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# ACHIEVING THE RESILIENT ENTERPRISE THROUGH STANDARDS



## Ground System Architectures Workshop (GSAW)

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# OMG® Standards Activity



**Software / Hardware Standards**  
**300+ Organizations**  
**60+ Universities**



Addressing IT standards for more than two dozen verticals, including: C4I, Finance, Healthcare, E-Government, Space, Industrial Internet of Things, etc.

The mission of the Object Management Group (OMG) is to develop technology standards that provide real-world value for dozens of vertical industries. OMG is dedicated to bringing together its international membership of end-users, vendors, government agencies, universities and research institutions to develop and revise these standards as technologies change throughout the years.



**Life Insurance & Market  
Research Association**



**Cloud Computing End User Advocacy Group**  
**700+ Organizations**  
**Cost = Free on Registration**

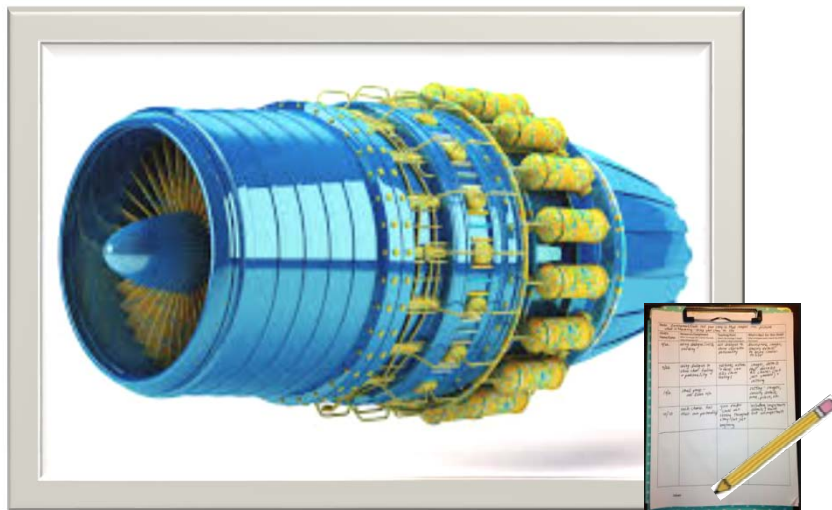


