Moving from Standards Development to Field Implementation: A Case Study of a Regional Demonstration Project

Pacific Northwest Smart Grid Demonstration Project Interoperability Working Group

November 2011

Agenda

- Project Interoperability Goals
- Standards WG Objectives & Process
- TIS/TFS Process and Results
- Output Standards Process and Results
- Input Standards process and Results
- Lessons Learned and Recommendations

Project Interoperability Goals

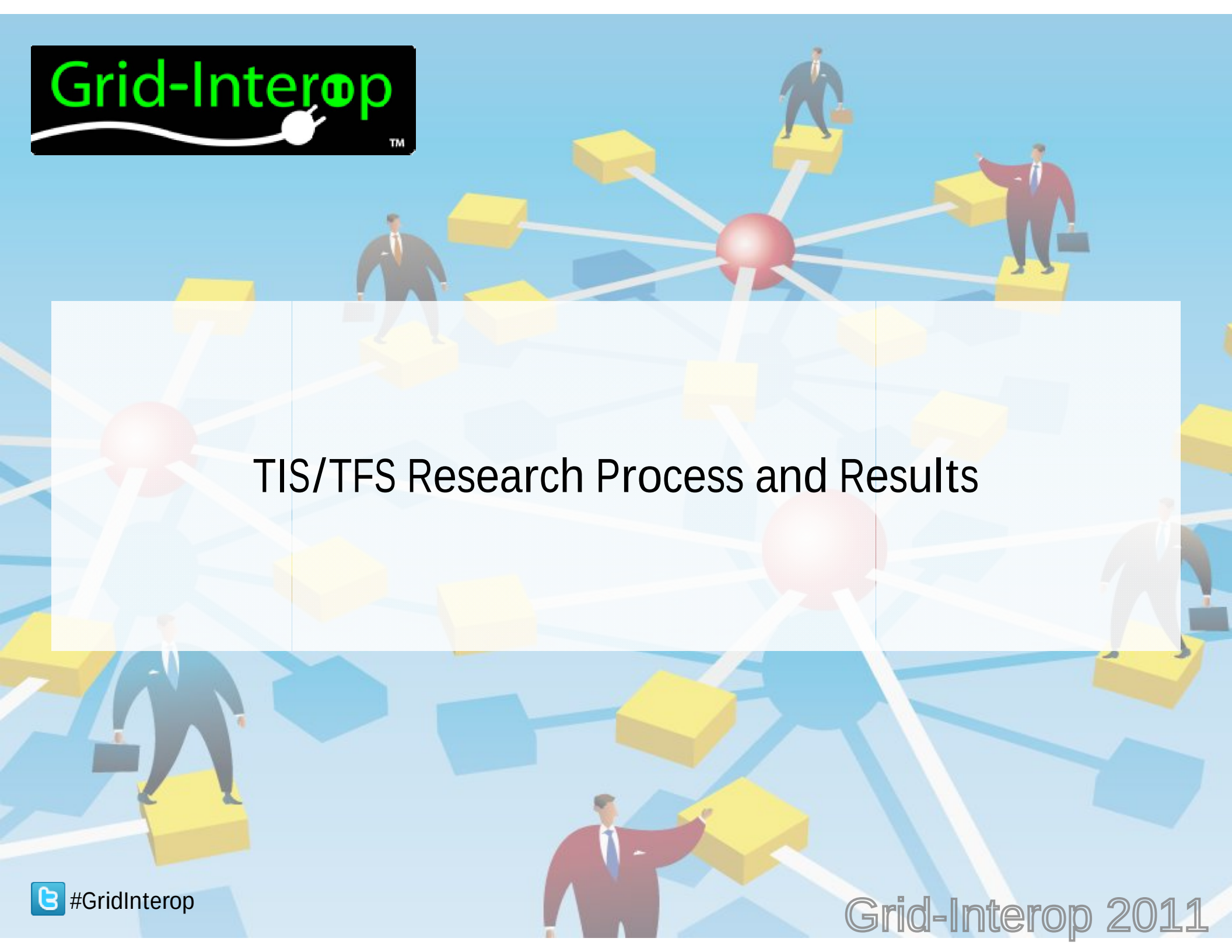
- *"Advance standards for 'interoperability' (the smooth, seamless integration of all elements of the electric system) and cyber security approaches"*
- *"Interoperability will be addressed at the points of interface between the systems and will draw from and contribute to the current NIST smart grid interoperability standards activities…"*
- *"…defining real-time pricing signal standards and further definition of transactive control"*

Working Group Objectives

- Investigate the potential for incorporating appropriate Smart Grid interoperability standards into the PNW Project technology
- Create a knowledge base of existing standards that are relevant to PNW Project…
- Recommend appropriate standards for the PNW Project technology design
- In cases where no standards exist or they are inadequate, adapt/merge/modify or help create where needed
- Provide feedback to the Standard Setting Organizations where shortcomings are observed and suggest changes based on the Project experience
- Assist Project Utility Partners in understanding which standards relate to their demonstration projects and how to make use of them

