

DER Energy Market Design: Part 1

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Agenda

- **Overview & Purpose**
- **Aggregations**
 - Aggregations & Dispatch
 - NYISO's Approach to Aggregations
- **Transmission Nodes**
 - NYISO's Approach to Transmission Nodes
- **DER Registration**
 - NYISO's Registration Approach
 - Dispatchable DER Registration, Aggregator & Aggregations
- **Aggregation Metering**
- **Aggregation Registration**
- **Scheduling and Pricing**
- **Energy Bids by Suppliers**
- **Other**
 - Appendix A: Transmission Nodes
 - Appendix B: Registration and Bidding Parameters for DER Facilities and Aggregations

Background

Date	Working Group	Discussion points and links to materials
03-06-18	Market Issues Working Group (MIWG)	DER Market Design: Aggregations
04-26-18	Market Issues Working Group (MIWG)	DER Market Design: Measurement & Configuration
06-01-18	Market Issues Working Group (MIWG)	DER Market Design: Updates
06-19-18	Market Issues Working Group (MIWG)	DER Market Design: Updates
07-26-18	Market Issues Working Group (MIWG)	DER Market Design Updates: Energy Market Bid to Bill Examples
10-09-18	Market Issues Working Group (MIWG)	DER Market Design Update: Wholesale Obligations for Dual Participation
10-10-18	Market Issues Working Group (MIWG)	DER Market Design Update
11-05-18	Market Issues Working Group (MIWG)	DER Market Design Updates
12-18-18	Market Issues Working Group (MIWG)	DER Overall Energy Market Design Review

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Overview & Purpose

Purpose of the DER Roadmap Effort

- Develop and enhance participation opportunities for DER in the NYISO-administered wholesale markets by creating:
 - A Dispatchable DER Participation Model; and
 - Dispatchable Homogenous Aggregations of DER
- Create a model that supports the **NYISO Market Design Vision - *Attract and retain*** the most efficient resources *to meet NY's reliability needs.*

Purpose of this Presentation

- Review previous topics discussed with stakeholders to enable and enhance the participation of DER in the NYISO Wholesale Energy & Ancillary Services Market **only**;
- Identify the Market Administration and Control Area Services Tariff (Services Tariff) sections affected by the topic discussed for draft Tariff that has been posted
 - There are ministerial edits throughout the tariff to add in, “and Aggregations” where appropriate
 - Sections of tariff have been removed throughout for language pertaining specifically to DADRP and DSASP
 - The Services Tariff posted along with this presentation has text in it that is highlighted in gray, this is language that was filed for Energy Storage Resources
- This presentation does not cover the following topics which will be discussed in future presentations:
 - Interconnections/ERIS/CRIS (expected 2/6)
 - Capacity (expected 2/6)
 - Dual Participation (expected 2/15)

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DER Definition for the Market Design

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- **DER: A Generator, Energy Storage Resource, Intermittent Power Resource, Energy Limited Resource, or Capacity Limited Resource participating in an Aggregation whose maximum physical injection is 20 MW or less and Demand Side Resources (including facilities that can reduce Load and inject Energy) that respond to the ISO's instructions.**
- **Dispatchable DER are a subset of DER that are capable of responding in real-time to NYISO dispatch instructions.**

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Aggregations Market Services (§ 4.1)

Aggregations

- Aggregations may qualify to provide Energy, Capacity and Ancillary Services
- Minimum offer requirements for all Aggregations will be at 100 kW (§ 4.1.4*)
- Aggregations with a real-time physical operating problem making their schedule infeasible must notify the NYISO (§ 4.1.6)

*All tariff section references in this presentation are to the Services Tariff, unless otherwise noted.

Aggregation Dispatch

- **Aggregations will not receive unit commitment from the NYISO and will instead be considered as only a dispatch resource, when participating in the wholesale market (§ 4.1.8)**
 - Aggregation will not have any commitment parameters such as start up cost considered in the market evaluation
 - Dispatchable DER will likely be serving a primary function other than providing Energy and Ancillary Services to the NYISO-administered wholesale markets, and therefore will already be “committed” when used to serve that primary function. It follows, then, that those resources will not require a day-ahead or real-time commitment by the NYISO.
 - In addition, unit commitment requires knowing the off/on status of the resource. Given that a Aggregation is an Aggregation of DER, it is not possible to determine Aggregation’s on/off status
- **An Aggregation will be treated as online and available for dispatch if requested by a Transmission Owner (§ 4.2.3.1)**
- **An Aggregation will be treated as online and available for dispatch in the Supplemental Resource Evaluation (§ 4.2.4)**

NYISO's Approach to DER Aggregations

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DER Aggregation Approach

- **Aggregations were chosen as the preferred participation method for DER in NYISO markets**
 - Similar to the methodology for the development of Transmission Nodes, the concept of an Aggregation allows for the participation of smaller distributed resources to act in concert to meet minimum eligibility requirements

Basics for all Types of Aggregations

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- Resources will be permitted to aggregate to meet minimum requirements and performance obligations for eligible participation models
- The Aggregator will be the NYISO Market Participant
- The Aggregation will be a group of one or more resources participating in the NYISO Market, represented by a PTID
 - Bids will represent the offer of the Aggregation
 - Performance will be measured in aggregate
 - Financial settlements will be in aggregate
 - NYISO intends to separately process the injection, withdrawal and load reduction data to ensure accurate settlements

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What Resources can Aggregate (§ 4.1.10)

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- **The proposed rules are technology neutral, and will permit most resource types to aggregate**
 - The NYISO's proposal will prohibit Generators with PURPA contracts, Limited Control Run of River Resources, Behind-the-Meter Net Generation Resources, Municipally-owned Generation, System Resources, and Control Area System Resources from participating in an Aggregation
 - These participation models recognize certain resource-specific attributes, hence NYISO is proposing to not allow aggregations for these participation models.
- **Aggregation participation will be open to individual facilities/DER with:**
 - 20 MW or less injection capability
 - Individual facilities may have a nameplate capability greater than 20 MW if sufficient controls exist to limit the physical injections to 20 MW or less
 - Any amount of Load reduction
 - There is no maximum limit on Load reductions by Demand Side Resources
- **The proposal does not include a maximum number of individual facilities in an Aggregation or a maximum MW limit**

Aggregation & Ancillary Services (§ 4.1.10)

- Similar to today's Ancillary Service requirements, resources must have the capability to meet the minimum bidding obligation of the product they wish to offer
- Aggregation minimum offer size is 100kW
 - Regulation Services is a bi-directional product
 - This would in turn, require these Aggregations to have a UOL of at least 200 kW to participate in Regulation Service
 - Amount of Regulation Service offered must equal 100kW at a minimum which requires a UOL higher than 100kW in this situation

Aggregations (§ 4.1.10)

- Non-dispatchable Demand Side Resources [DSR] (*i.e.*, those resources that are not capable of responding to real-time dispatch signals from the NYISO) may continue to participate in the EDRP or SCR Program
- All other Aggregations must be dispatchable and will be dispatch-only (similar to ESR and BTM:NG Resource participation models)

Aggregation Composition

§ 4.1.10.1

DER Market Participation

- **The DER participation model will only be available to Aggregations**
 - An Aggregation consists of two or more individual resources, except that Demand Side Resources and individual facilities that can reduce load and inject energy (i.e., transition from being Load to Supply without an infeasible operating range), will be permitted to individually use the DER participation model as a single-resource Aggregation
- **Individual facilities in an Aggregation will participate under the market rules for either:**
 - A DER Aggregation (when there are multiple Resource types in the Aggregation), or
 - The specific Resource type (when there is a single Resource type in the Aggregation)

Aggregation - Resource Type Modeling/ Rules

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- Aggregations of a single resource type (other than dispatchable Demand Side Resources) must contain two or more resources that participate under the same rule set that each resource would have otherwise participated under, if the resources had participated in the NYISO markets individually
- Aggregations will be modeled as an individual unit for the purpose of identifying the rule set applicable to the Aggregation
 - Mixed resource type Aggregations will follow the DER participation model, not the various participation models of the individual units
 - Examples:
 - A homogenous Aggregation of Intermittent solar will adhere to solar specific reporting requirements and pay forecasting subscription fees
 - An Aggregation containing an ESR, solar, and Load Reduction Resources will follow the DER participation model

Single Resource Type Aggregations

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- **An Aggregation will only be considered a “Single Resource Type” Aggregation when:**
 - Each individual resource in the Aggregation is eligible (except for the minimum size requirement) to participate in the participation model (e.g., as an Energy Limited Resource), and
 - Each individual resource in the Aggregation has the same operating characteristics (e.g., continuous ESRs)
- **All Resources within an Aggregation will be bid as a single unit**
 - Example: an ESR Aggregation will be Bid in as either a single ISO-Managed or Self-Managed (Bids will not be submitted for individual ESR)