**Industrial Internet of Things**  
**270+ Organizations**



**Software Quality**  
**500+ Organizations**  
**Cost = Free on Registration**

**1960 — Jet performance data is downloaded by eyes & hand**

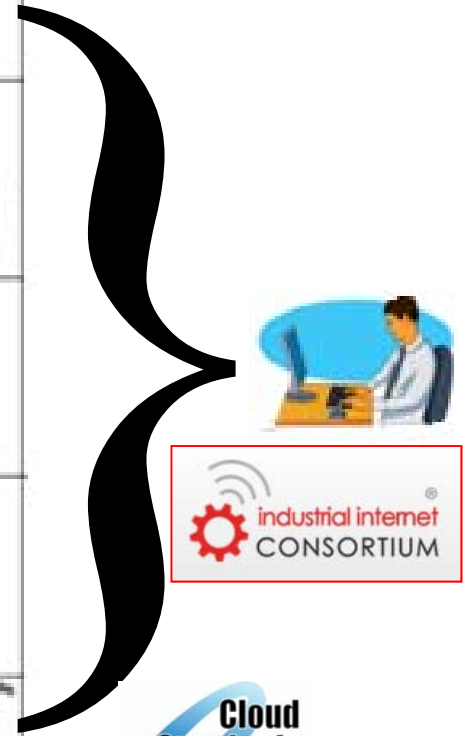


**2015 — Jet performance data is downloaded by hand**



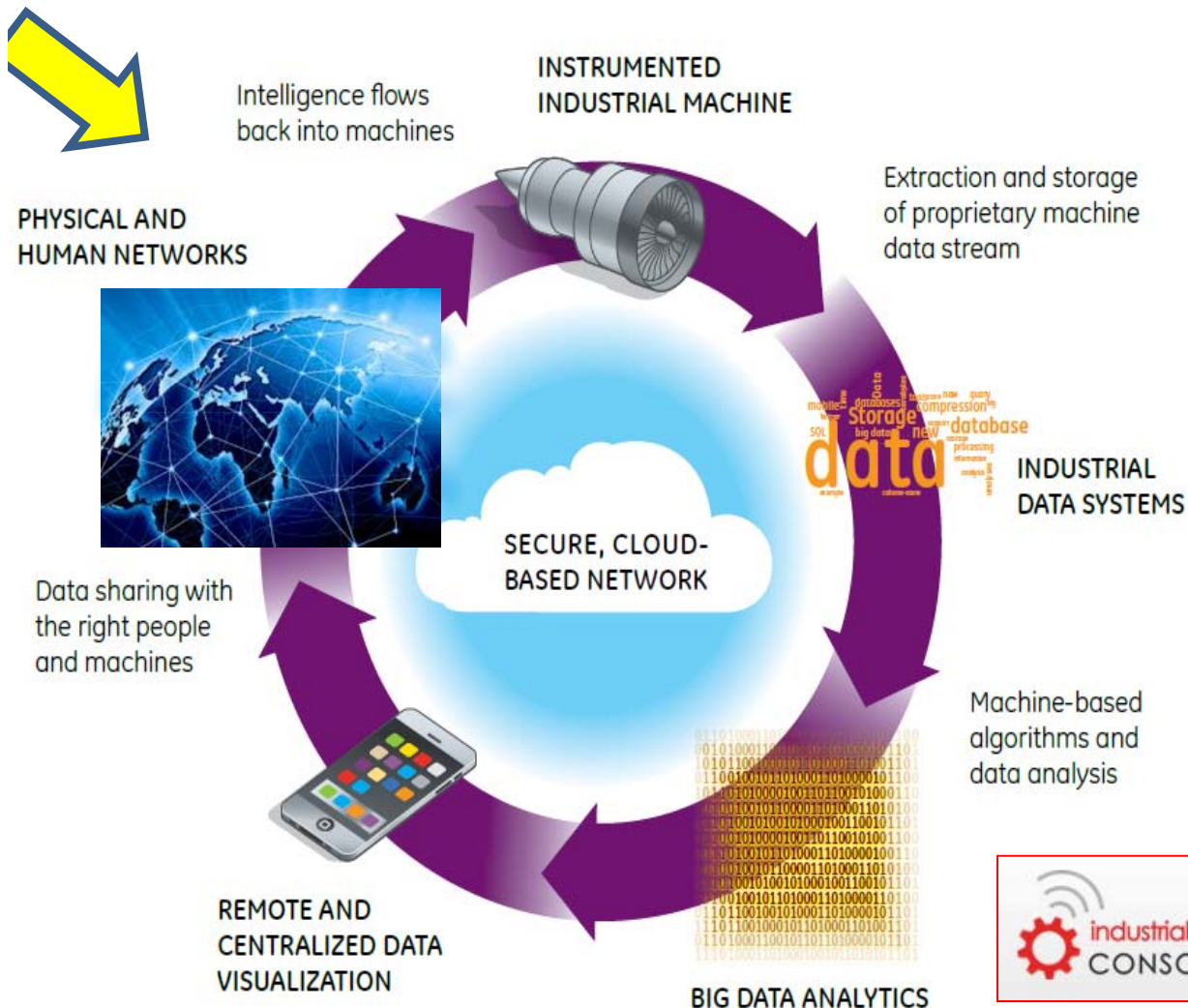
**2017 — Jet Performance Data is Downloaded Wirelessly on the Fly & Performance Modified in Flight**

|                    |   |
|--------------------|---|
|                    | 15 Years ago  |
| Listening to music |    |
| Watching a movie   |    |
| Contacting people  |    |
| Reading the news   |   |
| Making music       |  |





# A New Industrial Revolution With Multiple Impacts



## Causing the need to address:

- Standards (OMG)
- Data Residency Challenges (OMG)
- IoT Architecture & Security (IIC)
- Cloud Best Practices (CSCC)
- Software Quality (CISQ)





## Open Standards & Modeling Provide Savings & Focus

Targeting open standards **lowers Life-Cycle costs, Reduces Risk & Increases Resiliency and Returns on Investment (ROI)** through:

