



Industrial AI for
Smarter Infrastructures

Semantic Historian for IoT Applications

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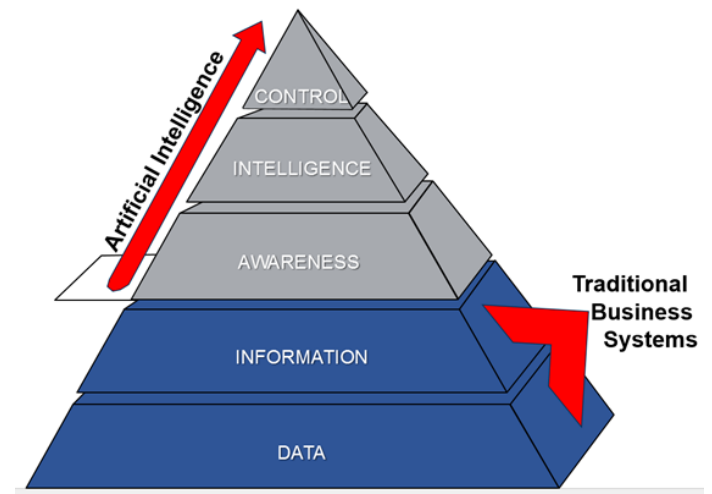
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> Agenda

- About SmartCloud
- Applicable Reference Applications
 - NERC: SAFNR
 - NY-ISO: DSASP
- Semantic Historian for IoT Applications
- Lessons Learned

> About SmartCloud

- Founded in 2009
- Headquartered in Bedford, MA
- Deep history in **Artificial Intelligence**, real time and expert systems applications
- 100+ years experience in software and services in mission critical data & decision management
- Software company focusing deploying energy, compliance and industrial automation applications based on the **Semantic Historian** product in its core CRex platform.
- SmartCloud's CRex platform is ideal for Industrial Internet-of-Things
- **SaaS** business model
 - Solutions developed and maintained by SmartCloud
 - Applications hosted either at customer premise, in cloud, or at secured data center
- Investment from **Rockwell Automation** in 2013