Participation Models Available to DER

Dispatchable	<h2>Aggregations of DER</h2> <p>An aggregation under the responsibility of an aggregator and consists of resources:</p> <ul style="list-style-type: none"> Can qualify to participate in Energy, Ancillary and Capacity market Capable of responding in real-time to NYISO's direction 	Generator Resource Model	Consisting of Only Generators <ul style="list-style-type: none"> Aggregation must consist of 2 or more Generator DER
		Energy Storage Resource Model	Consisting of Only Energy Storage Resources (ESR) <ul style="list-style-type: none"> Aggregation must consist of 2 or more ESR DER
		Dispatchable DER Model	Consisting of Only Demand Side Resources (DSR) <ul style="list-style-type: none"> Aggregation must consist of 1 or more DSR DER No DER in the aggregation can inject into the grid, load reduction only
			Mix of Generators, Energy Storage Resources, and Demand Side Resources <ul style="list-style-type: none"> Aggregation must consist of 2 or more Resource Types (i.e. Generator, ESR, DSR) Capable of injection and/or load reduction
Non-Dispatchable	<h2>Individual Resource</h2> <ul style="list-style-type: none"> Can qualify to participate in Energy, Ancillary and Capacity market Capable of Injection Capable of responding in real-time to NYISO's direction 	Generator Model or Energy Storage Resource Model	Individual Generator or Energy Storage Resource Individual Generator or Energy Storage Resource under the responsibility of a Market Participant
		Special Case Resource Model	Special Case Resources (SCR) Individual Demand Side Resources or Small Customer Aggregation under the responsibility of a Responsible Interface Party (RIP) and are resources: <ul style="list-style-type: none"> Qualified to participate in Capacity market
		Emergency Demand Response Model	Emergency Demand Response Program (EDRP) Individual Demand Side Resources under the responsibility of a Curtailment Service Provider (CSP) and are resources: <ul style="list-style-type: none"> Qualified to provide Energy during reliability events

Aggregations, Participation Options

Resource Type	As Aggregations of:	As an Individual Energy Storage Resource	As an Individual Energy Limited Resource	As an Individual Gen	As an Individual Intermittent Power Resource
DSR	DER, SCR, EDRP	No	No	No	No
ESR	ESR	Yes	Yes	Yes	No
Wind	IPR (wind only)	No	No	No	Yes
Solar	IPR (solar only)	No	No	No	Yes
GTs	Gen (GTs only)	No	Yes	Yes	No
Other Gens	Gen	No	Yes	Yes	No
Mixed	DER	No	No	No	No

Note: All resources must individual qualify to be eligible to aggregate as an Aggregation of LESR, CLR, ELR
 Note: Generators with PURPA contracts, Limited Control Run of River Resources, Behind-the-Meter Net Generation Resources, Municipally-owned Generation, System Resources, and Control Area System Resources are not eligible to aggregate as an Aggregation

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NYISO's Approach to Transmission Nodes § 4.1.10.2

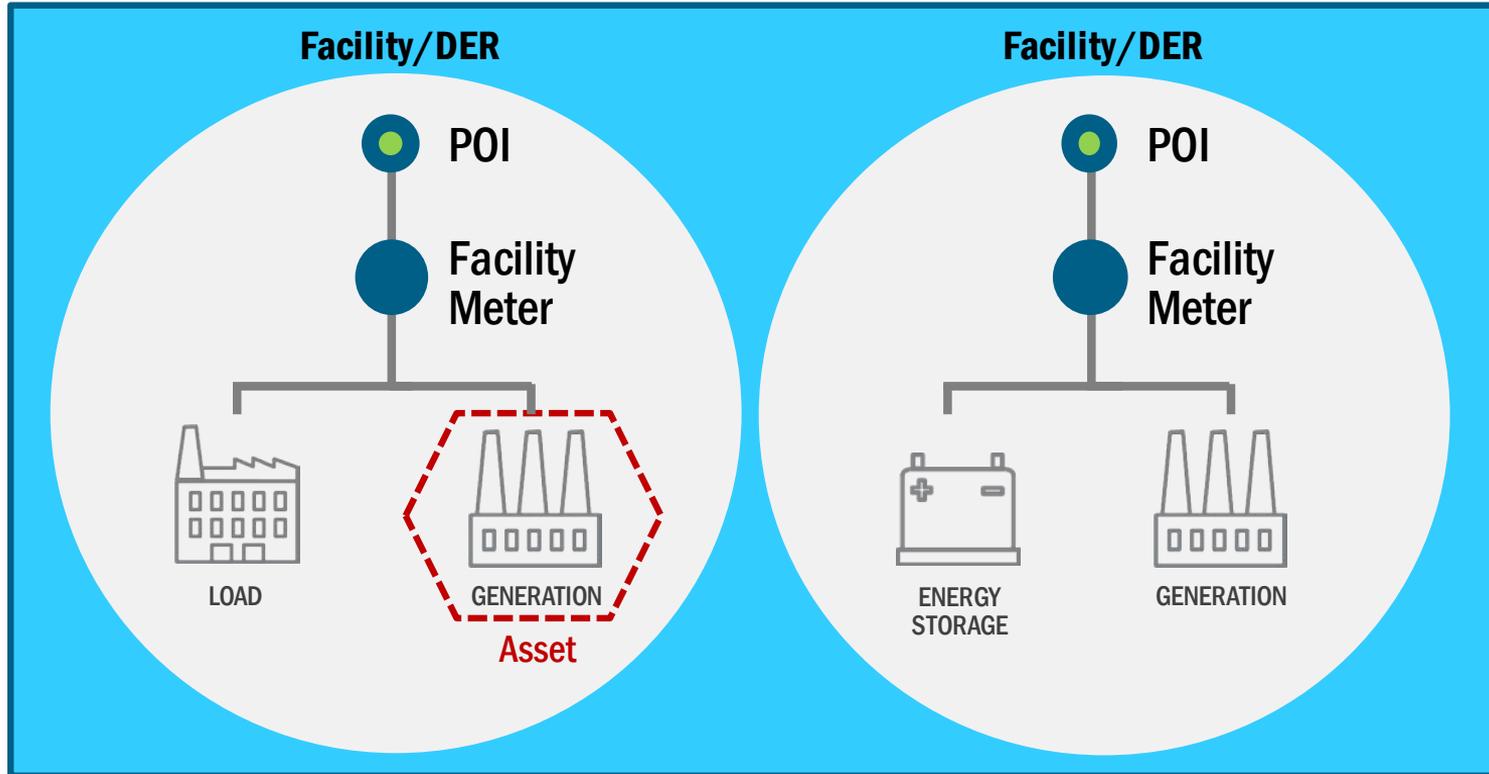
Terminology

- **Point of Interconnection (POI)** – Where the individual asset or facility/DER electrically interconnects to the distribution or transmission system
- **Transmission Node** – The virtual point at which the entire Aggregation will be modeled on the transmission system
 - Aggregation performance will be measured at the Transmission Node
 - The Transmission Node will be the “Transmission Bus” at which LBMP will be calculated
- **Resource Type** – includes Demand Side Resources, Energy Storage and Generation
- **Dispatchable** – a resource that is able to respond to real-time (i.e., at least 5-minute) dispatch signals

Terminology Overview

Aggregation

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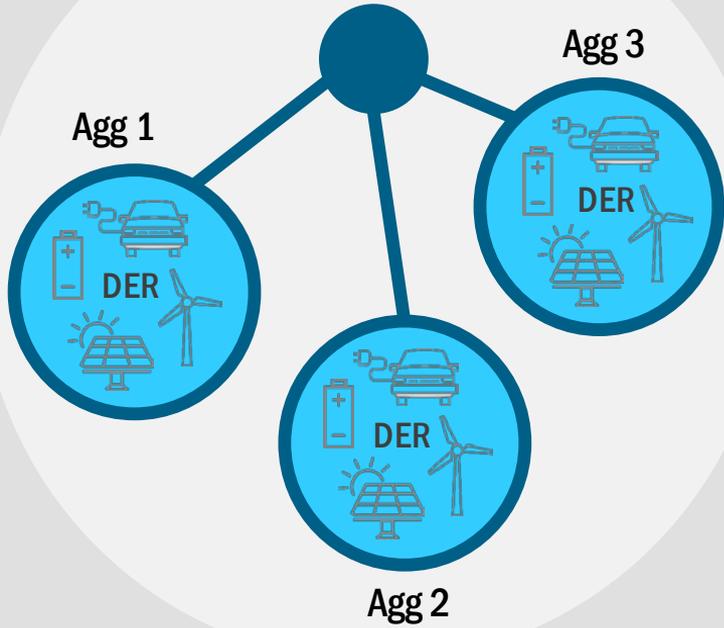
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NEW YORK
INDEPENDENT
SYSTEM OPERATOR

