The Internet of Things #IoT

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Outline

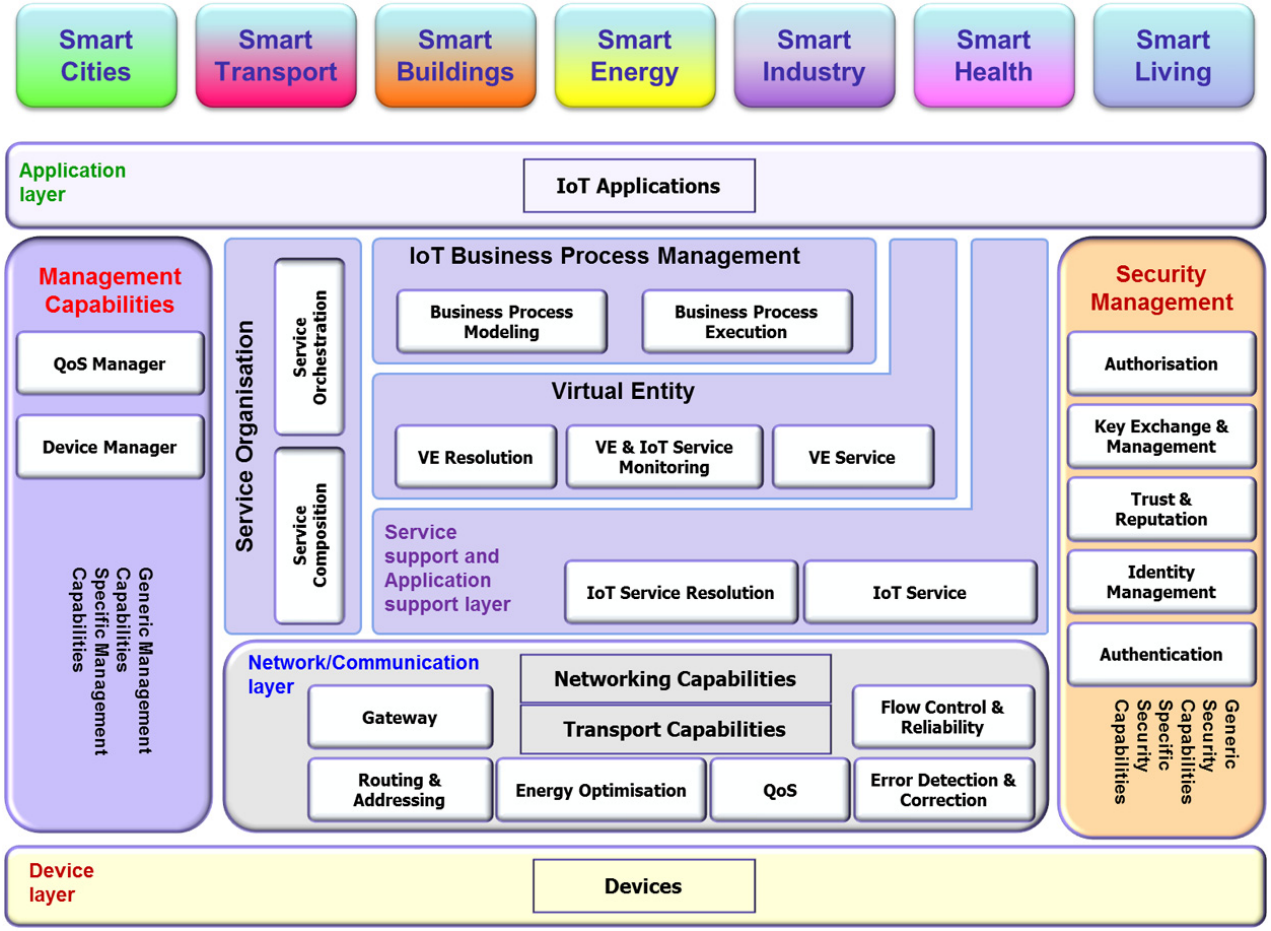
- Definition and architecture specified by ITU-T
- Use cases specified by oneM2M
- Six levels of systems with increasing complexity
- Protocol stack from sensors to business value
- Application programming interfaces (API)
- Demonstrations
- Privacy engineering and management
- Summary

IoT Definition by ITU-T

A dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual “things”

- Have identities, physical attributes, and virtual personalities
- Use intelligent interfaces
- Are seamlessly integrated into the information network
- Often communicate data associated with users and their environments

