Musings on the Four Horsemen of the Apocalypse and IOT

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Agenda

- Four Horsemen of the Apocalypse, **Cloud**, **Mobile**, **Big Data**, **Social**
- What is the Internet of Things?
- Current Landscape
- Other IoT Security Challenges
- Path Forward to Securing IoT
- IOT Primitives & Composition
- Discussion

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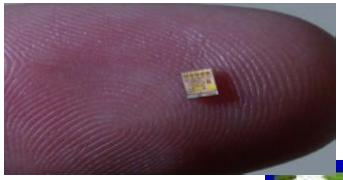
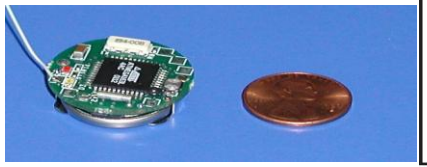
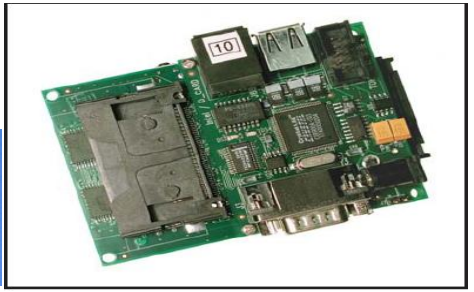
Embedded Physical World

New Machines*







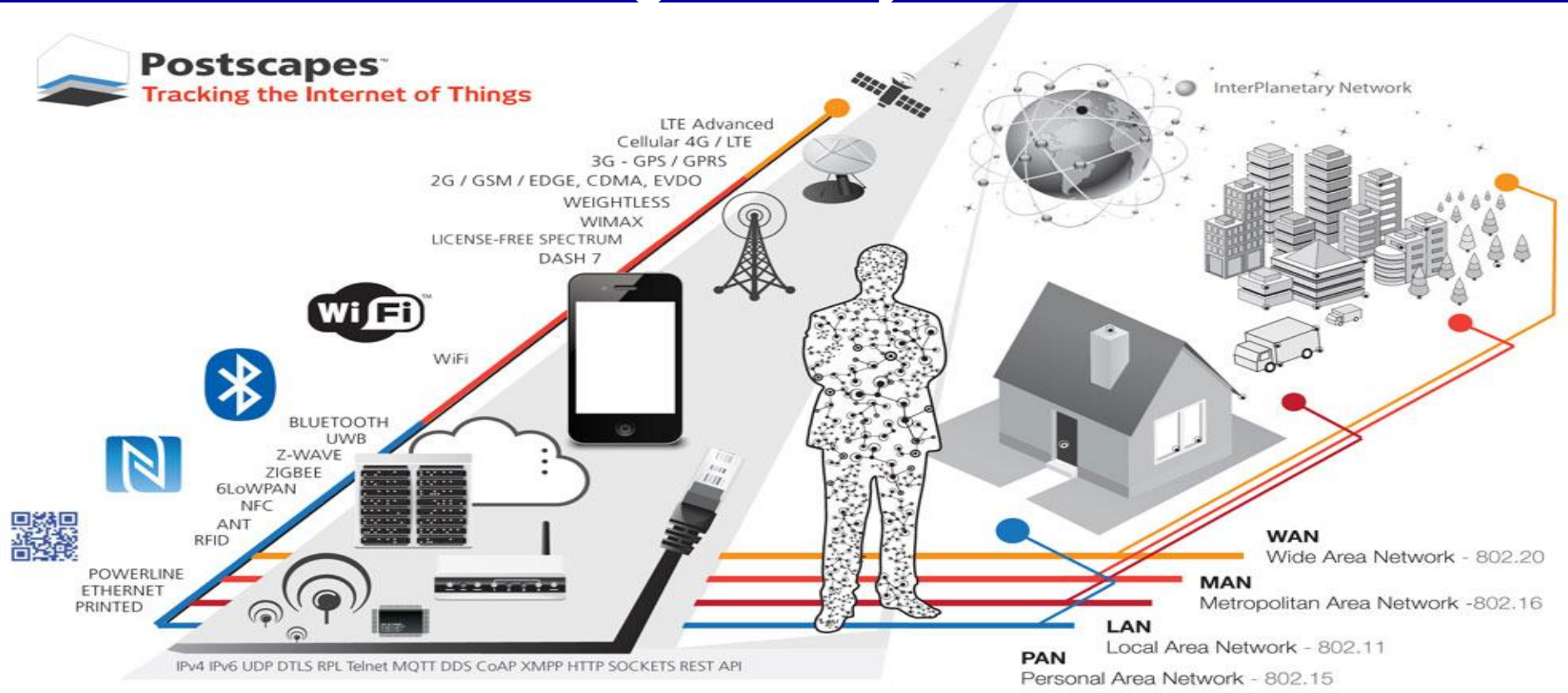
New Environments*
New Applications*

New Scale*

Billion to trillion devices!

