

DevCon 2006

OPC Unified Architecture

A 3-day Conference for: **Decision Makers, Engineers & Visionaries**

OPC-UA Architecture

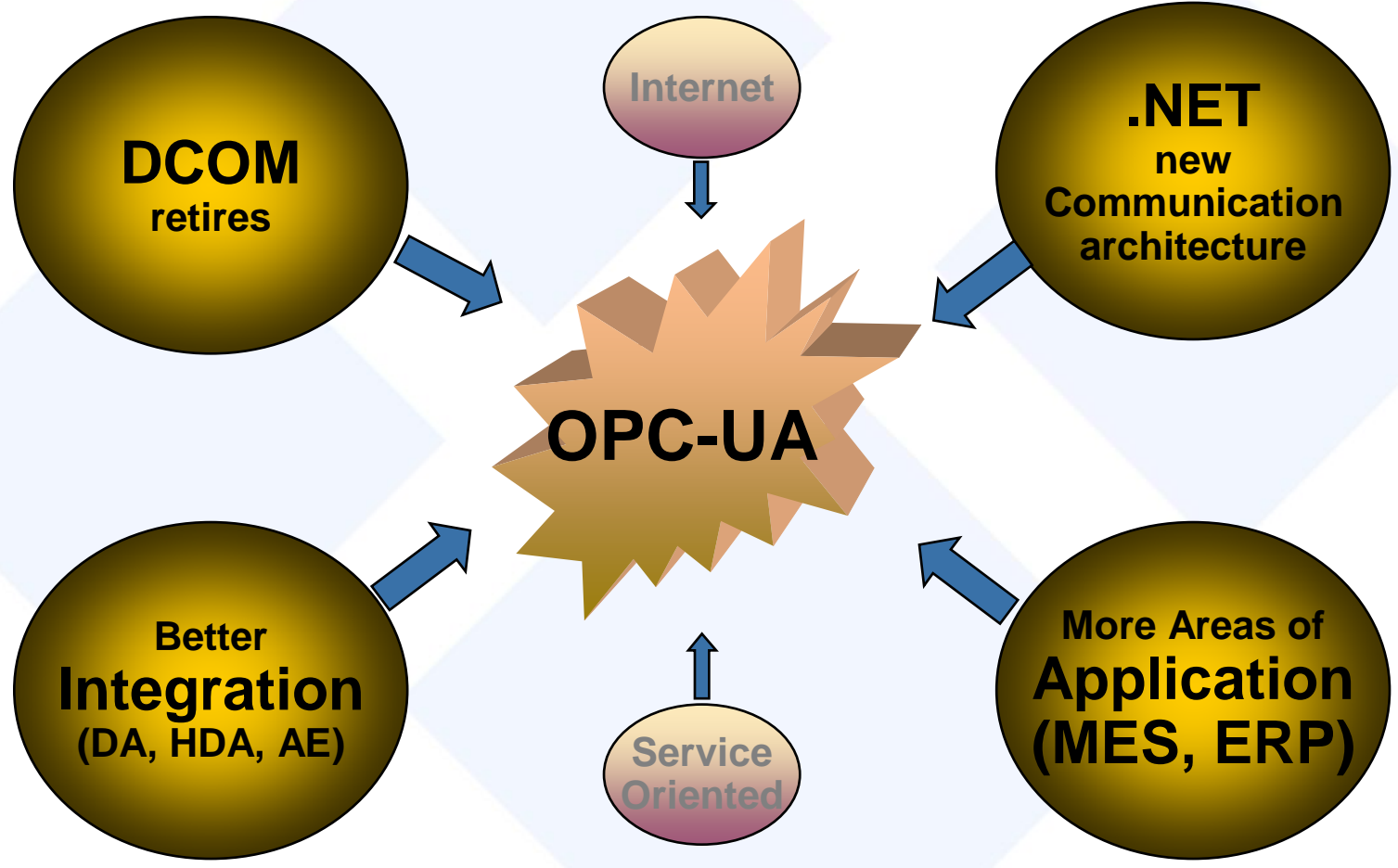
OPC just keeps getting better...

