Standard IIoT Message Modeling for Enterprise Integration – A collaborative Approach

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National Institute of Standards and Technology

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NIST SID, Who We Are?

National Institute of Standards and Technology
U.S. Department of Commerce

NIST Mission:
Promoting U.S. Innovation and Industrial Competitiveness by advancing **measurement science, standards, and technology** in ways that enhance economic security and improve our quality of life.

NIST Engineering Lab Smart Manufacturing Programs

Enable the next generation of innovative and competitive manufacturing through advances in measurement science

- ❑ **Measurement Science for Additive Manufacturing**
- ❑ **Measurement Science for Manufacturing Robotics**




- ❑ **Model-Based Enterprise**
- ❑ **Trustworthy Systems, Components, and Data for Smart Manufacturing**

https://www.nist.gov/el/goals-programs/smart-manufacturing

The Era of Industrial Internet of Things (IIoT)

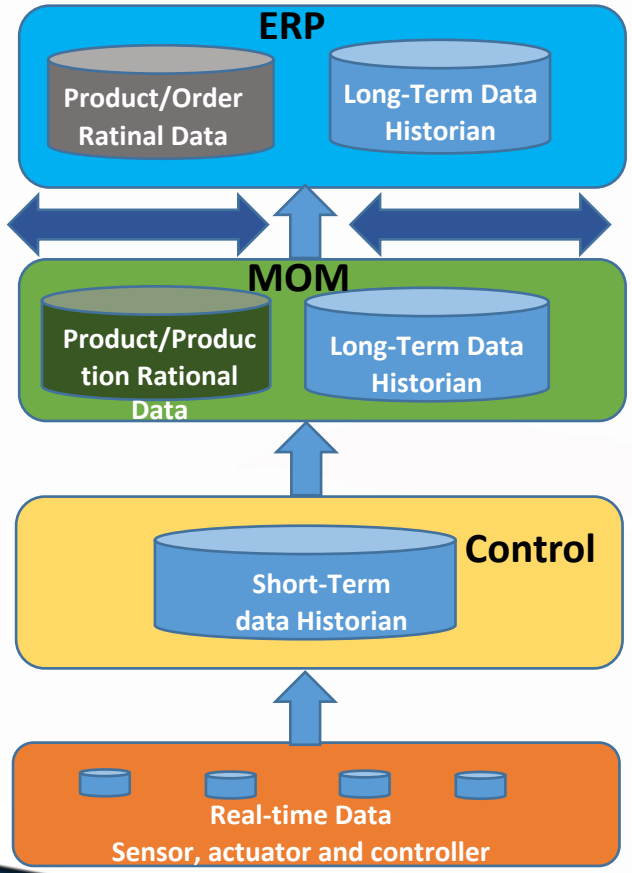
https://www.i-scoop.eu/internet-of-things-guide/industrial-internet-things-iiot-saving-costs-innovation/industrial-internet-things-iiot/

Connected everything, beyond Factory boundaries

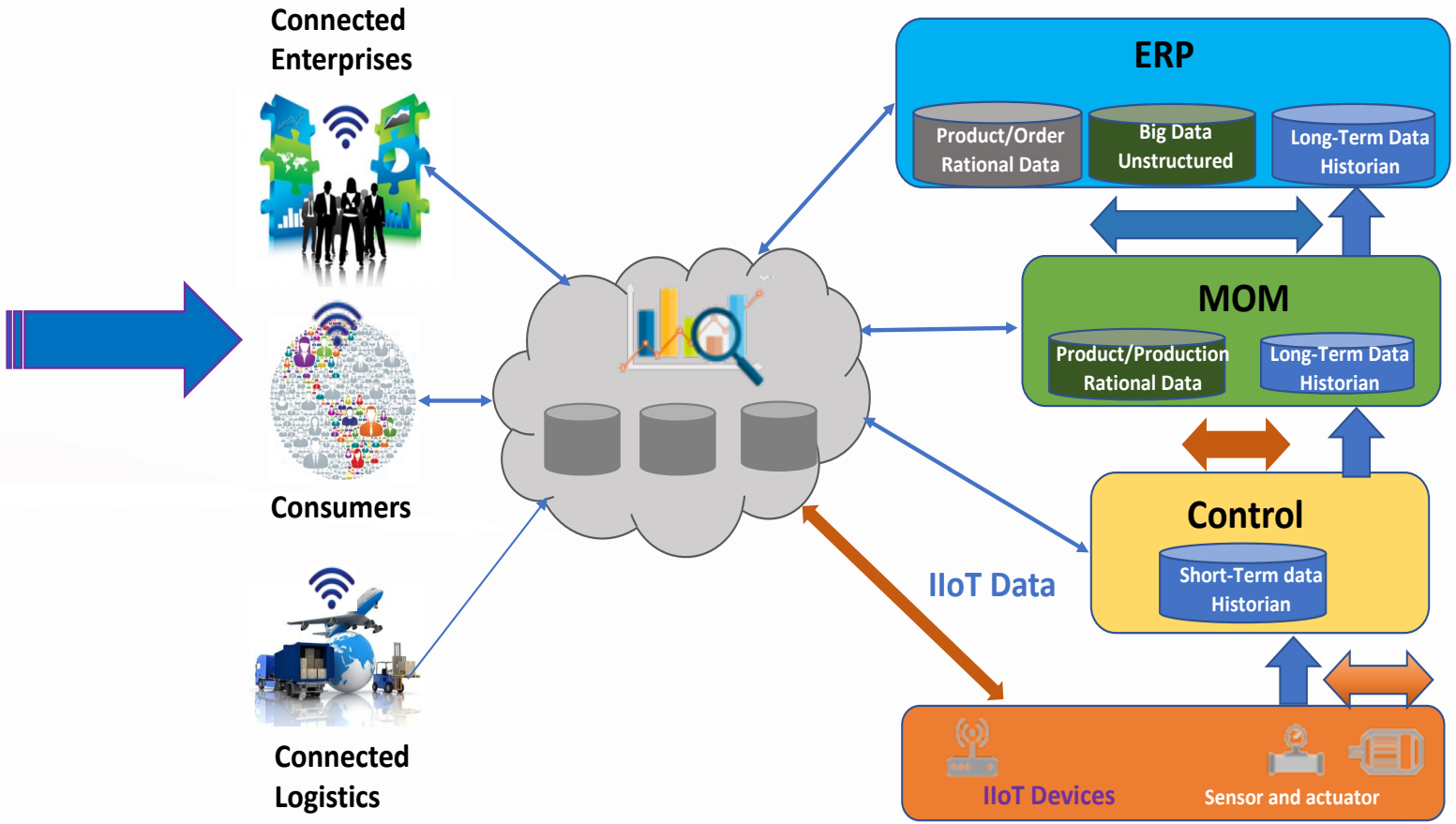
- Any mobile devices
- GPS Devices
- Machines on the factory floor
- Inboard and portable sensors
- Actuators and controllers
- Parts/products
- Human machine interfaces
- Control center
- Trucks and warehouses
- Farm machinery
- Handheld devices
- Offices and homes
- …

