CIM-Based Integration

Using the IEC 61968-9 specification for Systems Integration

October 2012

Agenda

I. Presenter Introductions

II. Naperville Smart Grid Initiative Overview

III. Defining the Integration Design

IV. Key Integration Considerations

- Message Delivery
- Message Content
- Message Transformation

V. Project Takeaways

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Technology Integration

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Background

◆ Over 12 years of experience focused in IT strategy, application development, and systems integration.

◆ Cross-industry consulting experience applying technical and industry standards to complex issues.

◆ Technical delivery of solutions to help streamline business processes, deliver complex analytics, and enable trading partner integration.

Related Experiences

◆ Technical integration design and planning for City of Naperville, IL Smart Grid Initiative

◆ Architected the enterprise IT architecture including systems, integration platform, reporting platform, and hardware for a leading retail energy supplier.

◆ Built custom SOA-based systems integration platforms before many of the current standards and systems existed.

Key Relevant Skills

◆ Deep skills in Microsoft application and database technologies

◆ Expertise with various middleware products, specifically BizTalk Server

◆ Strong abilities to communicate and coordinate across the many vendors that are involved in a systems integration project.

Background

- Senior Consultant in the Technology Integration solution team at West Monroe Partners.
- Focused has been on Smart Grid systems integration projects for the Energy & Utilities industry.

Related Experiences

- 4 years experience with custom application development, web service, mobile app, and systems integration
- Sean is currently the technical lead on the systems integration project for a DOE ARRA grant recipient.

Key Relevant Skills

- Deep skills in Microsoft application and database technologies
- SOA and Pub-Sub design patterns
- Expertise with various middleware products, specifically BizTalk Server

Sean Teska
Senior Smart Grid Integration Consultant

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# The NSGI program was a start-to-finish Smart Grid Implementation.

- ◆ Naperville Quick Facts
  - ~145,000 residents
  - ~57,000 Electric meters (5000 C&I, 52,000 Residential)
  - Peak demand: 388 MW
  - Annual energy usage: 1,550,000 MWh
  - Service Area: 46 square miles

- ◆ Key Project Benefits – meter reader cost savings, energy management programs to reduce peak demand including advanced rates and HAN devices

- ◆ As of October 8, 99% of meters have been installed and are communicating through the systems and integrations that we have built.

Three new applications were selected and installed and the CIS functionality was substantially upgraded.

Legend

| Pre-Smart Grid | Post-Smart Grid | Long Term |
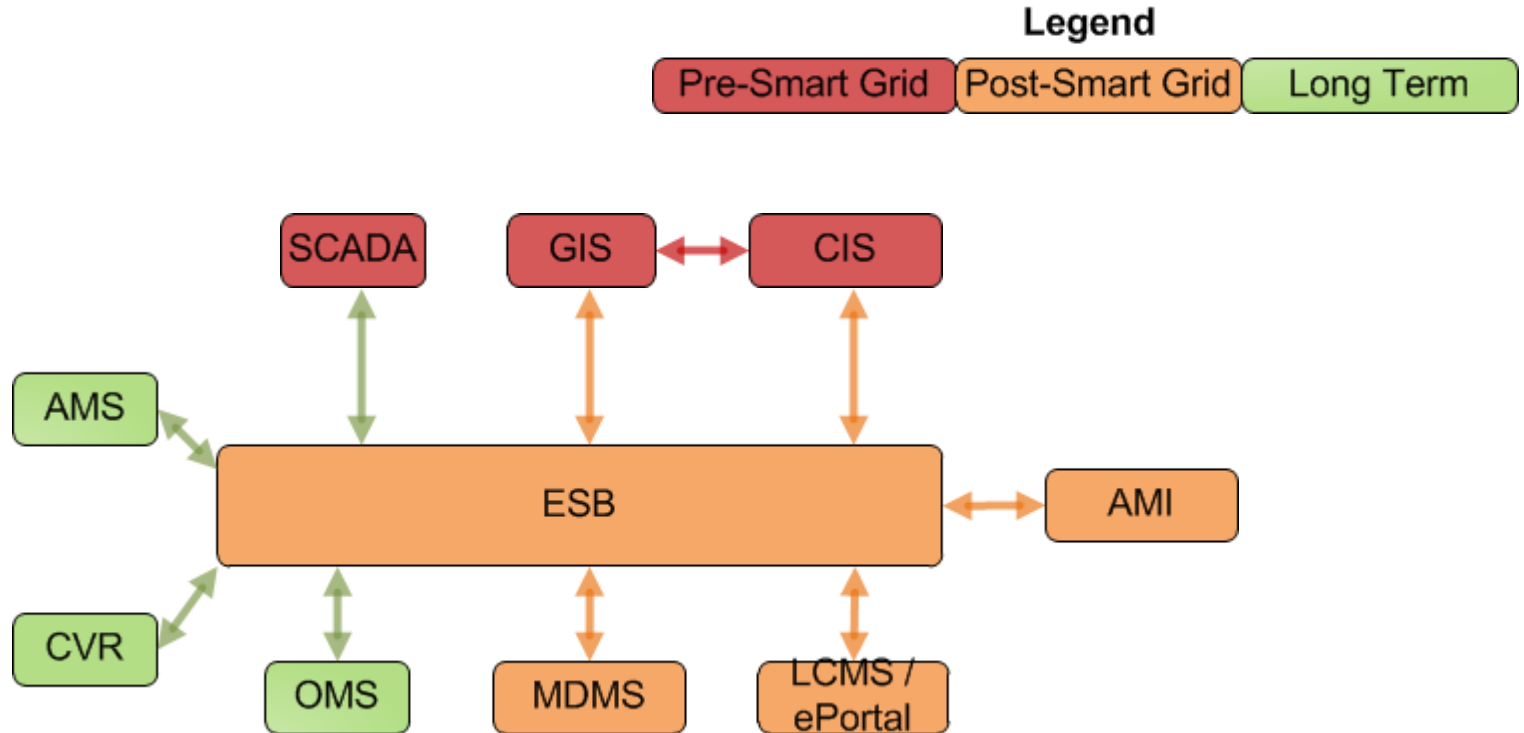
Over 40 integration use cases were identified. We needed a robust design that looked to the future.