Jim Luth

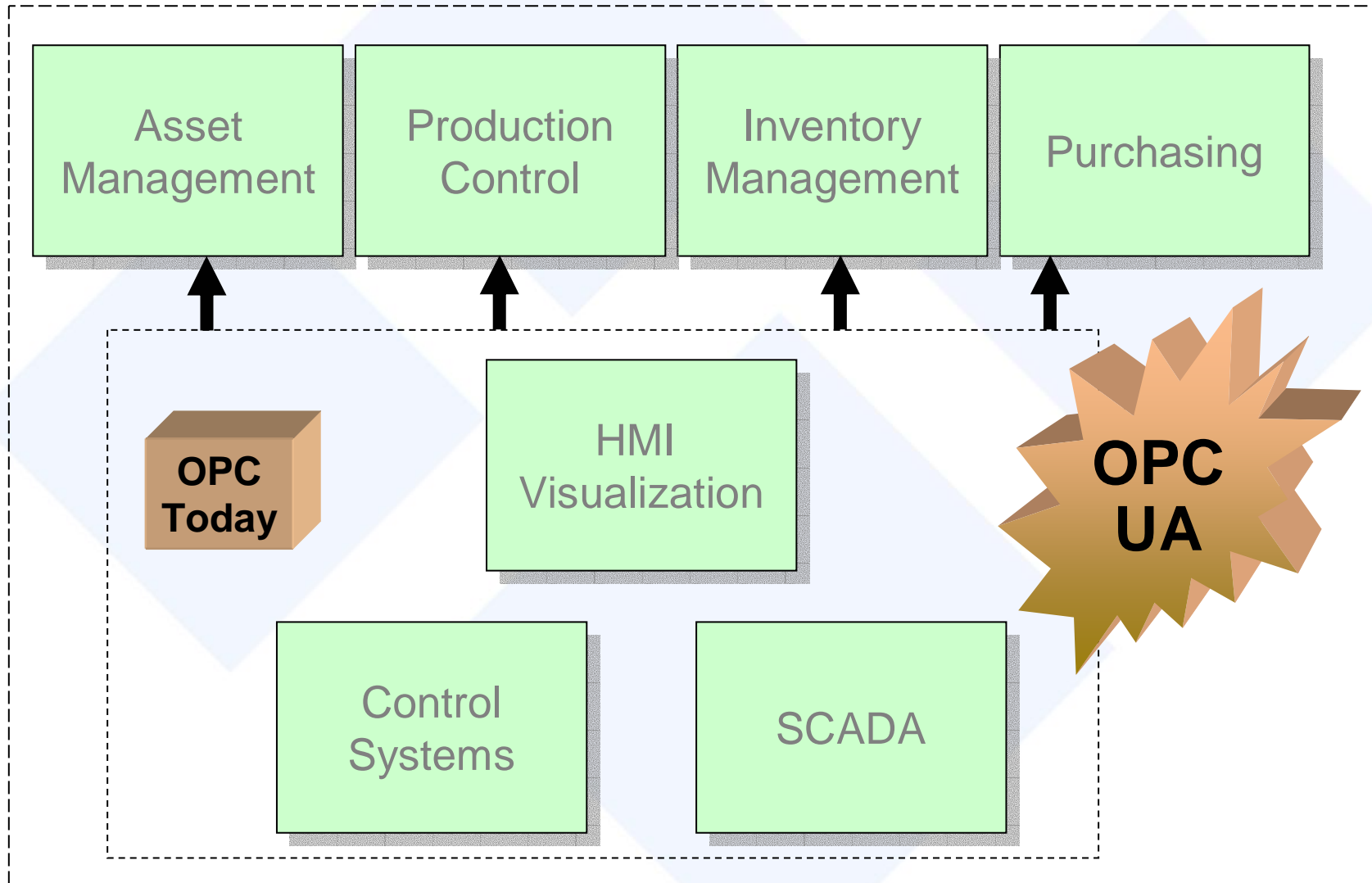
OPC Foundation Technical Director

October 2006

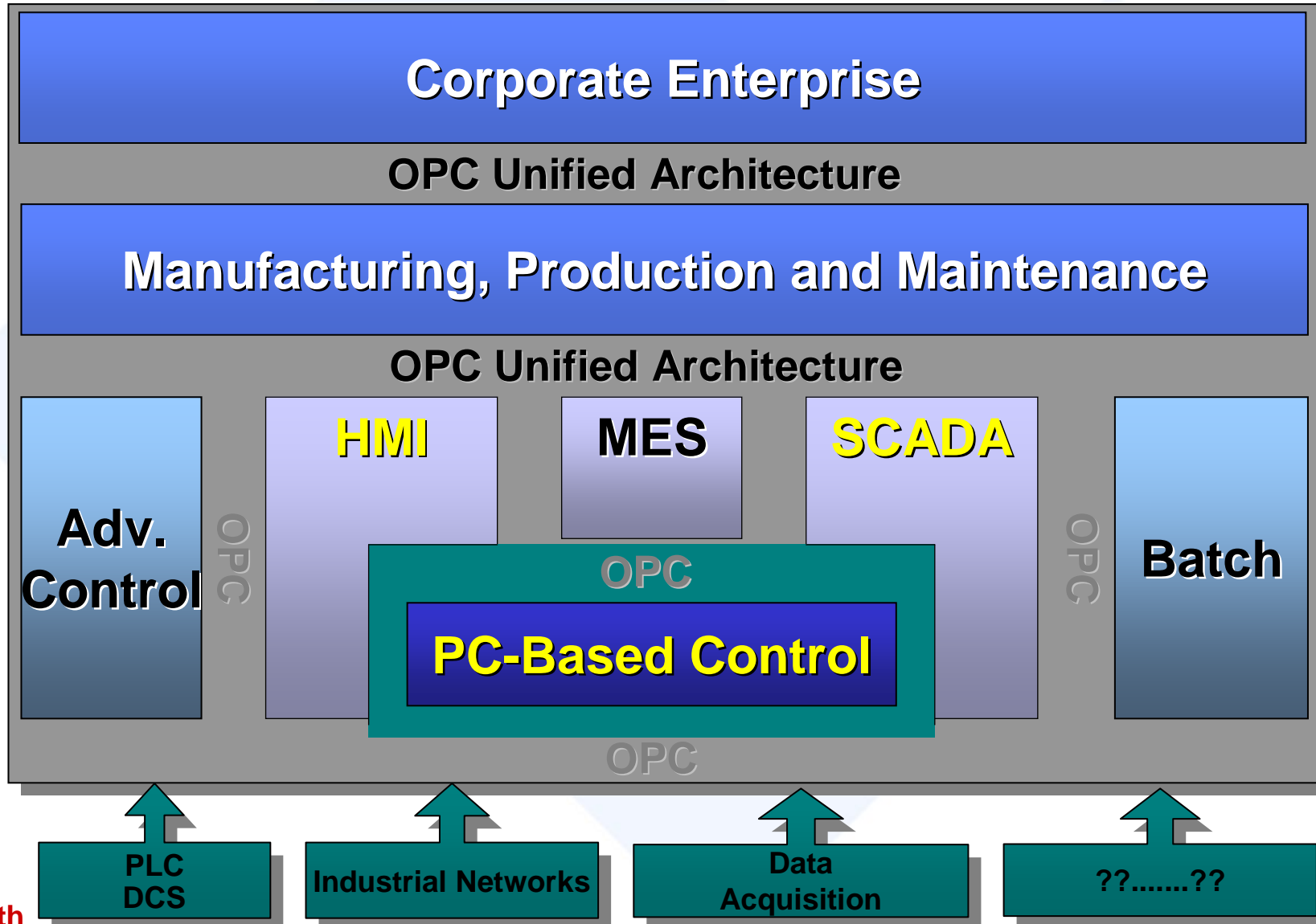
OPC Unified Architecture Motivation

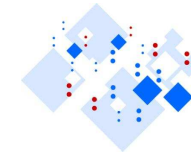


Enterprise Integration



Industry-Standard
interOperability, Productivity & Collaboration





● Architecture

- Integration of DA, A&E, Commands, Complex Data, and Object Types

● Designed for Federation

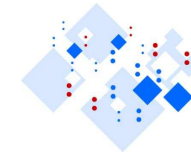
- abstract data/ information from the plant floor, through information models, and up to enterprise systems

● Information Modeling

- development and deployment of standard information models to address industry domains specifics

● Complex Data

- OPC Standard & Domain & vendor specific.....



● Security

- Collaboration, Development & Reference

● Enterprise Integration

- OPC UA standard messaging system

● Robustness / Reliability Designed & Built in....

- NO Failures
- Sequence numbers, keep-alives, resyncing, and support for redundancy

● Commands

● Companion Standards

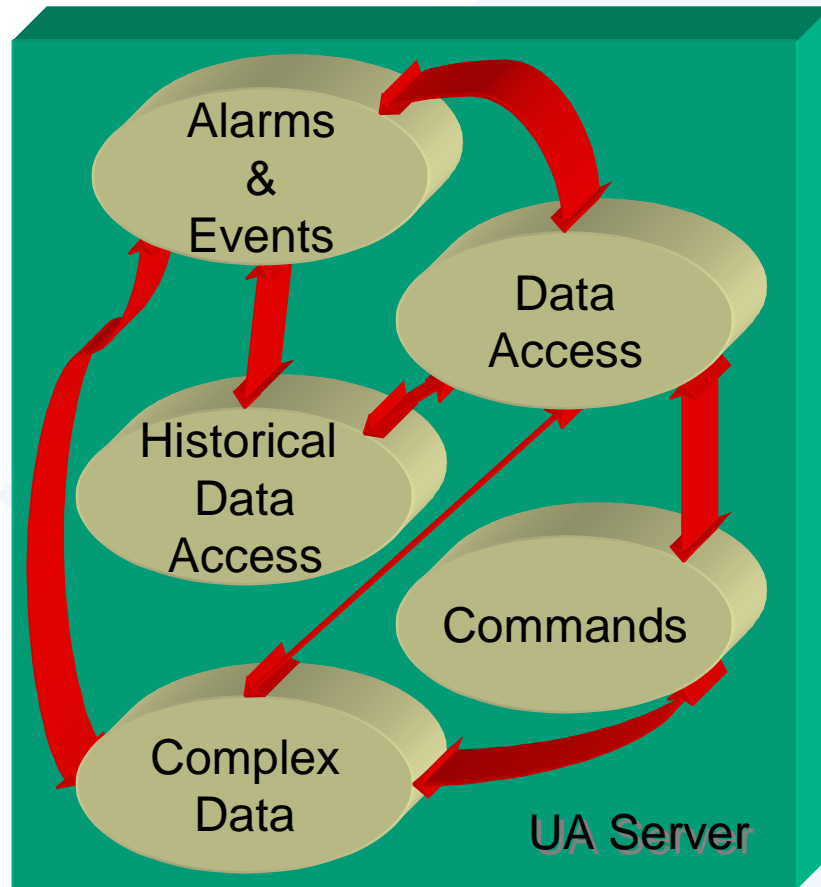
- industry groups define what OPC Unified Architecture “transports”