Manufacturing Data Integration Paradigm Shift

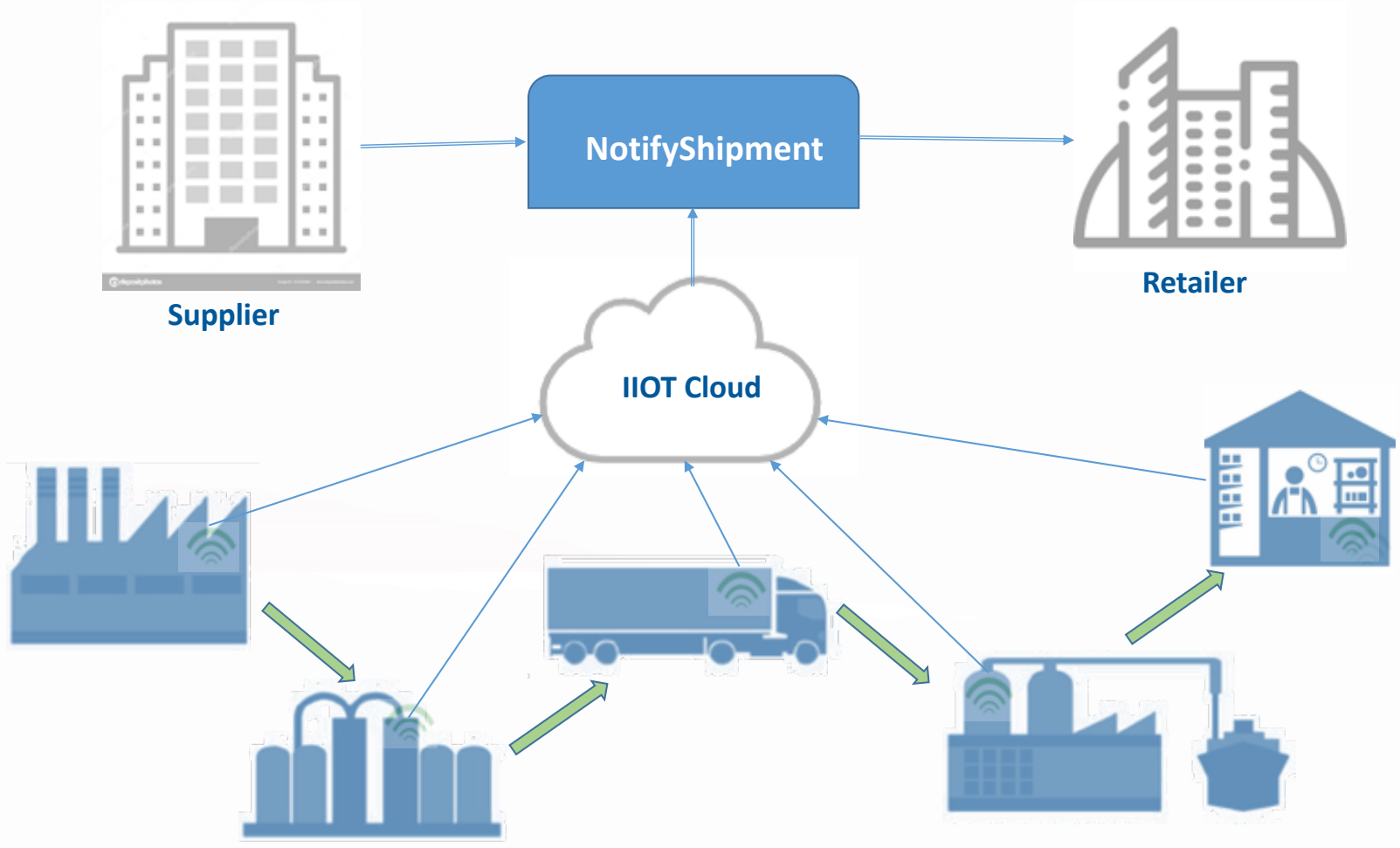
Manufacturing Data Integration Hierarchy