- ◆ Data Synchronization
  - ▪ Initial Customer, Meter, Account, Location Loading
  - ▪ Automated and Manual Metering
  - ▪ ePortal Account Details
- ◆ Process Automation
  - ▪ Meter Exchange
  - ▪ Remote Connect / Disconnect
  - ▪ Demand Response Event Management
  - ▪ Smart Meter Billing
- ◆ Real Time Data Access
  - ▪ On Demand Reads
  - ▪ Outage and Restoration Alarms

Standards-Based

Future-Focused

Robust

Scalable

The systems provided functionality covered by various 61968 standards.

1. Account information
2. Configuration, installation, etc.
3. Controls and signals
4. **Customer data set**
5. **Data obtained by special read**
6. **Demand response signals**
7. **Disconnect/reconnect, demand reset**
8. **Install, remove, repair, disconnect, reconnect**
9. **Load curves, Measurement history, etc.**
10. Load scenarios
11. **Meter health and tamper detection**
12. **Meter history**
13. **Meter readings**
14. Meter service request
15. **On request read**
16. **Outage and restoration verification**
17. **Power reliability and quality events**
18. **Readings, events and status**
19. **Special read**
20. Tariffs, parameters
21. Transaction information
22. Transaction records
23. Tokens

Source: IEC 61968-9
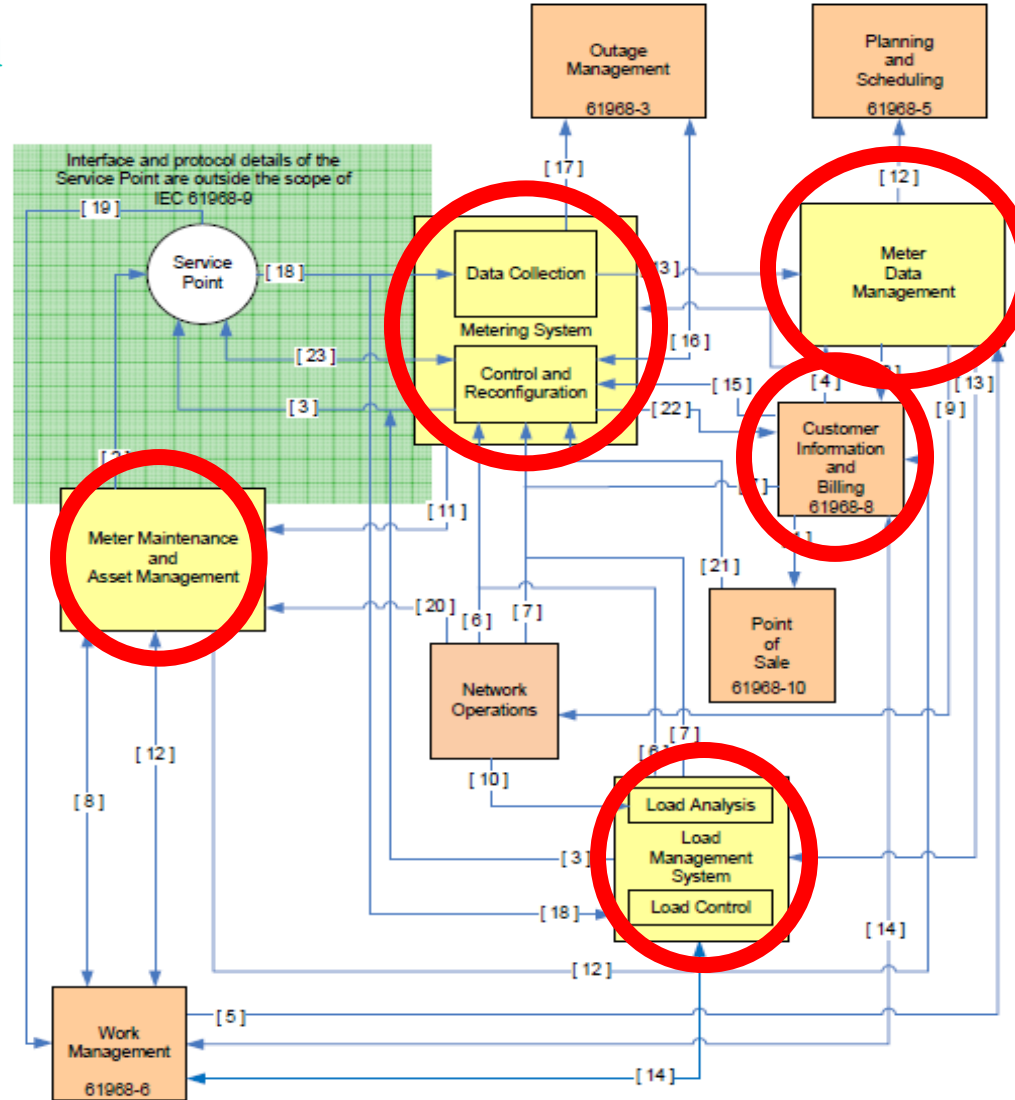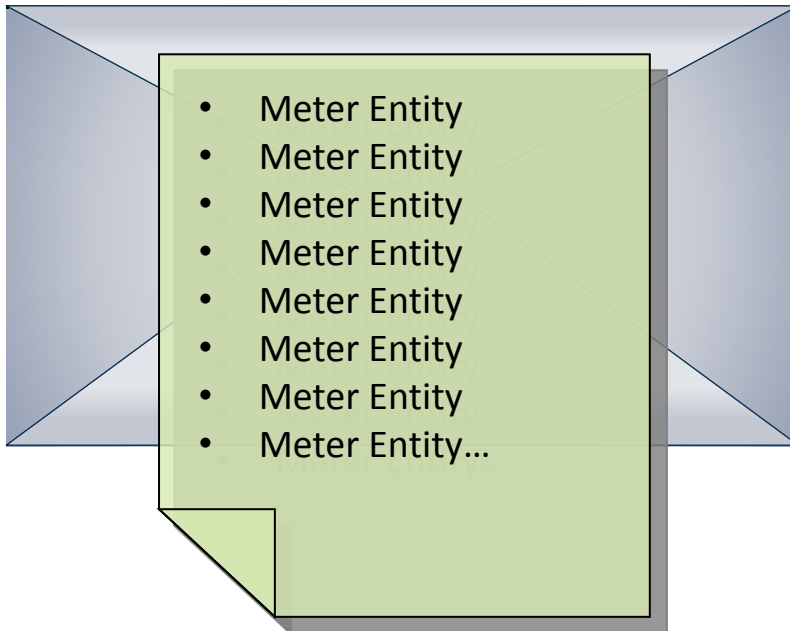
Message Delivery Considerations