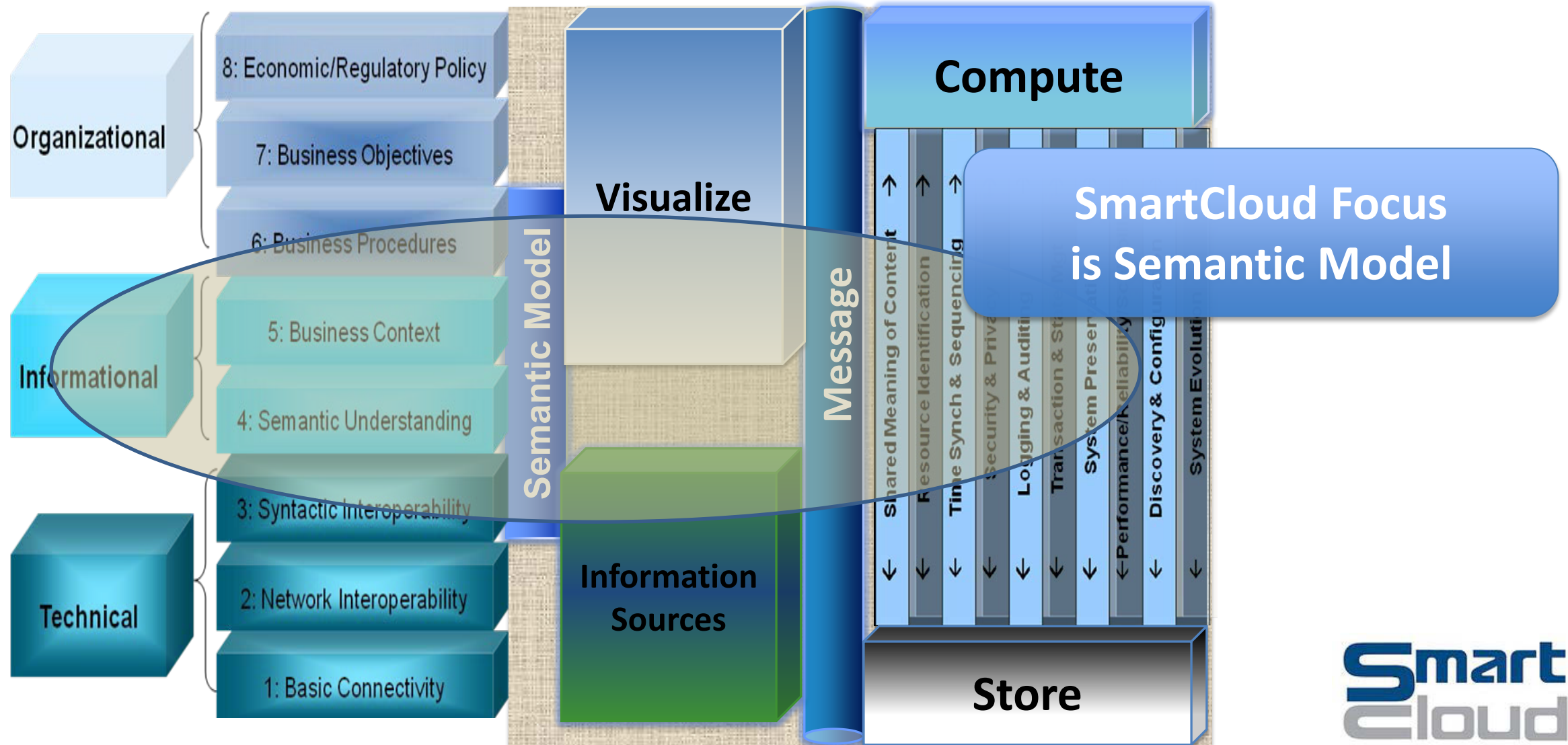
> Customers – Energy and Utilities



Federal Energy
Regulatory Commission

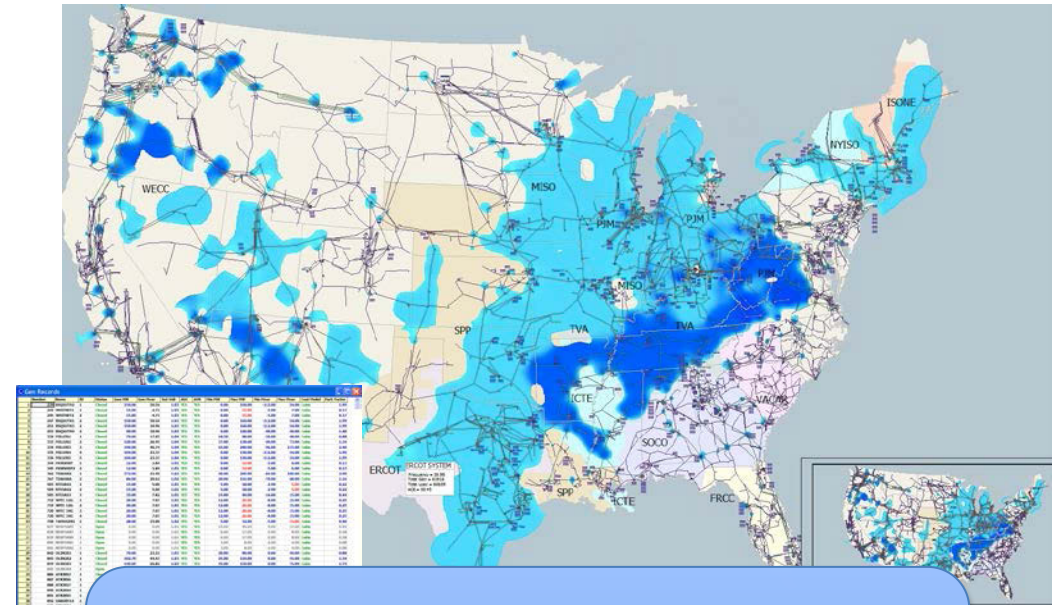


> CRex Technology – Relative to GWAC



> Typical Semantic Application: SAFNR V2 (Situation Awareness for FERC, NERC and Regional Entities)