IoT Architecture by ITU-T



IoT Use Cases by oneM2M

1 Agriculture

2 Energy

2.1 Wide area energy related measurement/control system for advanced transmission and distribution automation

2.2 Analytics

2.3 Smart meter reading

2.4 Environmental monitoring of remote locations to determine hydropower

2.5 Oil and gas pipeline cellular/satellite gateway

3 Enterprise

3.1 Smart building

4 Finance

IoT Use Cases by oneM2M

5 Healthcare

5.1 M2M healthcare gateway

5.2 Wellness services

5.3 Secure remote patient care and monitoring

6 Industrial

7 Public services

7.1 Street light automation

7.2 Devices, virtual devices and things

7.3 Car/bicycle sharing services

7.4 Smart parking

7.5 Information delivery service in the devastated area

IoT Use Cases by oneM2M

8 Residential

8.1 Home energy management

8.2 Home energy management system (HEMS)

8.3 Plug-in electrical charging vehicles and power feed in home scenario

8.4 Real-time audio/video communication

8.5 Event triggered task execution

8.6 Semantic home control

8.7 Semantic device plug and play

9 Retail

IoT Use Cases by oneM2M

10 Transportation

10.1 Vehicle diagnostic and maintenance report

10.2 Remote maintenance services

10.3 Traffic accident information collection

10.4 Fleet management service using digital tachograph (DTG)

IoT Use Cases by oneM2M

11 Other

11.1 Extending the M2M access network using satellite

11.2 M2M data traffic management by underlying network operator

11.3 Optimized M2M interworking with mobile networks (optimizing *connectivity* management parameters)

11.4 Optimized M2M interworking with mobile networks (optimizing *mobility* management parameters)

11.5 Sleepy node

11.6 Collection of M2M system data

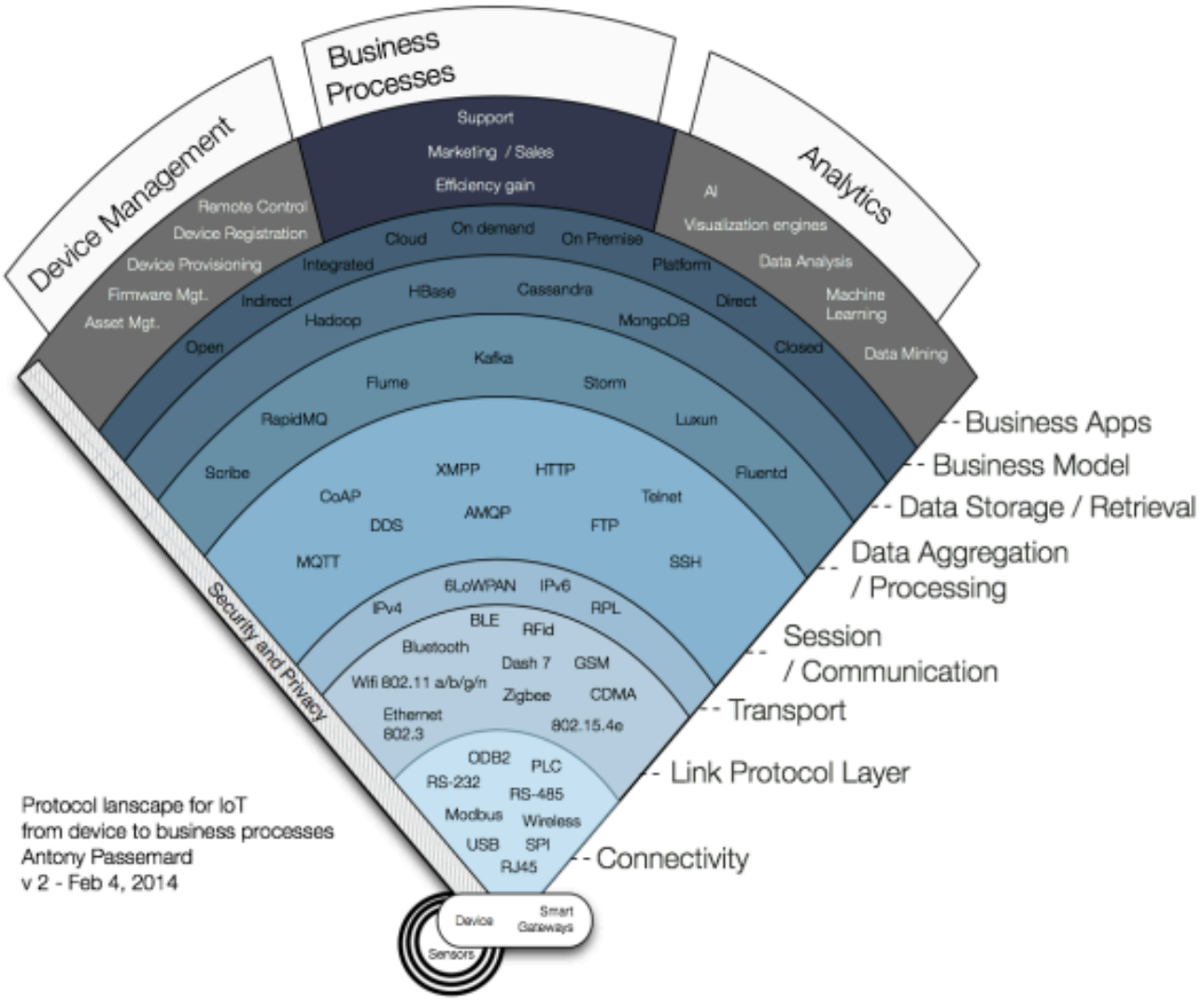
11.7 Leveraging broadcasting/multicasting capabilities of underlying networks