Naperville's use cases segment systems by user role and not functionality. This created the need for redundant functionality supported by non-standard message delivery routes.

◆ The CIM specifies that On-Demand Reads are sent from the Customer Information and Billing System to the Metering System.

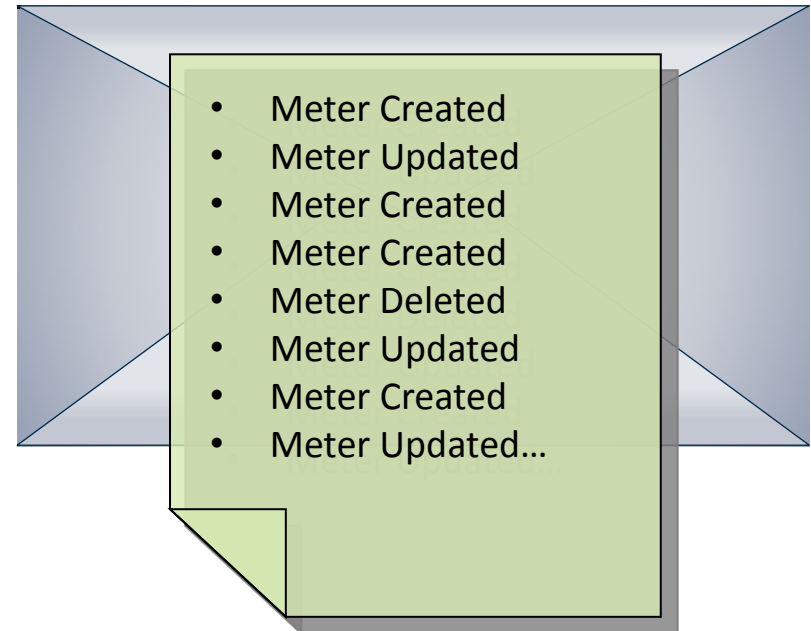◆ Naperville required three systems to perform the On-Demand Read function.
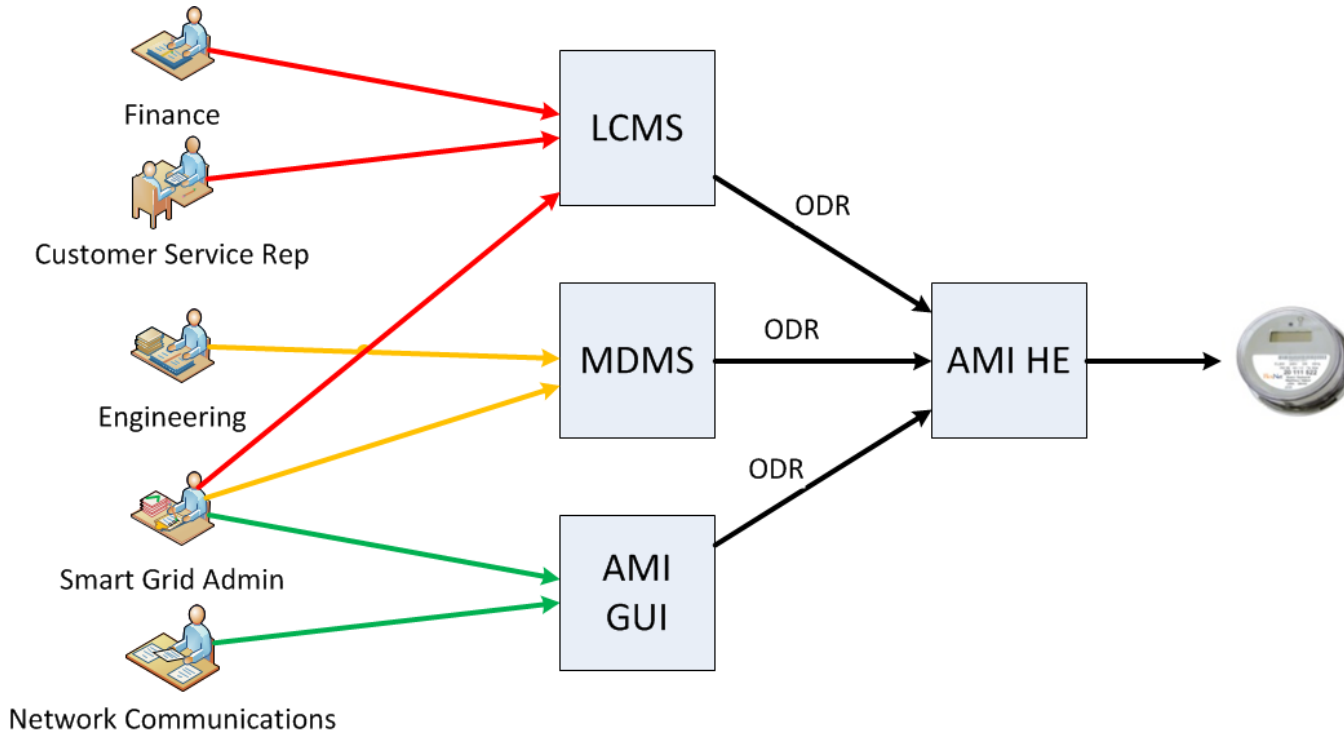
Message delivery for non-CIM compliant interfaces required additional consideration because messages were published without message type verbs.