Zone

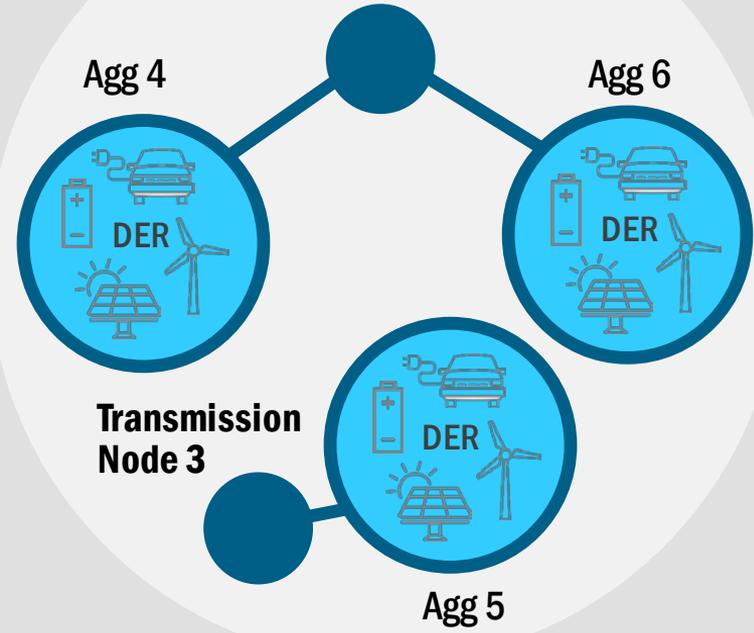
Subzone A

Transmission Node 1



Subzone B

Transmission Node 2



Transmission Node Background

- **Transmission Nodes reflect the collection of electrically similar facilities to which individual DER may aggregate as an Aggregation with a single PTID**
- **The DER Roadmap outlined the need to:**
 - Consider all Transmission Nodes that allow the NYISO to best represent DERs impact on the transmission system
 - Deliver more granular pricing data to incent efficient locational investment

Aggregations and Transmission Nodes

- **Aggregations grouped at a Transmission node allow NYISO to effectuate dispatch in a manner that both sends correct price signals and effectively relieve transmission constraints on the system**
 - This transmission node level granularity, instead of Load Zone level, will more effectively relieve transmission constraints thereby resulting in lower overall total production cost

NYISO Transmission Node Approach

- The NYISO considers individual DER to be small resources, often times distributed across multiple sites, often times connected to the Distribution system
- These individual DER would not normally have the ability to participate in NYISO Markets, when only taking into account their individual operating characteristics

Transmission Node Mechanics

- **The ISO shall establish the set of Transmission Nodes in the New York control Area**
 - All Transmission Nodes will be identified in ISO Procedures
- **Aggregators will work with Transmission Owners to determine which ISO identified Transmission Node, each individual DER/Facility electrically maps to**
 - Only DER/Facilities which map to the same Transmission Node may be aggregated together
- **Aggregators may enroll one or more Aggregations at a Transmission Node**

***See slides Appendix A for additional information**

Locational Requirements for all Aggregations

- **All resources within a Aggregation will be required to be electrically behind the same NYISO modeled Transmission Node**
 - The NYISO is working with utilities to identify the set of Transmission Nodes which will accurately reflect intra-zonal congestion
 - The NYISO will work with utilities to verify the resources modeled at the proper Transmission Nodes
 - See Appendix for additional details on the Transmission Nodes

DER Registration

§ 4.1.10.3

DER Registration

- Participants in any of the DER Aggregation participation options will have registration requirements similarly to the registration requirements of NYISO's reliability programs
- Participants will be required to register:
 - Themselves as Market Participants
 - Each of their individual resources (DER)
 - The ability of the aggregation to participate in the registered NYISO programs

DER/Aggregation Registration

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- **Aggregator will be required to register individual DER's parameters/unique operating characteristics, which will be a hybrid of existing Generator, ESR and Demand Response Parameters**
 - Matrix of required information for cumulative Aggregation values will be dependent on the characteristics of each individual DER, see appendix B for a list of parameters
- **An aggregator may register any number of Aggregations at a transmission node**
 - Transmission nodes will be unique to a single TO's subzone
 - A subzone may have multiple transmission nodes

Resources Changing Aggregations

- An Individual Resource may leave its current Aggregation and/or join a new Aggregation at the start of a calendar month. Registration of Resources that leave or join an Aggregation shall be completed in accordance with ISO Procedures. The ISO shall approve all valid Resource registrations before the Resource is allowed to participate in an Aggregation.
- Additional rules for ICAP Suppliers changing Aggregations are located in § 5.12.13.3.

Aggregation Metering

§ 4.1.10.4

Aggregation Telemetry, Approach

- DER Aggregations will have the ability to participate in NYISO markets as a single entity, similar to large scale units which participate in the markets today
- In order to maintain reliability and effectuate economic dispatch, it is crucial that the NYISO is able to do so in a manner that is in line with that of other units participating in the same products

Meter Services Entities

- The NYISO is working on a set of rules that will establish the qualification requirements and operating protocols for third party Meter Services Entities (§ 13)
 - Aggregators may use authorized Meter Services Entities to provide metering and telemetry services for wholesale market participation
- Meter Services Entities are intended to remove barriers and increase DER participation by offering Aggregators the option to procure metering services competitively
 - *Meter Service Entity Design Updates, ICAP Working Group, November 30th, 2018*
 - *<https://www.nyiso.com/documents/20142/3759319/DER%20Market%20Design%20-%20Meter%20Service%20Entity%20Design%20Updates.pdf/4ee326f7-5dfb-feeb-ae09-f17008dd3233>*

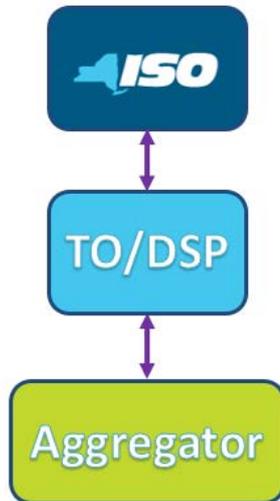
Real-Time Telemetry for Power System Operations: Communication Options

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- Existing rules require Generators to send data through the appropriate TO to the NYISO
 - DSASP Resources have the option of direct communication with the NYISO as the primary communication path
- There will be two options for DER communication of telemetry data:
 - Existing communication path through the TO to the NYISO; and
 - Simultaneously to the NYISO and TO
- For both options, the utility must receive the same telemetered values as the NYISO for the purposes of maintaining Interim Control Operations
 - Interim Control Operations are activated under emergency conditions when NYISO is not able to function and the Transmission Owners take over the system operation to maintain grid reliability. See section 8 of the Emergency Operations Manual for additional details

Options for Real-time Telemetry Data Communication Paths

Option 1 – Aggregator communicates only with DSP and DSP provides data to/from NYISO



Option 2 – Aggregator communicates with both DSP and NYISO in parallel



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Real-Time Telemetry & Settlement Data

- Similar to Generators participating in the NYISO markets today, the Aggregation will be required to send all telemetry signals for 24 hours of the day, 7 days a week if it is participating in the wholesale markets
 - This will be required regardless of dispatch schedule, for the independent signals for:
 - Aggregation aggregate signal, **and**;
 - Aggregation aggregate Injection, **and**;
 - Negative Generation (when an Aggregation eligible to withdraw Energy is dispatched to withdraw), **and**;
 - Aggregation aggregate Load Reduction
- The aggregator will need to measure the injection, **withdrawal** and the load reduction of all DER within the Aggregation, during dispatch
 - This will be done regardless of utilization of assets for meeting dispatch
 - This applies to both real-time telemetry and settlement data submission

Real-Time Telemetry & Settlement Data, con't

- The aggregator will substitute values of zero for the load-reduction response of all load reduction DER during intervals of non-dispatch by the NYISO
- The aggregator will send any non-zero injection response of all injecting DER during intervals of non-dispatch by the NYISO
 - This will ensure that the sub-zonal load calculations are accurate

Real-Time Telemetry Requirements for Power System Operations: 6-Second Scan Rate

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One of NYISO's responsibilities is maintaining the reliability of the New York Bulk Power System and timely information on market resource performance supports this mission. 6-second telemetry of resources participating in NYISO's market is crucial to effectively maintain the reliability of the grid.

- Real-time telemetry updated every 6 seconds provides essential two-way communication of operational data between market resources and NYISO
- NYISO relies on real-time telemetry for situational awareness necessary to balance supply and demand within the New York Control Area (NYCA), and to identify and respond to normal and abnormal conditions

Real-Time Telemetry Requirements for Power System Operations: 6-Second Scan Rate, cont'd

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- **NYISO currently requires 6-second scan rate for real-time telemetry for all market resources participating in NYISO's Energy and Ancillary Services Market[†] for the following reasons:**
 - **Situational Awareness**
 - 6-second telemetry is needed for NYISO to maintain situational awareness of the NYCA power system, especially during times of significant or unexpected grid events or changes
 - System operators must have an accurate understanding of the power system conditions at all times in order to make quick decisions and direct resources as needed to maintain reliability
 - **Automatic Generation Control**
 - 6-second telemetry is necessary for NYISO's Automatic Generation Control process to control market resources in order to maintain NYCA generation and load balance
 - NYISO's Automatic Generation Control process operates every 6 seconds and provides all market resources basepoints of their required operating level

(Continued on next slide)

[†]DADRP Resources are not required to have telemetry

Real-Time Telemetry Requirements for Power System Operations: 6-Second Scan Rate, cont'd

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- NYISO currently requires 6-second scan rate for real-time telemetry for all market resources participating in NYISO's Energy and Ancillary Services Market † for the following reasons (Continued from previous slide):
 - Reliability Compliance
 - 6-second telemetry is needed to meet mandatory bulk power system transmission operating reliability criteria, including criteria unique to New York State
 - New York State Reliability Council's D.1 reliability requirement ‡ requires bulk transmission facility overloads above Short Term Emergency (STE) rating be relieved within 5 minutes
 - To meet the New York State Reliability Council's requirement, NYISO requires 6-second telemetry of market resources to develop and quickly communicate the required schedules to the market resources
 - Emergency Response
 - Even though NYISO's Security Constrained Economic Dispatch (SCED) nominally operates on a five-minute period, NYISO will use SCED at any time to immediately respond to unexpected system events
 - NYISO requires 6-second telemetry from market resources to develop and quickly communicate the required schedules to the market resources and confirm that they are responding as required
 - NYISO will dispatch any available market resources, including energy-only resources, to respond to reliability events and resolve them timely

