



## Applying The Generic Interface Definition (GID) As Web Services For Control Center Application Integration Using The Common Information Model (CIM)



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### Topics To Be Discussed:

- Utility Industry Standards
  - The Common Information Model (**CIM**)
  - The Generic Interface Definition (**GID**)
- Overview of Web Services
- Service Oriented Architecture (SOA) and the Enterprise Service Bus (ESB)
- The GID as Web Services
- Application of GID to Control Center Application Integration




# Common Information Model CIM

## Generic Interface Definition GID



**Common Information Model (CIM) is an object-oriented information model of the power system**


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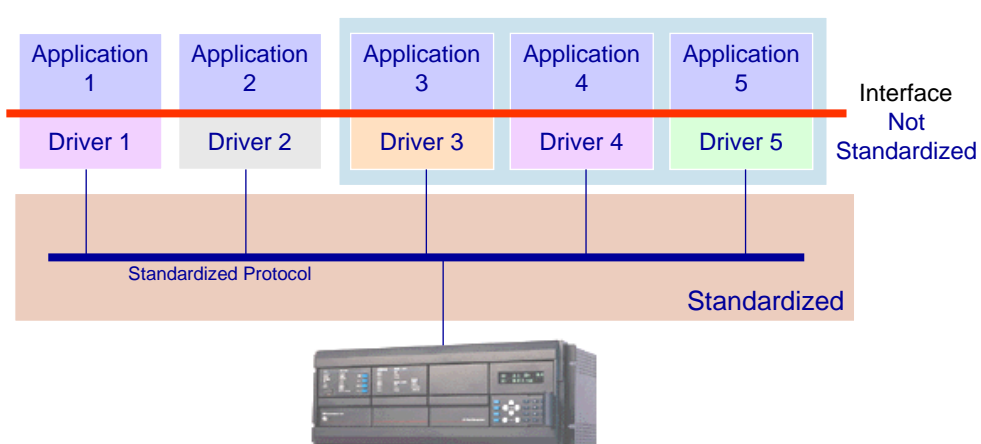
## CIM and GID are Related

- Provide a common agreement on **WHAT** data is exchanged
  - The Common Information Model (CIM)
  
- Provide a common agreement on **HOW** to exchange the data
  - The Generic Interface Definition (GID)
  
- Why do we need interface standards?

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## Interfacing Protocols to Applications



The diagram illustrates the relationship between applications and protocols. At the top, five application boxes (Application 1 to Application 5) are shown. Below each application is a corresponding driver box (Driver 1 to Driver 5). A red horizontal line is drawn across the drivers, with the text "Interface Not Standardized" to its right. Below the drivers is a large brown rectangular area representing a protocol layer. A blue horizontal line is drawn across this area, with the text "Standardized Protocol" to its left and "Standardized" to its right. Vertical lines connect each driver to the protocol layer. At the bottom of the diagram is a photograph of a network device, likely a switch or router, connected to the protocol layer.

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**Impact of Lack of Interface Standards**



- Each application developer has to develop drivers for all popular protocols.
- Application developers spent considerable resources on drivers instead of applications.
- Result:
  - Everybody has to solve the same protocol problems (less interoperability)
  - Have to make application decisions based on protocol functionality (less choice)
  - Less application functionality
  - Higher application costs

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**Using Protocols: Interface Standards Useful**

The diagram illustrates a network architecture where five applications (Application 1 to Application 5) are connected to a central network device. Application 1 and Application 2 each have their own individual driver. Application 3, Application 4, and Application 5 share a single, common driver. All drivers are connected to a central horizontal bus, which is then connected to a network device (represented by a rack-mounted unit).