Published message

- Meter Entity
- Meter Entity
- Meter Entity
- Meter Entity
- Meter Entity
- Meter Entity
- Meter Entity
- Meter Entity…

What they were trying to say…

- Meter Created
- Meter Updated
- Meter Created
- Meter Created
- Meter Deleted
- Meter Updated
- Meter Created
- Meter Updated…
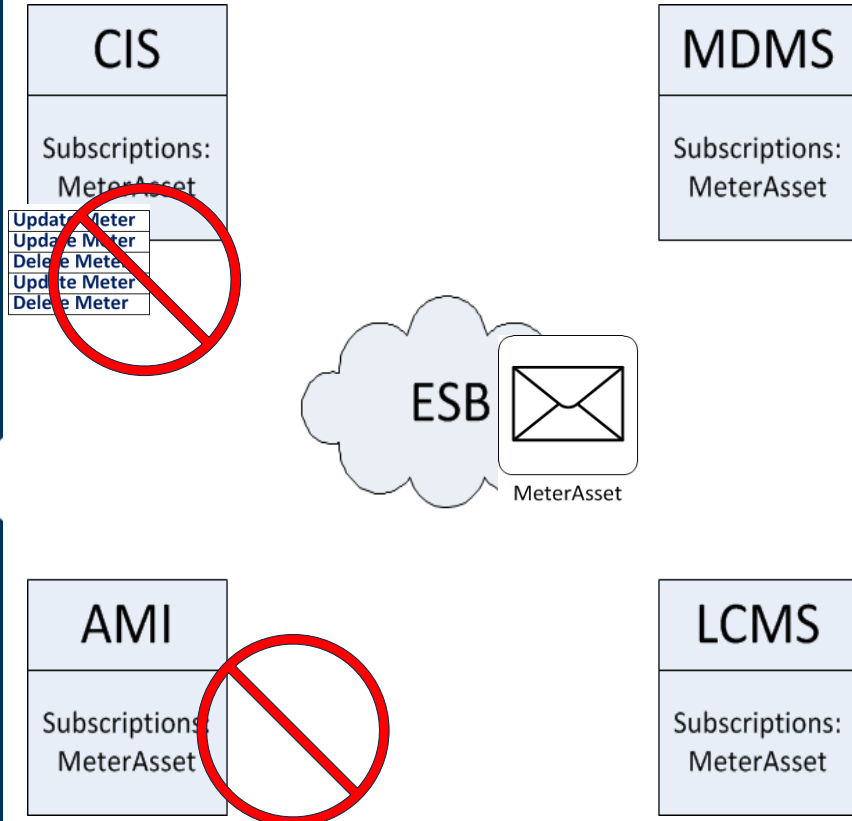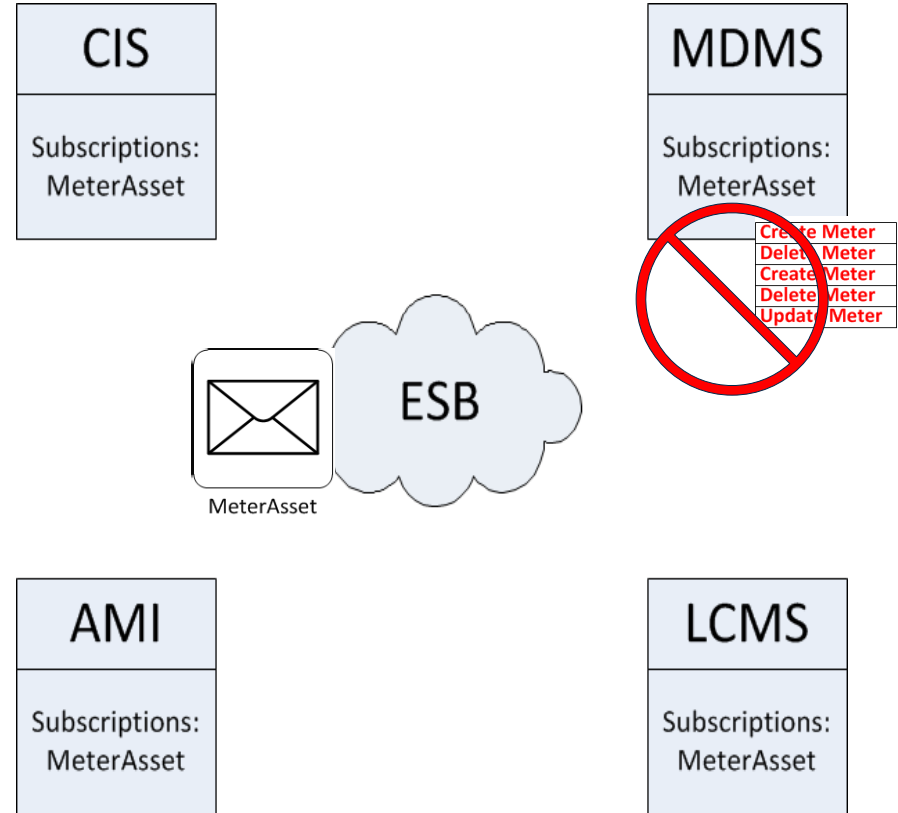
Non-compliant messages were mapped into CIM schemas by the ESB, but subscriptions to those CIM schemas resulted in incorrect message delivery.