OPC-UA Fundamentals

- Based on standards for the Web
 - XML, WSDL, SOAP, WS-*
- WS-Policy negotiates protocol and encoding
- WS-SecureConversation provides secured sessions
- Optimized for the Intranet
 - OPC Binary encoding over TCP



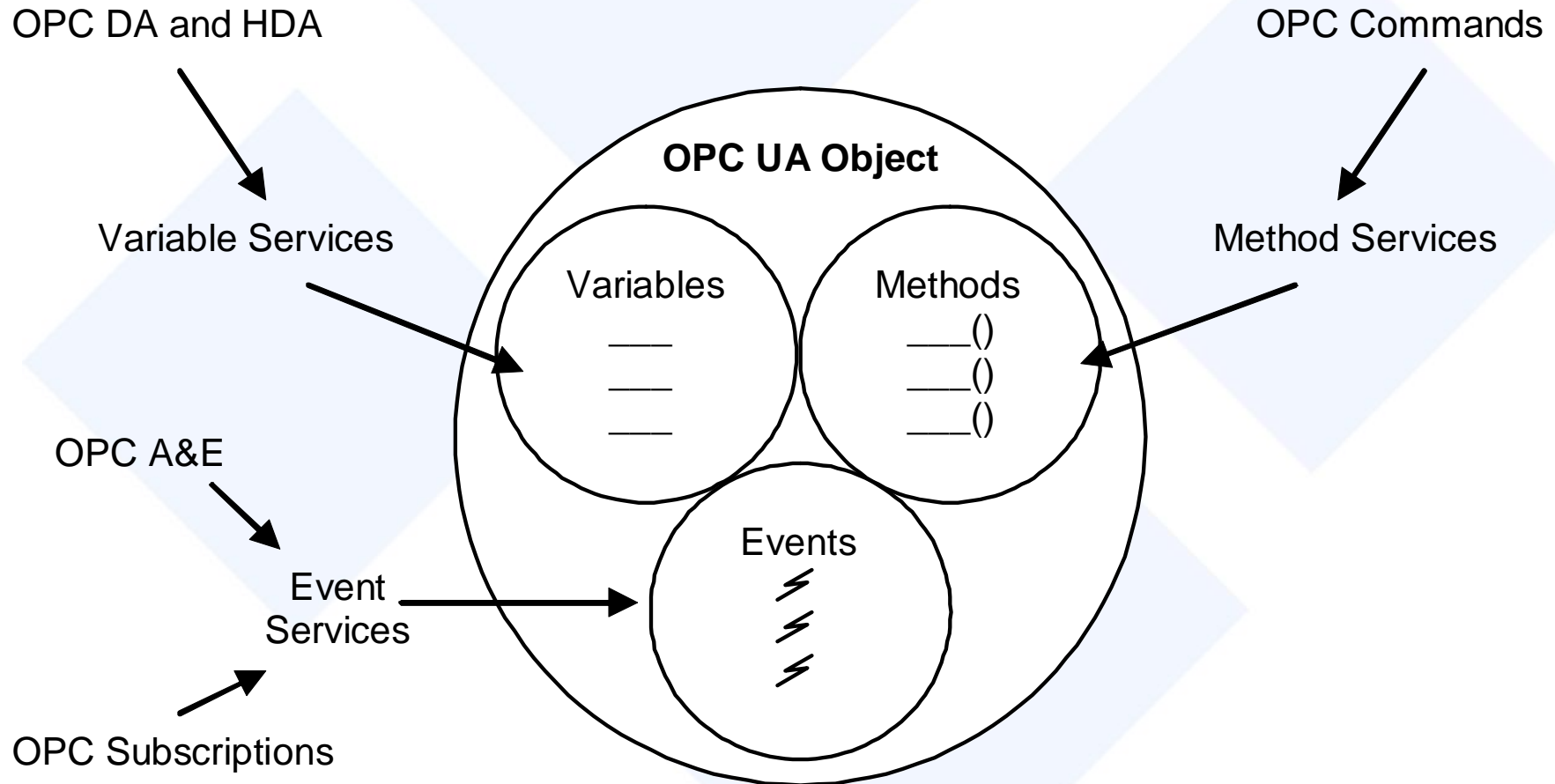
OPC Interface Unification



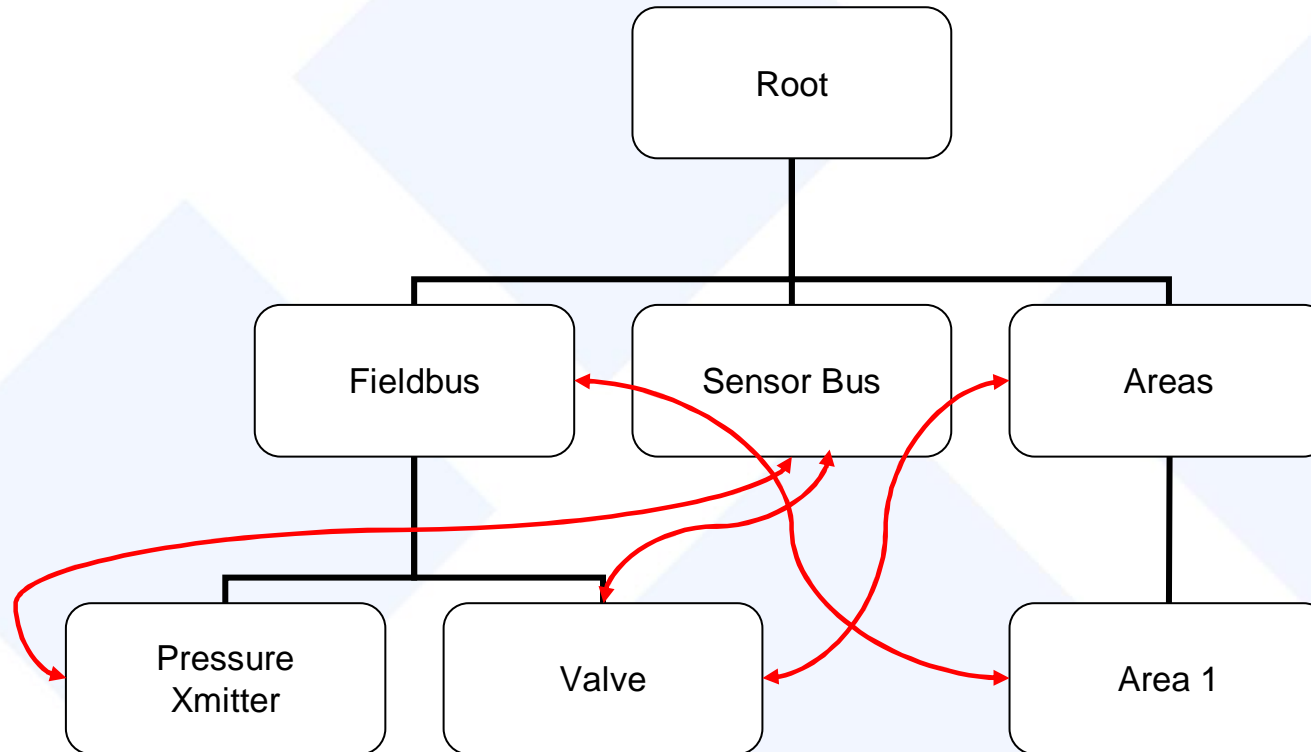
- SOA (Service Oriented Architecture)
- Single set of Services
 - Query, Read, Write, Subscribe...
- Named/Types relationships between nodes

The UA Server embodies the functionality of existing OPC Servers using a single set of services