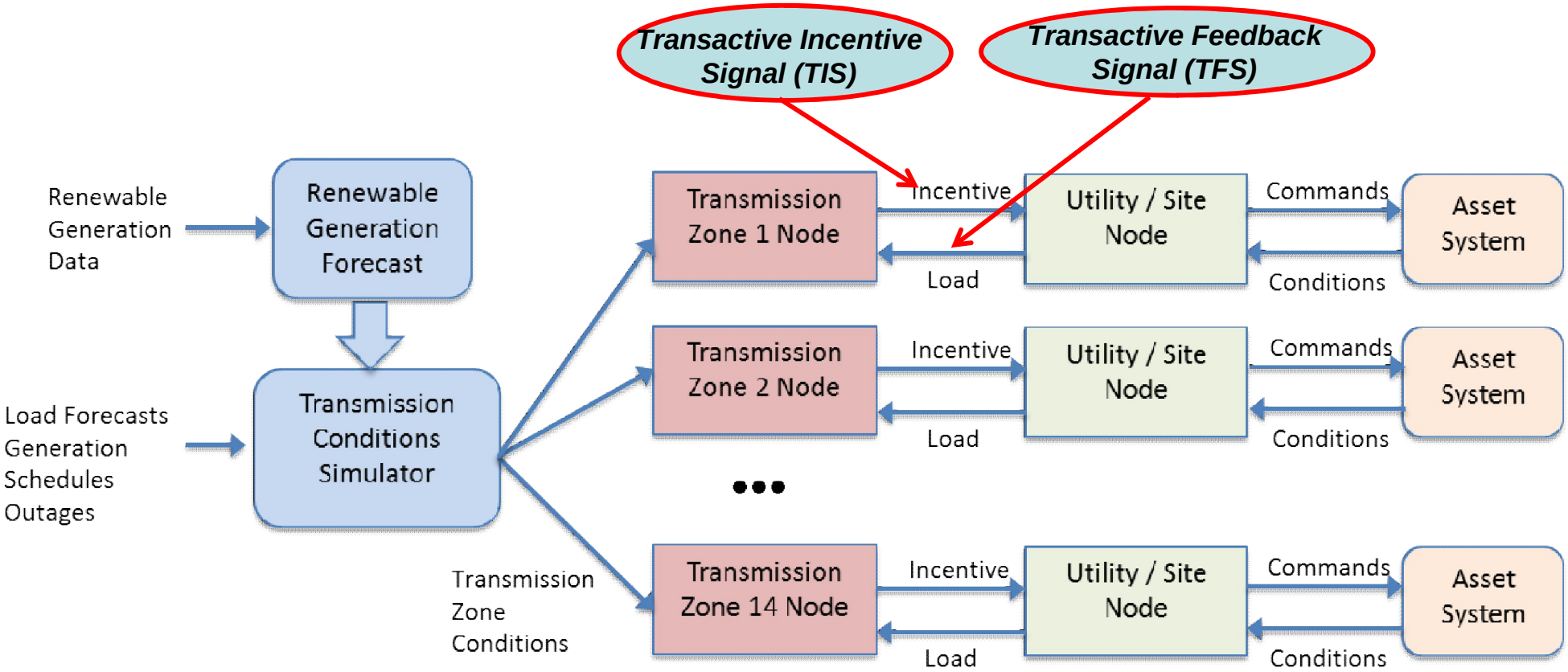
Standards Research Processes

- Start with the NIST recommended standards in the V1.0 Smart Grid Standards Framework and Roadmap and Draft V2.0
- The Work Group has to date experimented with three distinct methodologies:
  - TIS/TFS: detailed analysis of relevant standards and recommendation to the Design team
  - Transactive Node output formats to control of responsive assets: survey of the utility partners
  - TIS/TFS input standards for data to be used in computing the signals: review of applicable standards with input from utilities and the Bonneville Power Administration



TIS/TFS Research Process and Results

PNW Demonstration Project Interface



Transactive Signal Interfaces between Participants

Responsive Asset Classes

Asset Classes	TIS/TFS	Distributed Generation	Distributed Storage	Consumer Portal	Smart Meter/ AMI	Smart Appliances	Programmable Thermostat	Demand Response Unit: Load Control Module	PHEV/ EV	Comm/ Industrial DR	Smart Transformers/ Fault Indicators	IVVC, CVR, VO/ Voltage Regulators	Microgrid Control
Utility 1	X	X		X	X		X			X	X	X	
Utility 2	X	X	X									X	X
Utility 3	X	X											
Utility 4	X			X	X	X		X					
Utility 5	X		X	X	X		X		X	X		X	X
Utility 6	X	X	X					X				X	
Utility 7	X				X			X		X		X	
Utility 8	X			X	X		X	X				X	X
Utility 9	X							X				X	
Utility 10	X	X	X		X					X			X
Utility 11	X	X	X	X	X					X			X

TIS/TFS Research Process

- Standards identified in the NIST Framework and Roadmap V1.0
- Expanded to include standards being considered for inclusion in the Roadmap and SGIP
- SGIP Priority Action Plans (PAPs), especially PAP 3 (price), PAP 4 (scheduling), and PAP 9 (DR, DER, markets)
- Determine if there were standards the Project should borrow from

TIS/TFS Research Process

- *Supporting Standard Documentation:* standard reference documents
- *Status of the Standard:*
  - Has it been formally adopted?
  - What version is the current one?
  - Is there a formal certification program in operation?
  - Are there products certified or in development?
  - Estimated schedule for completion and availability of vendor products?
- *How is the standard relevant to the PNW Demo Project?*
  - Which aspects of the Project's technology could be satisfied in whole or part using this standard?
  - What benefits would it have over custom-developed solutions?

