# IPSO Semantic Working Group

Milan Milenkovic, Principal, IoTsense
www.iotsense.com

July 15, 2017

# IPSO Sematic Interoperability WG

- Formed in 2016 after IPSO SO phase to work on <span style="color:red">interoperability across specifications and domains</span>
  - Work with other specs, backward compatibility IPSO SO

- Not (yet another) data model
  - Representation of salient features of other models for interoperability
  - Terminology: "meta" model representation, annotation, markup?
  - Work plan
    - Architectural principles, requirements, meta-model description, mappings OCF et al. & reiterate…

IoTsense

# Why xD Interoperability?

## McKinsey IoT market projection 2025

**Vehicles**
Autonomous vehicles and condition-based maintenance
$210B–740B

**Home**
Chore automation and security
$200B–350B

**Offices**
Security and energy
$70B–150B

**Cities**
Public health and transportation
$930B–1.7T

**9 settings**
gave us a cross sector view of a total potential impact of
$3.9 trillion–11.1 trillion per year in 2025

**Factories**
Operations and equipment optimization
$1.2T–3.7T

**Outside**
Logistics and navigation
$560B–850B

**Human**
Health and fitness
$170B–1.6T

**Worksites**
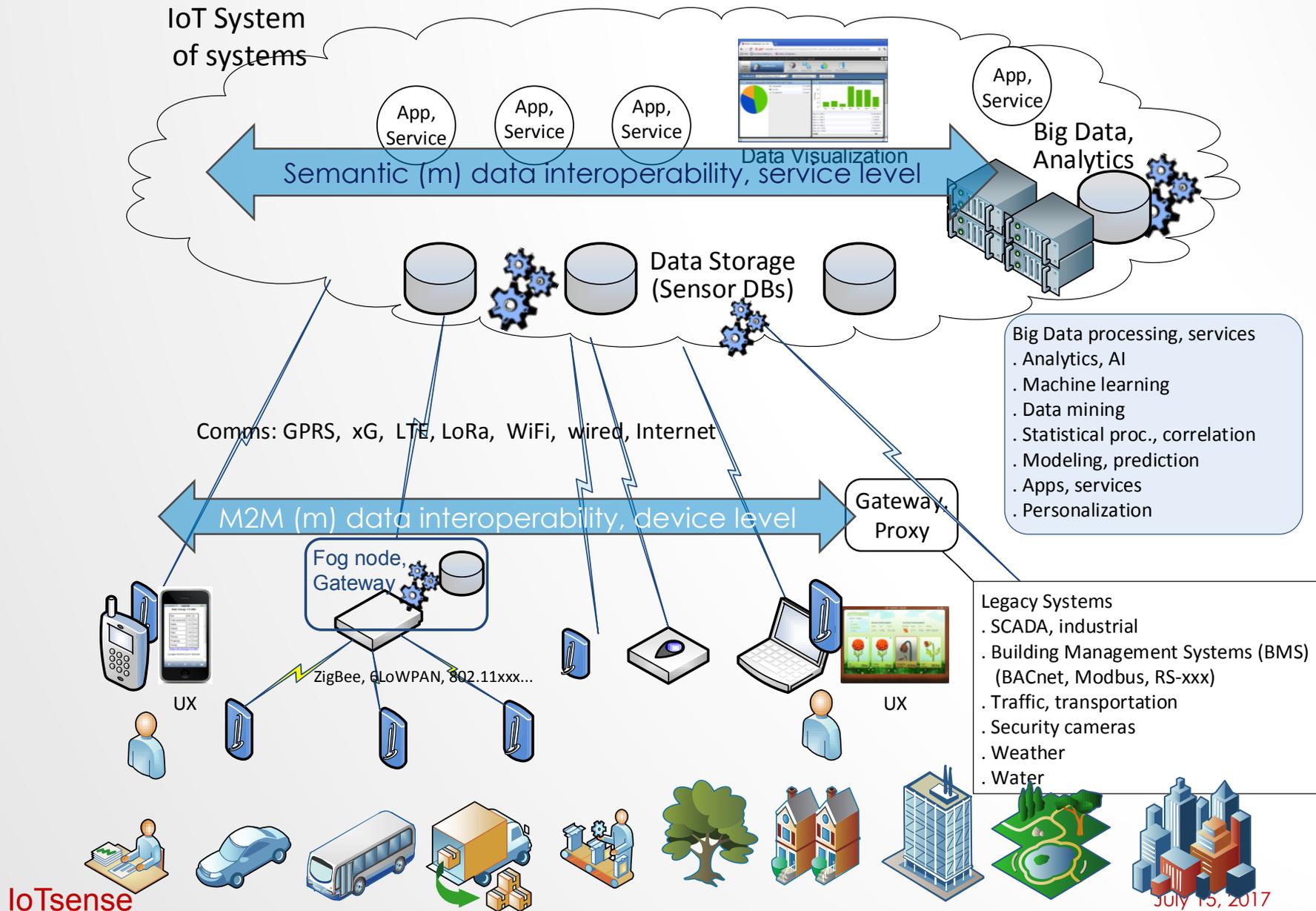Operations optimization/ health and safety
$160B–930B

**Retail environments**
Automated checkout
$410B–1.2T

*Interoperability +40% TAM*

McKinsey & Co Global Institute report "IoT: Mapping the Value Beyond the Hype Hype"

# Why Interoperability?

- That 40% IoT TAM increase, and

- Enable IoT data aggregation across verticals and domains
  - Deliver IoT big-data promise: interoperable large, diverse data sets
  - Portable apps/services: data mining, analytics, optimization, ML, viz
  - Customers own their data – avoid vendor and cloud lock-in

- Who needs this? (few examples)
  - Smart buildings: HVAC, lighting, occupancy, elevators, security
  - Building operators: optimize across a portfolio of buildings, BMSs
  - Smart cities: holistic view of disparate systems: buildings, energy, transportation, lighting, security, emergency response
  - Industrial: optimize processes with multi-vendor machinery, tools
  - Transportation: collect data on traffic, mapping across vendors, v2v
  - Others …

# Interoperability: what exactly?

IoT System of systems

App, Service

App, Service

App, Service

App, Service

Data Visualization

Big Data, Analytics