11.8 Leveraging service provisioning for equipment with built-in M2M device

Complexity Levels of IoT Systems

Level	Node	Analysis	Storage	Example
1	Single	Local	Local	Home Automation
2	Single	Local	Cloud	Smart Irrigation
3	Single	Cloud	Cloud	Tracking Package Handling
4	Multiple	Local	Cloud	Noise Monitoring
5	Multiple + Coordinator	Cloud	Cloud	Forest Fire detection
6	Multiple + Centralized Controller	Cloud	Cloud	Weather Monitoring

IoT Protocols

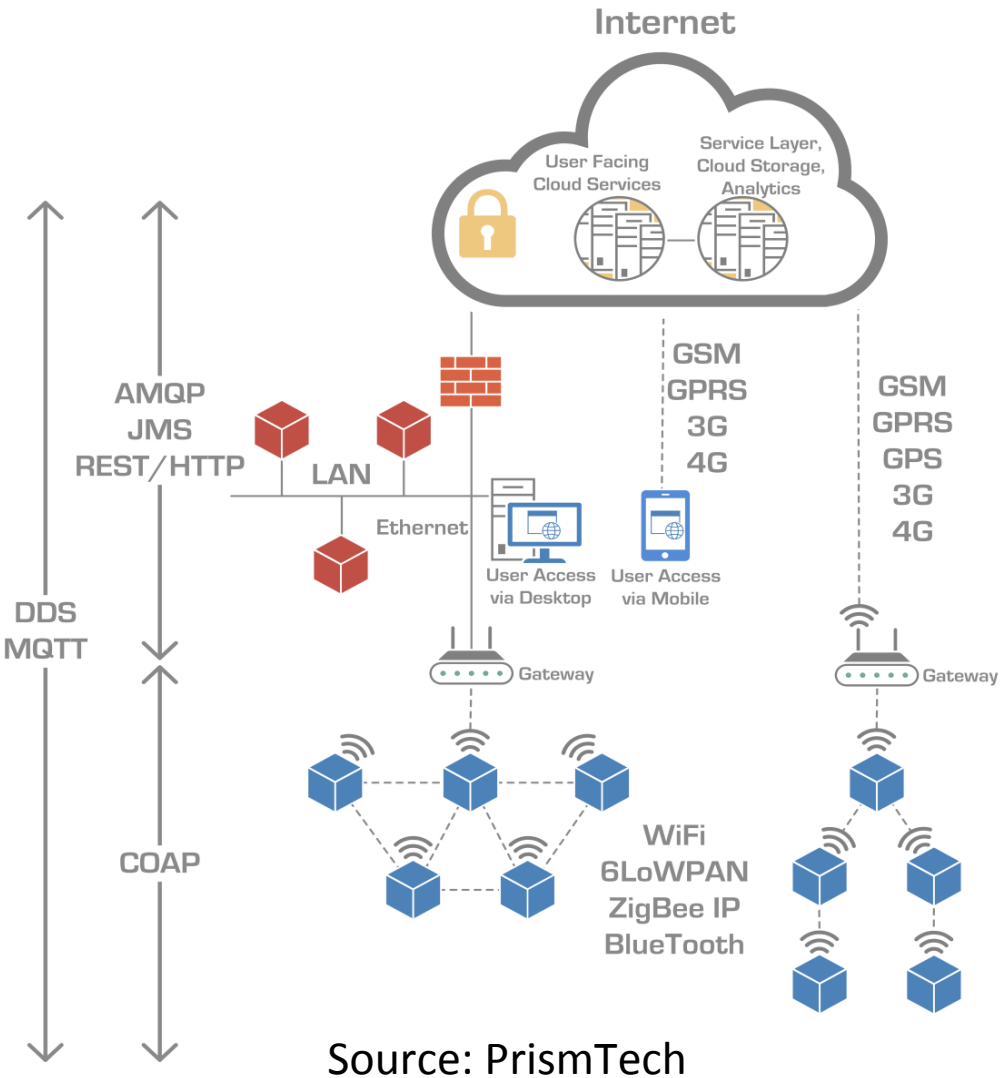


https://entrepreneurshiptalk.wordpress.com/2014/01/29/the-internet-of-thing-protocol-stack-from-sensors-to-business-value/