† DADRP Resources are not required to have telemetry

‡ NYSRC Reliability Rules & Compliance Manual: <http://www.nysrc.org/pdf/Reliability%20Rules%20Manuals/RRC%20Manual%20V41.pdf>

Real-Time Telemetry Requirements for Power System Operations: Scan Rate (Cont'd)

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- **NYISO will require 6-second scan rate for real-time telemetry for Aggregations**
 - DER Aggregations will have similar impacts on real-time grid operations as that of other market resources
 - Demand Side Resources participating as dispatchable DER will be seen as supply that is equivalent to traditional generation in the real-time grid operations and therefore requires the same treatment and visibility as generation resources
 - A critical aspect of DER integration is the ability to instruct all market resources, including Aggregations, to address reliability events such as providing relief on a overloaded transmission facility
 - NYISO will rely on Aggregations, like all dispatchable market resources, to satisfy the reliability requirements of the New York State Reliability Council
 - Aggregations will provide services comparable to generation resources for the purposes of real-time grid operations

6-Second Scan Rate Real-Time Telemetry Costs

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- **NYISO's evaluation has indicated that multiple cost effective technologies exist for providing 6-second scan rate for real-time telemetry and is not a barrier to entry**
 - NYISO's 6-second telemetry accuracy requirement of $\pm 5\%$ range is less stringent than the $\pm 0.2\%$ range for the settlement data → cost effective approaches could be used for telemetry
 - NYISO gives the flexibility to the aggregator (i.e., DER aggregator) to use cost effective technologies to acquire and transmit telemetry data between DER and aggregator
 - There is no significant cost difference between 6-second scan rate versus 1-minute scan rate for telemetry
 - NYISO's evaluation indicates that the 6-second telemetry between DER and aggregator for a 0.250 MW DER could be met with a cost \$1 per MWh/month
 - Based on one time metering device and installation cost of \$600 + optional secure gateway device and installation cost of \$1000; existing broadband internet connection and router; one time costs levelized over 5 years = \$26.70/month; monthly maintenance cost for the metering device and secure gateway of \$20.00/month → Total monthly costs = \$46.70/month; Based on 6 hour/day energy output → \$1.00 per MWh/month cost
- **Small DER in an Aggregation can utilize alternate telemetry approach to minimize the cost of providing 6-second scan rate for the real-time telemetry**

Revenue Data

- **Similar to Generators participating in the NYISO markets today, the Aggregation will be required to send all revenue grade meter files by noon* the next day following dispatch**
 - This will be required regardless of dispatch schedule, for the independent categories for:
 - Aggregation aggregate signal comprised of:
 - Aggregation aggregate Injection
 - **Aggregation aggregate Negative Generation**
 - Aggregation aggregate Load Reduction

*DER resources will be required to comply with all existing meter data management schedules and standards for generators and tie lines for submissions, revisions, and challenges. See section 3 of the Accounting and Billing Manual for details.

Reporting & Retention

■ Requirements:

- All data used in and for telemetry is subject to the same data retention requirements as traditionally metered resources *i.e.*, 6 years
- NYISO reserves the right to audit telemetry infrastructure and data to ensure compliance with NYISO requirements

Alternate Telemetry Approach

This alternate telemetry methodology could be utilized by small DER participating in an Aggregation

Alternative Telemetry Approach

- NYISO proposes to allow small DER participating in an Aggregation to provide real-time operational data for telemetry at a 6-second scan rate through an alternative method to directly metered methods *i.e.*, Traditional
- Alternative telemetry is the manner of deriving the status and output of a resource without a traditional meter on a six second basis.
- Alternative telemetry concepts the NYISO is aware of:
 - Representative devices of the responding resources *i.e.* thermostat
 - Use of status changes, communicated by exception, that indicate when the resource is output limited, derated to a specific range, or operating under a specific operating parameter
- **DER employing an alternative methodology for telemetry will be required to meet the same operational requirements as directly metered telemetry methods**
 - NYISO's existing telemetry requirements for all Generators (including Intermittent Power Resources, Energy Limited Resources, DSASP Resources) participating in NYISO's Energy Markets include:
 - 6-second (or faster) scan rate
 - Not to exceed 10-sec one-way latency (from the resource to NYISO or from NYISO to the resource)
 - Not to exceed 20-sec round-trip latency (from NYISO to resource and back to NYISO)
 - Not to exceed $\pm 5\%$ full-scale error

Alternative Telemetry Eligibility

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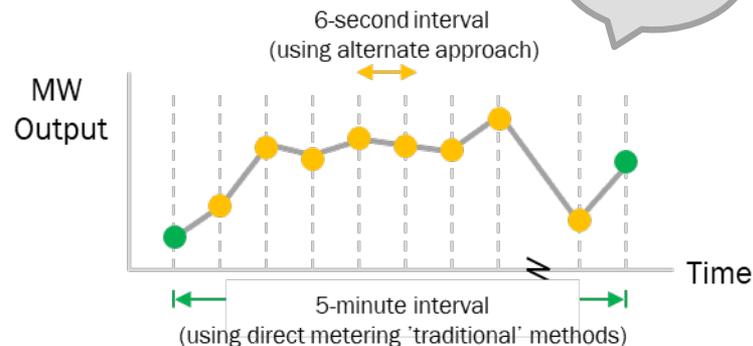
- This option for alternative telemetry will be limited to DER with a load reduction/max injection below 100 kW
 - DER below 100 kW cannot individually participate in NYISO wholesale markets and, because of their capability, their operating information must be aggregated by an aggregator
 - The NYISO is attempting to lower barriers to market entry for resources small enough where traditional telemetry solutions may not be cost-effective
- **Alternative telemetry methodologies must employ the status or measurement of a physical device**
 - ex. Thermostat
- **Alternative telemetry solutions must incorporate traditionally metered telemetry with a periodicity of 5 minutes or faster**
- **The use of alternative telemetry methodologies must be communicated to and approved by the NYISO before use by a DER**
- **Aggregation's electing to use alternative telemetry would be ineligible to offer Regulation Service**

Alternative Telemetry Requirements Recap

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Operational Requirements:

- For each DER within an Aggregation, the Aggregation is expected to have MW output data for that DER on a 6-second basis to generate its aggregate MW output values for telemetry to the NYISO
- Resource 6-second MW output values comprise:
 - Measurements through direct metering ('traditional') methods (e.g., CT/PT) from the resource with periodicity of 5 minutes or faster, and
 - Calculated values through an alternate approach to augment direct metered values as needed to produce operational data on a 6-second basis



Reporting Requirements:

- All data used to develop alternative telemetry is subject to the same data retention requirements as traditionally metered resources *i.e.*, 6 years
- NYISO reserves the right to audit and disapprove alternative telemetry schemes if found noncompliant with NYISO's telemetry requirements

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Aggregator Registration § 4.1.10.5

Aggregator Registration

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- **Aggregators will be required to**
 - Register as a Market Participant
 - Post collateral
 - Aggregators will be required to follow all existing market Collateral requirements for their Aggregations
 - Based on market products qualified and enrolled in

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Scheduling & Pricing

§ 4.2.6 and 4.4.2.3

Scheduling & Pricing, Approach

- DER Aggregations will be scheduled consistent with their bids and capabilities, consistent with the treatment of other units participating in NYISO markets
- DER Aggregations will be eligible to set prices for the programs/participation models in which they are Scheduled & Dispatched
- Day-Ahead and Real-Time LBMPs will be calculated at the Transmission Node

Energy Bids by Suppliers

§ 4.2.1.3.1, 4.2.1.4 and 4.4.1.2

Energy Balancing with Generation

10/9
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- Aggregators will be allowed to balance individual DER response within the Aggregation to achieve Aggregation dispatch
- Example:
 - Aggregation contains one 5 MW ESR and one 4 MW generator
 - Aggregation bids in and is scheduled to charge 1 MW
 - The ESR charges at 5 MW while running its generator at 4 MW
 - Aggregation response = -5 MW of ESR + 4 MW of injection = - 1 MW
 - The Aggregation would be invoiced for 1 MW of Energy withdrawals from the wholesale market

Energy Balancing with Load Reduction

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- Load Reduction DER within an Aggregation may provide balancing within the Aggregation if the Real-time LBMP is greater than the Net Benefits Test (NBT) threshold price
 - Aggregation contains one 5 MW ESR and 4 MW of load reduction
 - Aggregation bids to charge 1 MW at \$25
 - NBT is \$22; LBMP is \$29
 - Aggregation is scheduled to charge 1 MW
 - The ESR charges at 5 MW while the Aggregation is providing 4 MW of load reduction
 - Aggregation response = -5MW of ESR + 4 MW of load reduction = -1 MW
 - Aggregation is invoiced for 1 MW at LBMP

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Energy Balancing with Load Reduction, con't