- **Increased Quality** (Specification, Designs and Implementation)
- **Vendor Neutrality** Specifications & Increased Competition
- **Increased Flexibility, Adaptability and Agility**
- **Higher Levels of Innovation**
- **Increased Levels of Interoperability**
- **More Efficient Use of Existing Resources**
- **Access to a larger and better trained labor pool**
- **OMG Standards & Models are taught** in Comp Science & Cyber Security programs (community colleges as well as 4-year schools).
- **Reduces risk as well as cost and improves overall resultant product(s) by modeling behaviors of systems**

**Open Standards enable users to focus on unique business/operational needs rather than common technical challenge(s)**

# OMG's Space Domain Task Force (SDTF)

What is it ? And What does it Do?

Specifically chartered  
to foster the development of  
space-related standards

# The OMG Space Domain Task Force

- Space professionals committed to greater interoperability, reduction in costs, schedule, and risk for space applications through increased standardization



- The SDTF works cooperatively with the CCSDS to ensure consistent space standards are developed.



- OMG's Space DTF is Fast but not too fast : 9-24 months to deliver a standard
- Final result will be specifications and interfaces NOT products
  - Implementations of OMG specifications by users
  - Those implementing specifications need not be OMG members
  - Specifications are *freely* available
- Collective wisdom - broad range of input
- Standards/Specifications based upon Gov't & Industry consensus



# Specifications Freely Available

## OMG Space Domain Task Force (DTF) Delivered Specifications



- [XTCE](#) (XML Telemetry and Command Exchange) (1.1)
- [GEMS](#) (Ground Equipment Monitoring Service)
- [SOLM](#) (Spacecraft Operations Language Metamodel)

### Work-In-Process

- [XTCE](#) 1.2 Revision Task Force deadline March 2018

## Space & Other Relevant Specifications Being Initiated



- GMSEC (Goddard Mission Services Evolution Center) C2 Mission Services
- CubeSat Reference Model (CRM) (INCOSE & OMG Initiative),
- Future Work being Considered** Ontology, archiving, display, cyber
  - Ground Station Ontology (Spacecraft Operations Language Metamodel),
    - <http://www.omg.org/hot-topics/spacecraft-ground-systems-rfi.htm>
  - Data Archiving,
  - Display Page Exchange,
  - Cyber Security



## Other OMG Relevant Specifications to Consider



- Data Delivery Services (DDS)
- Information Exchange Framework (IEF)
- Cyber Security for Front Line Systems
- [Software Based Communications](#)
- **Work-In-Process**
- Secure Network Communications (SNC) RFI
- Alarms & Event Notification and Scheduling
- Telescope Reference Model
- [Secure Networking Communications](#)

# XTCE & XUSP Status

## XTCE

- XTCE 1.2 RTF has dispositioned 244 of the issues submitted.
- ALL of the remaining issues closed in ballot on Feb 12th and resolved.
- The resulting revised schema will be largely forward compatible with existing XTCE 1.1 documents and members of the RTF are developing tools to transform forward incompatibilities, e.g. element name changes
- On-track for submission of the RTF report at the Spring 2018 OMG meeting in Reston, VA.
- XTCE 1.1 is being used by military, space agency, and commercial space programs as an open exchange format.

**XUSP** - a tailored version of XTCE to support CCSDS formats and typical field constraints

- XUSP RTF is awaiting publication of XTCE 1.2, since it is a defined subset profile of the XTCE specification. XUSP is a tailored version of XTCE to support CCSDS formats and typical field
- No pending issues, but after publication of XTCE 1.2 an issue will be submitted to address compatibility.