Unified Object Model

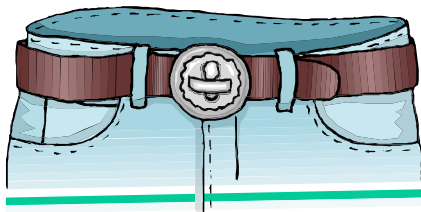
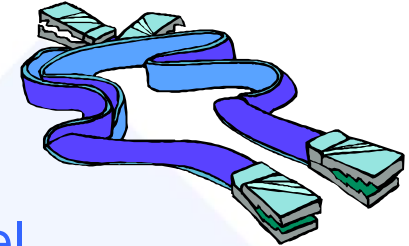


OPC-UA Address Space



- Full Mesh – Network Model
- Unlimited Named/Typed Relationships
- “Views” are used to present hierarchies

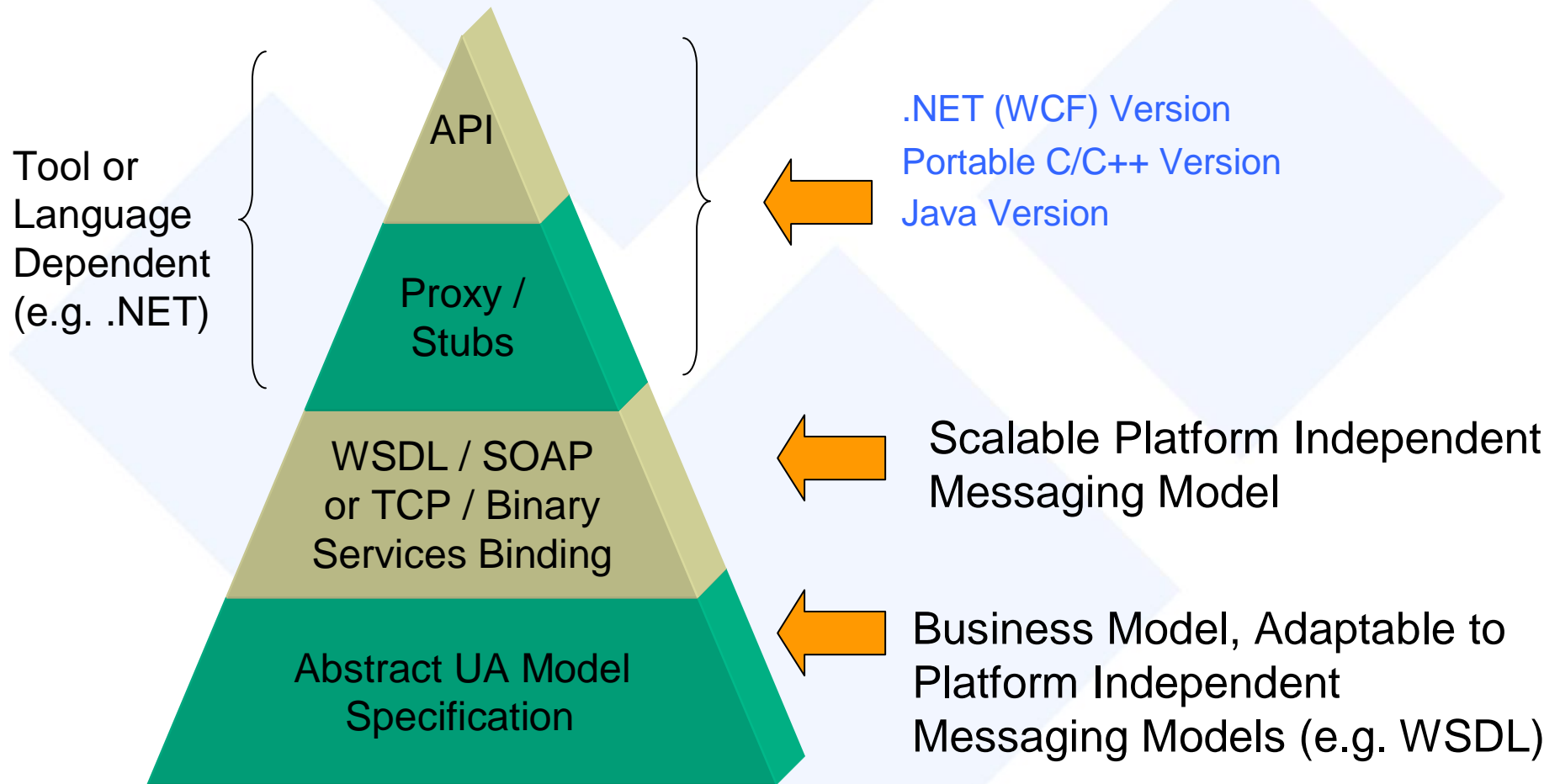
- Subscription Update Features
 - Keep-alive (heartbeat) messages
 - Allows clients to detect a failed server or channel
 - Sequence Numbers in each update message
 - Allows client re-sync to obtain missed messages
 - Decouples callback channel from notification mechanism, allowing callback channel to be reset without loss of data
- Redundancy Features
 - Designed for easy (optional) redundancy of both Clients and Servers
 - e.g. re-sync request can be sent to a backup server



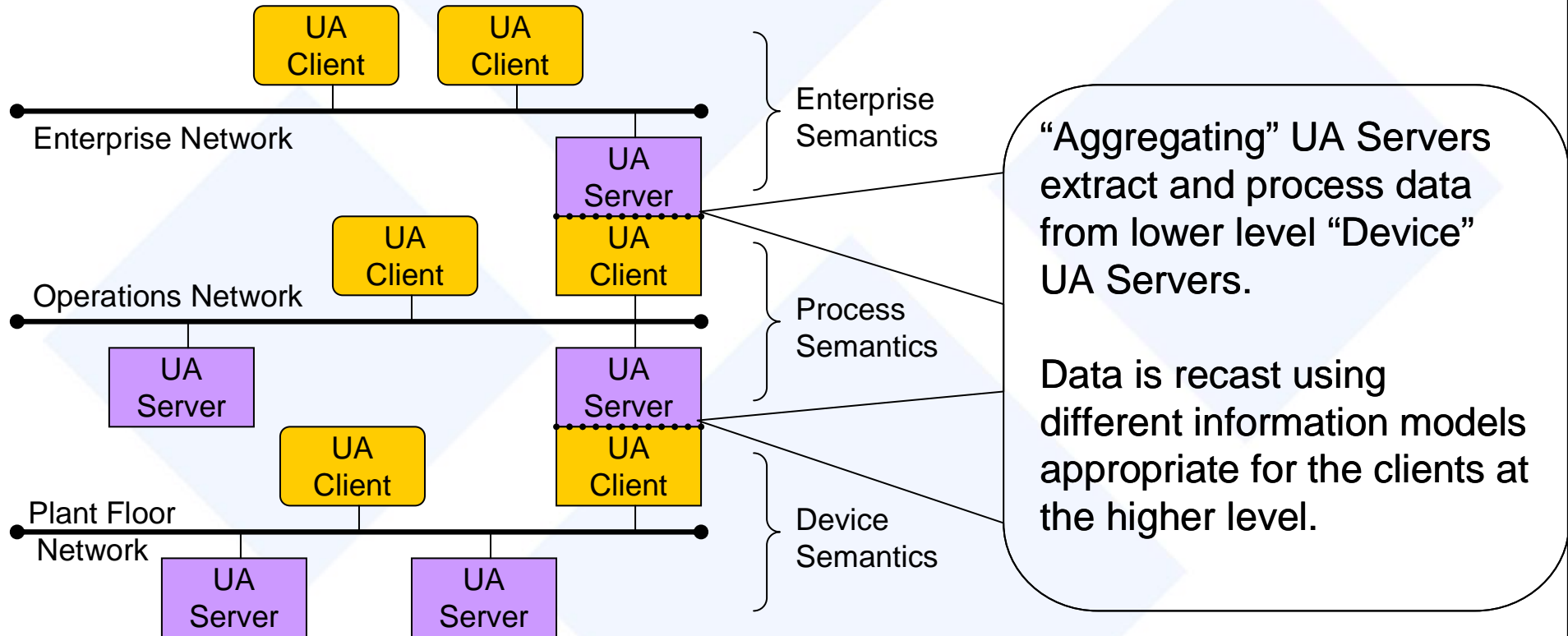
- UA Clients present credentials to UA Servers (x509 certs on both sides).
- UA Servers require authentication and authorization.
 - Access control can be fine-grained down to the property level.
- Optional message signing and encryption.