TIS/TFS Research process

- *Detailed background:* overview of the standard and specific parts most relevant to the Project
  - What does the standard do?
  - Why this standard versus other standards that address the same interfaces or functionality?
  - If specific parts or components of the standard are most relevant, why?
- *Additional details for design team decisions:* details that allow the design team to make a decision
  - Are commercial test tools and test suites available to support adoption?
  - What changes do the standards imply to initial Project design concepts and specifications?
- *Summary of observations and recommendations*

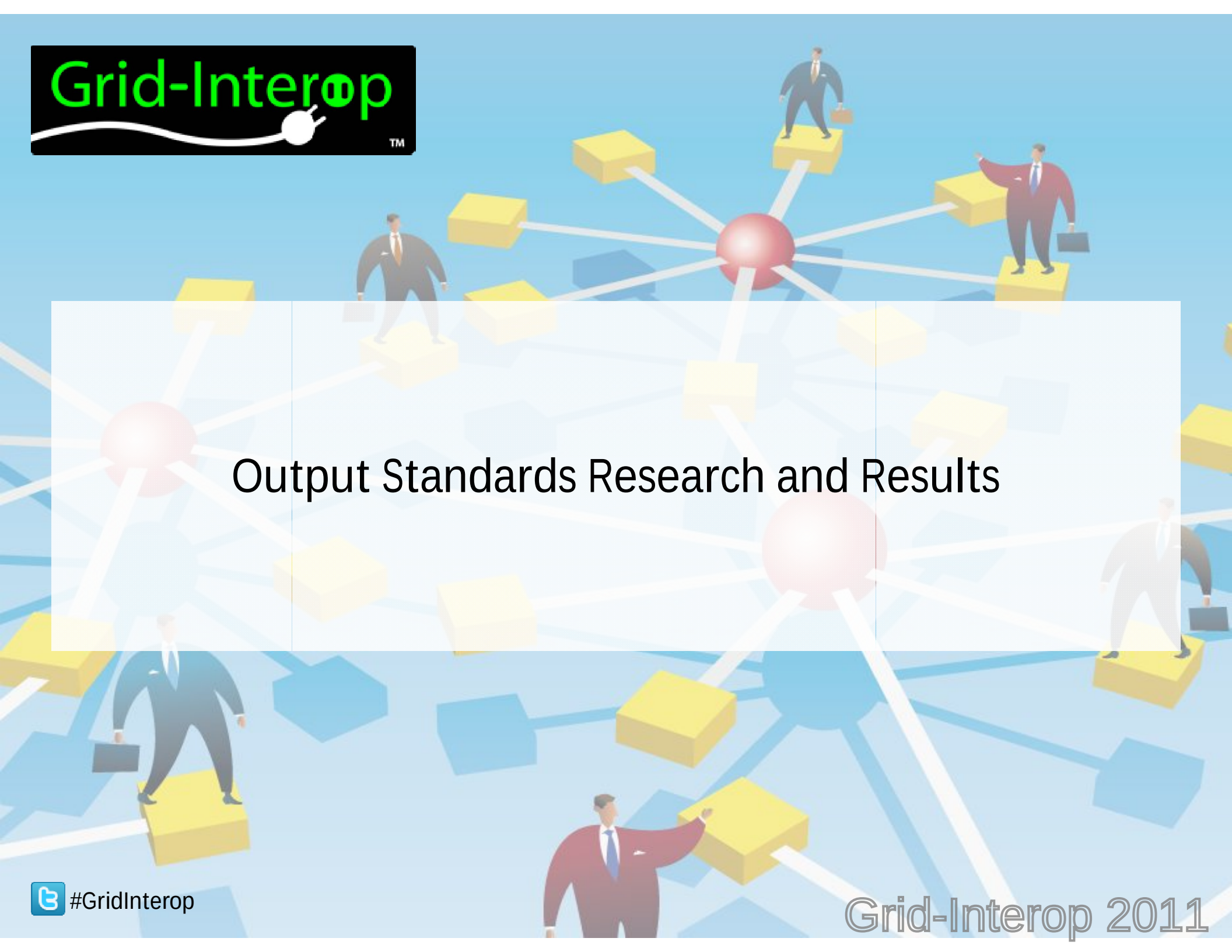
TIS/TFS Research Results

Requirement/ Interface	Standard	Status
TIS/TFS Fields Syntax, Semantics	eMIX V1.0	Recommended to design
TIS/TFS Fields Syntax, Semantics	SEP 2.0	Review again for RC2 Toolkit
TIS/TFS Fields Syntax, Semantics	ISO 18012	Included already in TIS/TFS design
TIS/TFS Fields Syntax, Semantics	ISO/IEC 15067-3	Included already in TIS/TFS design
TIS/TFS Fields Syntax, Semantics	ISO/IEC 15045	Companion to 18012
TIS/TFW Fields Syntax, Semantics	IEC 61850	Researched Part -4-720 DR integration from load end. RC2 Toolkit?