# Command & Control Message Specification (C2MS)

## What is it?

- A set of standard message formats for the exchange of information for C2 functions
- About 30 messages covering areas like events, telemetry frames or parameters, directives, navigation, commanding, and more.
- Aligned with key interfaces normally found in today's commercial C2 system products

## Where did it come from?

- NASA's Goddard Mission Services Evolution Center (GMSEC) Interface Specification document provided the primary source material
- NASA will retire its ISD when C2MS is published
- Note: ONLY the message formats are being standardized, not the API or components

## What is the status?

- NASA has worked with the Space Domain Task Force on C2MS for the past year and submitted the required materials for consideration in mid-February 2018
- Should become a formal standard later in 2018



# OMG Space DTF (SDTF) Future Backlog

- Telemetry Display Page Definition Exchange
  - No draft RFP exists, yet, just conceptual. Some interest, but this is a difficult problem.
- Ground Data Delivery Interface
  - No draft RFP exists, yet, but has been discussed as a companion spec to GEMS for delivering binary mission and housekeeping data within a ground station.
- Alert Management System
  - US Air Force EGS adopted the OMG C4I Alert Management Service (ALMAS) specification rather than request a specific space domain specification
- Goddard Core Flight Services (Cfs)
  - Goddard has several technologies with more general space industry applicability that are waiting for the results of the C2MS RFC from NASA for a possible path forward.
- Spacecraft Operations Ontology



### The International Council of Systems Engineers (INCOSE)



**Available  
OMG Stds**

- Utilized OMG's Systems Modeling Language to Develop
- A CubeSat Reference Model that provides information
  - For universities, students, businesses and developers of CubeSats
  - Provides Behavior modeling between subsystems
  - Validation & Verification (V&V) processes
  - Coordination points for launch



### Model Based Systems Engineering (MBSE)

Formalized application of modeling to support requirements, design, analysis, validation, and verification

### Systems Modeling Language™ (SysML™)

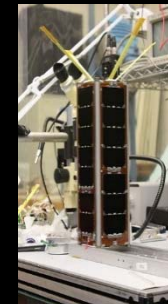
A graphical modeling language for modeling complex systems including hardware, software, information, personnel, procedures, facilities and Coordination's



Systems Engineering  
Methodology

System Modeling  
Tools

Interfaces with  
Other Models



**Purpose:** To Provide a CubeSat Reference Model that CubeSat teams can use as a starting point for their mission-specific CubeSat model





# CISQ/OMG Standards Process & Published Standards

## Consortium for IT Software Quality (CISQ) Work Groups

### Software Sizing - Published

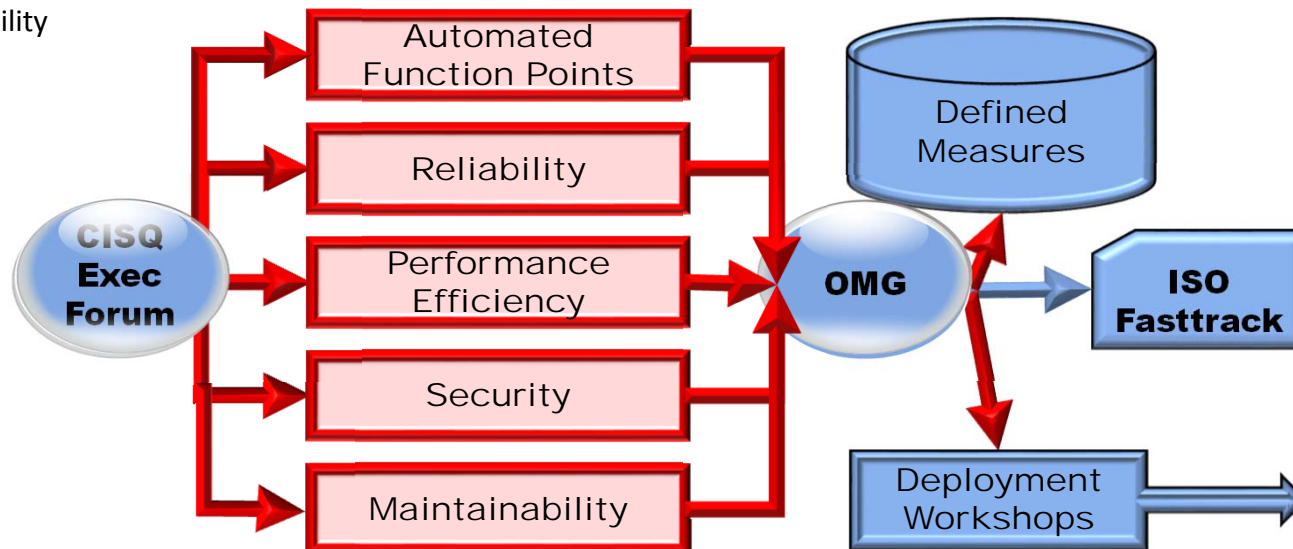
- Automated Function Points
- Automated Enhancement Points