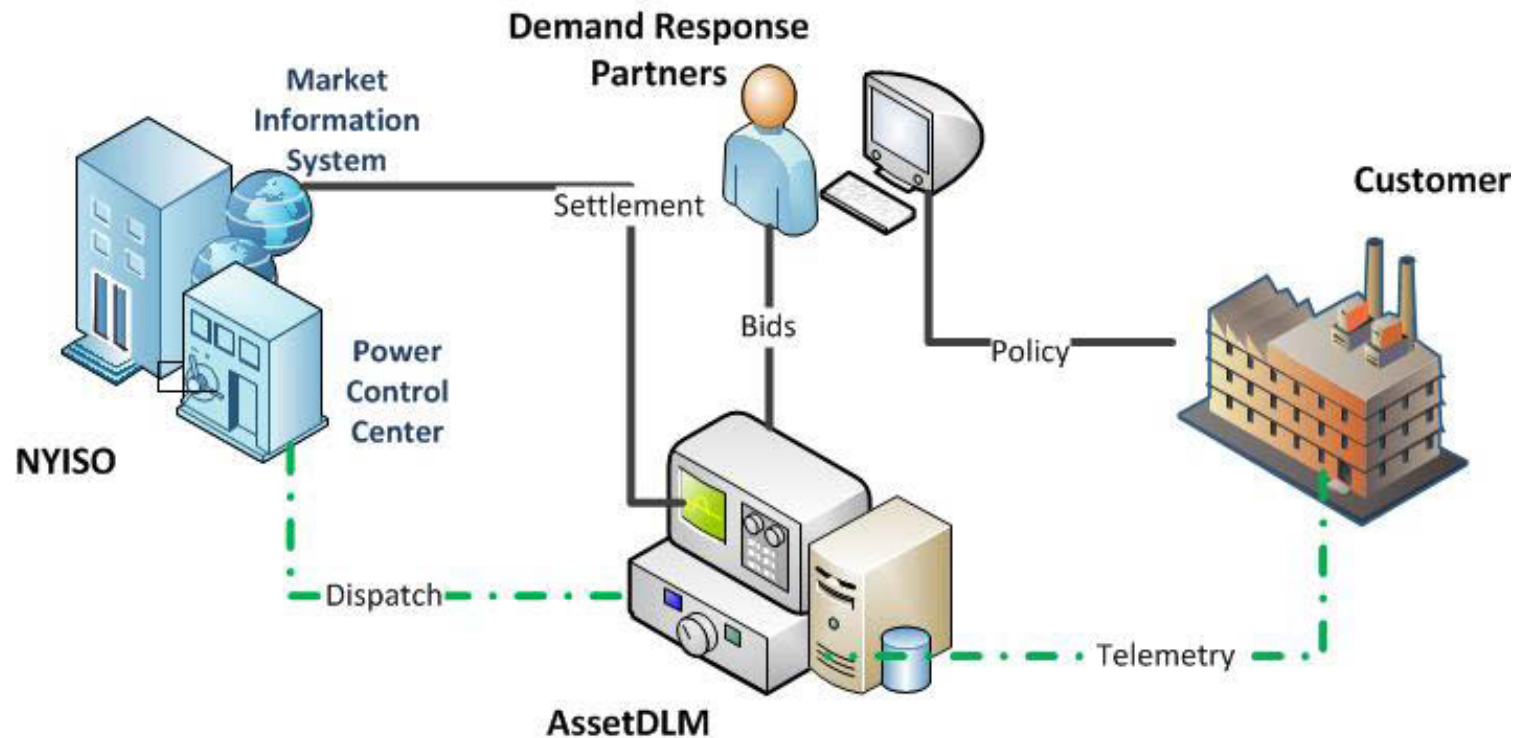
- **Situation Awareness** for Bulk US Power System
- Captures 33,000 substation data points in **real time** for NERC
 - Updates 6-20 seconds
- **Fuses** data with semantics from 13 RCs, 7 different EMS vendors
- Resolves formats, duplications, update timing, missing data...
- **AI reasoning** to drive visualizations of data and emerging events (e.g. stale data detection)
- Leverages **CIM** (Generation and Transmission)