*NSF

Connecting the Physical World



Current Network not designed to connect the physical world

Why Four Horsemen?

- Vast change in mobile, second wave of change in cloud, social continues to build, big data gets bigger, and now IOT.

- Complex technology, divergent business models, nervous governments/policy makers, different architectural schemes (API vs Cloud, etc.) many competing ecosystems

- Complexity, metastasizing attack surfaces, and security technology/thinking that is not scaling

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Four Horsemen

- Mobile, Social, Big Data, Cloud, and IOT/Sensors are/will contribute to the vast increase
- IoT is expected to exacerbate the complexity surrounding the four horsemen - mobile, social, big data, and cloud
- Need advances in math around large datasets, graph theory, machine learning, algorithms, etc.
- Future of computer science is in the **processing**, **analysis** and **safeguarding** of large amounts of distributed data (Hopcroft et al.)

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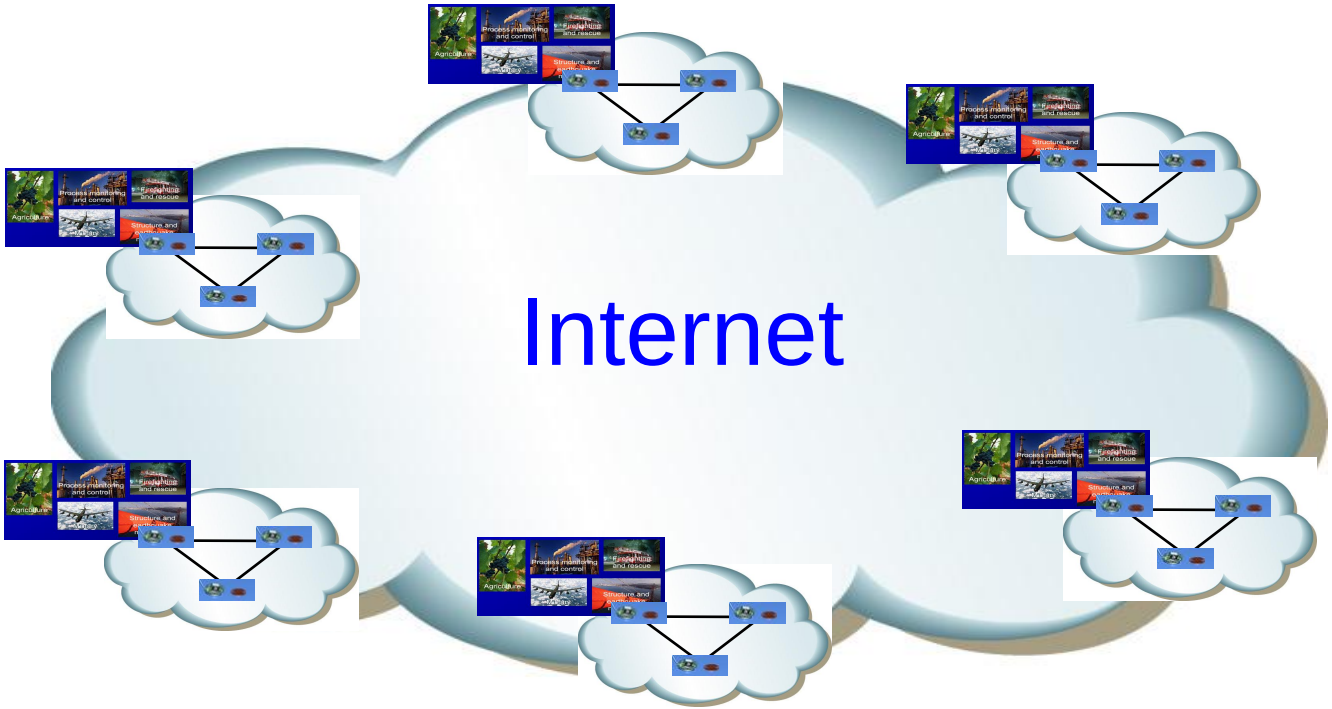
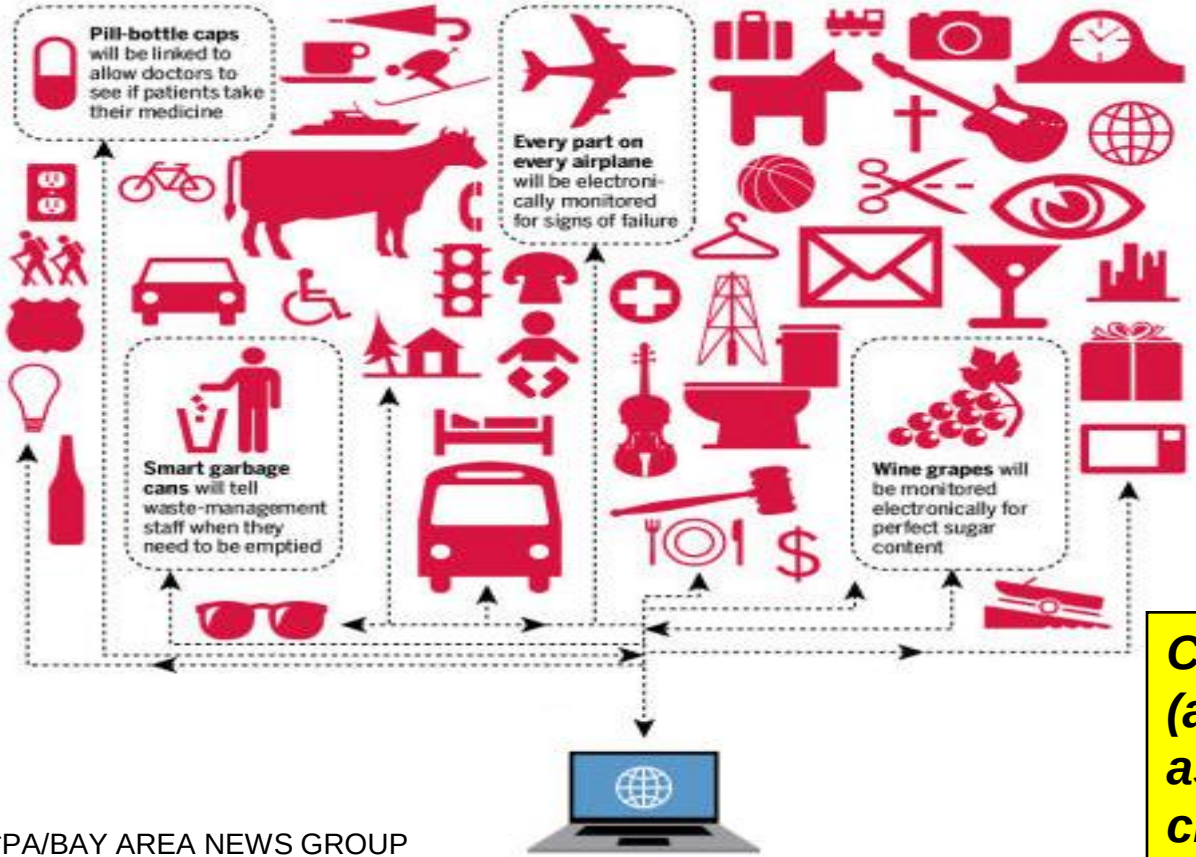
Securing the Physical World



Current architecture not designed to secure the physical world

Devices will be heterogeneous



Heterogeneous in:

- Functionality
  - Data sensed
  - Actions invoked
- Processing capability
- Network and platform protocols, standards, technologies
- Applications and services
- Security requirements and capabilities

Combining physical objects (and specifically, their associated devices) will create new capabilities!