← Semantic (m) data interoperability, service level →

Data Storage (Sensor DBs)

Big Data processing, services
. Analytics, AI
. Machine learning
. Data mining
. Statistical proc., correlation
. Modeling, prediction
. Apps, services
. Personalization

Comms: GPRS, xG, LTE, LoRa, WiFi, wired, Internet

← M2M (m) data interoperability, device level →

Gateway, Proxy

Fog node, Gateway

ZigBee, 6LoWPAN, 802.11xxx...

Legacy Systems
. SCADA, industrial
. Building Management Systems (BMS)
   (BACnet, Modbus, RS-xxx)
. Traffic, transportation
. Security cameras
. Weather
. Water

UX

UX

**IoTsense**

# Interoperability: what exactly?

- [IIC] conceptual interoperability: represent information in a format whose meaning is independent of the application generating or using it

- Data interoperability, multiple flavors

- <span style="color:red">Semantic, "service-level"</span> interoperable data format across specifications, providers, and domains

- <span style="color:red">Syntactic, "device level",</span> M2M. (most current standards)
  - Structured objects and properties to reflect physical objects
  - Interoperability intra-domain (spec), monoculture
  - Some specs also cover discovery, management, provisioning, security

# IPSO Semantic WG, current status

- Cross-domain, "inter-specification" interoperability
  - Will work on both semantic and M2M (syntactic) interoperability
- Assumptions etc.
  - IoT system is in fully functional state (we don't specify how) nodes discovered, configured, provisioned, security established
- Test use[r]s
  - Syntactic interop – universal home controller, heterogeneous devs
  - Semantic interop – cloud service API for aggregated data, sm. city
- Work in progress
  - Syntactic is a harder problem, needs data and interactions interop
  - Start with common data, meta-data interoperability = semantic
  - Re M2M (syn), define useful (reduced features?) interoperability

# IPSO SemWG, other Q&As

- Opportunities for integration
  - Plenty, supposed to work with all others

- Opportunities for collaboration
  - Actively discussing partnerships
    - Progression: interest, technical, formal

- Research opportunities
  - Meta-annotation: format, expressiveness, completeness
  - Algorithmic vs. manual translation
  - Data, meta-data retrieval: APIs, languages?
  - Interactions: events, commands – representation and operation

# Q&A

milan@iotsense.com