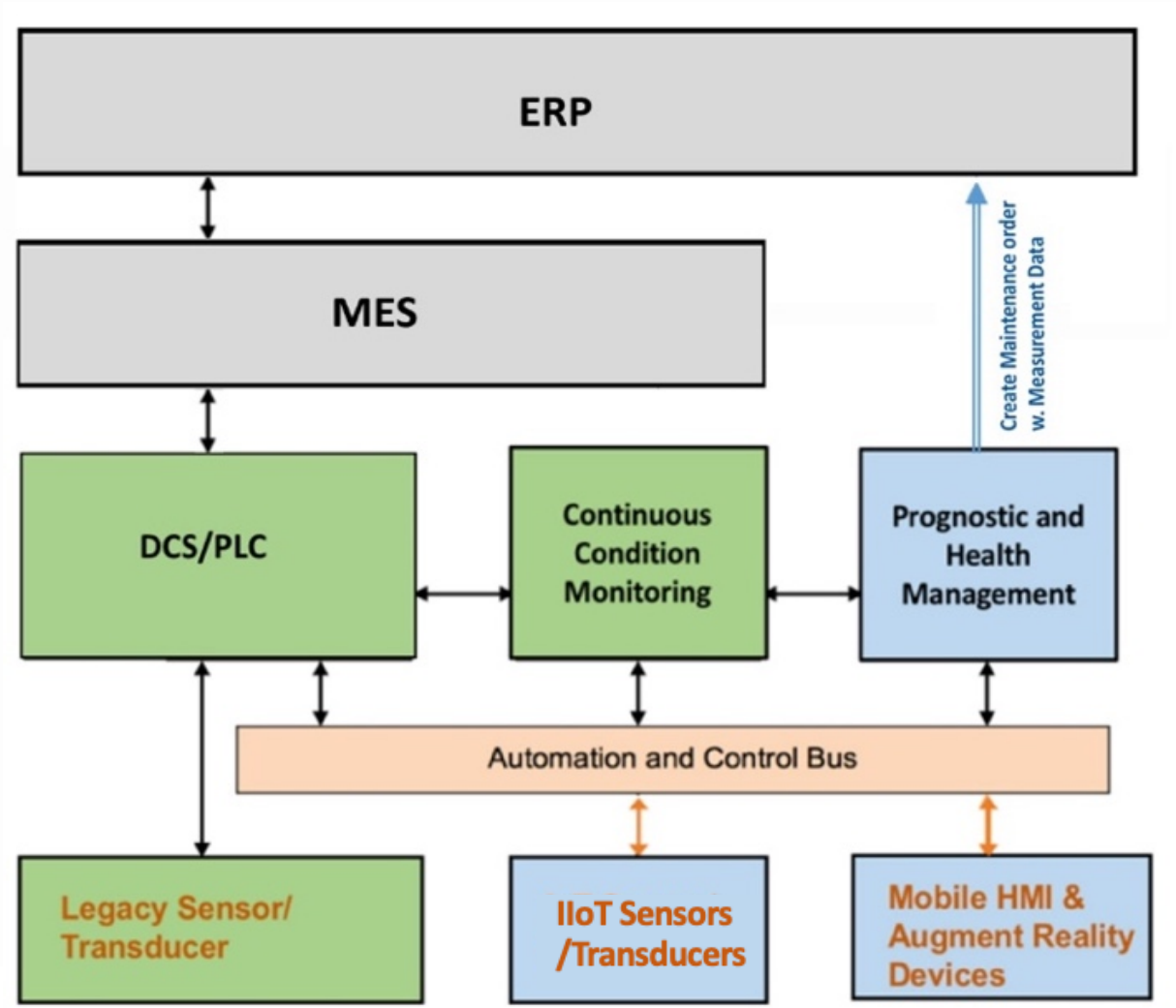
IIoT Introduced Data Integration Paradigm



IIoT Data Communicated in Business Scenarios

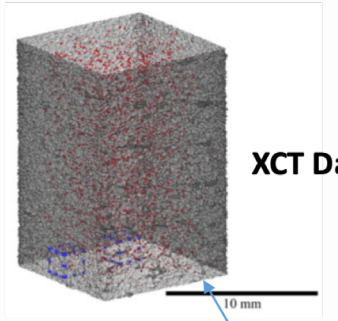


Condition based Maintenance and Operation



- Integrated production system and asset management system.
- CBM and CBO for smart production scheduling and smart maintenance scheduling
- Improved production efficiency, asset performance and reduced cost.