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## Interface Standards

- Enables interoperability for applications and devices with minimal development
- Allows more resources to be applied to applications
- Enables 3<sup>rd</sup> party market for drivers and applications
  - Enables niche players to exist
- All parties have a self-interest in seeing that this works
- Results
  - More Choice
  - Less Work
  - **Lower Costs**
- **WIDESPREAD SUCCESS IN PROCESS AND AUTOMATION INDUSTRIES**



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## GID provides standardized interfaces

- GID (IEC61970-40X) Interfaces:
  - Generic Data Access (GDA): For model management/access and distribution of model updates.
  - High-Speed Data Access (HSDA): For access to real-time measurement data.
  - Time Series Data Access (TSDA): For access to historical measurement data.
  - Generic Events and Subscriptions (GES): For pub/sub of generic XML messages.
- GID is based on existing open standards for both energy and industrial:
  - Object Management Group (OMG): Data Access for Industrial Systems, Data Access Facility.
  - OLE for Process Control (OPC): Data Access, Historical Data Access, Alarms & Events.



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## GID is based on existing widely used standards

- OPC Foundation (<http://www.opcfoundation.org>) developed application programming interfaces to enable plug and play of applications and drivers called OLE for Process Control (OPC).
  - OPC Foundation: 362 member companies (end users and OEMs)
- OPC is dominant in the industrial automation and process control industries providing connectivity to **hundreds of key applications**.
- GID is a platform independent version of OPC supporting a model driven architecture capable of being used on any computing platform.

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## GID and OPC

GID Service	OPC
<b>HSDA</b> High Speed Data Access	<b>DA</b> Data Access
<b>TSDA</b> Time Series Data Access	<b>HDA</b> Historical Data Access
<b>GDA</b> Generic Data Access	<b>UA Query</b> Unified Architecture (future)
<b>GES</b> Generic Eventing and Subscriptions	<b>AE</b> Alarms & Events

- GID is platform independent AND model-driven:
  - OPC uses vendor determined namespace for data
  - GID uses a namespace derived from the CIM for all data

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## Overview of Web Service Based Integration





The GID as a Web Service



## A Disclaimer



- Many many options and architectures involving languages, transport, XML, etc. can all be referred to as "Web Services"
- Simplified overview to illustrate some basic points



## What are Web Services?

- A structured integration architecture using XML messaging over a similar network architecture as the world-wide web (WWW)
- Web Services:
  - Can reuse existing network infrastructure used by the WWW (Internet, Intranet)
  - Allows a client to discover the services and data supported by a server.
  - Defined by the World Wide Web Consortium: <http://www.w3c.org>
  - Uses a standard framework for integration development using widely deployed tools (Java (etc.), .Net, etc.)



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## The World Wide Web

- Uniform Resource Identifiers – URI
  - Provide defined ids to refer to elements on the web
  - Successor to the Uniform Resource Locator (URL)
- Hyper-Text Markup Language – HTML
  - A standardized method to describe document structures allowing browsers to render information for the human reader
  - Predecessor of eXtensible Markup Language (XML) – a more generalized language not tied specifically to document rendering
- Hyper-Text Transport Protocol – HTTP
  - A standard protocol for web clients (browsers) to communicate with web servers



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## Web Services is Similar

- Universal Description, Discovery, and Integration (UDDI)
  - Framework for describing, discovering and managing web services
- Web Services Description Language (WSDL)
  - An XML format for describing the network services operating on XML messages containing either document-oriented or procedure-oriented information.
- Simple Object Access Protocol (SOAP)
  - An XML based protocol for exchange of information in a distributed environment over HTTP.