Scenario: After a Meter Service Work Order, the CIS publishes updated and deleted meter records
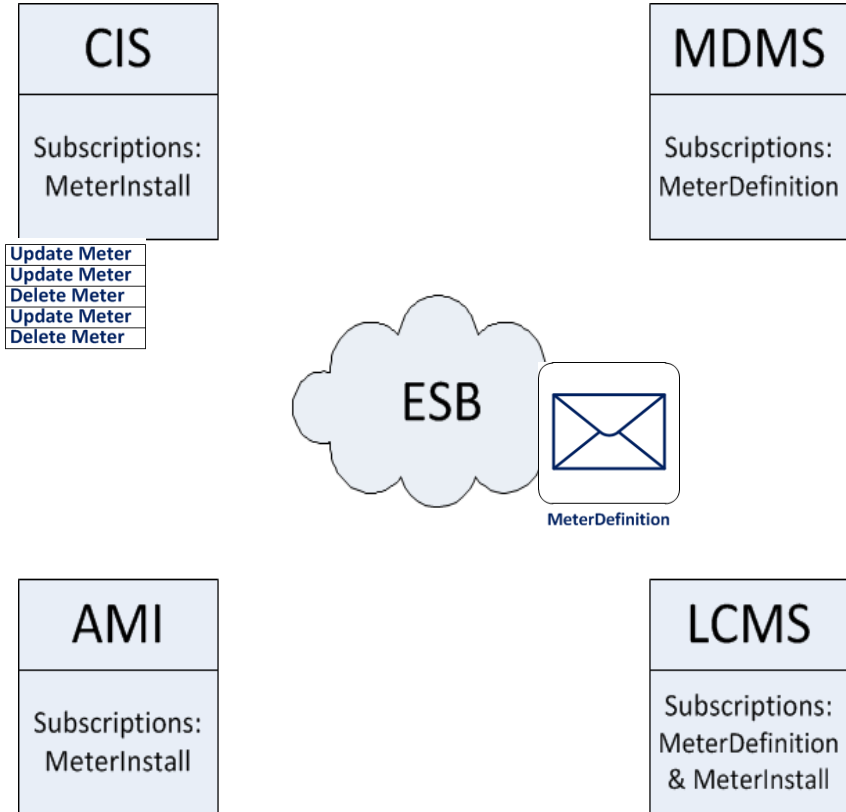
CIS
Subscriptions: MeterAsset

Update Meter
Update Meter
Delete Meter
Update Meter
Delete Meter

MDMS
Subscriptions: MeterAsset

ESB
MeterAsset

AMI
Subscriptions: MeterAsset

LCMS
Subscriptions: MeterAsset

Scenario: After a meter installation, the MDMS publishes new, updated, and deleted meter records

CIS
Subscriptions: MeterAsset

MDMS
Subscriptions: MeterAsset

Create Meter
Delete Meter
Create Meter
Delete Meter
Update Meter

ESB
MeterAsset

AMI
Subscriptions: MeterAsset
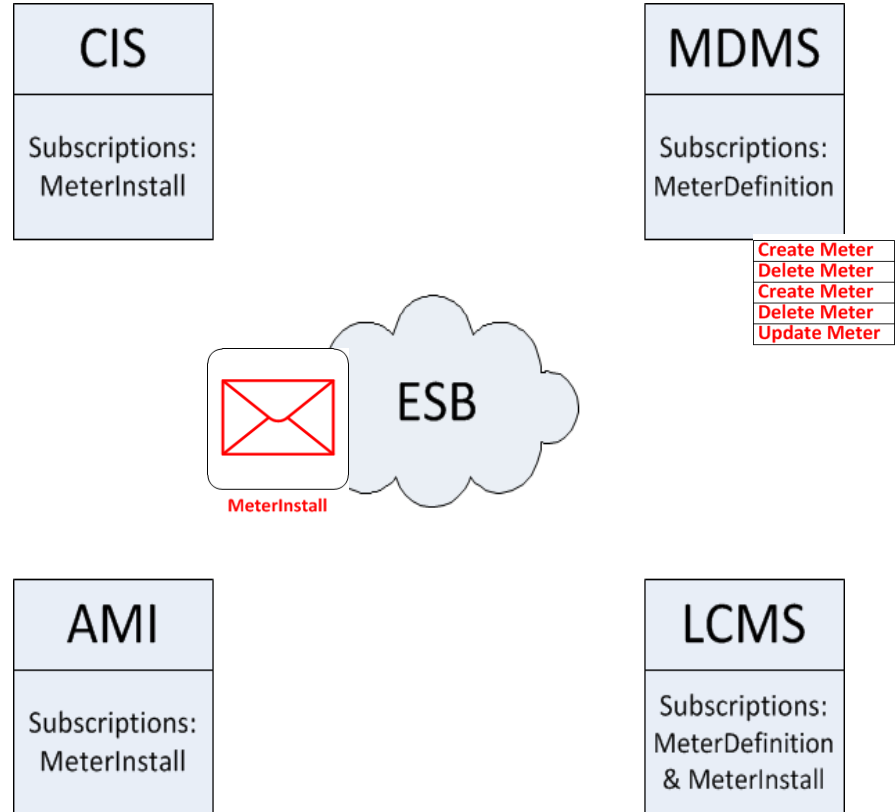
LCMS
Subscriptions: MeterAsset

Encapsulating CIM schemas with "Process Definition" messages allowed the ESB to leverage the CIM internally and enabled systems to subscribe only to their desired messages.