IIoT Data as a Commodity for Business Transactions



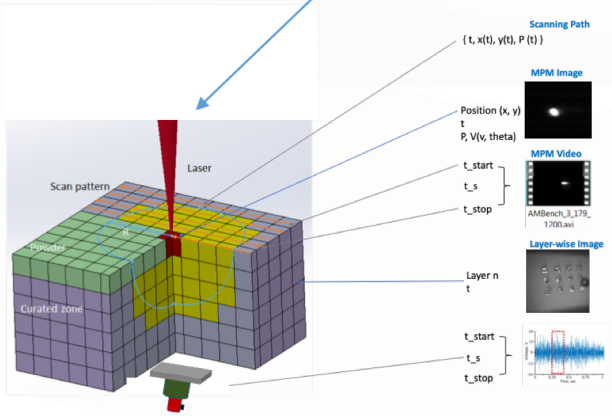
XCT Data set

RESTful

MIDAS Server

AMMD Server

Data Fusion for Part Qualification



Streaming

Register

Edge Computing

Data Pre-processing &Feature Extraction

Automatic Contextualization

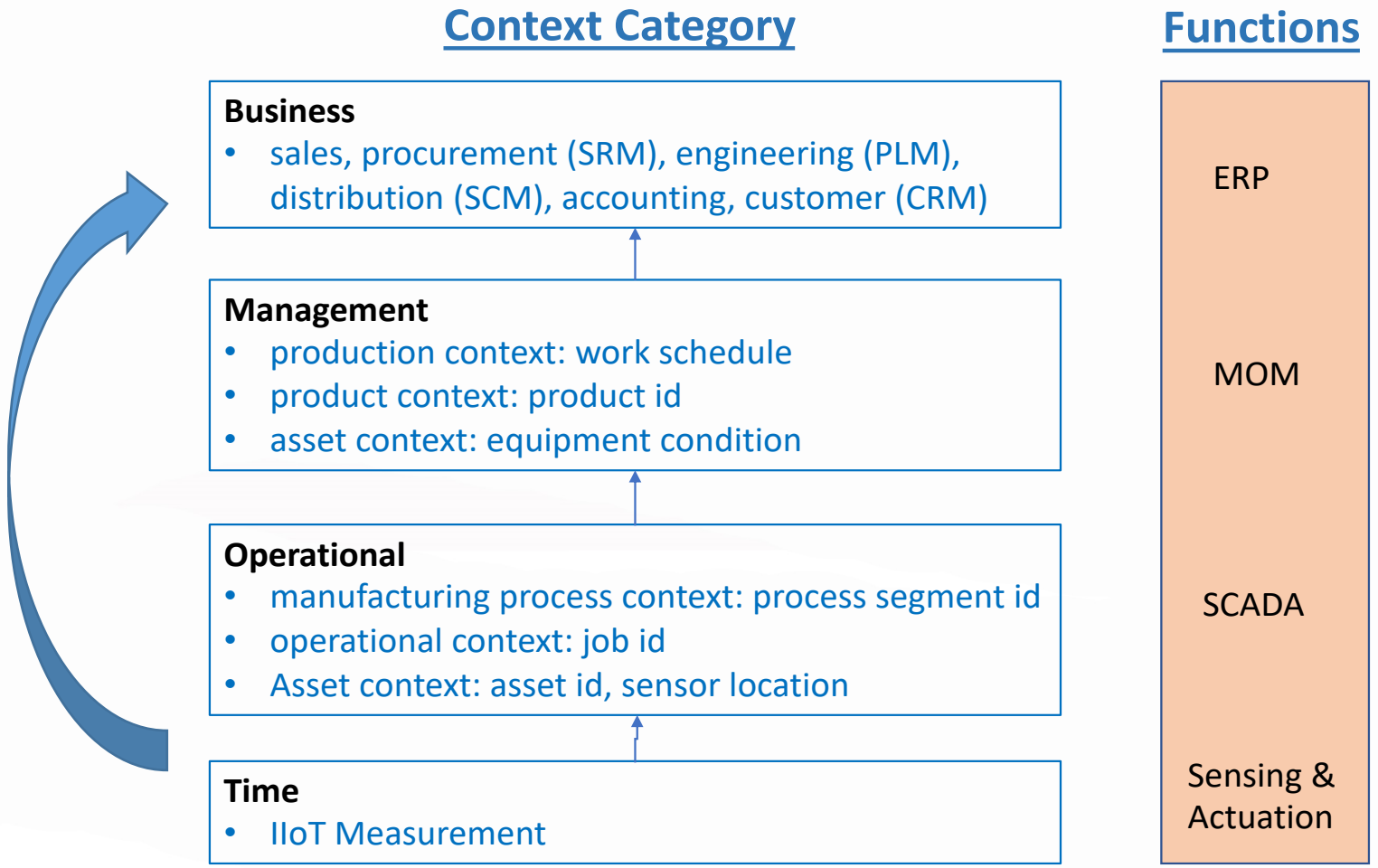
Streaming

Annotation

AM in-situ Data generation

IIoT Sensors /Transducers