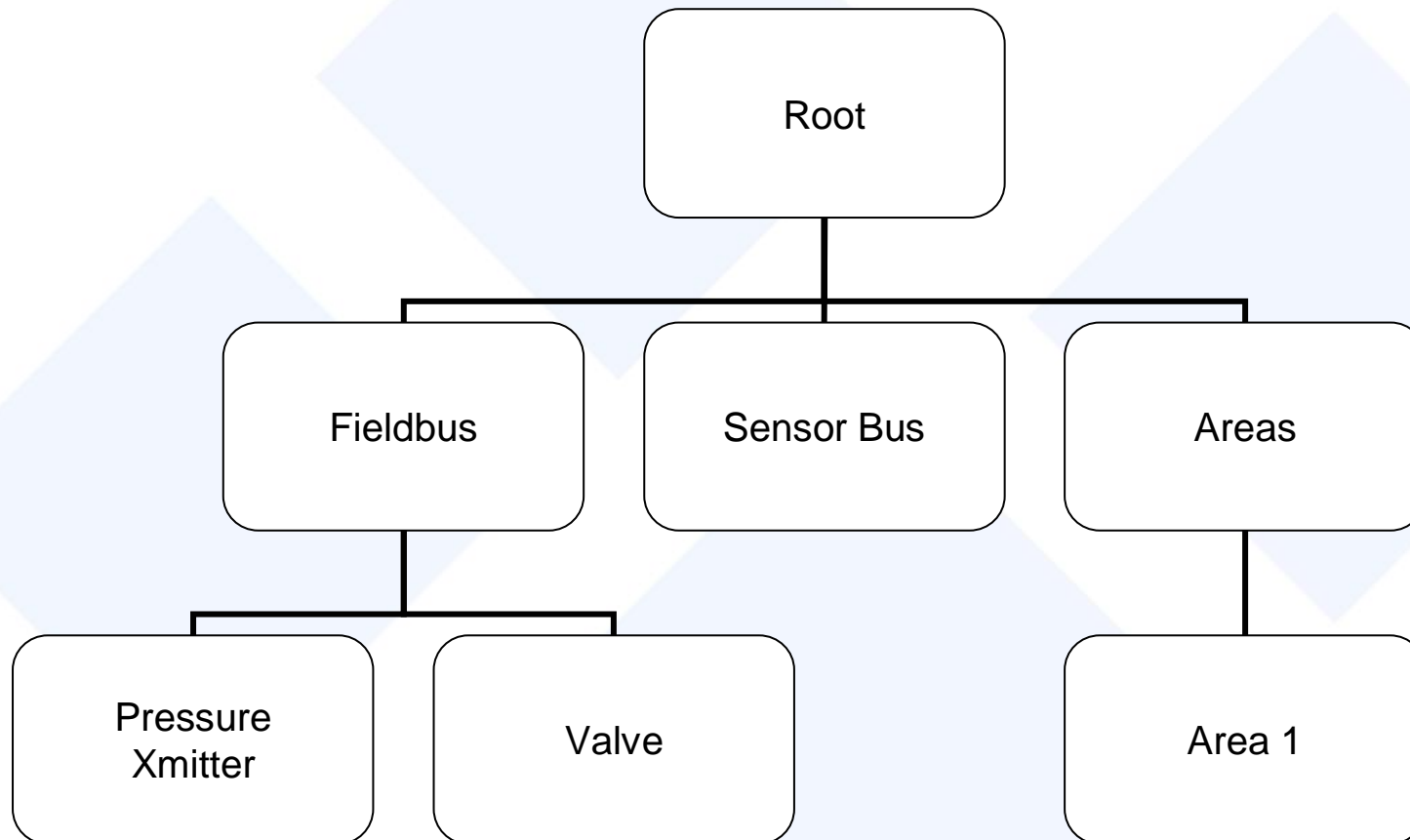
Communication Layering



UA Server Chaining

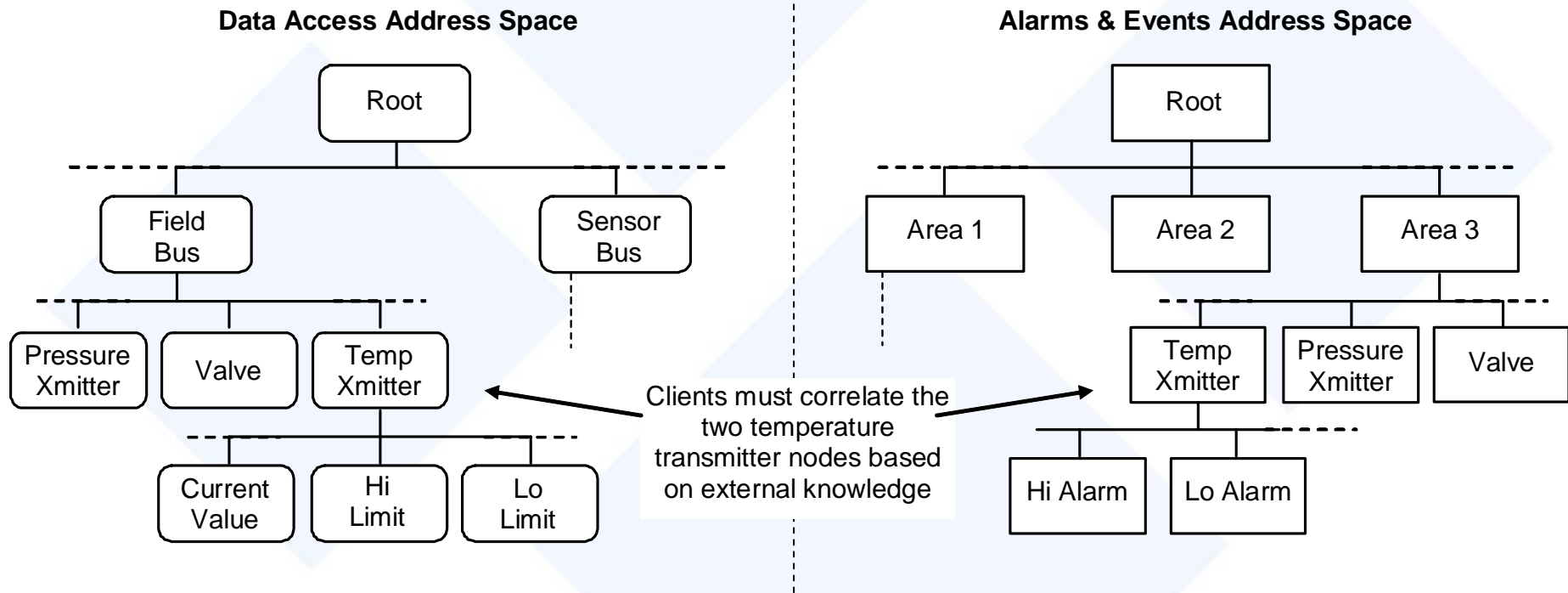


OPC Address Space Today

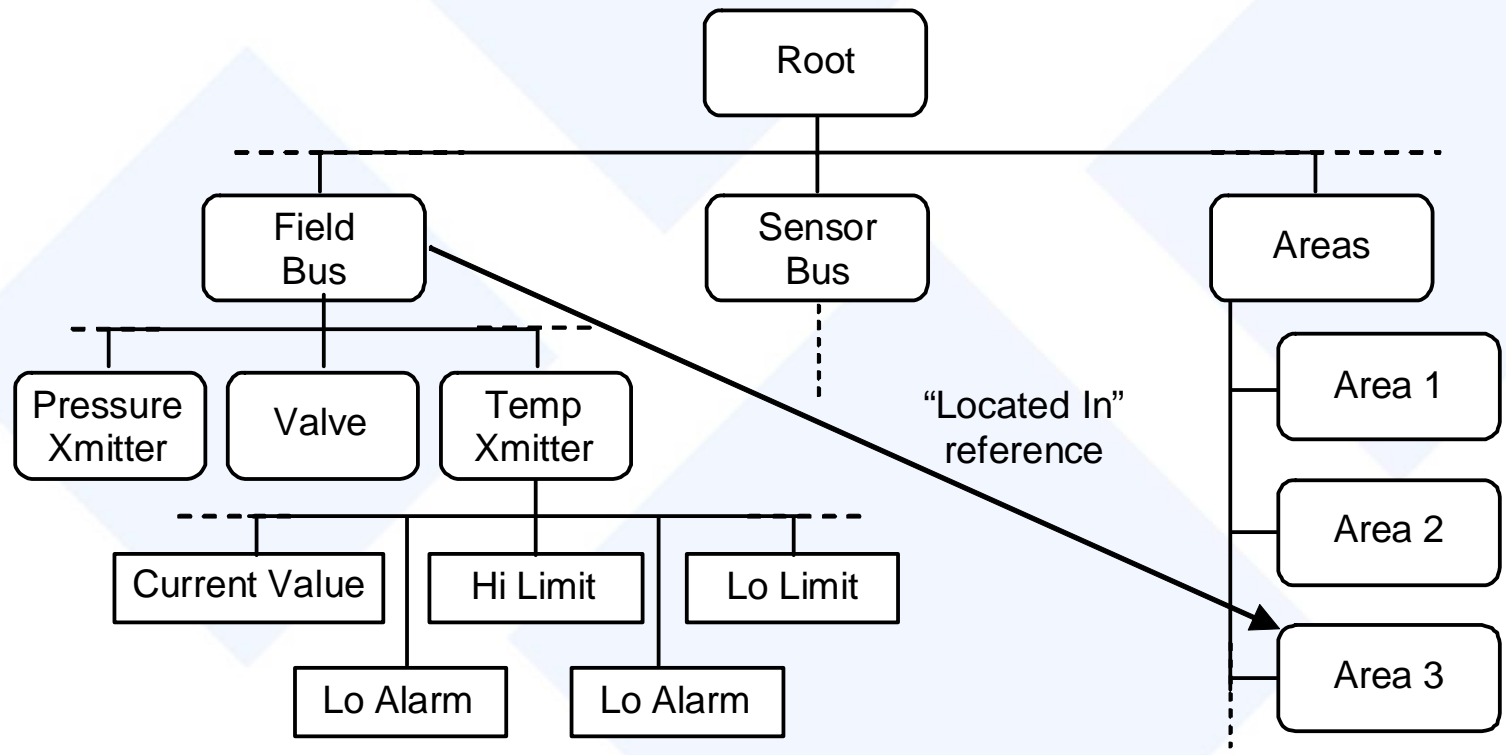


- Pure Hierarchy
- Parent/Child Relationships Only

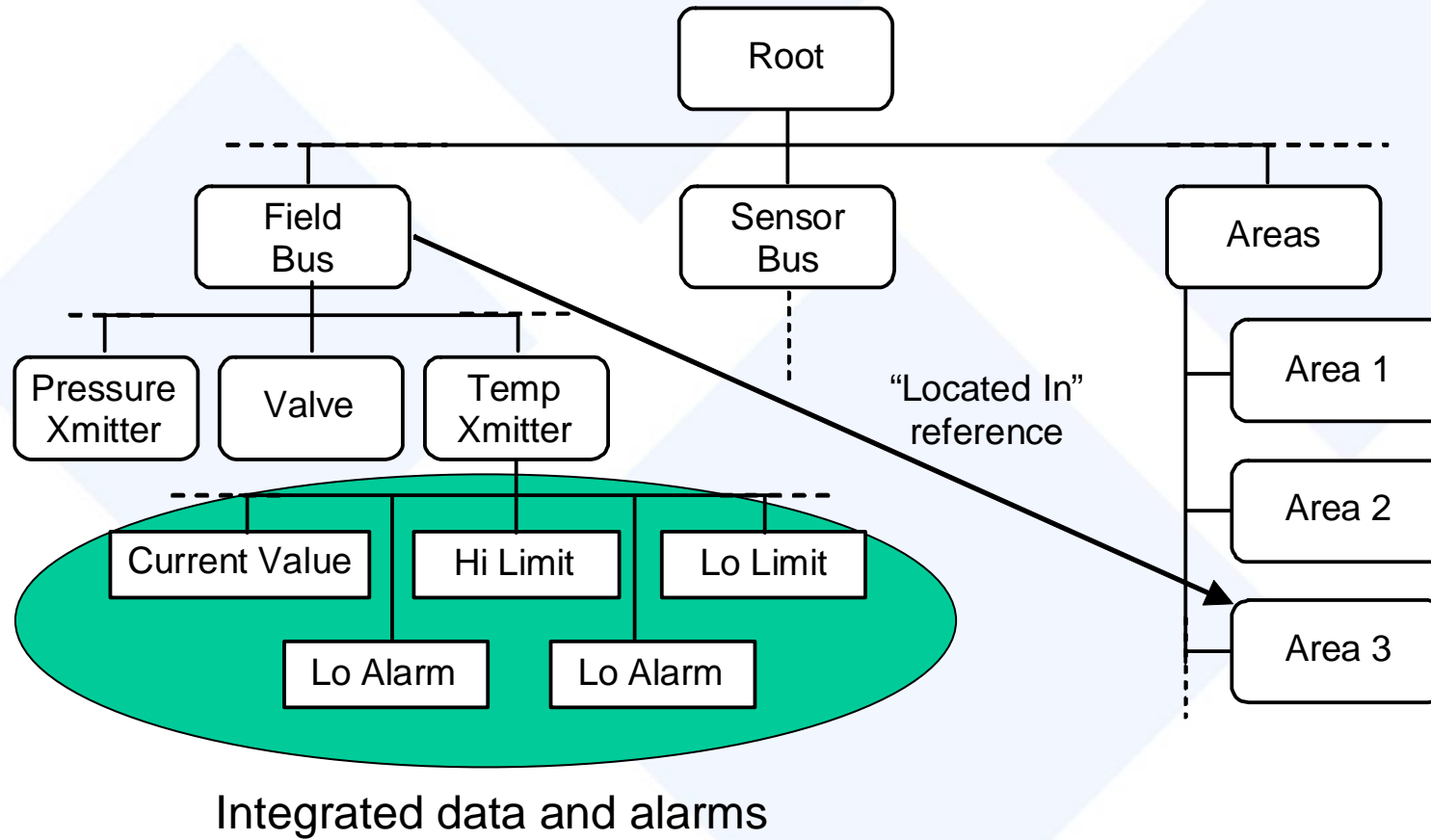
Data Items and Alarms Today



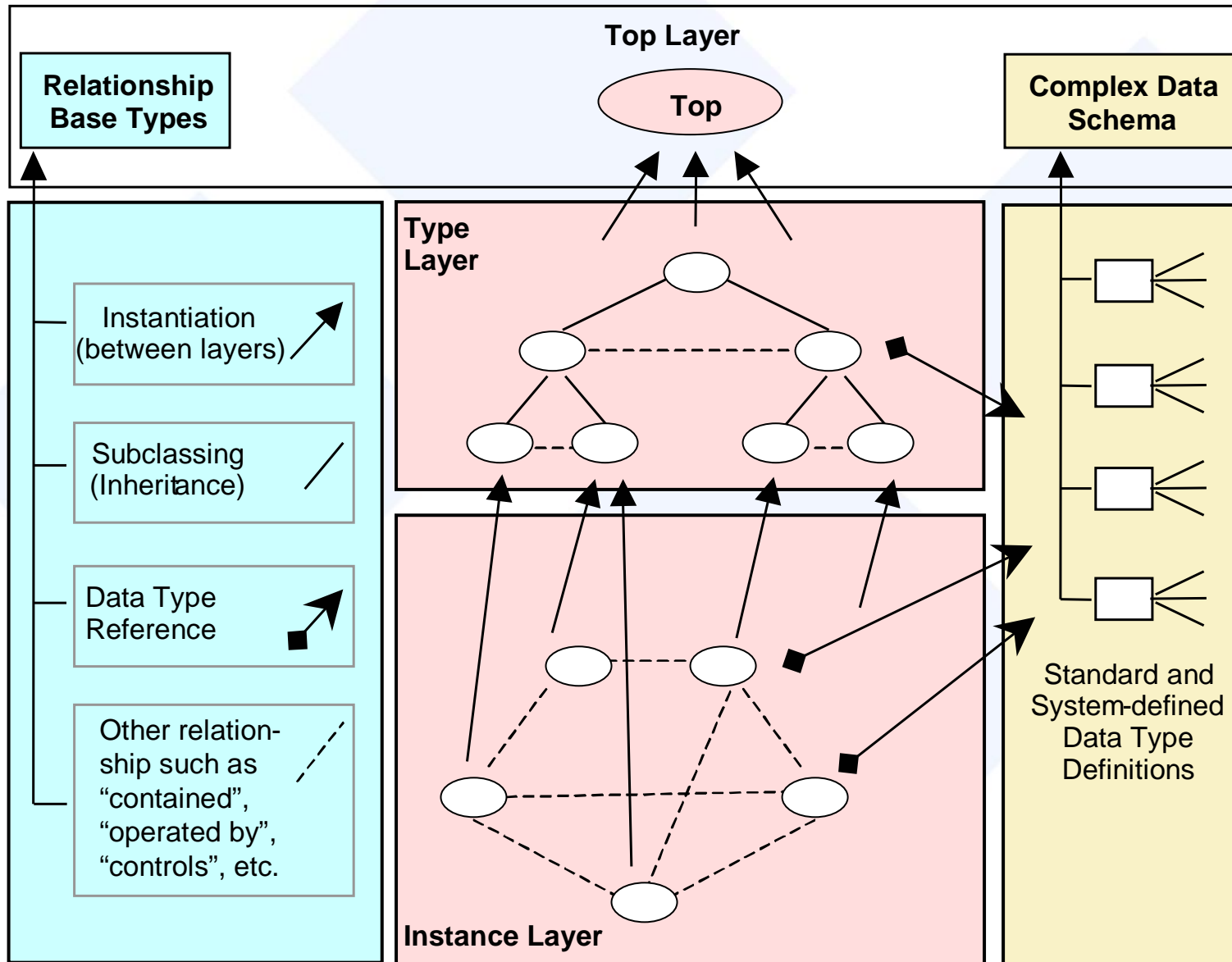