TIS/TFW Fields Syntax, Semantics	CIM, 61970	Recommended to design
Identification of universal object ID Node description	CIM with 61850 identifiers.	Recommended to design for topology of nodes
TIS interval Start Time	WS-Calendar	Recommended to design
Utility standards	P2030	Researched. Rejected.

Recommended Incorporated

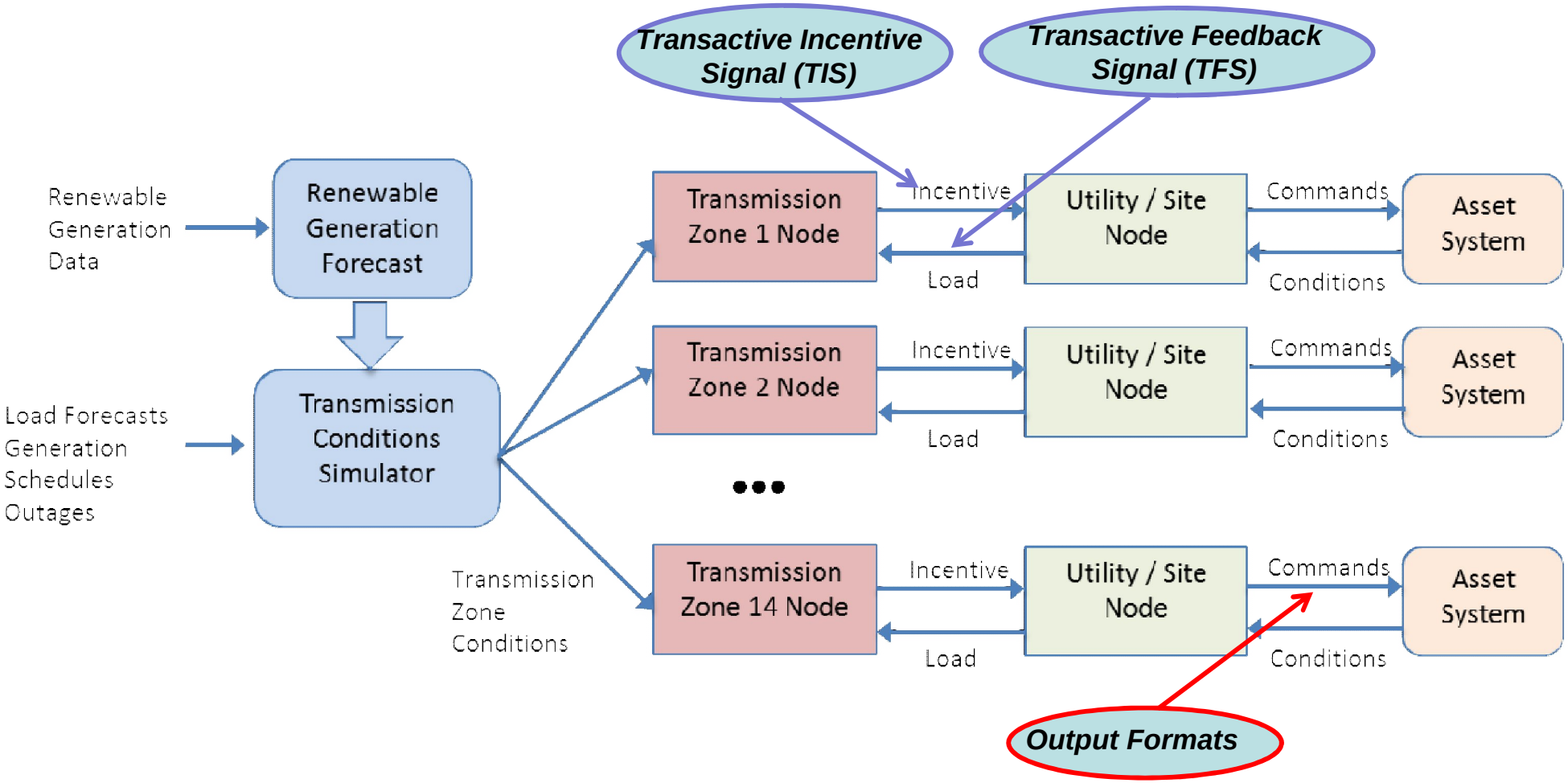
Results

- ISO 18012 and related standards already specified as requirements
- Recommended consideration of WS-CAL and CIM
- Recommendations too late to influence design decisions



Output Standards Research and Results

PNW Demonstration Project Interface



Transactive Signal Interfaces between Participants

Output Standards Survey

- How are you [utilities] planning to implement your Transactive Control Node?
  - IBM iCS-based Node (ISO/IEC 18012)
  - iCS Node Proxy Node
- How are you planning to convert the TIS information to the protocol used to communicate with your responsive assets?
- What format or formats will you use to communicate local data to the Transactive Node?
- Would it be useful to include conversions to/from your data formats? Which formats would be most useful?