Challenges of IIoT - Enterprise Integration

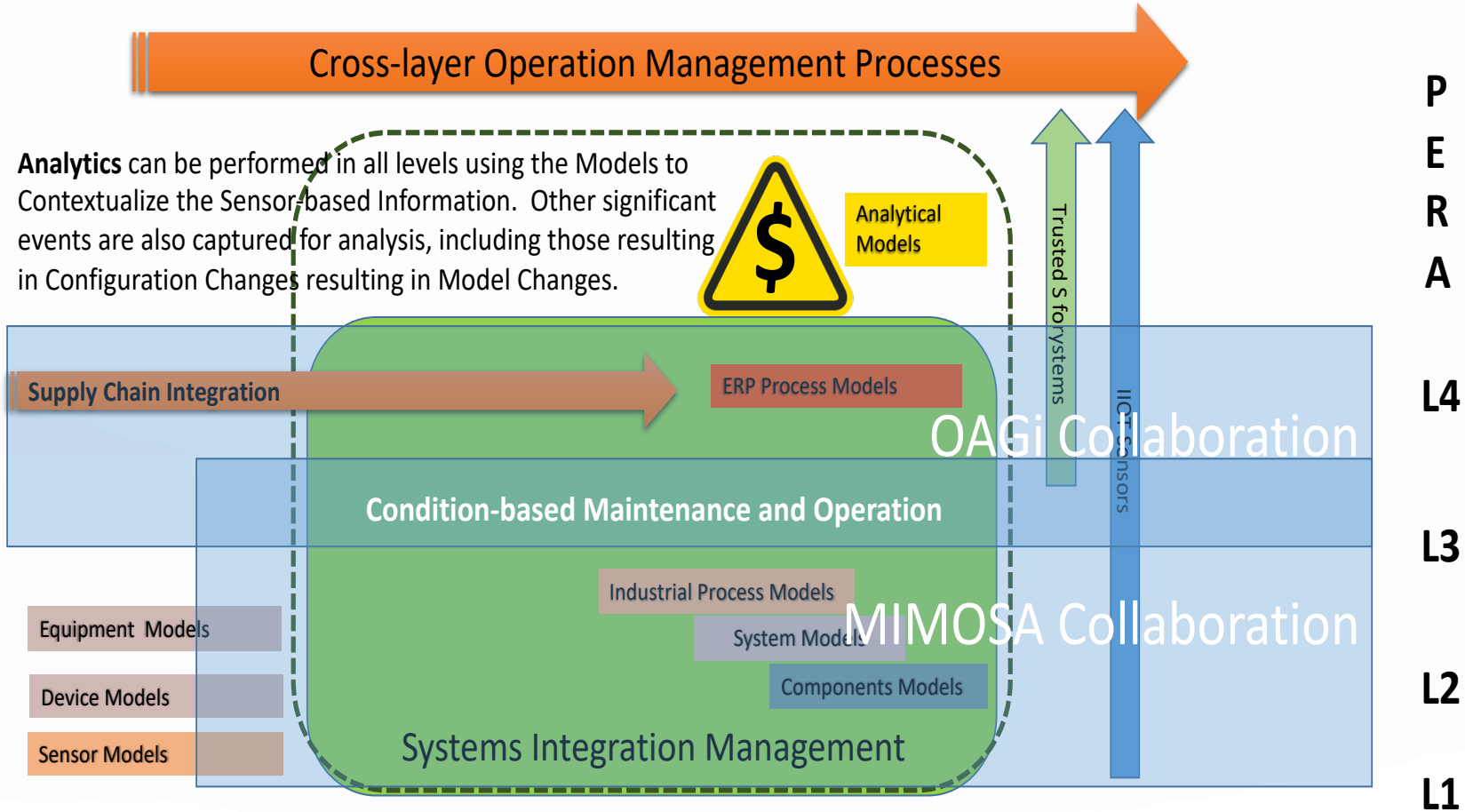


- Important context missing for business integration
- No universal IIoT data model across application domains for Business messages

OAGIS-MIMOSA-NIST Collaboration

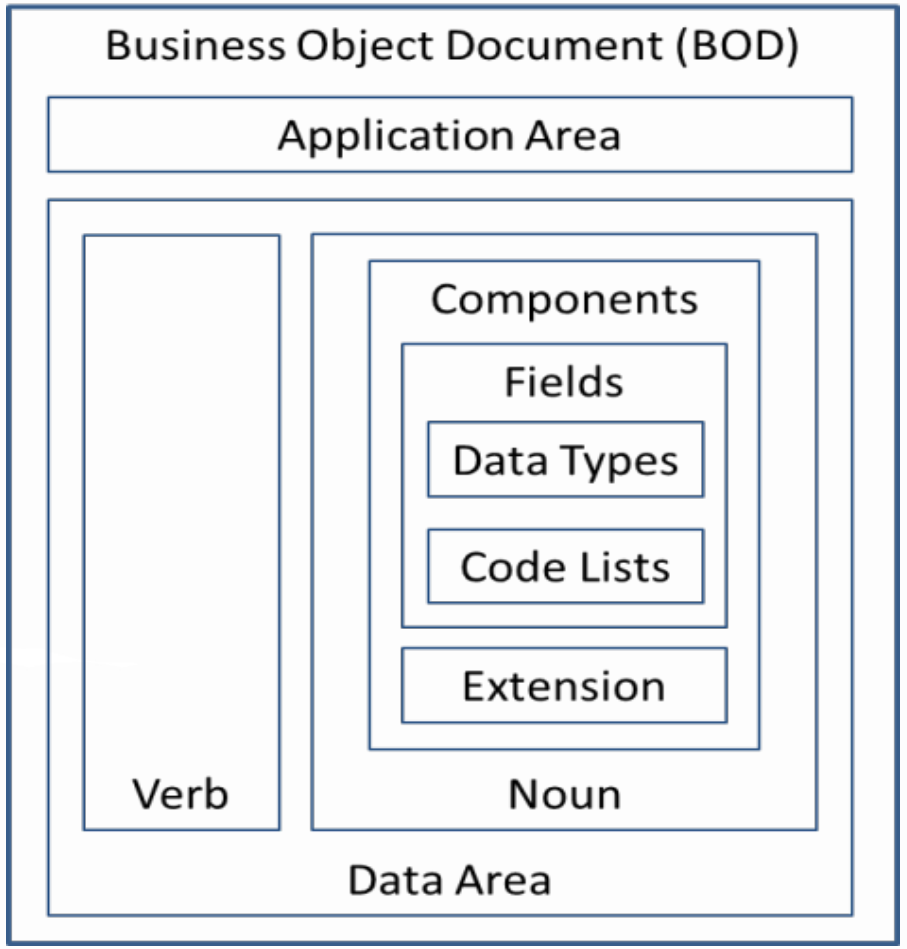
Goal: Increase efficiency of enterprise and production data standards through joint development using