IoT Protocols

6LoWPAN	IPv6 over Low power Wireless Personal Area Networks
AMQP	Advanced Message Queuing Protocol
CoAP	Constrained Application Protocol
DDS	Data Distribution Service
HTTP	Hypertext Transfer Protocol
JMS	Java Message Service
MQTT	Message Queue Telemetry Transport
REST	Representational State Transfer
WebSocket	
XMPP	Extensible Messaging and Presence Protocol

IoT Connectivity Protocols

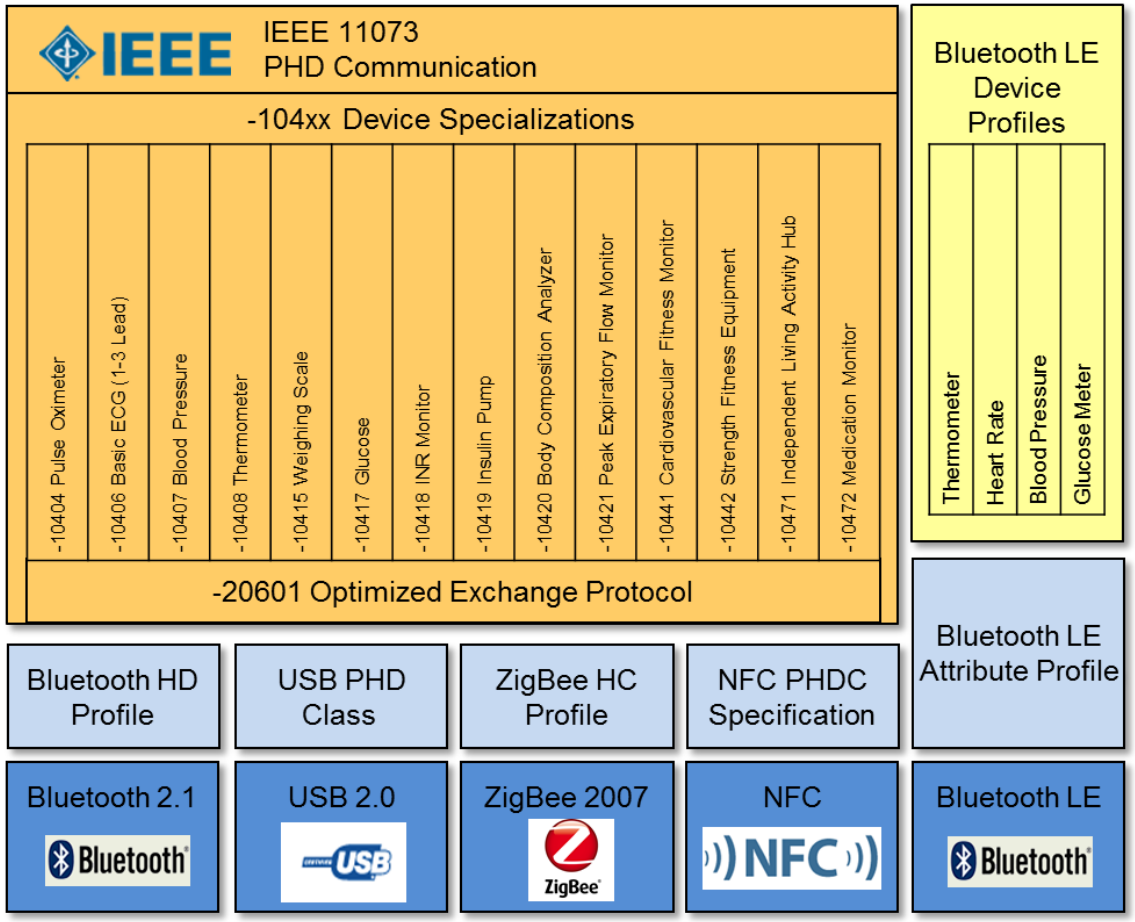


Source: PrismTech
http://www.prismtech.com/download-documents/1561

Demonstration

- REST API
  - Smart parking:
    - Django, Python, MySQL, Raspberry Pi, and Ultrasonic Sensor
  - Smart lighting
    - Django, Python, SQLite3, Raspberry Pi, LED, and Light Sensor
- Mobile apps
  - Automatic, Cardiio, Nest, and SmartThings

