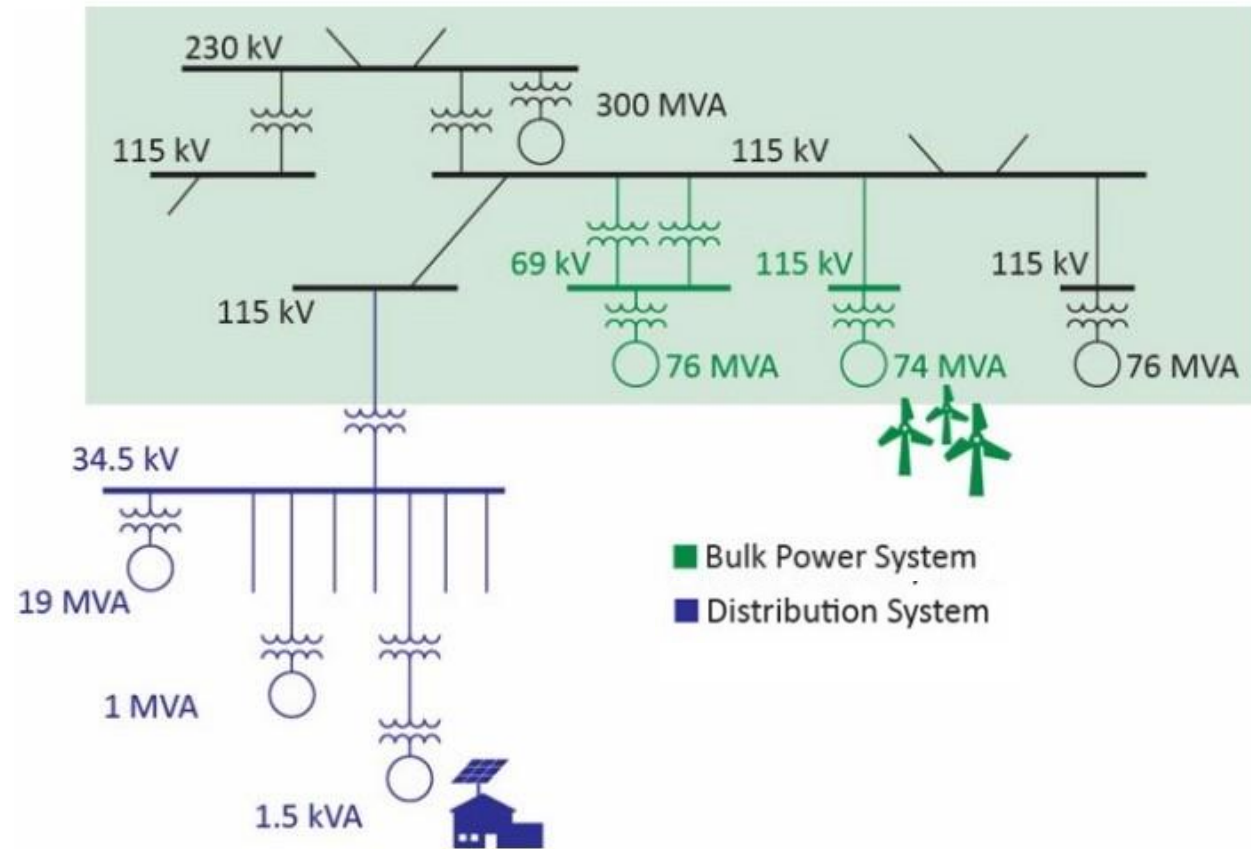
- LDC could receive IESO schedules/dispatches for all participating DER(A) to have situational awareness over the distributions system
- LDC must coordinate with IESO regarding “shared” DER(A) that provide services to both distribution system and the IESO’s wholesale market

Total DSO

- LDC acts as DSO aggregator and submits a single offer to IESO at each T-D interface for DAM and RTM markets (post IESO’s Market Renewal)
- LDC is responsible for assessing distribution system conditions on an ongoing basis and reporting adjustments in DER(A) capacity and offers to IESO when affected by system changes
- LDC is subject to active wholesale market participation, reliability directives,* performance obligations, and reporting requirements

* IESO Market Manual 7.1"defines a reliability directive as an operating instruction issued by a control room operator where action by the recipient is necessary to address reliability."