Responsive Asset Classes

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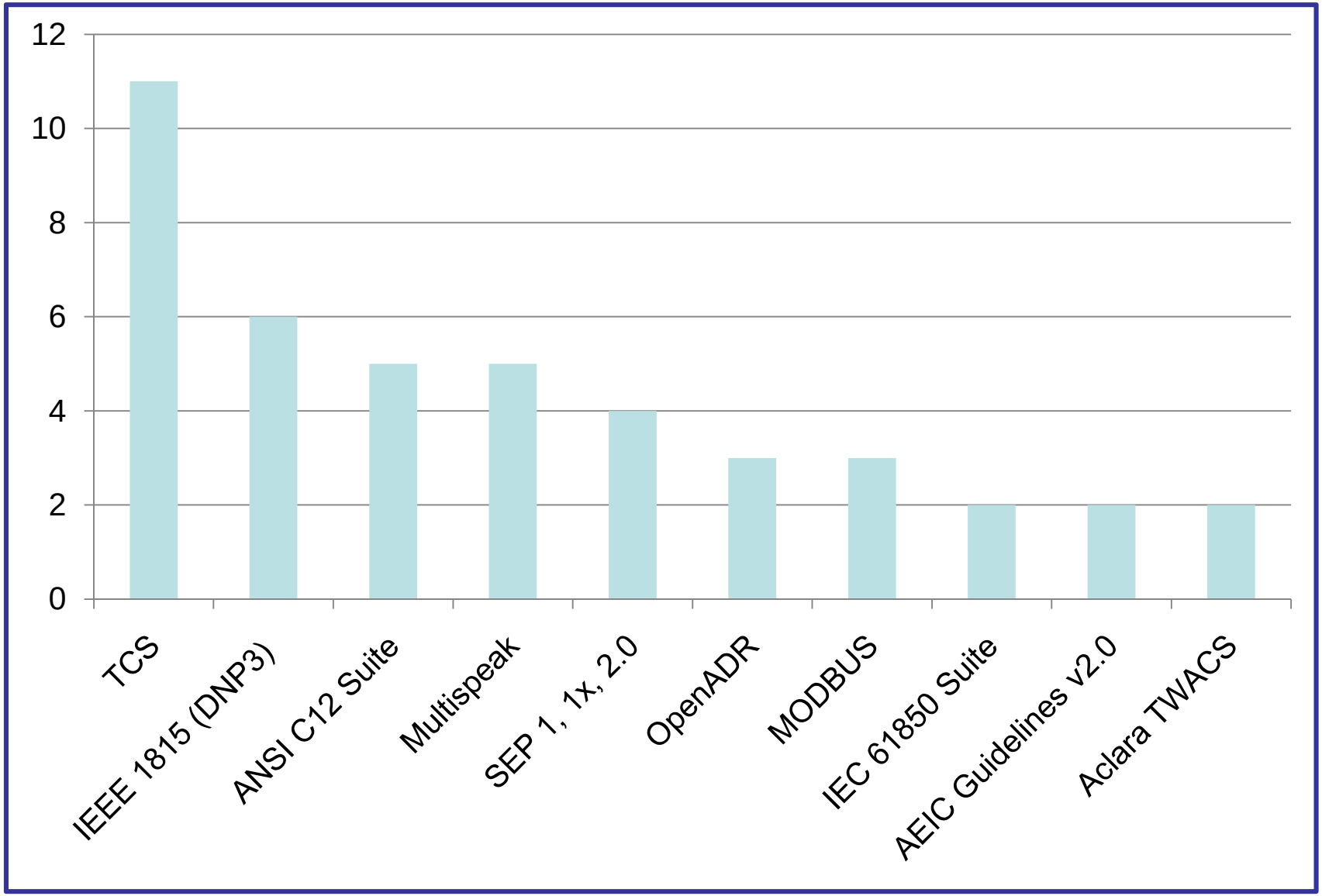
Output Standards Survey