- OAGi Message Model
- MIMOSA CCOM Data Mode
- NIST Semantic Refinement Tool

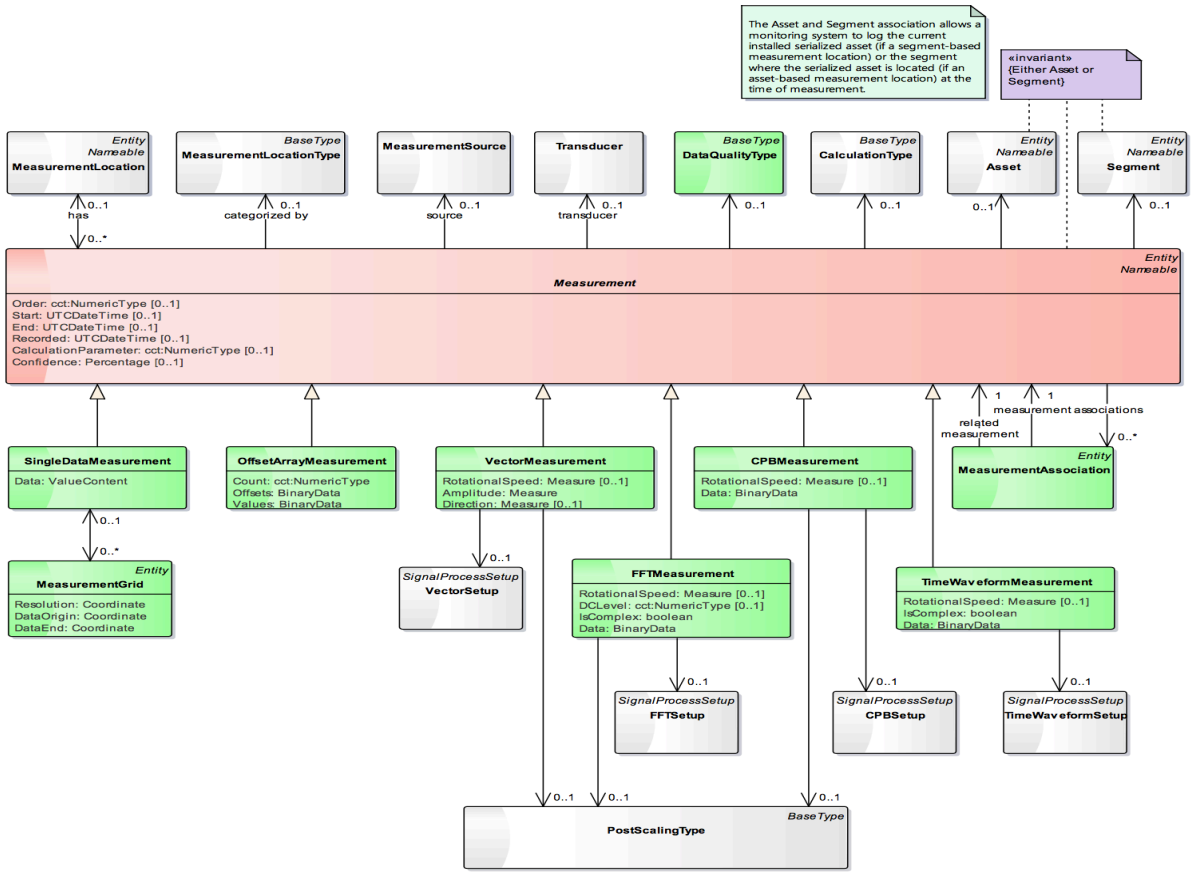


OAGi Message Model/Architecture

- The Open Applications Group promotes **business process interoperability** based on open standards and tools.
- Open Applications Group Integration Specification (OAGIS) defines **a common content model (BOD)** and **common messages** for communication between business applications.