Secure connection to
NERC's CIP environment

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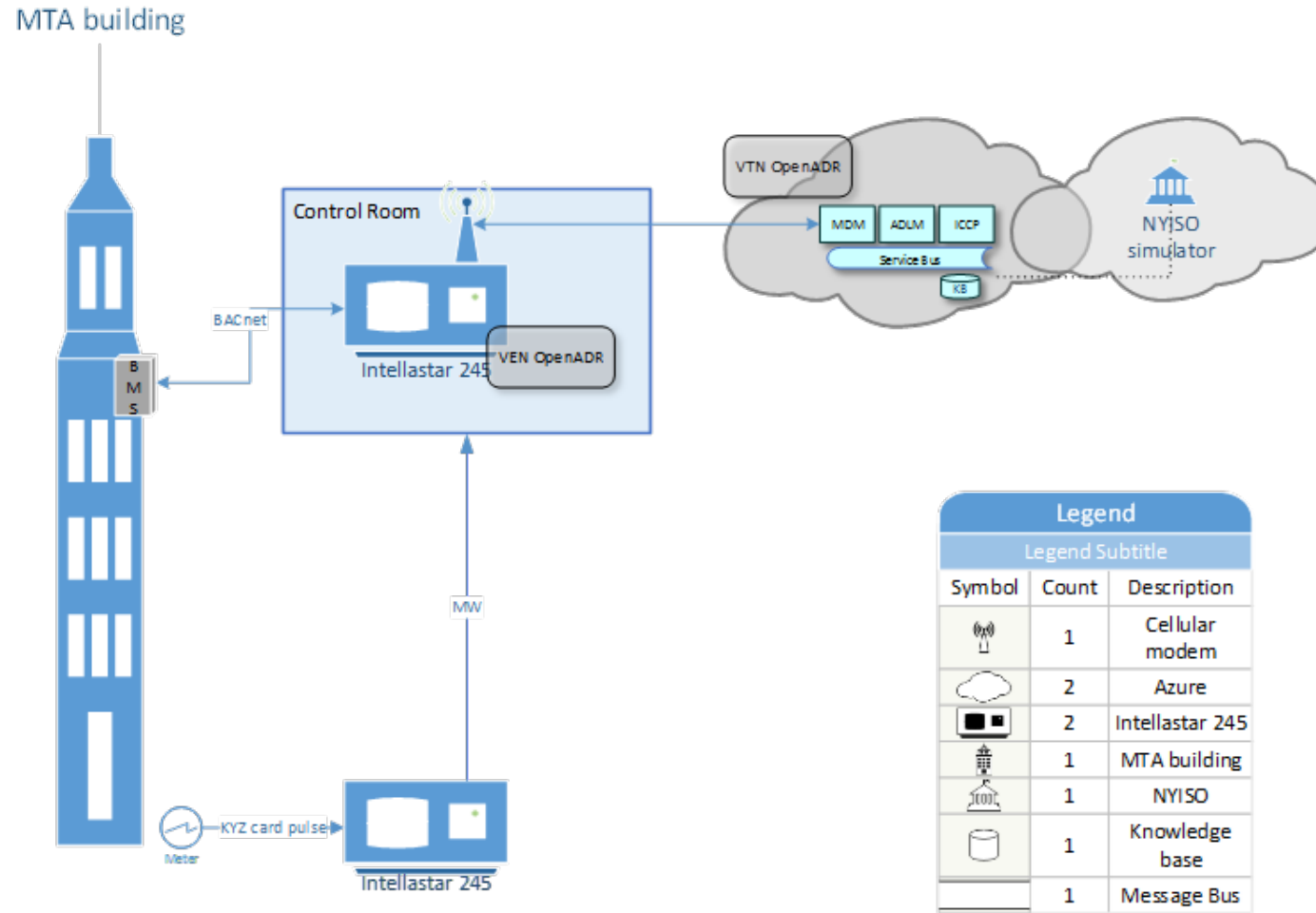
> NY-ISO DSASP Program