Observations

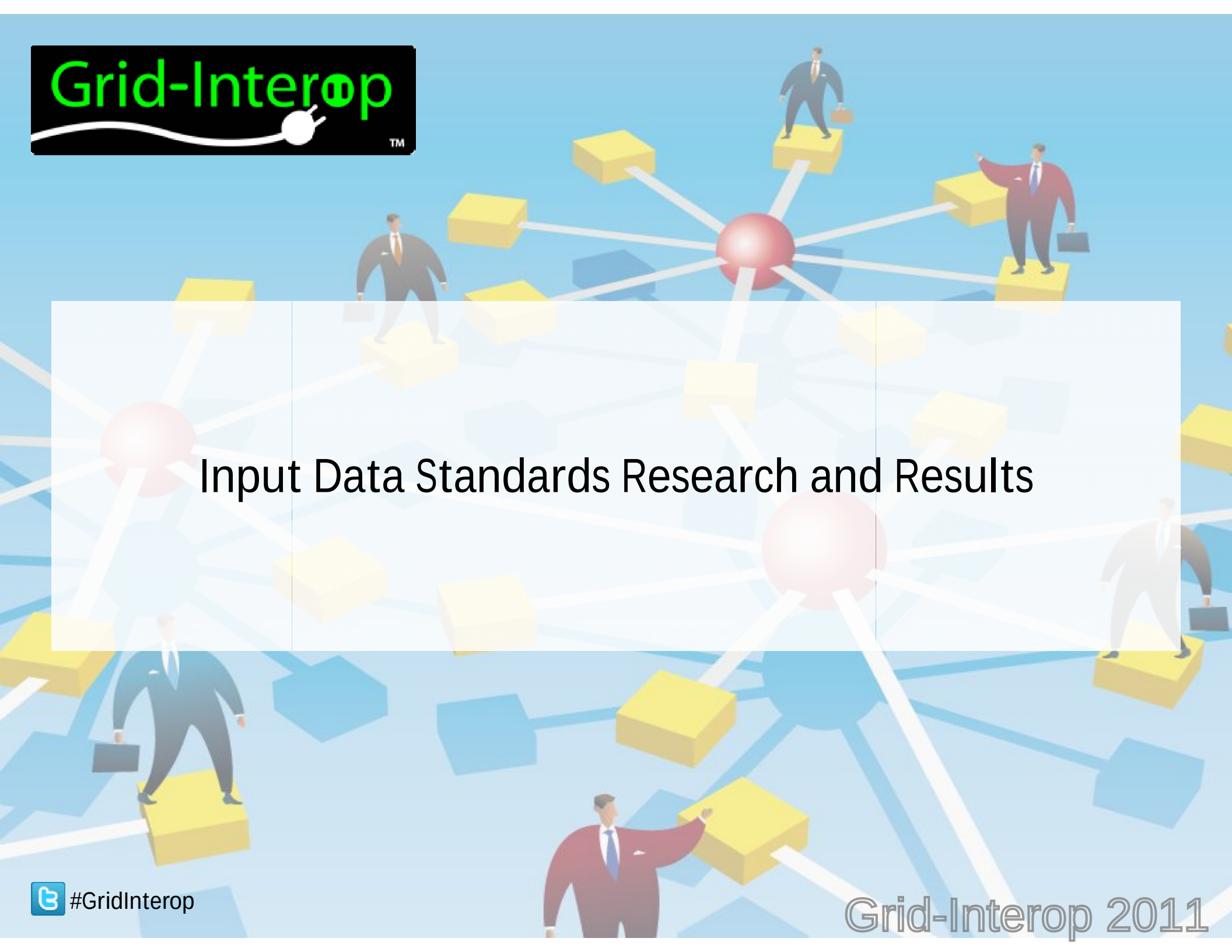
- Observation 1: The following standards are most likely to be used in the control of responsive assets:
  - ***IEEE 1815 (DNP3)*** 6 utilities
  - ***Multispeak*** (Version x.x?) 5 of the utilities will be using Multispeak as their integration language
  - ***SEP 1.x*** At least 4 utilities will be communicating 1.x signals to their responsive assets
- Observation 2: Other popular standards planned or in use include then ANSI C12.x suite for meter data and OpenADR and MODBUS

Recommendations

- Due to the variety and uniqueness of assets, control systems, vendors and architectures:
  - Recommendation 1: Provide the outputs of the TIS and associated RC2 Toolkit functions in a ***well-defined XML Schema and corresponding set of semantic definitions*** as inputs to each Subproject for its unique control system
- For future Transactive Control standards work:
  - Recommendation 2: Consider the following standards for potential **output** adapters in future releases of the Transactive Control specification:
    - IEEE 1815 (DNP3), Multispeak Version 4.x and SEP Version 1.x
    - OpenADR Version 2
    - SEP Version 2