Scenario: After a Meter Service Work Order, the CIS publishes updated and deleted meter records

Scenario: After a meter installation, the MDMS publishes new, updated, and deleted meter records

CIS
Subscriptions:
MeterInstall

Update Meter
Update Meter
Delete Meter
Update Meter
Delete Meter

MDMS
Subscriptions:
MeterDefinition

ESB
✉
MeterDefinition

AMI
Subscriptions:
MeterInstall

LCMS
Subscriptions:
MeterDefinition
& MeterInstall

CIS
Subscriptions:
MeterInstall

MDMS
Subscriptions:
MeterDefinition

Create Meter
Delete Meter
Create Meter
Delete Meter
Update Meter

✉
MeterInstall
ESB

AMI
Subscriptions:
MeterInstall

LCMS
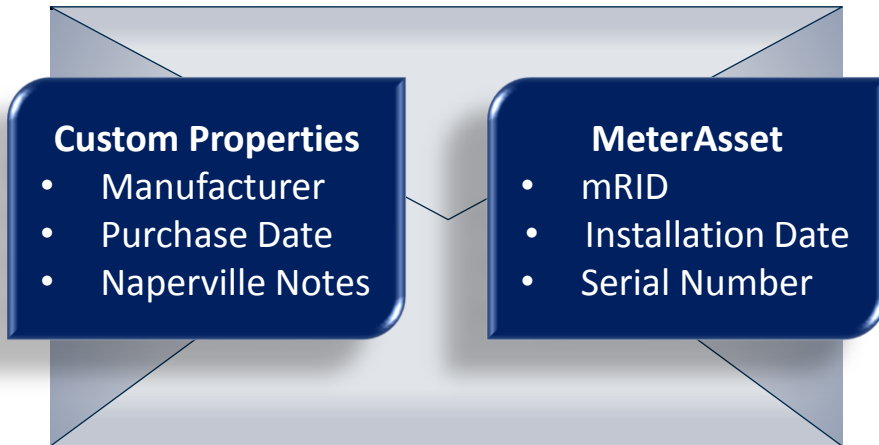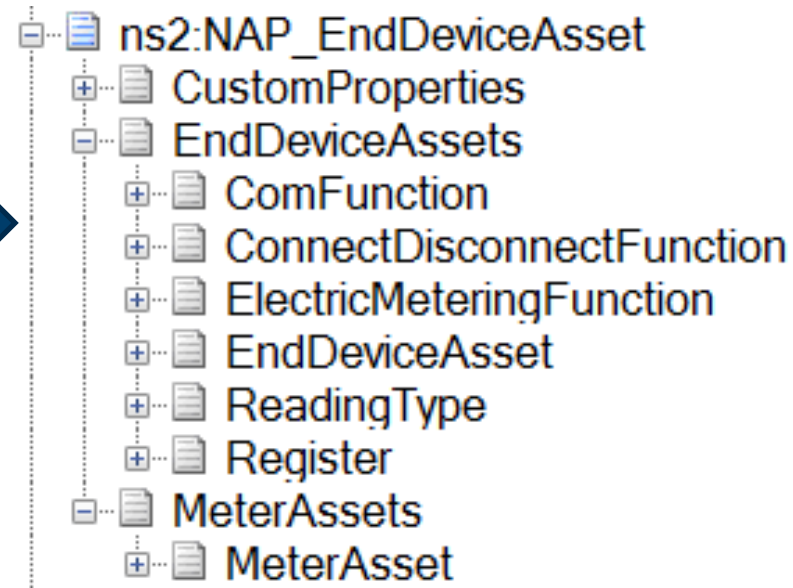Subscriptions:
MeterDefinition
& MeterInstall

Message Content Considerations

CIM schemas were extended to transfer Naperville specific data between systems.

NAP_EndDeviceAsset

Actual Usage

Custom Properties
- Manufacturer
- Purchase Date
- Naperville Notes

MeterAsset
- mRID
- Installation Date
- Serial Number

ns2:NAP_EndDeviceAsset
- CustomProperties
- EndDeviceAssets
  - ComFunction
  - ConnectDisconnectFunction
  - ElectricMeteringFunction
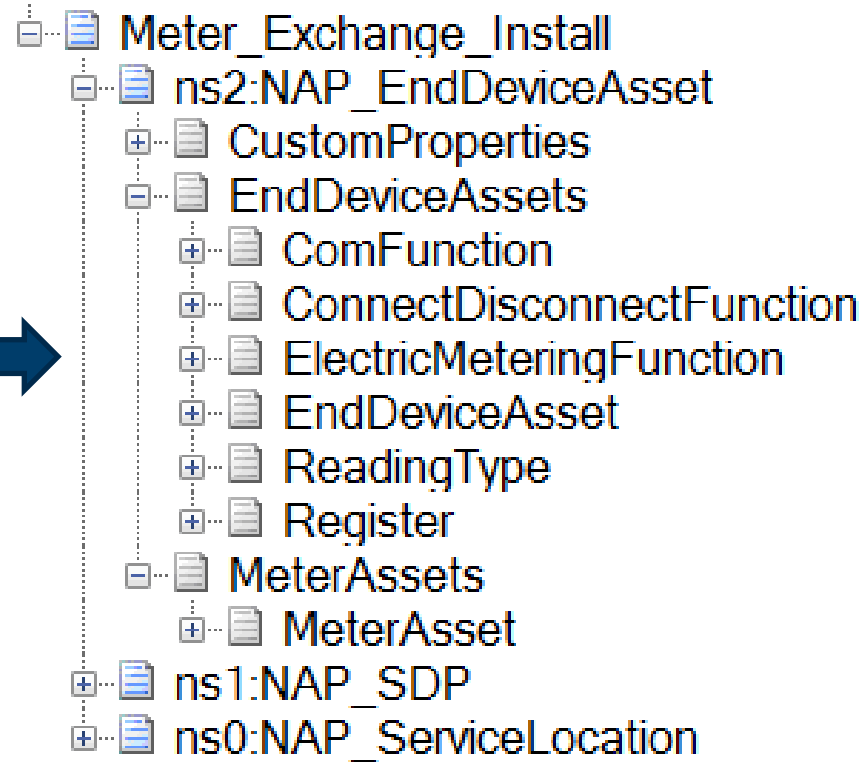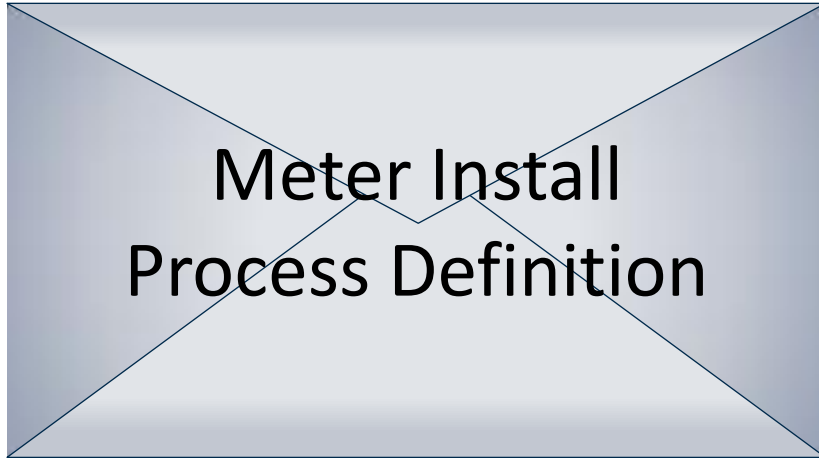 - EndDeviceAsset
  - ReadingType
 - Register
- MeterAssets
  - MeterAsset