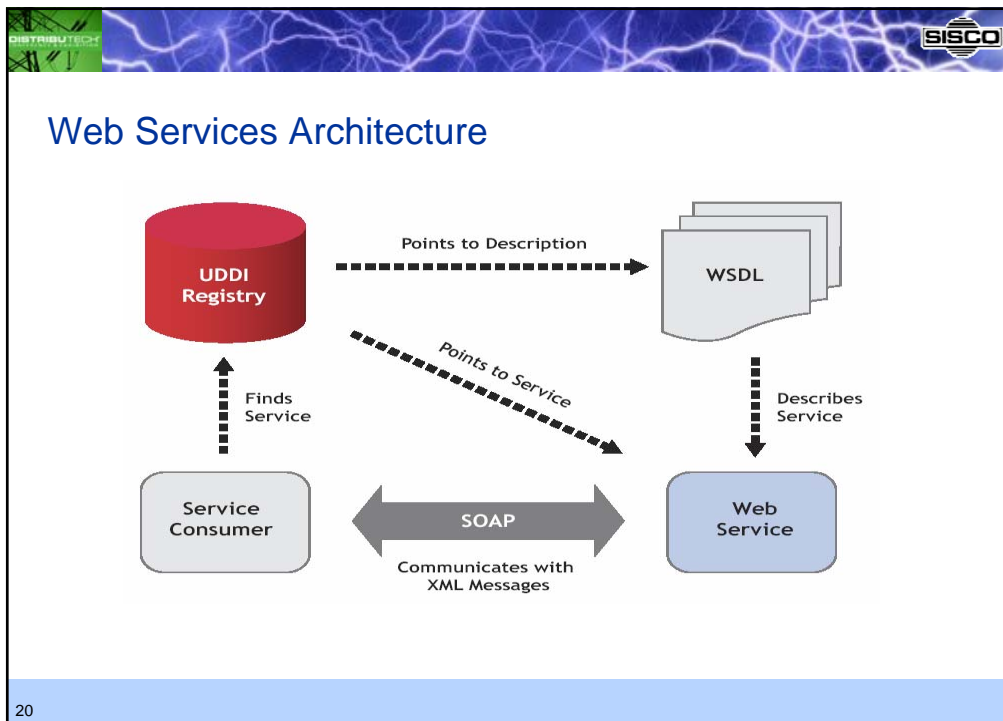
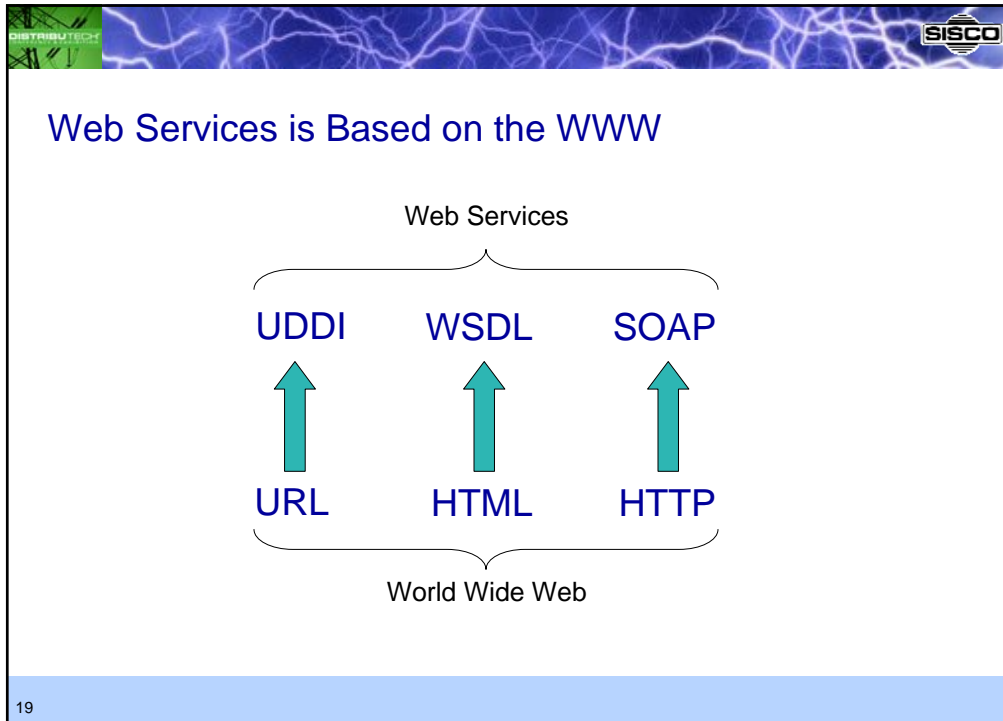
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## Brief Tutorial