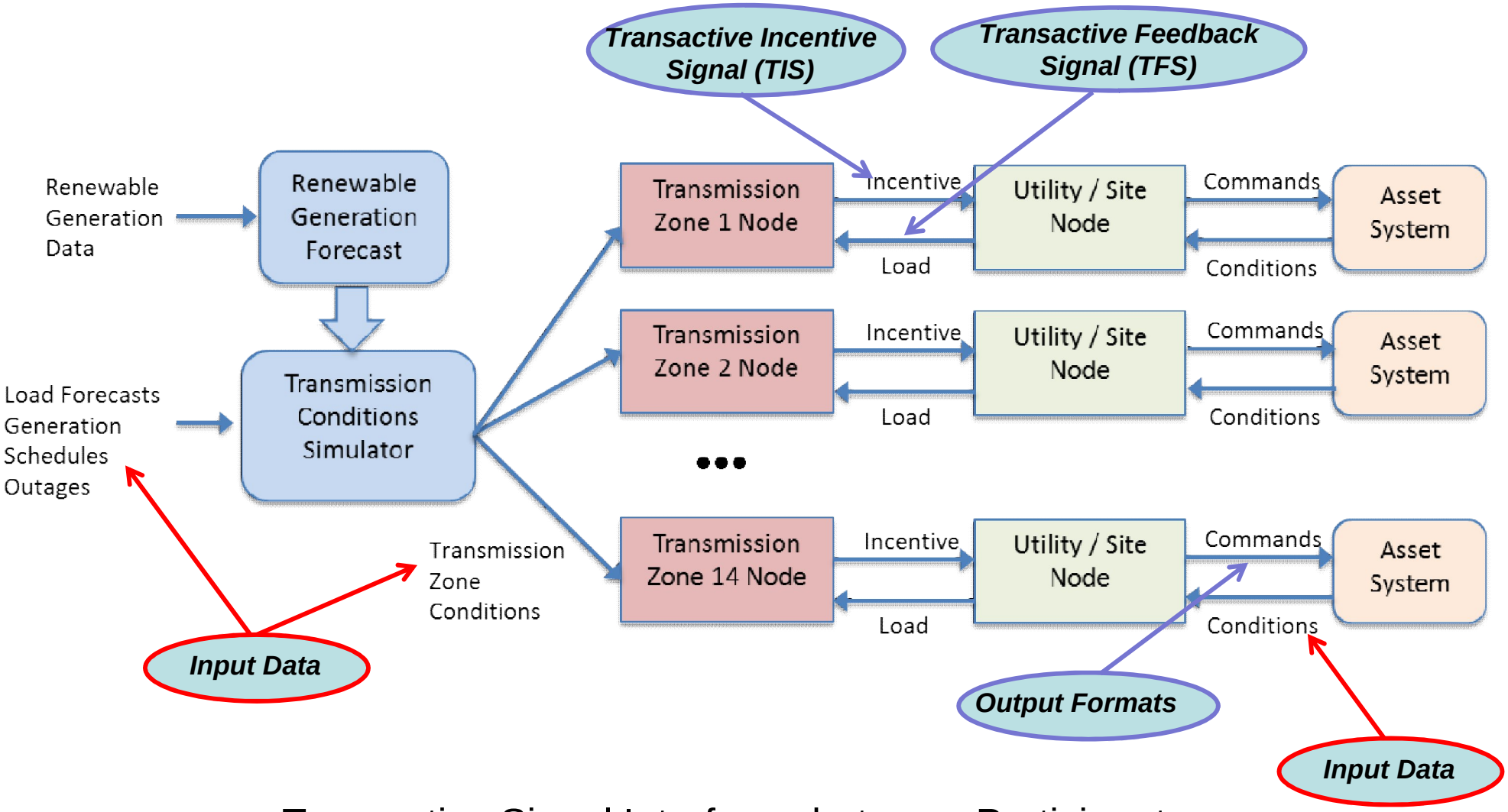
Results

- No clear output standards required
- Designed neutral XML output schema – converted by utility for their needs



Input Data Standards Research and Results

PNW Demonstration Project Interface



Transactive Signal Interfaces between Participants

Input Data Standards Process

1. Review transactive node input data types
2. Review standards related to each data type
3. Select suitable standards for further research
4. Research candidate standards with Project experts to gain consensus
5. Recommendations to design team