Combining extended CIM schemas and "Process Definition" messages allowed Naperville to deliver custom data to multiple systems while still utilizing the CIM.

Meter Install Process Definition

- Meter_Exchange_Install
  - ns2:NAP_EndDeviceAsset
    - CustomProperties
    - EndDeviceAssets
      - ComFunction
      - ConnectDisconnectFunction
      - ElectricMeteringFunction
      - EndDeviceAsset
      - ReadingType
      - Register
    - MeterAssets
      - MeterAsset
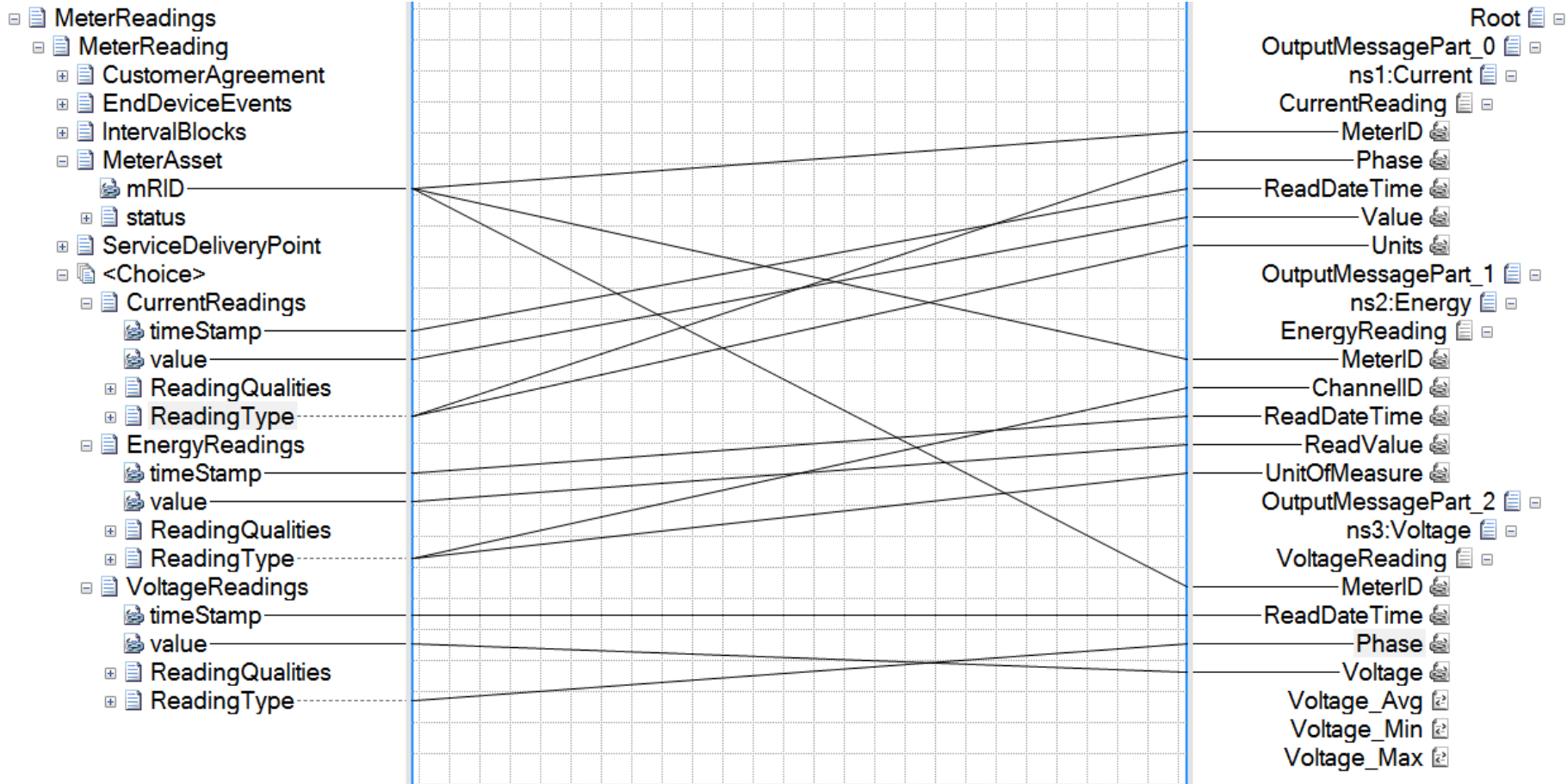 - ns1:NAP_SDP
  - ns0:NAP_ServiceLocation