- If the NBT threshold price is less than the Real-time LBMP, Load Reduction DER within a Aggregation will not be permitted to provide balancing within the Aggregation
- Example:
 - Aggregation contains one 5 MW ESR and 4 MW of load reduction
 - Aggregation bids to charge 1 MW at \$25
 - NBT is \$35; LBMP is \$29
 - Aggregation is scheduled to charge 1 MW
 - The ESR charges at 5 MW while the Aggregation is providing 4 MW of load reduction
 - Aggregation response = -5MW of ESR + 4 MW of load reduction = -1 MW
 - Load Reduction component of Aggregation response is not credited to the Aggregation because Real-time LBMP was below the NBT threshold price; Aggregation is invoiced for all 5 MW of Energy withdrawals
- Aggregation may also be penalized for failing to follow dispatch instructions (i.e., over-withdrawal charges)

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Energy Balanced Bids

- A Supplier's Bid for an Aggregation may comprise Energy supply and Energy withdrawals if the Aggregation contains at least one Withdrawal-Eligible Generator
- When the Bid for the Aggregation comprises both supply and withdrawals, each point of the Bid curve shall reflect the net offer, such that the net supply or withdrawal value is submitted

Aggregation & Ancillary Services

- **Aggregations will be eligible to supply the Ancillary Service Products for which all DER within the Aggregation are eligible to supply**
 - Example 1: An Aggregation would be eligible to supply Regulation only if all DER in the Aggregation are eligible to supply Regulation
 - Example 2: If one resource in the Aggregation is only eligible to supply 30 Minute Non-Synchronous Reserves, the entire Aggregation is only eligible to supply 30 Minute Non-Synchronous Reserves

Aggregation & Ancillary Services, con't

- Aggregations will be dispatch only and the NYISO will only have the real-time visibility of the operating state of the entire Aggregation as a whole
 - NYISO will not have real-time visibility to the operating status of individual DER
- Compliance with Northeast Power Coordinating Council standard requires that synchronous reserves can only be awarded to resources that are synchronized to the electric grid¹
- Aggregations containing generator-based DER will only be eligible to provide Non-Synchronous Operating Reserves because the NYISO will not know real-time visibility of the grid synchronization operating state of the individual generator-based DER within the Aggregation

¹NPCC Glossary of Terms: <https://www.npcc.org/Standards/Directories/Glossary%2020171103.pdf>

Next Steps

- Continue Review of Tariff (2/6)

Feedback?

- Email additional feedback to:
DER_Feedback@nyiso.com



Don't forget the underscore

Appendix A: Transmission Nodes

Transmission Nodes - Identification

Transmission Node Background

- **Transmission Nodes reflect the collection of electrically similar facilities to which individual DER may aggregate as an Aggregation with a single PTID**
- **The DER Roadmap outlined the need to:**
 - Consider all Transmission Nodes that allow the NYISO to best represent DERs impact on the transmission system
 - Deliver more granular pricing data to incent efficient locational investment

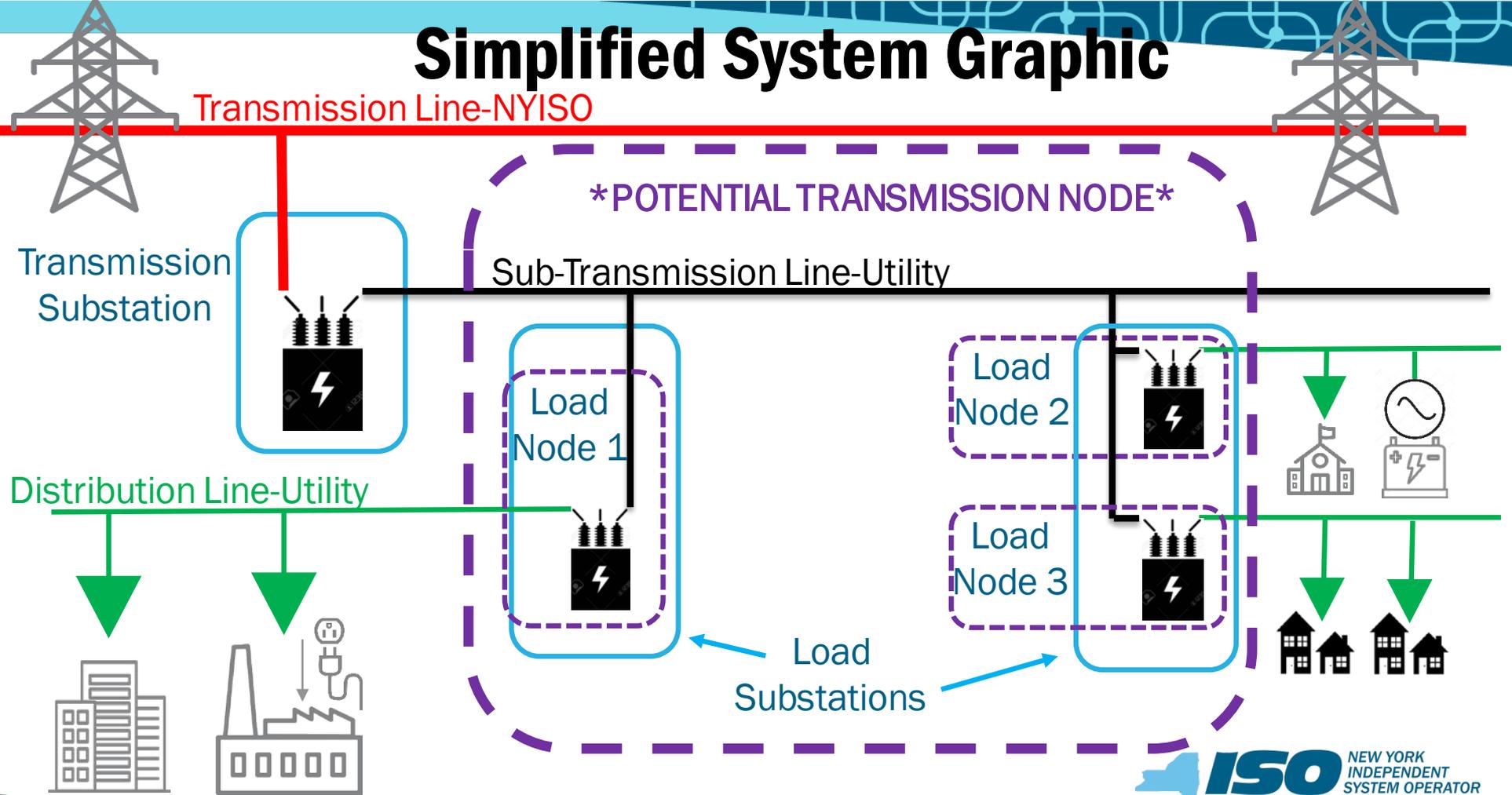
Transmission Node Pricing and DER Mapping

- **Transmission Nodes will be priced individually, similar to generator nodes**
- **Transmission Node pricing will be calculated using the same LBMP calculation today:**
 - $\text{LBMP} = \text{Marginal Energy} + \text{Transmission Congestion} - \text{Losses}$
- **Transmission Nodes are for the purpose of wholesale market participation**
 - The NYISO proposes to coordinate with the local distribution utility to manage any distribution level constraints in the process of identifying the electrical bounds of each Transmission Node

Load Nodes

- **Load Nodes provide the most detail to the NYISO model**
 - Load nodes are associated with distribution stepdown transformers at facilities below the transmission level NYISO currently secures
- **While below a kV level that NYISO currently secures, DER interconnected at Load Nodes will face congestion and loss characteristics reflective of the transmission facilities that feed the load**
- **Load Nodes can be “mapped” up to the transmission system, but vary in paths based on the particular distribution owner service territory**