TN Toolkit Data Input Standards

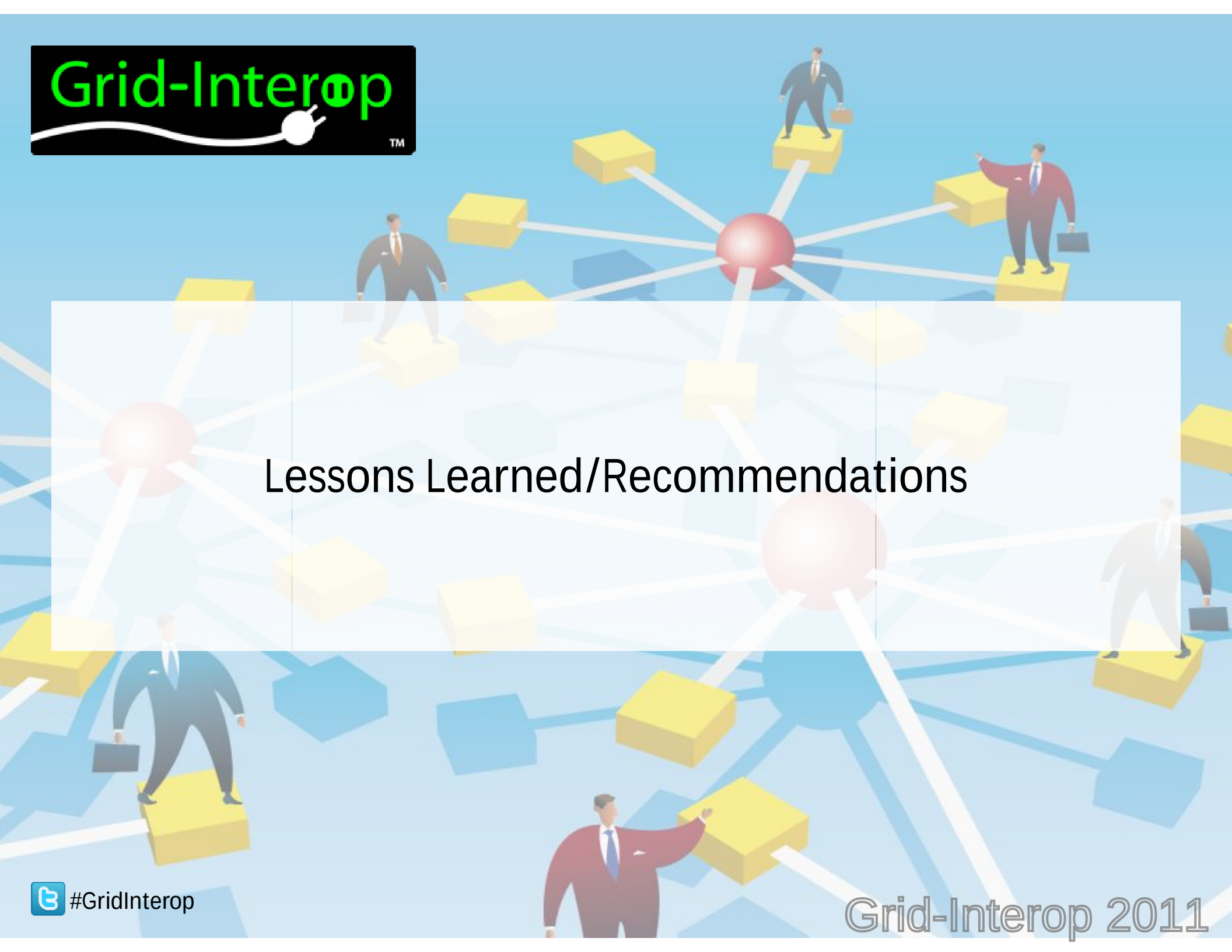
- Forecasted Wind (EI-203 TIS/TFS)
- Hydro Schedule (EI-204 TIS)
- Price of Fuel (EI-206 TIS/TFS)
- Regional Load Forecasts (EI-215 TIS/TFS)
- Power Market Indices (EI-218 TIS)
- Generation Schedule (EI-219 TIS)
- Transmission Topology (EI-205 TIS)
- Availability of Wind (EI-202 TIS/TFS)
- Extra-Regional Transfers (EI-207 TIS/TFS)
- Interchange Schedule (EI-208 TIS/TFS)
- Solar Availability (EI-209 TIS)
- Solar Forecast (EI-210 TIS/TFS)
- Automated Metering (EI-212 TIS/TFS)
- Non-Power Constraints (EI-214 TIS/TFS)
- Available Transfer Capability (EI-213 (TIS))
- Generation Outage Schedule (EI-216 TIS)
- Transmission Outage Schedule (EI-217 TIS)
- Transmission Schedule (EI-220 TIS)
- Station Control Error (EI-221 TIS)
- Area Control Area (EI-222 TIS)
- Local Node Measurement (EI-223 TFS)
- DER Forecast (EI-225 TFS)
- Current Weather (EI-227)
- Forecasted Weather (EI-228)
- Power Tariffs (EI-232 TIS)
- Historical Load Data

Findings & Decision Basis

- ICCP
  - Requires investment
  - Client-server package required
  - Real-time standards, requires additional historian for data capture
- OPC Data Access
  - Requires investment
  - Client-server package required
  - Industry de facto standard, but few participants plan to use
- EIDE
  - Technology standard (WECC) for information transfer
  - XML Based, considered easier to implement
- METAR (Metrological data)
  - Flat file, XML compatible, many sources for the data
- GIS 19115
  - No evidence to include as a GIS standard for all participants

Results

- Still in process
- Didn’t find any standard with comprehensive input data formats to date



Lessons Learned/Recommendations

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1. *Functional requirements need to be explicit on the importance of standards - require consideration of standards during the design phase.* [If a specific standard a requirement, make explicit]
2. *Standards research needs to be done in parallel with actual design and made available in time to affect the design decisions* [Otherwise, the costs in time and effort to implement a standard into a started design may derail the standards effort]
3. *Designers need to be involved with standards investigations and need support for adoption* [Those responsible for implementation invariably are more supportive if involved in the implementation strategy decisions]

Lessons Learned/Recommendations

4. *Schedule time and resources for standards evaluation and adoption* [If standards are intended to be a key element build time and resources into the schedule to research and decide]
5. *Have team members with knowledge of and involvement in relevant standard groups* [Easier to get latest versions, status and understand and evaluate the standards investigated]
6. *Set up a clear evaluation process with clear criteria for selecting and implementing a standard* [Ensures all understand the process and outcomes]

In Summary

- The Project goal to “further interoperability standards” led to lessons on “HOW”
- Attempting to influence standards educated all on standards importance and status
- The path between standards development and implementation in the real world requires commitment and careful planning to succeed

Working Group Members

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