Message Transformation Considerations

Transformation between CIM schemas and non-CIM compliant interfaces led to additional development effort and performance issues
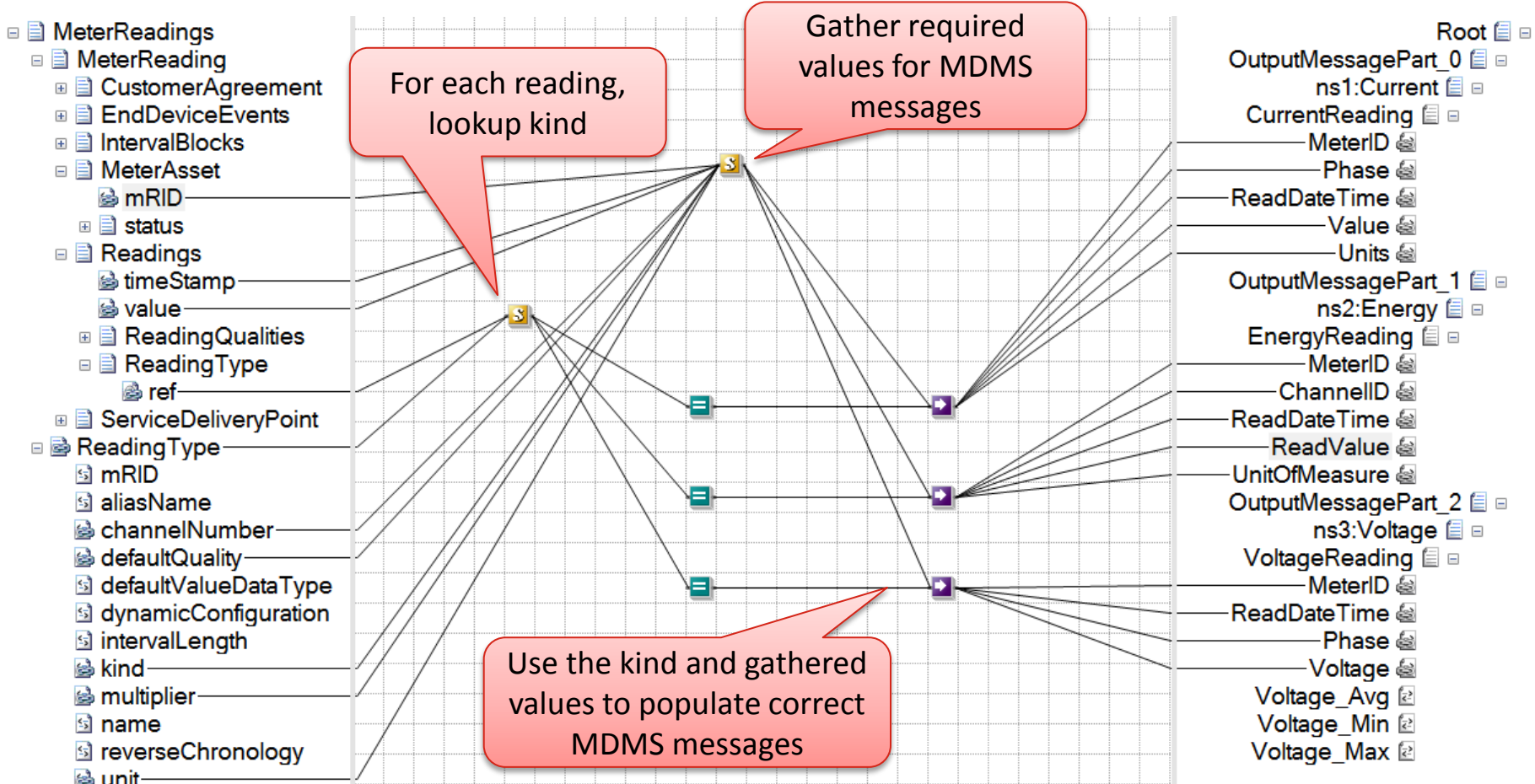
To simplify the transformation, we de-normalized the CIM Meter Readings schema.

The key takeaway from the project is that the CIM provides multiple benefits to an integration project, even when dealing with the challenges of non-CIM compliant systems.

- ◆ Coupling an ESB with the CIM can be very challenging.
  - Every non-compliant interface requires additional time spent on mapping both from inbound vendor into the CIM and from CIM to the outbound vendor
  - Normalizing published data during the mapping process can be challenging and may lead to unintentional issues like performance problems.
- ◆ CIM modification is a signal to take a moment and evaluate the current situation.
  - Do the benefits of a non-CIM compliant system outweigh the integration costs?
  - Why is the system subscribing to a non-standard data flow?
  - Will non-CIM data points improve the end-user's experience?
  - Are CIM schema customizations the result of optimization efforts?
- ◆ Ultimately, we built a future focused, standards-based, robust, scalable integration solution that will support Naperville moving forward.
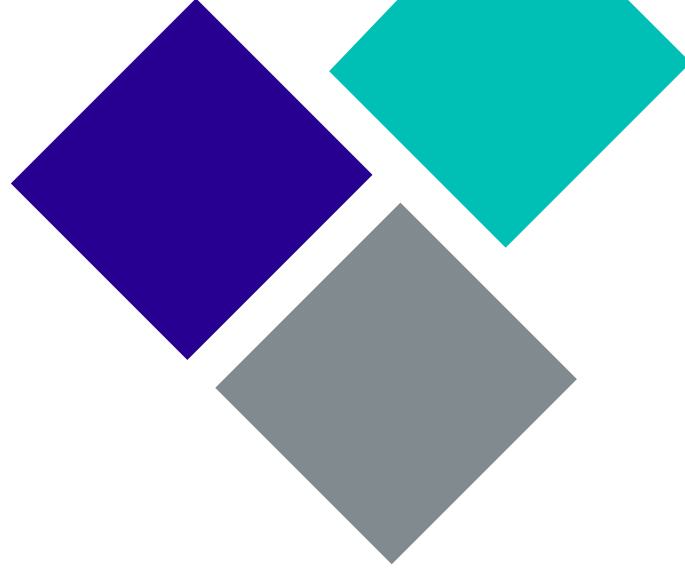
Questions?

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