UA Coherent Address Space



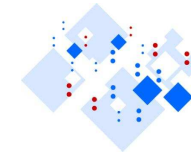
UA Coherent Address Space



Object Classes and Instances

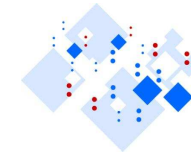


Complex Data Features

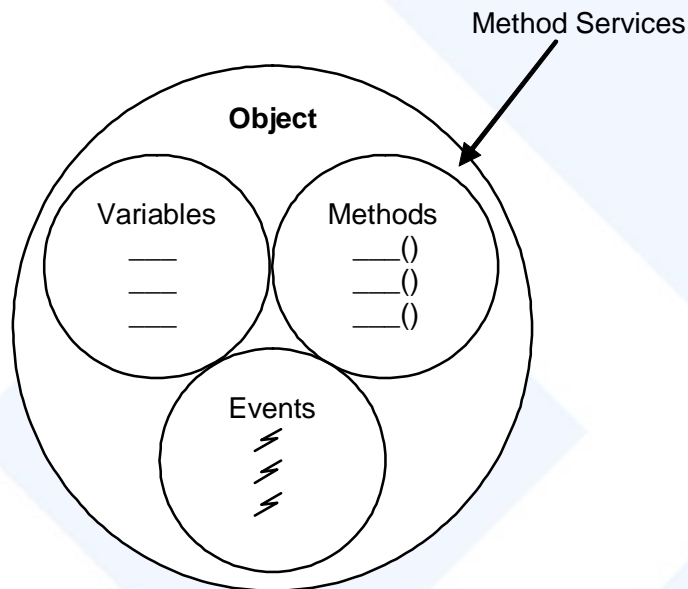


- Tells clients how to parse structured data
- Allows use of XML Schemas for describing XML data