- Web Services Description Language (WSDL) consists of:
  - Types – a container for data type definitions.
  - Message – an abstract, typed definition of the data being communicated.
  - Operation – an abstract description of an **action** supported by the service.
  - Port Type – an abstract set of operations supported by one or more endpoints.
  - **Binding – a concrete protocol and data format specification for a particular port type.**
  - Port – a single endpoint defined as a combination of a binding and a network address.
  - Service – a collection of related endpoints.
- Simple Object Access Protocol (SOAP)
  - Envelope - Describes what is in a message and how to process it
  - A set of encoding rules for expressing instances of application-defined data types within a message (e.g. the "Body")
  - A convention for representing remote procedure calls and responses.

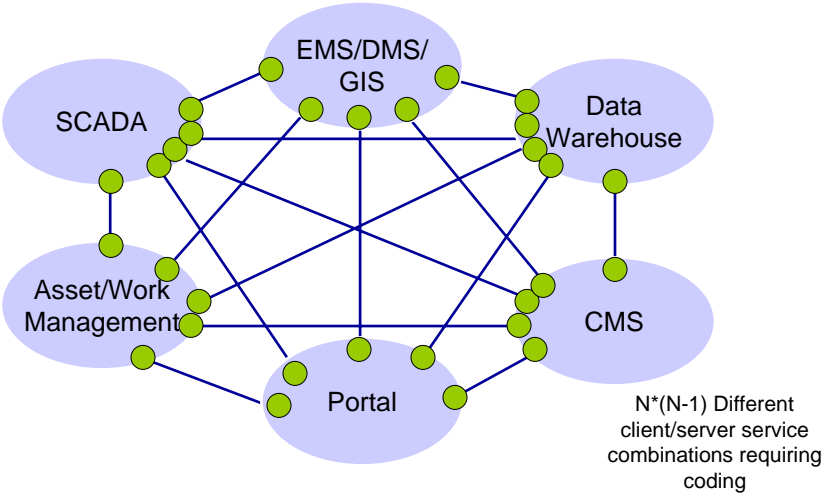
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## Service-Oriented Architecture (SOA)

- A **service-oriented architecture (SOA)** is an application framework that takes applications and breaks them down into individual business functions and processes, called **services**.
- Services are the building blocks of an SOA.
  - A service can be a business function, such as find the location of an asset, or determine a voltage level at a certain time, or a system capability such as authenticate user.
  - SOAs enable “packaging” business functions from new and existing applications in a simple and standardized way.
  - An SOA increases flexibility by treating elements of business processes and the underlying IT infrastructure as secure, standardized components (services) that can be reused and combined to address changing business priorities.
- **Can’t maximize the value of an SOA without open standards.**

## Generic Web Service Integration



Typically no agreement on common messages, models, services, etc.

**What is an Enterprise Service Bus (ESB)?**



**Flexible connectivity infrastructure for integrating applications and services to power SOA**

- ▶ **ROUTING** messages between services
- ▶ **CONVERTING** transport protocols between requestor and service
- ▶ **TRANSFORMING** message format between requestor and service
- ▶ **HANDLING** business events from disparate sources

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**Components Connect To An ESB Using Web Services**



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## SOA using ad-hoc web services with an ESB

- Significant benefits due to use of standards:
  - SOAP – HTTP for transport
  - WSDL to describe the services and messages supported
- Ad-hoc because each application specifies its own services
  - Each service provider independently defines their own services (WSDL)
  - Each client needing to access a service must discover and adapt to each unique web service provider.
  - Application integration still requires significant programming effort unique to:
    - The specific application functions involved
    - The developer/brand of the applications
- Result: **integration is customized and unique to each and every system**