Additional LDC Functions to Coordinate with DER(A): DP-DSO and T-DSO



Both Dual Participation and Total DSO

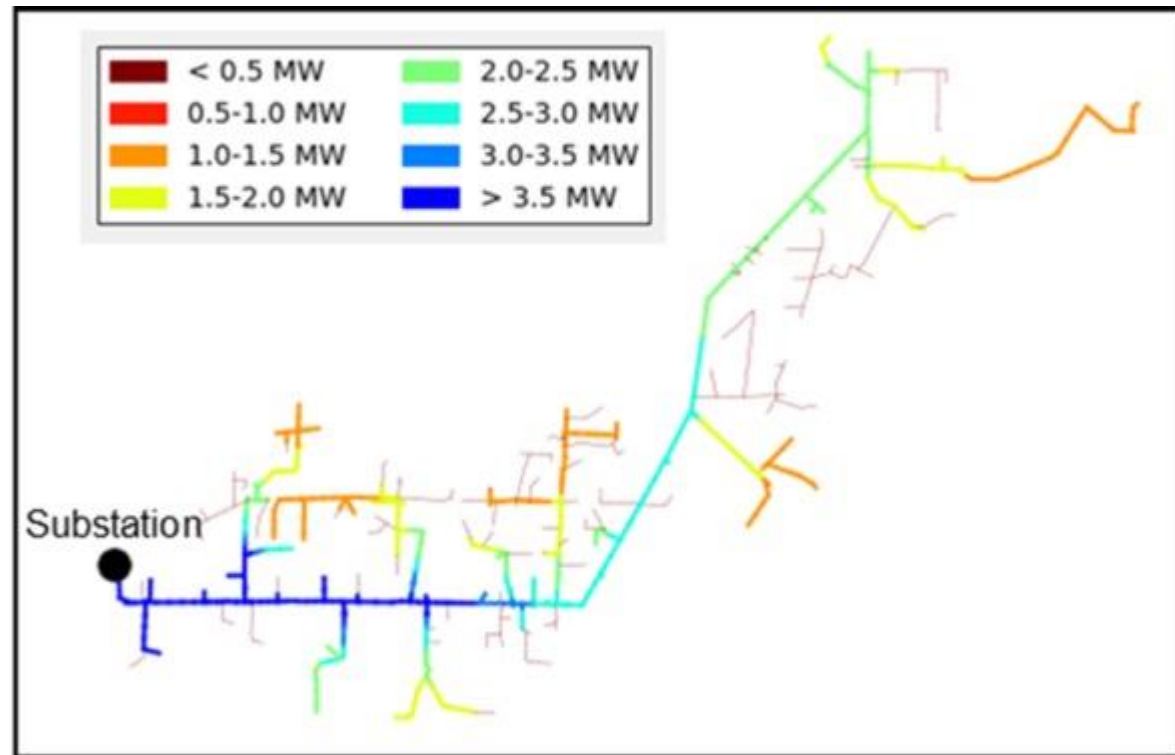
- LDC schedules/dispatches DER(A) providing distribution grid services
- LDC provides information on outages or abnormal distribution system conditions to all DER(A) participating in wholesale markets and/or providing distribution grid services
- In case of injecting DER, ability to monitor DER output and power system parameters at the point of interconnection (voltage, reactive power, DER status)

Total DSO

In addition to functions mentioned above, LDC must also perform the following tasks

- LDC must receive wholesale market offers from DER(A) and act as DSO aggregator
- Consequently, LDC must receive 5-minute IESO dispatch instructions and disaggregate to DER(A) and be subject to performance requirements
- LDC may need to adjust DER(A) dispatches and/ or notify IESO of an outage to reflect changes in system conditions and DER availability

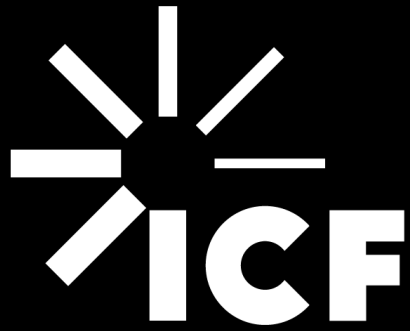
At High Levels of Market Participating DER(A), LDC Capabilities May Need to Expand Further



- LDCs may need ability to dynamically adjust DER output and offer flexible interconnection schemes
- Public release of hosting capacity information (through online maps, for example) may be needed
- LDC may need well-developed DER monitoring capability for injecting DER installations of various sizes (for e.g., <50 kW, 50-500 kW, >500 kW) to ensure situational awareness
- Power flow models may need to include details of DER locations and characteristics (size, type, etc.)
- Ability to analyze impacts of planned and unplanned system outages on need for DER(A) services and on ability of DER(A) to provide bulk system services. T-DSO would use this information to revise DER(A) market offers and re-optimize DER(A) dispatches.

A Summary of LDC Operational Capabilities in Each DSO Model

	DP-DSO	Total DSO
Own, maintain and operate physical distribution system assets	●	●
Create and implement distribution system plans to accommodate new loads and manage DER interconnections	●	●
Operational coordination with IESO regarding direct DER(A) participation in wholesale markets	●	○
Operational coordination with IESO where DSO is an active wholesale market participant	○	●
Act as DSO aggregator of DER for wholesale market participation	○	●
Schedule and dispatch DER(A) for wholesale market services	○	●
Schedule and dispatch DER for distribution grid services	●	●
Clearing and settlement activities	◐	●



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