- Defines OPC Binary data description language that uses XML to describe binary data structures
- Allows client to access device specific data descriptions (e.g. Fieldbus Foundation OD)

Methods vs. Programs

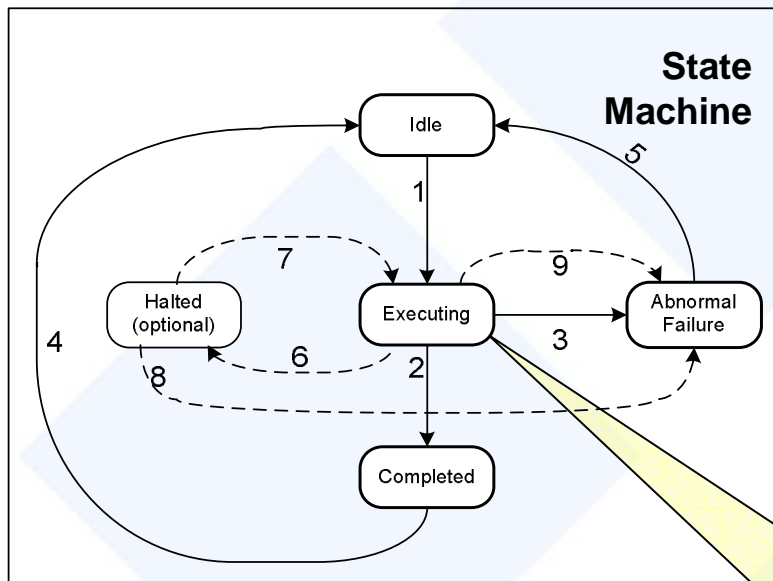


DevCon 2006
OPC Unified Architecture
A 3-day Conference for: Decision Makers, Engineers & Visionaries