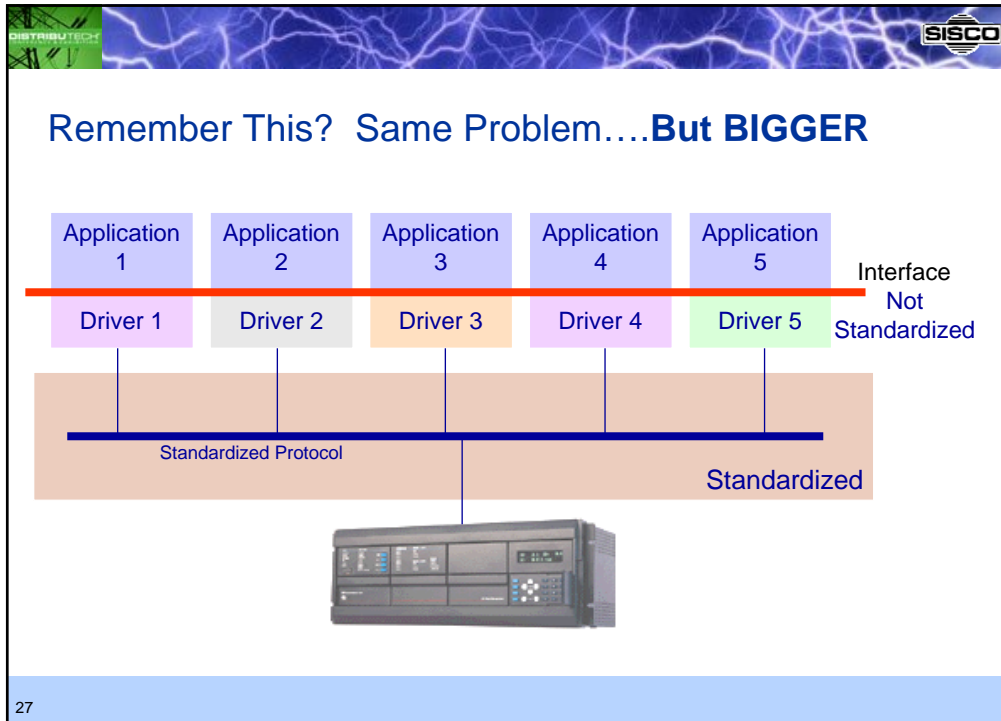
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  - Defined by the World Wide Web Consortium: <http://www.w3c.org>
  - Uses a standard framework for integration development using widely deployed tools (Java (etc.), .Net, etc.)
- **Web Services Do Not**
  - **Interpret and understand tags, values, or descriptions semantically (no standardized model)**
  - **Automatically connect services unless identical models are used**
  - **Define standardized services – only a standardize method of discovering, invoking, and managing services**

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## CIM and GID - Enable More Interoperability in a Web Services Environment

- Provide a common agreement on **WHAT** data is exchanged
  - The Common Information Model (CIM)
  - Standardized Data and Message Types
  
- Provide a common agreement on **HOW** to exchange the data
  - The Generic Interface Definition (GID)
  - Standardized Services to Exchange Data and Messages


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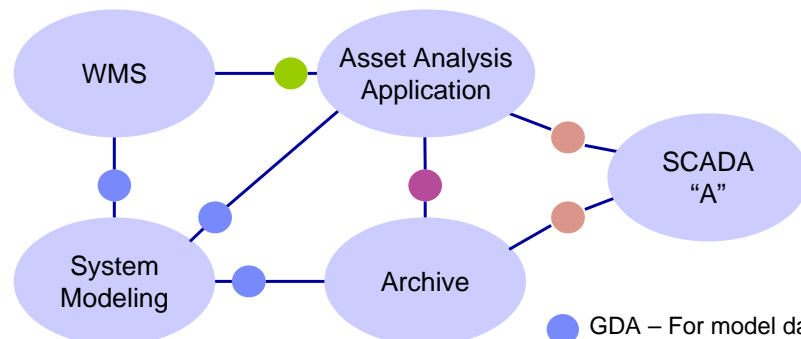
## GID provides standardized interfaces and services