- 6 Second telemetry of MW reading
- KYZ connection at meter
- 110 MW of load
- Aggregation within each zone
- Dispatch response monitored
- Cell and Ethernet telemetry
- Custom Hardware

Demand Side Ancillary Response Program
“Non-OpenADR Implementation”

> NYSERDA DSASP Architecture



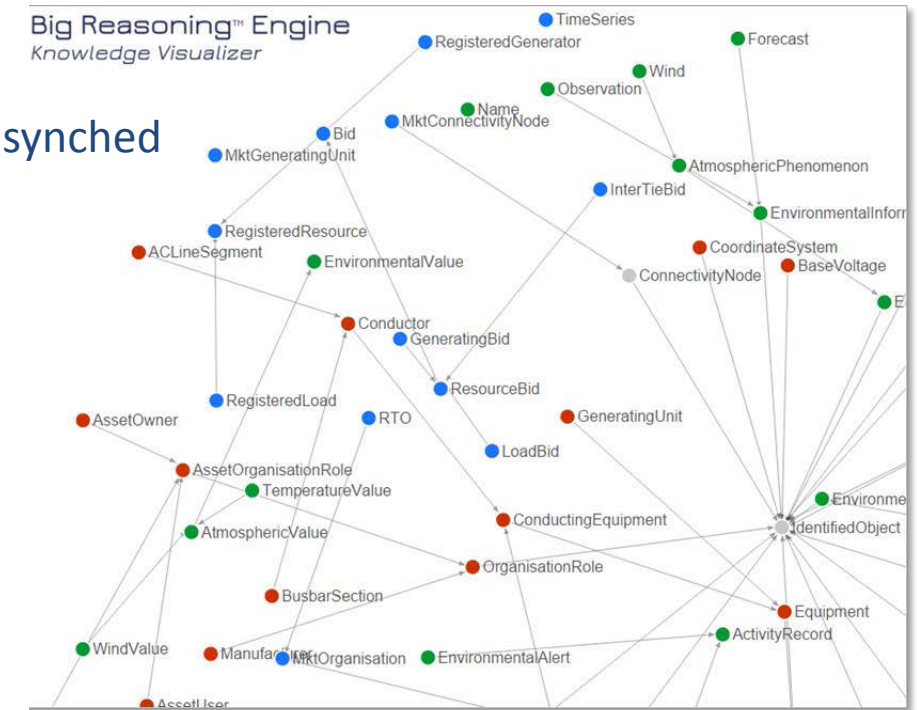
- Project to determine if buildings can provide DSASP load
- CIM based representation including (simulated) feeder information
- Using Commercially available hardware device – Intellistar
- Treating meter data collection as an IoT effort