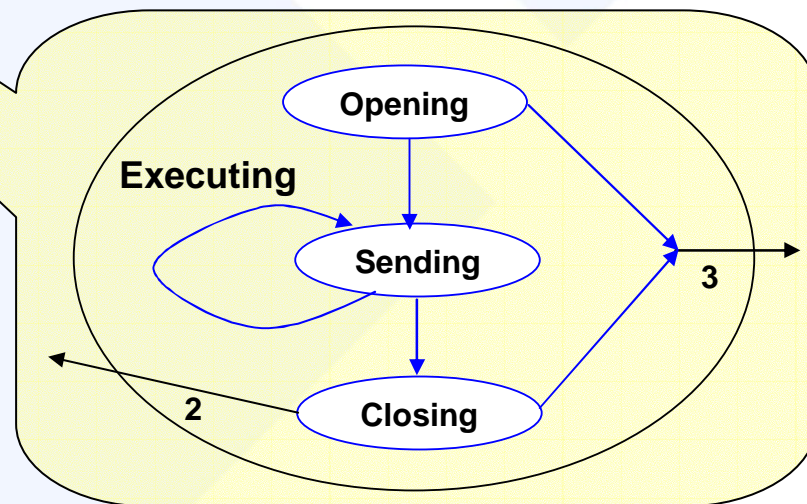
- Methods part of UA Base
- Synchronous invocation similar to blocking function calls.
 - AckAlarm()
- Programs built on top of Methods
- Programs represent executable components of objects , e.g.,
 - DownloadProgram(Name, InitState)
 - MonitorNetwork (From, Till, Interval)
- Execution time may vary from milliseconds to indefinitely.
- Asynchronous invocation is non-blocking. Results are returned using notifications.
- The client can control the execution.

Programs can have State



- UA defines the basic state machine.
- State transitions may cause notifications.

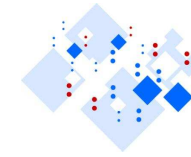
- Sub-states can be defined in particular for the executing state.



- OPC UA “Server Profiles” defined to allow servers with different capability levels
- Client can discover server profile
- Profiles and wrappers defined for migrating existing servers to UA
- More capable profiles also defined

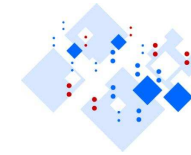
- Standard “Server” node defined in address space
- Standard diagnostic data items defined for the server, such as “SubscriptionCount”
- Server specific diagnostics can be added, with semantics defined by object type definitions

- Common services support DA, A&E, and HDA operations
- Protocol independence
- Timeless durability
- Integrated with the UA Data Model
- Partitioned into Service Sets



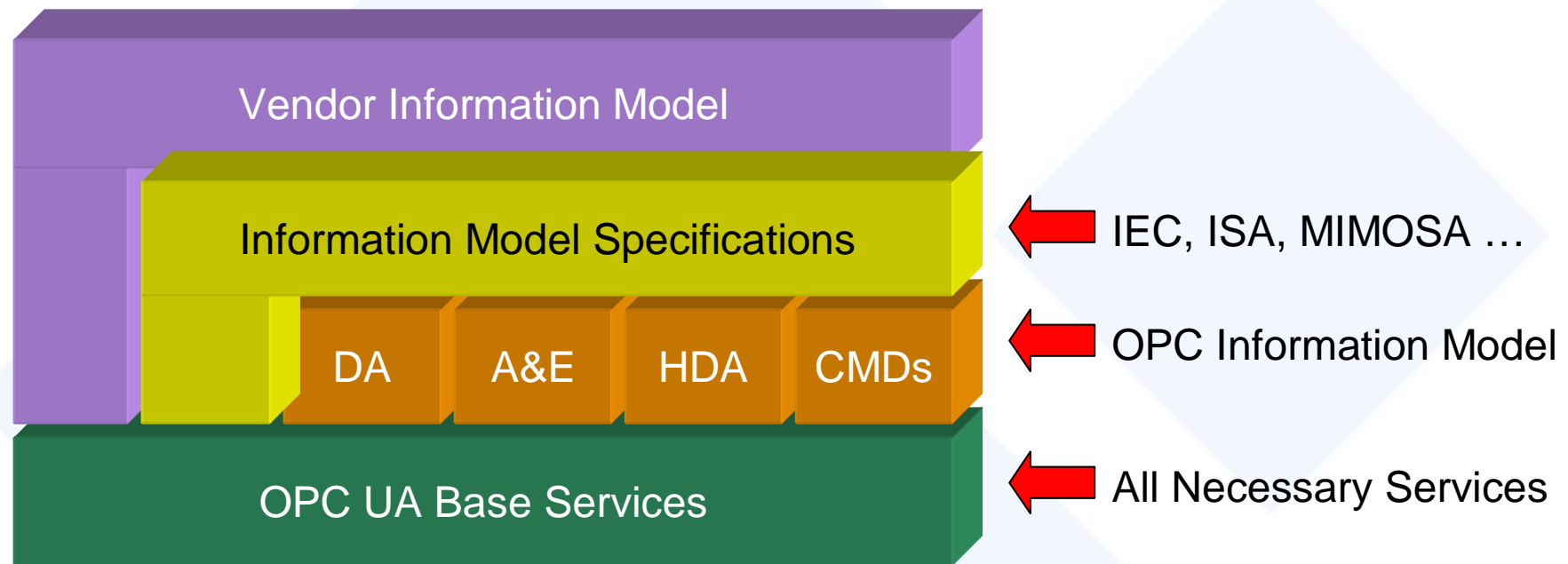
- Secure Channel Service Set
 - Open & Close Channel, GetPolicies
- Session Service Set
 - Create, Close, Activate, ImpersonateUser
- Node Management Service Set
 - Add & Delete Objects and References
- View Service Set
 - Browse, BrowseNext

UA Service Sets (2)



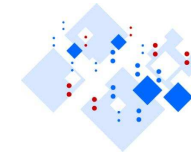
- Query Service Set
 - Get, GetNext
- Attribute Service Set
 - Read, Write, ReadHistory, UpdateHistory
- Method Service Set
 - Call
- Monitored Item Service Set
 - Create / Modify / Delete
- Subscription Service Set
 - Create / Modify / Delete, Publish, Republish

Specification Layering



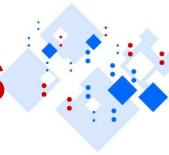
Clients written to just the base can still discover and access all data from the derived layers!

Base UA Specifications



- Part 1 – Concepts
 - A short white-paper like overview of UA
- Part 2 – Security
 - A non-normative introduction to the threats and countermeasures
- Part 3 – Address Space Model
 - Building block constructs of UA (Nodes, Objects, Events ...)
- Part 4 – Services
 - Service methods exposed by UA Servers and called by UA Clients
- Part 5 – Information Model
 - UA defined objects (e.g. Diagnostic Object, Audit Events)
- Part 6 – Mappings
 - Details that allow implementation on current technology (e.g. WS)
- Part 7 – Profiles
 - Defines conformity groups for implementation and certification

UA Information Model Specifications



- Part 8 – Data Access
 - Adds OPC-DA constructs (e.g. Quality, Timestamp ...)
- Part 9 – Alarms and Conditions
 - Adds stateful Alarms and Conditions
- Part 10 – Programs
 - Adds long running executable entities
- Part 11 – Historical Access
 - Adds HDA and Historical Events constructs

Questions?

- Jim Luth
- OPC Foundation Technical Director
- Jim.Luth@opcfoundation.org

