IloT standards at work

Andrew Watson
OMG Technical Director
Introducing OMG

• One of the most successful forums for creating open integration standards in the computer industry
  - Middleware platforms (DDS, CORBA & related specs)
  - Modelling platforms (UML, BPMN, SysML & related work)
  - Systems Assurance (SACM, DAF for SSCD ...)
  - Vertical domain specifications (C4I, Robotics, Healthcare ...)

• Member-controlled industrial consortium
  - Both vendors and users
  - Not-for-profit

• Interfaces freely available to all
  - Visit http://www.omg.org
## Worldwide Membership

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<th>EDM Council</th>
<th>Microsoft</th>
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IIoT: The Next Economic Revolution?

- Industrial revolution replaced muscle power with machines
  - Dramatic, continuing rise in global living standards began

- Information revolution similarly boosted brain power

- Their convergence promises further wave of rising productivity and prosperity
Industrial Internet Data Loop

Intelligence flows back into machines

Extraction and storage of proprietary machine data stream

Machine-based algorithms and data analysis

Data sharing with the right people and machines

Secure, Cloud-based Network

Instrumented Industrial Machine

Physical and Human Networks

Remote and Centralized Data Visualization

Big Data Analytics

Industrial Data Systems

The Numbers

• GPS-guided John Deere tractors seed fields with no overlaps or gaps between traverses
  - 10% cost saving = £40/acre (€150/hectare) for cereal farmer

• GPS-guided John Deere harvesters runs continuously at optimum 7 kph all day, not human operator’s typical 5 kph
  - Harvests 30% more in a day, optimising equipment use & weather windows, reducing operator fatigue

• Volvo excavators programmed with CAD model of hole to dig
  - 10-20% faster than human operator

• ASDA lorries’ deliveries planned & tracked via GPS
  - 5-10% cost savings, precise prediction of delivery times
The Risks

Cyberattack on German steel factory causes 'massive damage'

By Loek Essers
IDG News Service | December 19, 2014

A German steel factory suffered massive damage after hackers managed to access production networks, allowing them to tamper with the controls of a blast furnace, the government said in its annual IT security report.

The report, published Wednesday by the Federal Office for Information Security (BSI), revealed one of the rare instances in which a digital attack actually caused physical damage.

MORE GOOD READS

First Stuxnet victims were five Iranian industrial automation companies

Iranian hackers compromised airlines, airports, critical infrastructure...

10 deadliest differences of state-sponsored attacks

on IDG Answers ➔

How to protect against badUSB attack?
There are risks...

2 OCT 2012 | NEWS

4.5 million routers hacked in Brazil

The forensic breakdown of the attack came first from Fabio Assolini, a researcher for Kaspersky Labs, during a presentation at the Virus Bulletin conference. Graham Cluley at Sophos recounted the presentation in his blog.

Assolini described how at some Brazilian ISPs, more than 50% of users were reported to have been affected by the attack. After the six manufacturers affected issued firmware updates to plug the security hole, the number of compromised modems decreased. However, some 300,000 modems are still thought to be controlled by attackers.

Some 300,000 modems in Brazil are still thought to be controlled by attackers.
3 Most Important IIoT Design Policy goals

• Safety
  - Does not cause physical injury or damage to health (either directly, or via damage to property & the environment)

• Security
  - No unintended or unauthorised access, change or destruction of system or data & information it contains

• Resilience
  - System avoids, absorbs & manages dynamic adversarial conditions while completing assigned mission(s), reconstitutes operational capabilities after casualties

Source: Industrial Internet Reference Architecture
http://www.iiconsortium.org/IIRA.htm
Demanding requirements

• Safe, secure & resilient systems
  - Documenting & then achieving all design goals, even in the face of bad actors attempting remote interference

• Designers who have tools & skills that cut across multiple engineering disciplines, data science, cyber security, UIs
  - Squeezing inefficiencies out of complex systems

• Sensors & advanced instrumentation embedded in machines
  - Enormous data volumes distributed & analysed in real time

• Widely-used standards support all these
  - Already enabling IIoT-based innovation
  - Some relevant OMG activities ...
Assurance

• Measure of confidence that system meets policy goals

• Information Assurance (IA)
  - Availability, integrity, confidentiality, non-repudiation

• Safety Assurance (SfA)
  - Risk to the safety of people & equipment

• Software Assurance (SwA)
  - Free of exploitable vulnerabilities, functions to specification

• System Assurance (SysA)
  - All applicable safety, security, reliability, regulatory etc goals are met
OMG Systems Assurance specifications

- Common framework for analysis & exchange of information about system assurance and trustworthiness, including ...

- Structured Assurance Case Metamodel
  - For representing auditable claims, arguments & evidence that system satisfies particular requirements

- Automated Source Code Security Measure
  - Measured by detecting most-exploited source-code weaknesses (e.g. SQL Injection 1st, Buffer overflow 3rd)

- Dependability Assurance Framework for Safety-Sensitive Consumer Devices
  - Methodology for dependability argumentation for safety-sensitive consumer devices with embedded software
SysML

• Graphical modelling language for specifying, analyzing, designing & verifying complex systems that may include hardware, software, information, personnel, procedures
  - Provides means to precisely model large, complex systems-of-systems, from requirements to acceptance

• Aids communication across engineering disciplines
  - Co-developed with International Council on Systems Engineering (INCOSE)
  - Widespread tool support
  - Mature, widely-used
Ontology Definition Metamodel

• IIoT systems could generate huge amounts of data
  - New data categories may be added as systems evolve ...
  - ... with new units, meanings & relationships to each other
  - Hard-wiring static assumptions about data being created, analysed and used would limiting system adaptability

• Ontology Definition Metamodel (ODM) provides tools to categorise data & represent complex, evolving relationships
  - Enables reasoning about data types & relationships not foreseen at design time
  - A vital foundation for data analytics
Interaction Flow Modelling Language (IFML)

- User interface design will make or break IIoT systems
  - Much IIoT debate centres on machine/machine interactions
  - ... but data visualisation & analysis put humans in the loop
  - Must achieve seamless man-machine interface that minimises unnecessary input & undesired output

- IFML supports abstract design of user’s interaction with system
  - Independent of presentation technology
  - Focussed on structure of user interactions
  - No definition of graphics or styles
Data Distribution Service

- Integration “glue” for IIoT applications spanning data centres to edge sensors
  - Creates virtual, decentralised global data space abstraction
  - Excellent performance with real-time guarantees
  - Proven-interoperable products from multiple vendors
  - Available for safety-critical systems to DO-178C Level A
  - Integrated security framework
  - Fine-grained access control
  - Highly scalable
  - Proven in multiple mission-critical applications
DDS controls Grand Coulee Dam

Largest US hydro-electric plant (6.8 GW)

Fastest-responding major power source on US Western Grid
Kennedy Space Centre

NASA Orion Launch Control System

First Launch 5 Dec 2014

DDS-based SCADA system

300 k points @ 400k msgs/sec
Summary: What IoT standards do we need?

• Obviously, for networking together IoT devices
  - To allow multiple vendors’ products to work together with minimum (re-)configuration

• In Addition we need tools, training & (yes) standards for:
  - Specifying, analysing, designing, verifying complex systems
  - Dependability Assurance
  - Threat & risk modelling
  - Measuring Source Code security/robustness
  - ... other Safety, Security & Resilience issues

• (And by the way, OMG publishes standards in all these areas)
For more information

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Email: andrew@omg.org

Thank You!
Questions?