### Software Structural Quality - Published

- Security
- Reliability
- Performance Efficiency
- Maintainability

### Technical Debt – Published

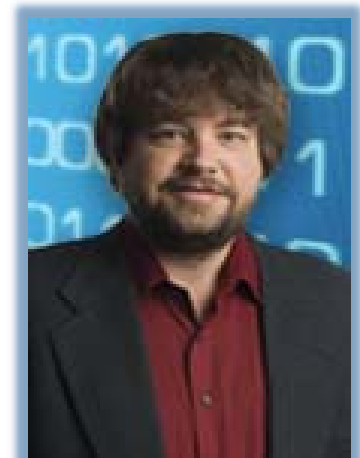
- A new OMG® standard for measuring the future cost of defects remaining in system source code at release
- The cost to fix structural quality problems constitutes the principal of the debt, while the inefficiencies they cause until fixed, such as greater maintenance effort or excessive computing resources, represent compounding interest on the debt



### For future development...

- Extending the software quality measures to embedded and real-time systems, which is critically important for the Internet of Things (IoT)
- A measure of quality-adjusted productivity

- **CWE-22** Path Traversal Improper Input Neutralization
- **CWE-78** OS Command Injection Improper Input Neutralization
- **CWE-79** Cross-site Scripting Improper Input Neutralization
- **CWE-89** SQL Injection Improper Input Neutralization
- **CWE-120** Buffer Copy without Checking Size of Input
- **CWE-129** Array Index Improper Input Neutralization
- **CWE-134** Format String Improper Input Neutralization
- **CWE-252** Unchecked Return Parameter of Control Element Accessing Resource
- **CWE-327** Broken or Risky Cryptographic Algorithm Usage
- **CWE-396** Declaration of Catch for Generic Exception
- **CWE-397** Declaration of Throws for Generic Exception
- **CWE-434** File Upload Improper Input Neutralization
- **CWE-456** Storable and Member Data Element Missing Initialization
- **CWE-606** Unchecked Input for Loop Condition
- **CWE-667** Shared Resource Improper Locking
- **CWE-672** Expired or Released Resource Usage
- **CWE-681** Numeric Types Incorrect Conversion
- **CWE-706** Name or Reference Resolution Improper Input Neutralization
- **CWE-772** Missing Release of Resource after Effective Lifetime
- **CWE-789** Uncontrolled Memory Allocation
- **CWE-798** Hard-Coded Credentials Usage for Remote Authentication
- **CWE-835** Loop with Unreachable Exit Condition ('Infinite Loop')



Robert Martin  
*MITRE*



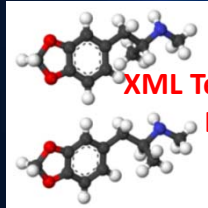
Common  
Weakness  
Enumeration  
[cwe.mitre.org](http://cwe.mitre.org)

Software Based Communications  
DoD's SCA & NASA's STRS  
OMG's SNC



Command & Control Message  
Specification (C2MS)

C4I Alert Management Service  
(ALMAS)



XML Telemetric & Command  
Exchange (XTCE)



XTCE US Government  
Satellite Conformance Profile

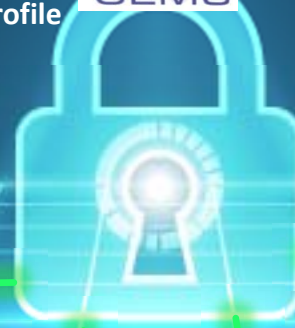


Ground Equipment  
Monitoring Service



Spacecraft Operations Language  
Metamodel (SOLM)

IEF  
Information Exchange Framework™



UAF  
OMG UNIFIED  
ARCHITECTURE  
FRAMEWORK®



# If Any of You Space Cat's Have Questions - You Can Be Directed To:

**Note Pages Available Upon Request**



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