Simplified System Graphic

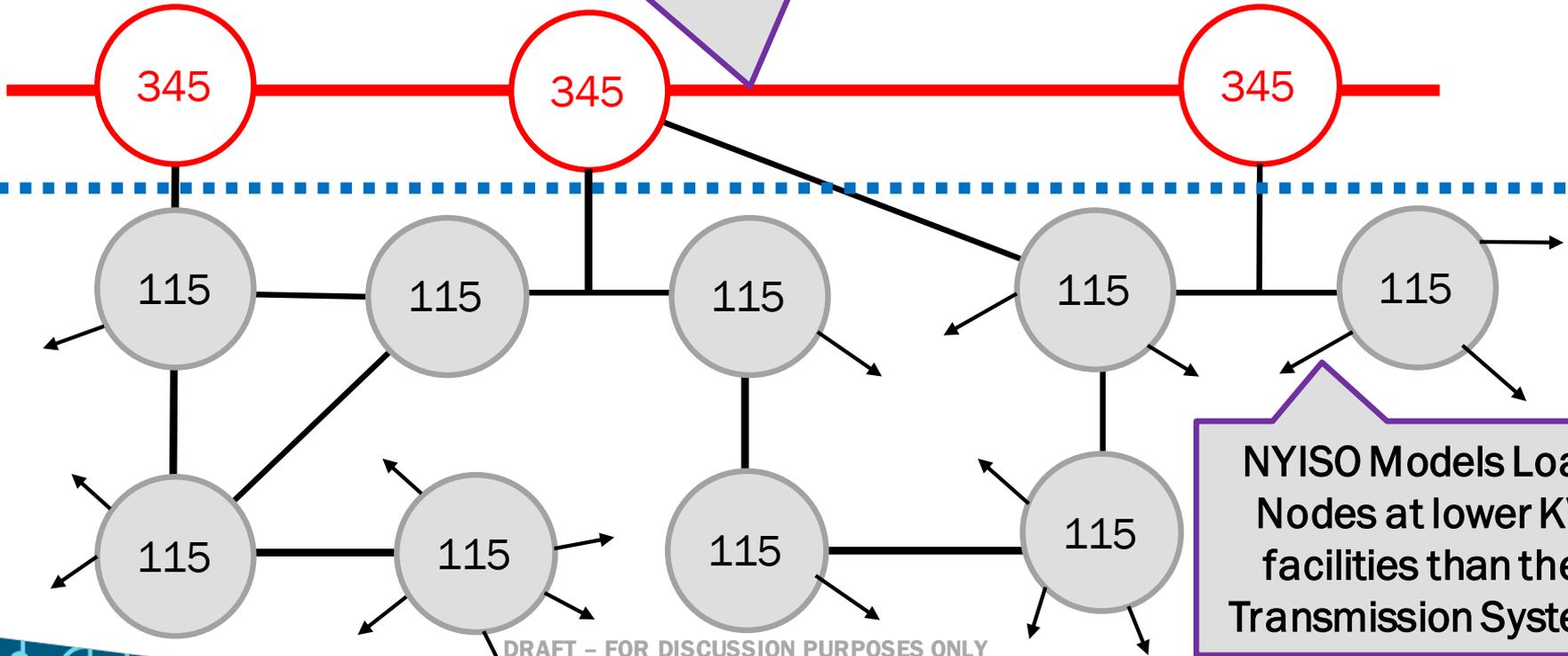


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Network Example

NYISO Secures the Transmission System

KV = Substation



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NYISO Process

- The NYISO will utilize a tiered evaluation of Load Nodes used by the NYISO and the Utilities to define each Transmission Node
- The NYISO will identify all substations with an associated Load Node and to which the NYISO has visibility shall be evaluated to be a potential Transmission Node
 - The NYISO will identify radially bused substations as instances where substations may be grouped as a single Transmission Node
- NYISO will additionally identify the step-down interfaces from the bulk electric system
 - These interfaces will indicate the minimum Transmission Nodes needed to represent bulk transmission conditions within each zone

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NYISO Process, cont'd

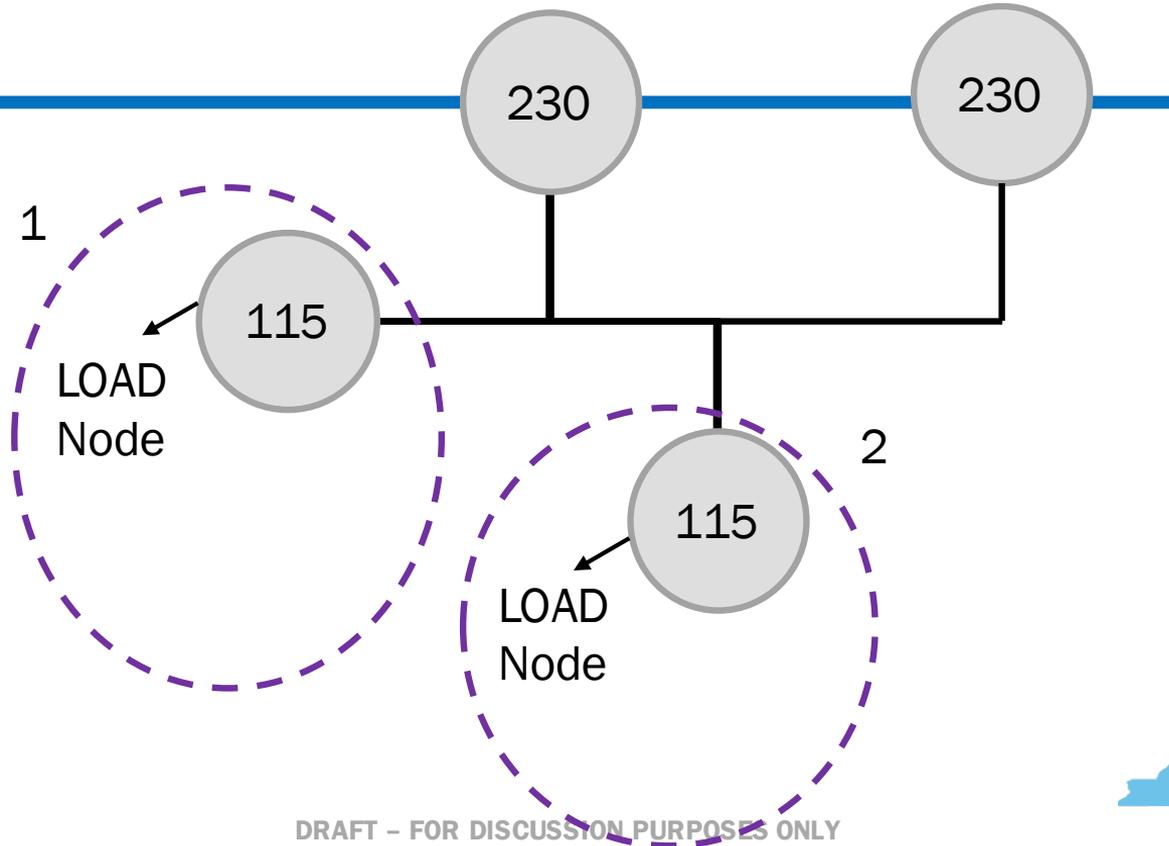
- In the final step, the NYISO and the Utilities will identify distribution facilities on the distribution system that may be negatively impacted if DER aggregations are dispatched as a single PTID across such facilities
 - These constraining distribution facilities might be:
 - Normally open circuits
 - Line overload potentials
 - Franchise demarcations
 - Once identified, distribution constraints will delineate the electrical bounds of either an expanded or constricted Transmission Node
- No interfaces identified in the 100+ kV project may be grouped with other Load substations in a Transmission Node
- Transmission Nodes will be Utility and Sub-Zone specific

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Transmission Nodes - NYISO Review of Load Nodes

Default Case: 2 Transmission Nodes

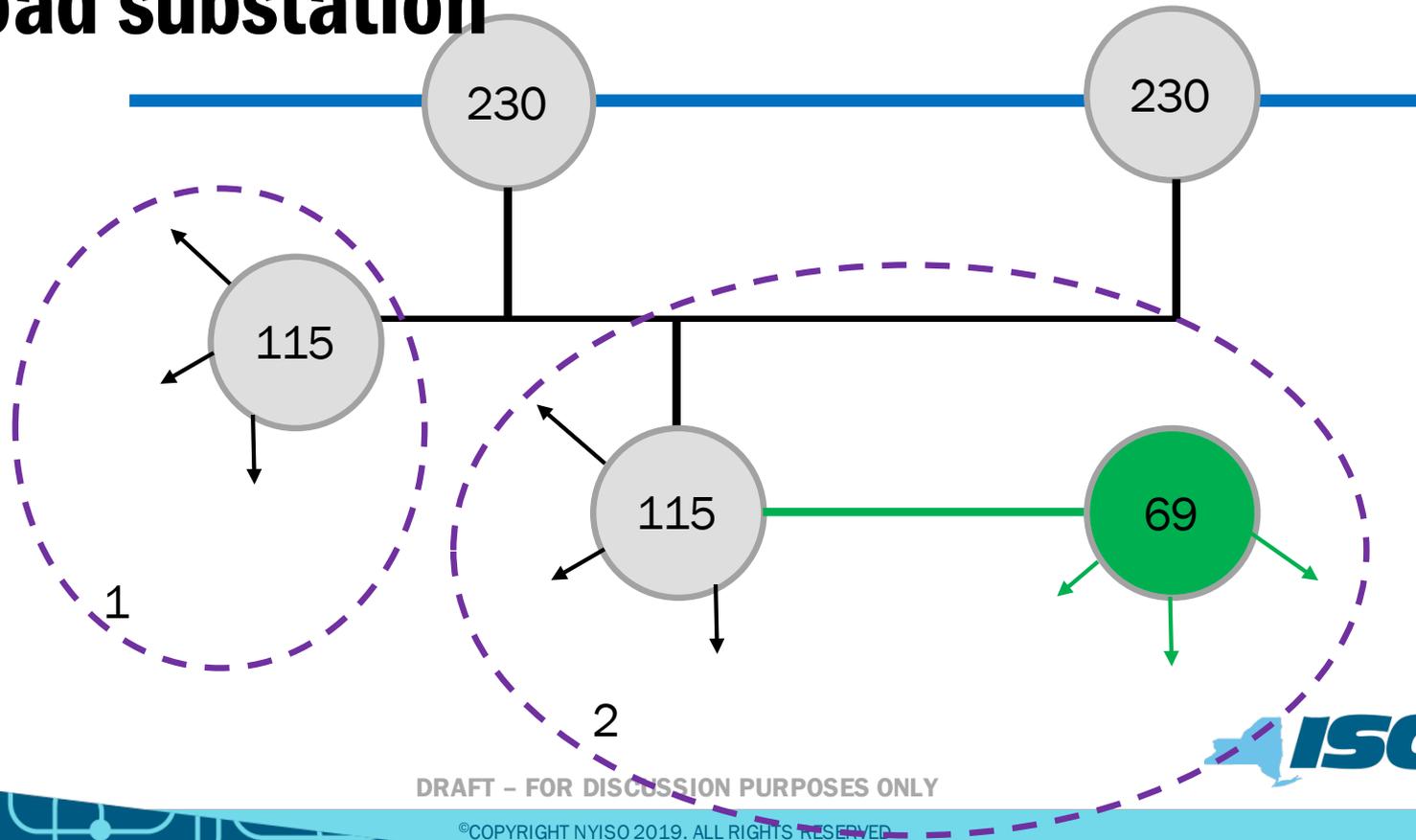


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Transmission Node serving more than one Load substation