MOMOSA Common Collaborative Object Model (CCOM)

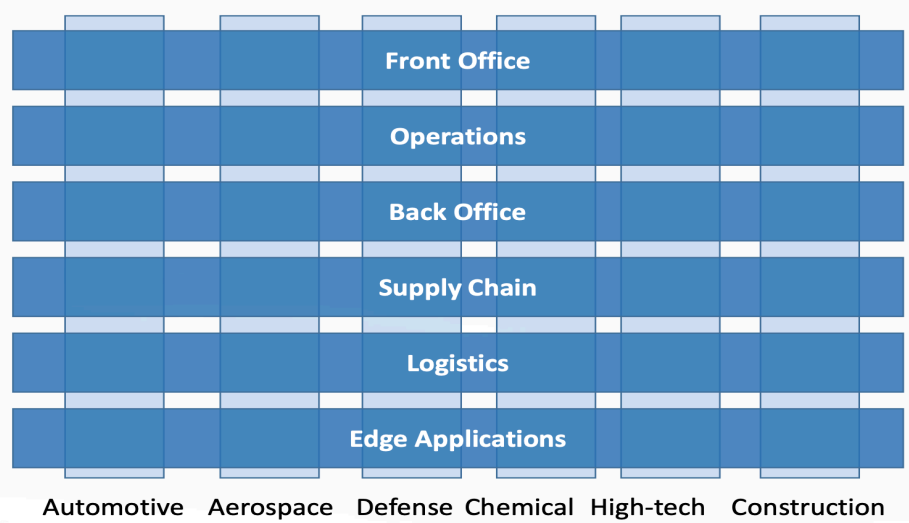


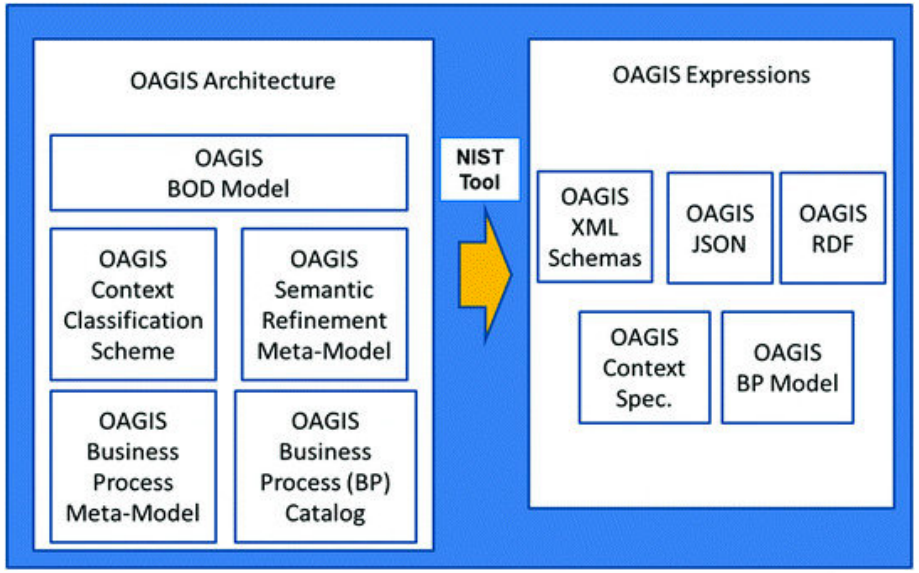
- CCOM - an information model for asset lifecycle management
- COM incorporated in the OIIE (Open Industrial Interoperability Ecosystem) specification and referenced by ISO TS 18101-1
- Supporting broad interoperability in a vendor-neutral fashion

NIST/OAGi Score Tool

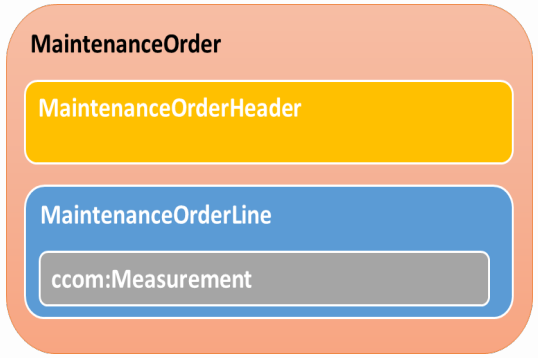
- The OAGi-NIST SCORE Tool is a prototype web-based tool, developed by NIST under the OAGI SRT Working Group

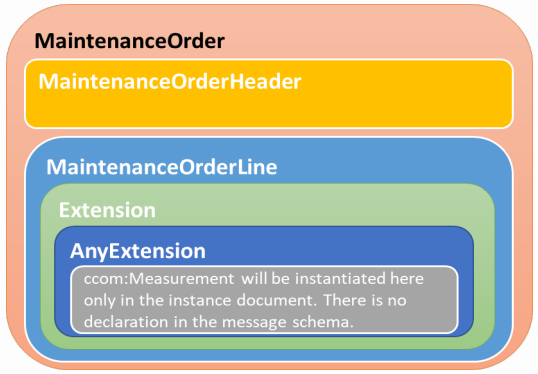
- Score tool allows allows standard messages or objects to be profiled based on contextual requirements;
  - Only Include necessary data elements
  - In a syntax of user choice
    - Russian Doll style XML schema
    - JSON schema
    - Open API 3.0 schema object