*PA/BAY AREA NEWS GROUP

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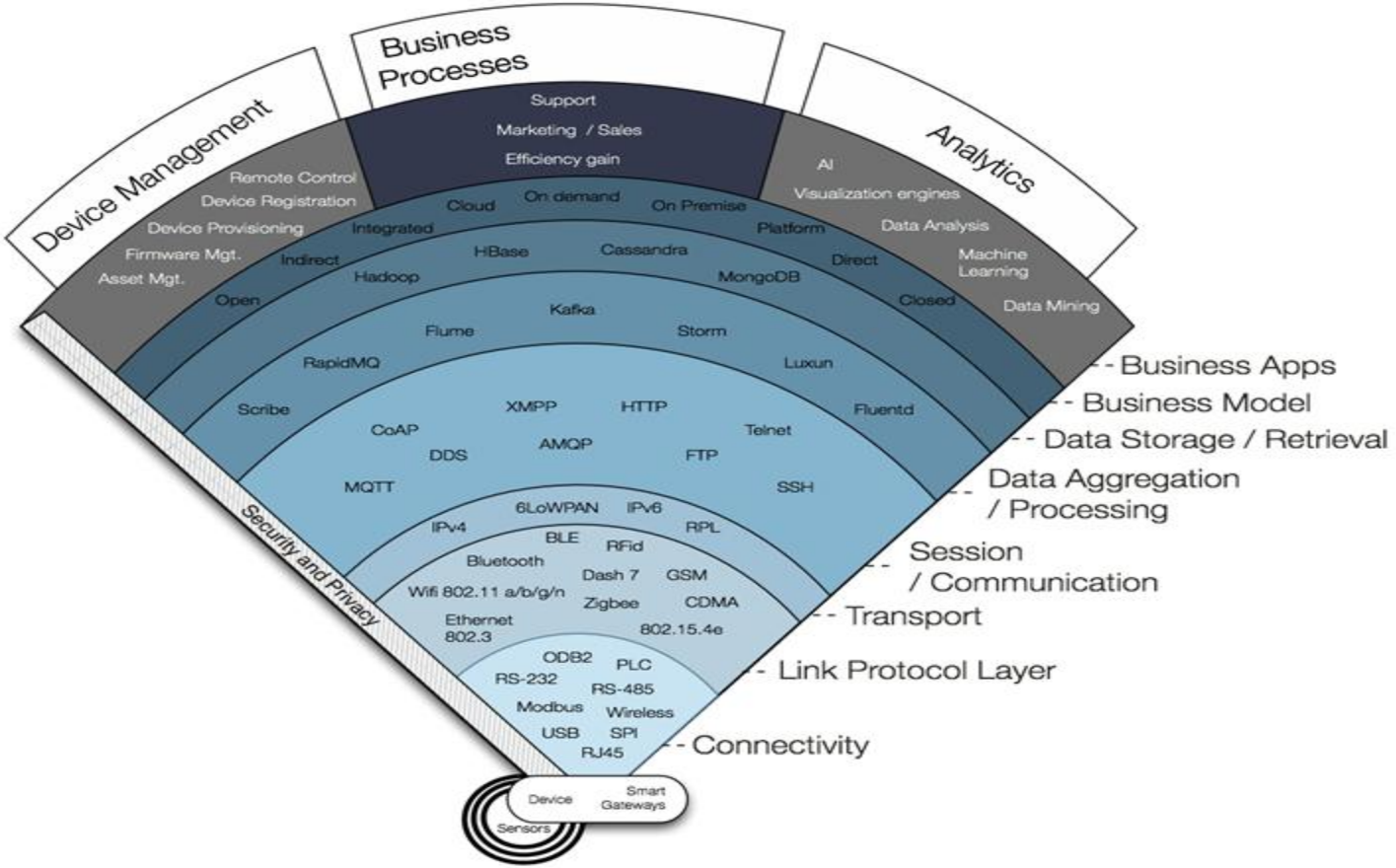
Myriad Technologies



*Passemard 2014

Current IoT Landscape

The Good

- IoT Standards Efforts, Active Consortia
- Numerous available products
- Numerous potential benefits

The Bad

- Overlapping IoT Standards Efforts
- Ecosystem and Platform battle
- Numerous incompatible devices with proprietary technologies
- Multiple, complex security challenges

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Other IoT Security Challenges

- Standardized IoT-related security definitions, taxonomies/ontologies, nomenclature, report/data formats, risk assessments, design patterns
- Authentication, authorization, and access control between very large numbers of devices
- Analyzing security of resource-constrained devices
- Analyzing and evaluating the security of existing standards and technologies for use in IoT:
  - Network standards, technologies, and protocols
  - Web/Cloud services
  - Mobile applications
  - Identity management, authentication, authorization, access control
  - Privacy

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Other IoT Security Challenges

- Scalable security analysis of numerous, disparate resource-constrained embedded devices
- Identity management between devices, IoT platforms, gateways, and cloud services
- IoT platforms (still under development by various organizations)
- Organizational policies regarding IoT security