- **Transmission Nodes may serve multiple Load substations when one Load substation is fed radially by another**
 - When two Load substations radially connect to the same transmission substation there is no difference in transmission congestion between the 2 Load substations
 - Therefore, the NYISO will initially propose a Transmission Node that comprises both Load substations together

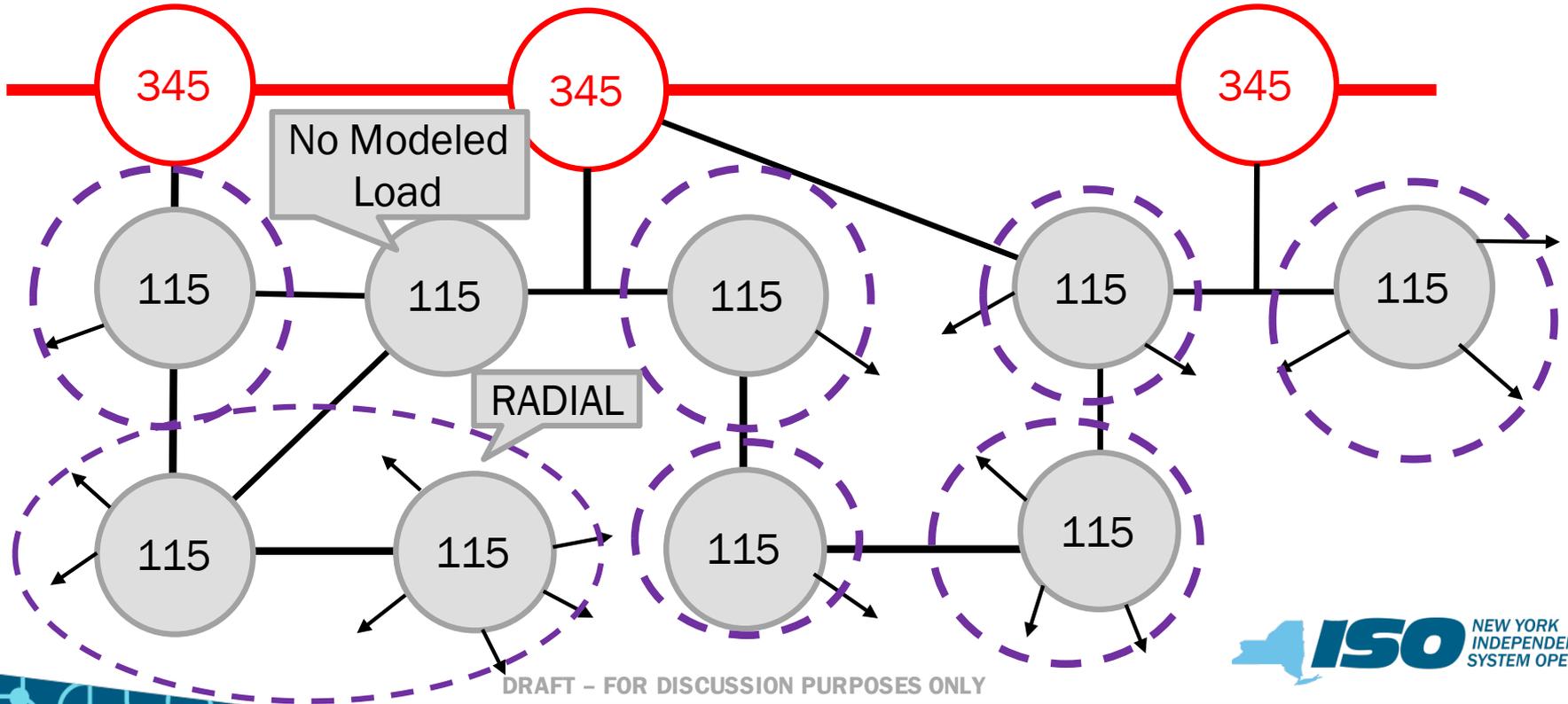
Transmission Node Including more than one Load substation



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NYISO Initial Review

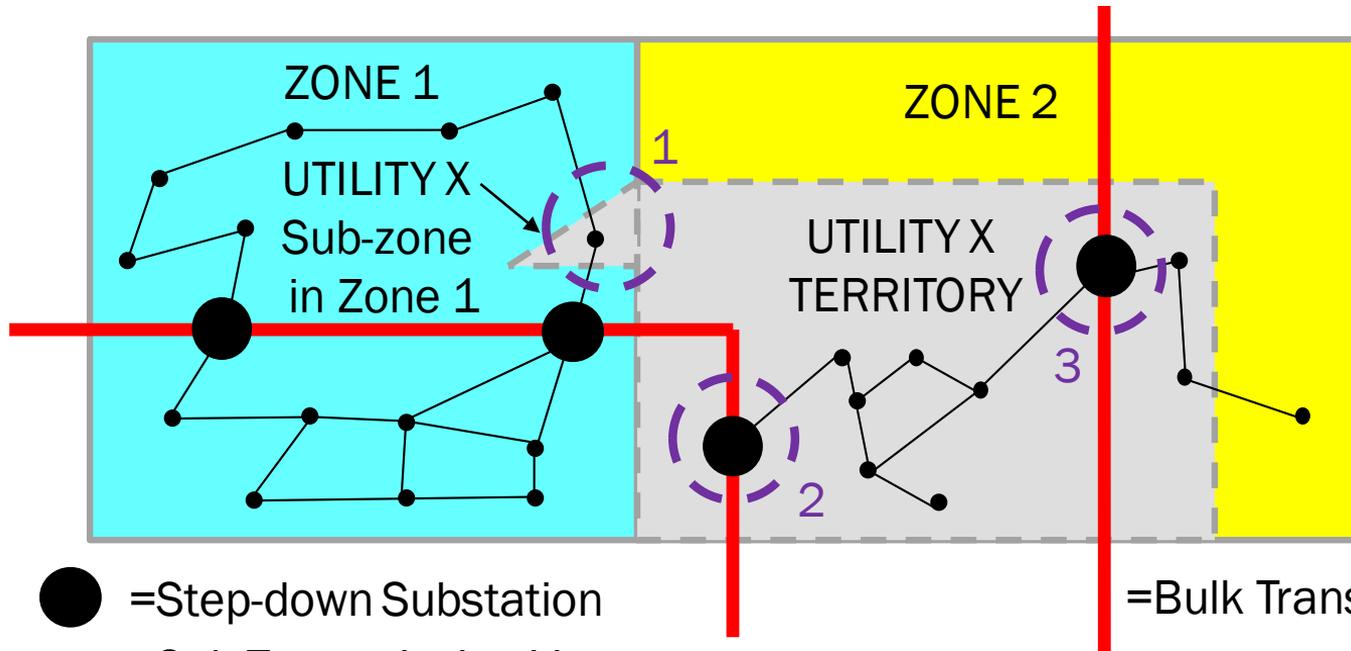


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Minimum Nodes for each Zone

- NYISO intends to develop at least one Transmission Node per sub-zone
- Additionally there will be at least one Transmission Node per step-down interface from the bulk transmission system to distribution lines under Utility jurisdiction