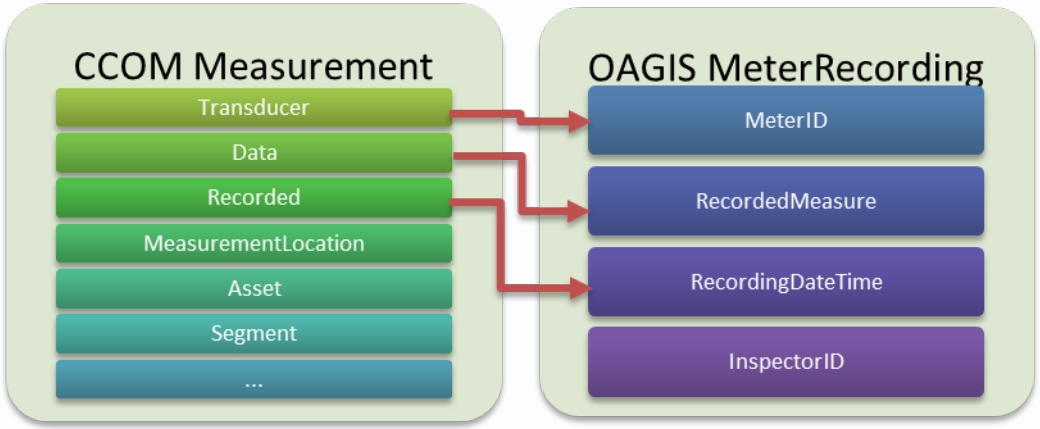


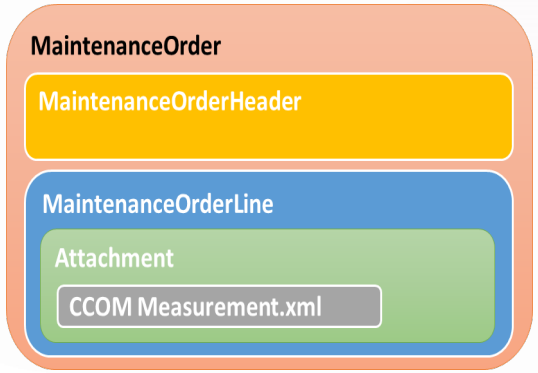


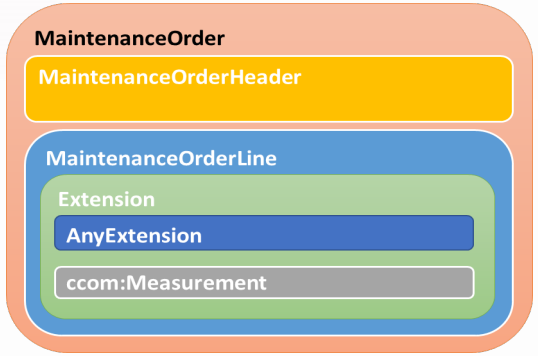
OAGIS-CCOM Integration Options

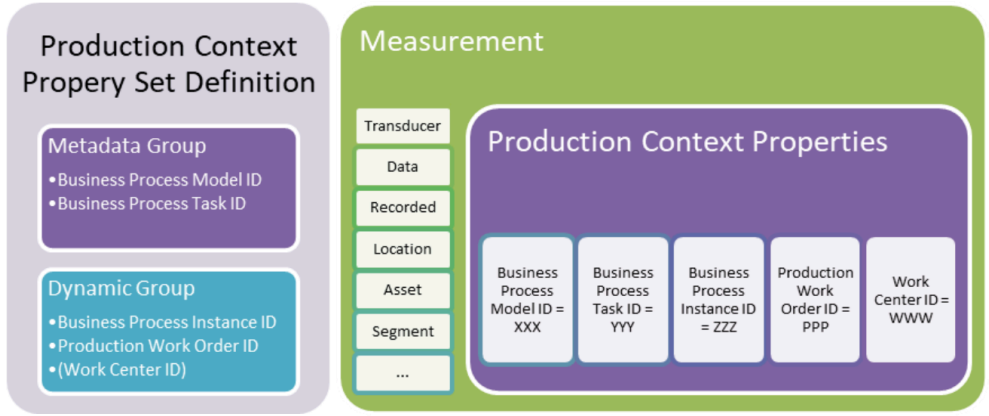












Integration Option Evaluation

Options	Plug-in Approach?	Content Validation	Single Namespace?	Sensitive to Pre-processing?
A. *Enhance OAGIS with CCOM components*	Yes	Single	Yes with tool	No
B. *Inline attachment of CCOM data in the OAGIS message*	Yes	Multi	Yes	Yes
C. *Attach CCOM data through the OAGIS run-time extension*	Yes	Single	No	No
D. *Attach CCOM data through the OAGIS design-time extension*	Yes	Single	Yes with tool	No
E. *Map CCOM data model to OAGIS components*	No	Single	Yes	No
F. *Additional operating context within CCOM via Mappings*	Yes	Single	Yes (No with embedded content)	No

OAGi-MIMOSA Joint Working Group – IIOT Messaging Whitepaper

IIoT Message Modeling for Enterprise Integration and Interoperability – a Whitepaper from OAGi, MIMOSA and NIST

Table of Contents

- Contributed by MIMOSA, OAGI members, including NIST
- Use cases identified from different application domains
- Challenges are identification
- Solutions were explored based on a CPO use case
- Future direction defined

Conclusion and Future Work

- In the age of the emerging Industrial Internet of Things (IIoT), there is an ever-growing need for efficient, reliable, and robust integrations across virtually all industry sectors. Message standards are key enablers.
- Standards development organizations can join forces and collaborate to use each other's capabilities rather than replicate these capabilities within their specifications.
- MIMOSA and OAGI has been collaborating and identified potential solutions for IIoT data and enterprise message integration
- A whitepaper is developed and more technical papers are coming up based on a case study, based on OIIE architecture
- Joint standards will be developed following the case study