OpenADR 2.0(b) Implementation

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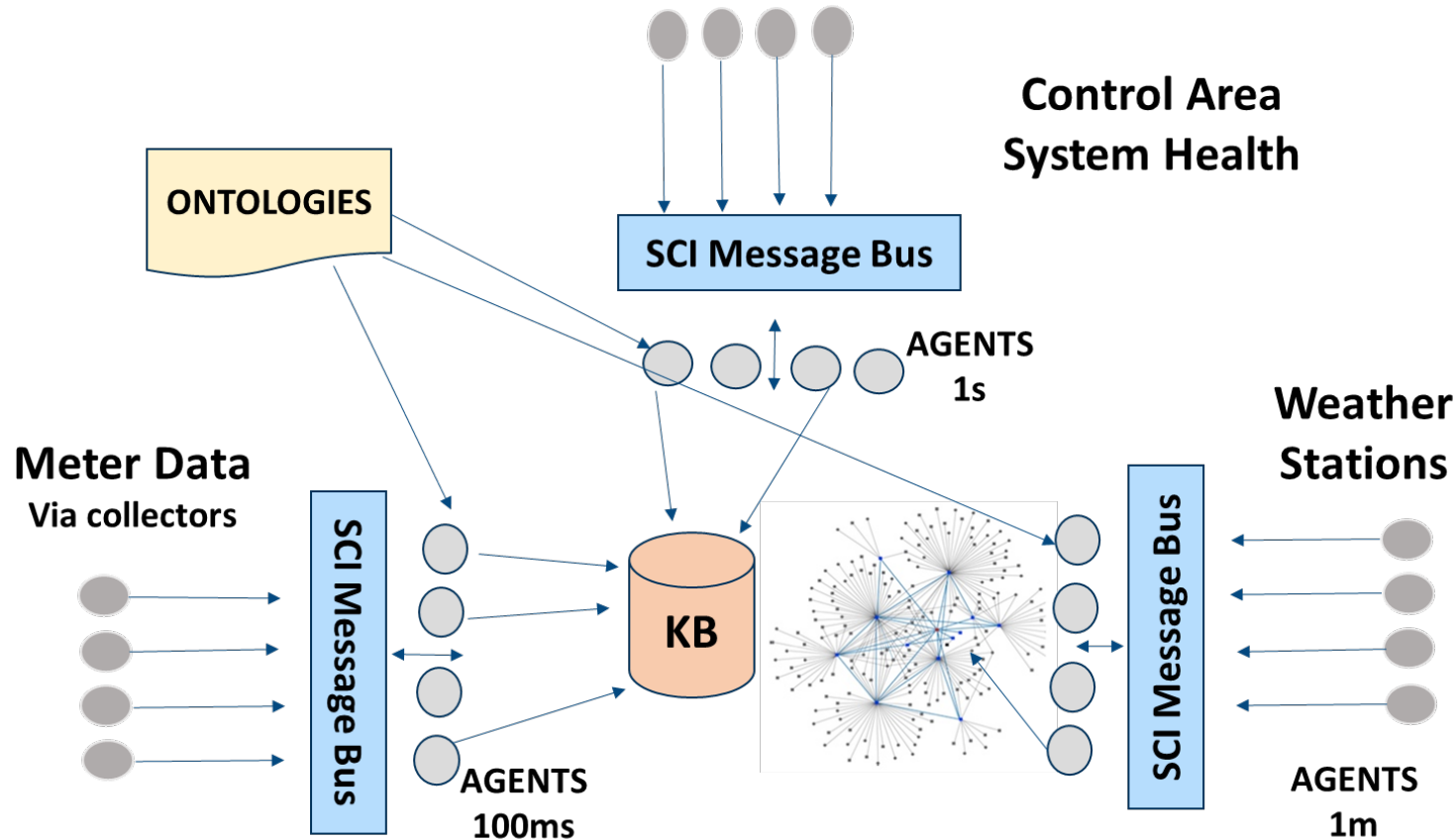
> Semantic Historian for Industrial IoT

- CRex uses a bus oriented architecture (cloud and hosted)
 - Important for IoT applications to handle large bursts of data
 - Each agent is synchronized (10Hz) to make sure all assertions are synched
- SSN and CIM are the base ontologies
 - SCI extends for weather and pricing information
 - Extend for applications like DR
- Physical storage is based on a graph database
 - Highly extensible, distributable
 - All Assertions have URIs
 - Same technology as in Facebook



Semantic Historian is a Database that stores *Data as Knowledge* –
CRex uses software agents to interpret an Ontology to make
Assertions to the Knowledge Base

> Architecture – Semantic Historian



SAMPLE EXPRESSIONS

- Show meters whose PUV (Per Unit Voltage) is greater than 1.05 when the temperature at the nearest weather station is greater than 85 degrees
- Show the total available load of Demand Response assets whose nearest feeder is within 10% of rated capacity

> Lessons Learned

- Cost effective provisioning of building monitoring and control requires standardization (100s to 1000s of buildings)
 - Auto-provisioning and/or auto-discovery
- Requires simple secure communication (e.g. certificates)
- Getting through customer firewalls is a problem
 - Redundant cellular modems is preferred
 - Use Ethernet to reduce costs
- Need to organize information as collected
- Need to automate SOPs in case of an anomaly
- Need to provide individuals perspectives of information for end users, utility, ISO
 - Real time energy user for end users
 - Situation Awareness for ISO, utility
 - Performance alert for aggregators