Minimum Nodes for each Zone



UTILITY X will have a minimum of 3 Transmission Nodes

- = Step-down Substation
- = Sub-Transmission Line
- = Load Substation

= Bulk Transmission Line

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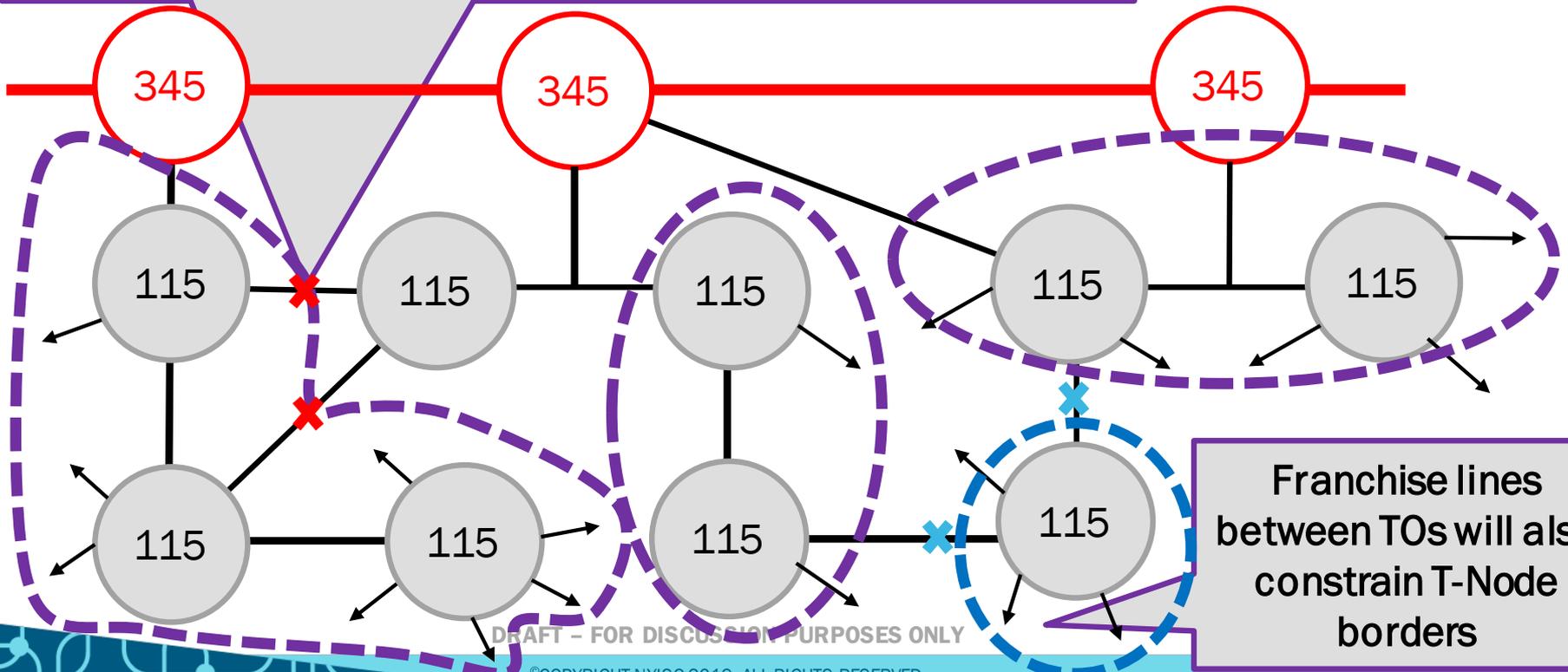
Transmission Nodes - Utility Review of Load Nodes

Utility Review of the Transmission Nodes

- **The applicable utility will identify the distribution facilities that DER should not aggregate across**
 - These facilities will be classified as a distribution constraint
 - Examples of constraints are: thermal overload potentials, franchise demarcations, and normally open circuits
- **The distribution constraints will delineate the circuits that can be considered electrically similar**
 - System sectionalization between Load Nodes at voltages lower than NYISO modeled Load Substations may necessitate multiple Transmission Nodes at a Load Substation
 - Multiple Load Substations can be considered electrically similar and may be combined into a single Transmission Node if no constraints are present between facilities

Potential Transmission Nodes after Utility Review

The potential for an overload between two 115 kV substations would prohibit DER to aggregate across the constraint



Franchise lines between TOs will also constrain T-Node borders

Transmission Nodes - Mechanics

Splitting Transmission Nodes

- **Proliferation of DER has the potential to disrupt the current models for power flow on the Distribution System**
 - Circuits that can be considered electrically similar today, may diverge with increased wholesale dispatch of aggregated DER or a change in load shapes
- **A new operational distribution constraint may arise within the circuits of a single Transmission Node that is then aggravated by wholesale dispatch**
 - Issues that appear chronically, suggest that the Transmission Node at issue, would be best modeled as two or more discrete Transmission Nodes

Changes to the List Transmission Nodes

- The initial list of Transmission Nodes created for the deployment of the DER participation model may be reviewed for potential changes:
 - Prior to a planned, permanent change to the system topology
 - A new Load Substation may require a new Transmission Node
 - The relief of a previously binding distribution constraint may allow DER to aggregate within a larger circuit
 - As requested by the NYISO or the applicable Utility
 - Chronic out of market actions related to the re-dispatch of DER at a Transmission Node may indicate a need to review Transmission Node boundaries

Transmission Node Mechanics

- **A Transmission Node will be priced similarly to a Generator Node today**
 - All Aggregations mapped to the same Transmission Node will receive the same prices
 - Aggregations will be able to set price
- **There will be no external Transmission Nodes**

Transmission Node Overview

Transmission Node Overview

- **ISO identified Transmission nodes are dynamic and may change over time**
 - Based on changing topography/price separation
- **The ISO shall review these changes on an annual basis and update, if needed**
 - Addition/Removal/Merging of Transmission Nodes will take effect at the beginning of a Capability Year
- **The Aggregator is responsible for notifying the ISO of the Aggregations in their portfolio which will be affected by these Transmission Node updates**

Appendix B: Registration and Bidding Parameters for DER Facilities and Aggregations

Sample DER Facility Registration Parameters

DER	Category	Name
DER Facility	Registration	Facility Name
DER Facility	Registration	TO Account #, TO, TO Voltage Level
DER Facility	Registration	Physical address, Street, City, Zip (match utility bill)
DER Facility	Registration	Transmission Node
DER Facility	Registration	Zone
DER Facility	Registration	Facility Contact
DER Facility	Registration	Maximum MW injection limit
DER Facility	Registration	Maximum MW generation capability
DER Facility	Registration	Maximum MW load reduction capability
DER Facility	Registration	Maximum MW storage capability
DER Facility	Registration	DMNC/DMGC
DER Facility	Registration	Meter Authority
DER Facility	Registration	Metering configuration (net facility only or direct metering), Meter Device, Serial #, Manufacturer, Model #, Accuracy
DER Facility	Registration	Telemetry Configuration (Alternative Telemetry/Real)
DER Facility	Registration	Interconnection Agreement (Yes/No/Not Applicable)
DER Facility	Registration	CRIS
DER Facility	Registration	Facility One-Line Diagram
DER Facility	Registration	DER Type : Injection, Load Reduction, Both
DER Facility	Registration	DER Asset type(s): Generator, Energy Storage, Curtailable Load, Hybrid (two or more of the other Asset types)
DER Facility	Registration	Generator Fuel Type
DER Facility	Registration	Nameplate Capacity
DER Facility	Registration	Asset kW Rating
DER Facility	Registration	Asset kW HR Rating
DER Facility	Registration	Asset Fuel Type
DER Facility	Registration	Emissions Compliance (Details of any environmental permit if applicable, otherwise Y/N)
DER Facility	Registration	Estimated DER Facility Host Load

Sample DER Aggregation Registration/Bid Parameters

DER	Category	Name
Aggregation	Registration	Maximum Run Time
Aggregation	Registration	Estimated Summer Operating Capacity
Aggregation	Registration	Estimated Winter Operating Capacity
Aggregation	Registration	Authorization Flag - Fixed Energy
Aggregation	Registration	Authorization Flag - Dispatch Energy
Aggregation	Registration	Authorization Flag - 10 Minute Spinning Reserves
Aggregation	Registration	Authorization Flag - 10 Minute Non-Synchronized Reserves
Aggregation	Registration	Authorization Flag - 30 Minute Non-Synchronized Reserves
Aggregation	Registration	Total Number of DER
Aggregation	Registration	ICCP Communication Installed
Aggregation	Registration	Target Commercial Operation Date
Aggregation	Registration	Communication and Data Management Plan
Aggregation	Registration/Bid	Emergency Response Rate
Aggregation	Registration/Bid	Regulation Capacity Response Rate
Aggregation	Registration/Bid	Normal Response Rate 1
Aggregation	Registration/Bid	Normal Response Rate 1
Aggregation	Registration/Bid	Normal Response Rate 2
Aggregation	Registration/Bid	Normal Response Rate 2
Aggregation	Registration/Bid	Normal Response Rate 3

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Sample DER Aggregation Parameters

DER	Category	Name
Aggregation	Bid	Market – DAM/RT
Aggregation	Bid	Date/Time (including each hour being offered)
Aggregation	Bid	Upper Operating Limit (MW)
Aggregation	Bid	Lower Operating Limit (MW)
Aggregation	Bid	Emergency Upper Operating Limit (MW)
Aggregation	Bid	Operating Mode: Self Committed Fixed and Self Committed Flex
Aggregation	Bid	Self Scheduled MW – 15 minute MW schedule values
Aggregation	Bid	Bid Curve (MW/\$ per MW) – up to 11 point curve for positive supply and negative generation representing the incremental cost
Aggregation	Bid	Fuel Type (optional)
Aggregation	Bid	Burdened Fuel Price (\$/mmBTU, optional)
Aggregation	Bid	10 Minute Spinning Reserves (\$/MW) - single \$ cost value (DAM only)
Aggregation	Bid	10 Minute Non-Synchronized Reserves (\$/MW) – single \$ cost value (DAM only)
Aggregation	Bid	30 Minute Spinning Reserves (\$/MW) – single \$ cost value (DAM only)
Aggregation	Bid	30 Minute Non-Synchronized Reserves (\$/MW) – single \$ cost value (DAM only)
Aggregation	Bid	Regulation Movement (\$/MW) – single \$ cost value (DAM & RTM)
Aggregation	Bid	Regulation Capacity (MW and \$/MW) – both the MW amount and single \$ cost value (DAM & RTM)
Aggregation	Bid	Unit Operation Offer Options
Aggregation	Bid	Fuel Type
Aggregation	Bid	Opportunity Cost

The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefits to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policy makers, stakeholders and investors in the power system



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