- GID Interfaces:
  - Generic Data Access (GDA): For model management and distribution of updates.
  - High-Speed Data Access (HSDA): For access to real-time measurement data.
  - Time Series Data Access (TSDA): For access to historical measurement data.
  - Generic Events and Subscriptions (GES): For pub/sub of generic XML messages including IEC61968 (WG14) Messages
- Interfaces are translated into services via WSDL for each GID interface in the IEC61970-40X specifications
- Results in GID as standardized web services

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## Integration Using GID Services

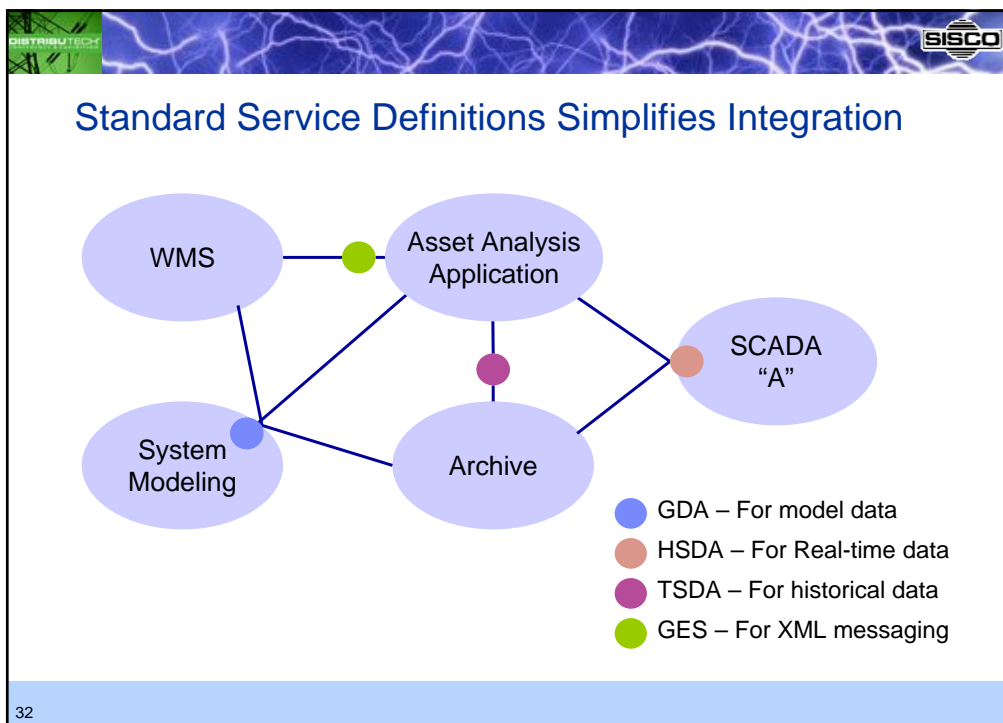
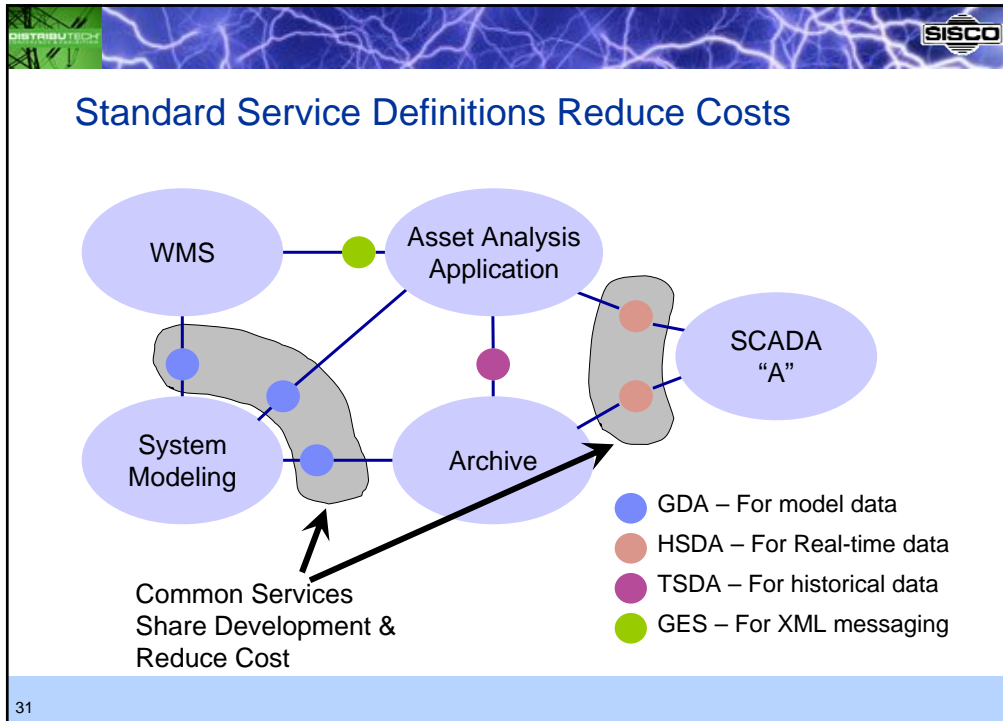