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Path Forward to Securing IoT

- Categorize the threats in terms of importance
  - Denial of Service vs Data Loss
  - Confidentiality (Encryption) vs Availability (Energy)
  - Quantify the Big Data challenge for security
- Develop primitives that can allow the IoT devices to be secure on a macroscopic vs microscopic level
  - Encryption of data vs Authentication of devices
  - Move expensive security operations on hardware vs software
  - Understand what is important: connectivity vs usability

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Path Forward to Securing IoT

- Encourage OEMs to make security a top priority during IoT product development
- Develop scalable approaches for analyzing the security of resource-constrained IoT devices
- Evaluate the suitability of using existing standards, technologies, and protocols for ensuring the security of IoT components and leverage wherever possible

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Path Forward to Securing IoT

- Develop standardized IoT definitions, taxonomies/ontologies, nomenclature, use cases, design patterns
- Develop standardized security specifications for IoT platforms, data formats, risk assessments
- Encourage the development of a smaller set of defacto standards for IoT security
- Develop and implement policy and practice to ensure the security of IoT, particularly when applied to critical infrastructures including energy grids or national defense systems

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‘Networks of Things’

Pieces, Parts, and Data

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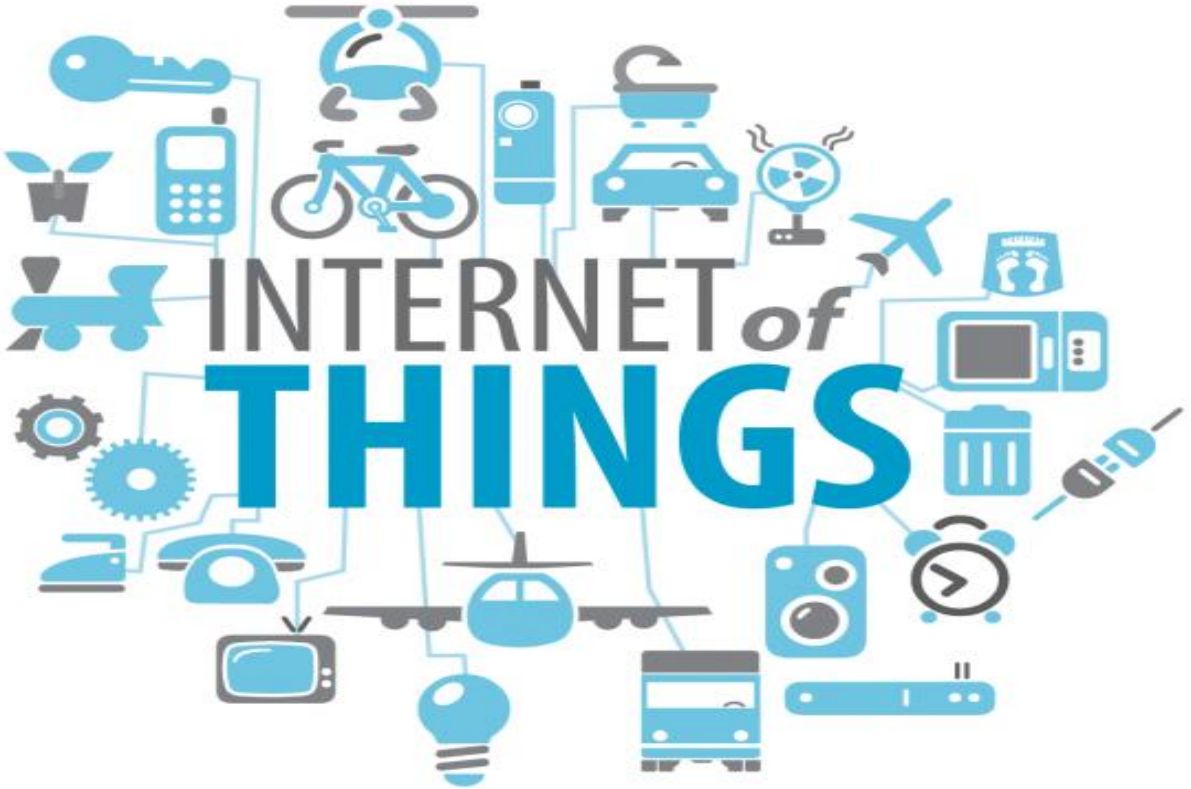
Discussion



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