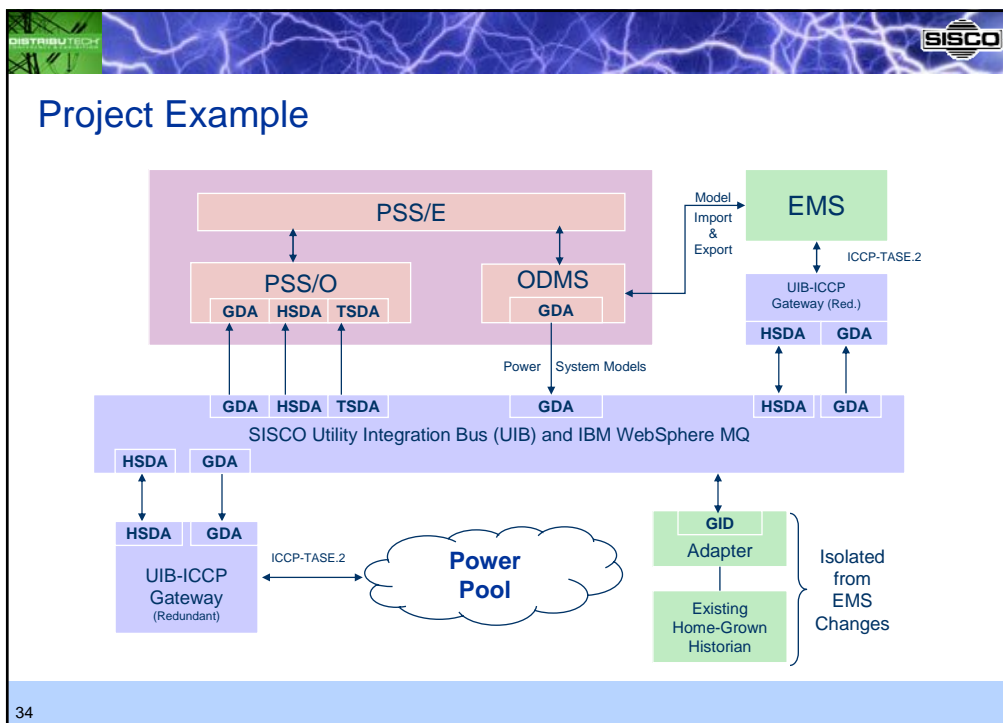
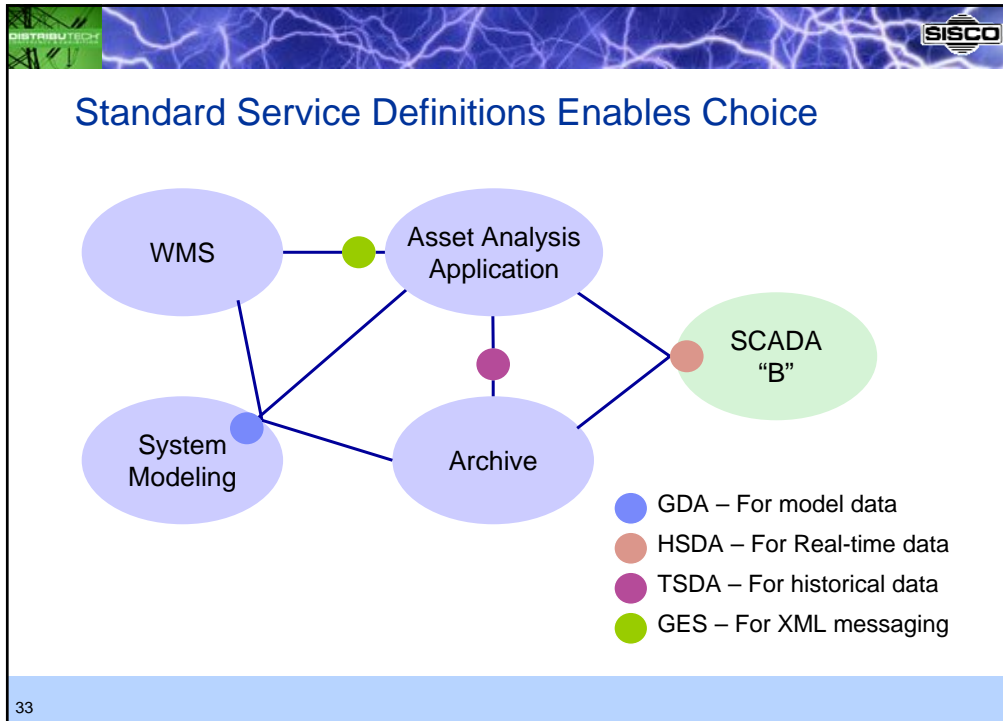
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    graph TD
      WMS --- GDA1(( )) --- SystemModeling[System Modeling]
      SystemModeling --- GDA2(( )) --- Archive
      Archive --- TSDA(( )) --- AssetAnalysis[Asset Analysis Application]
      AssetAnalysis --- GES(( )) --- WMS
      AssetAnalysis --- HSDA1(( )) --- SCADA[SCADA "A"]
      Archive --- HSDA2(( )) --- SCADA
  
```

- GDA – For model data
- HSDA – For Real-time data
- TSDA – For historical data
- GES – For XML messaging

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## GID Service Definitions – Status

- IEC61970-4XX Standards (GID):
  - Committee Draft August 2005
  - Web Service Implementations planned for 2006
- Existing GID Services:
  - High-Speed Data Access (HSDA)
    - OPC Data Access XML WSDL Exists today
  - Time-Series Data Access (TSDA)
    - SISCO developed XML based on similar approach to OPC DA XML

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## How can users help promote standardization?

- CIM Users Group is being formed as a special interest group of the UCA International Users Group for industry stakeholders to work together to improve CIM/GID standards
  - Maintain CIM model
  - Resolve technical issues
  - Conformance and interoperability testing
  - Maintain repositories:
    - Shared user experiences
    - CIM model extensions/artifacts, message templates, etc developed for projects
    - Sample files, models, white papers, etc.
- Benefits of joining:
  - Support rigorous product testing certification activities that will lower your system implementation costs
  - Gain timely access to information on standards activities and provide input at minimal cost and effort without joining the standards committees
  - Members only access to, technical information, repositories, and documents
  - Participate and help direct resolution of technical issues related to CIM/GID standards
  - Voting privileges

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## Conclusions

- SOA and ESB and the entire web service architecture is a robust widely used integration framework:
  - Widespread tool support
  - Discovery of services and models
  - Formalized description of semantics
- Without standardization of services application integration still depends on custom code and/or configuration that makes each system unique depending on the specific applications and business functions implemented.
- Using standardized GID based services enables reduces uniqueness increasing likelihood of off-the-shelf solution and reusability of developed code reducing costs.

## Thank You



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