Personal Health Device Communication (PHDC)



ECG: Electrocardiograph
INR: International Normalized Ratio

LE: Low Energy
NFC: Near Field Communication

Privacy Management

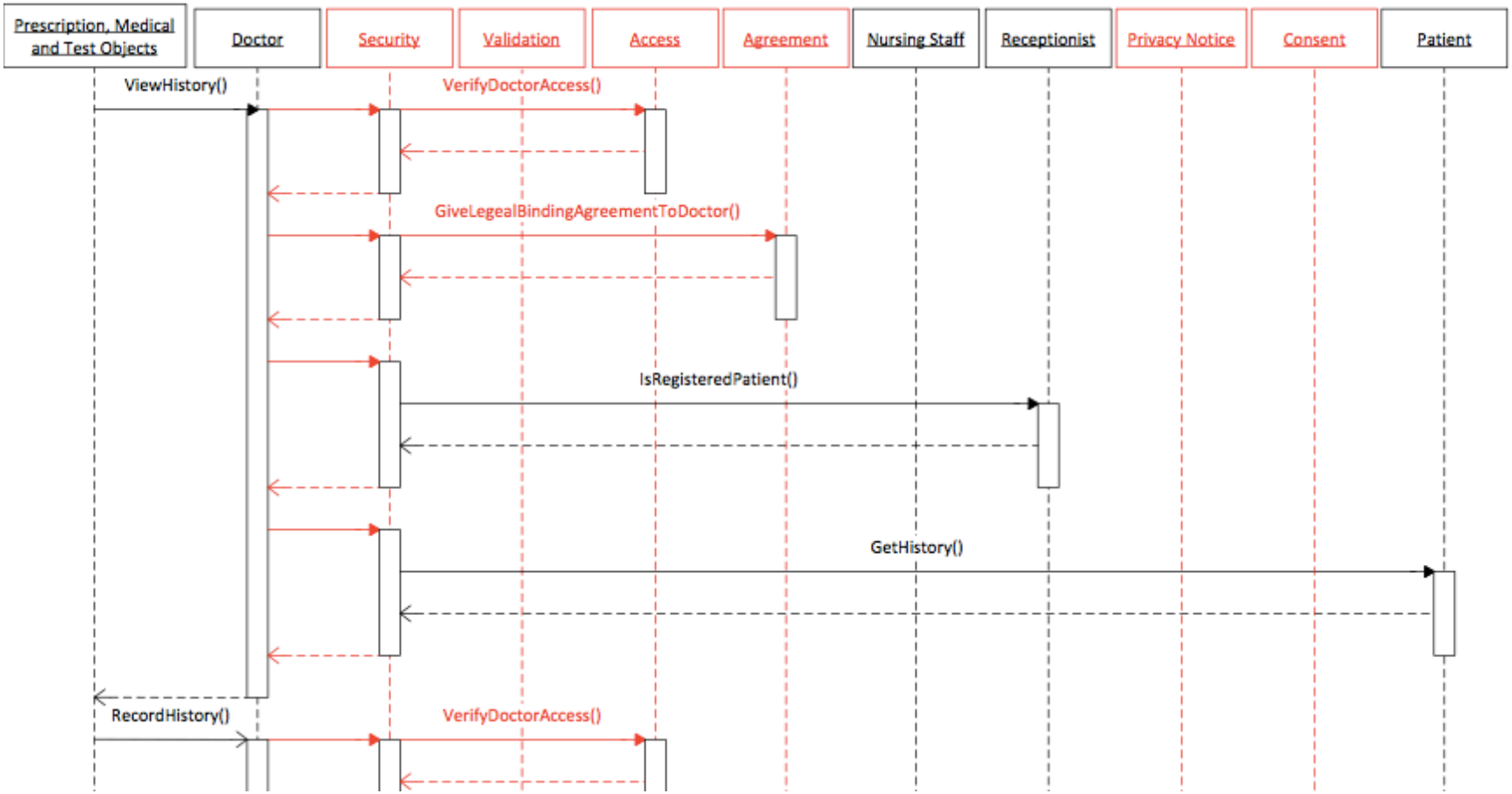
Fair and authorized processing

- Collection, storage, use, organization, recording, alignment, combination, disclosure by transmission, consultation, erasure, destruction, alteration, etc.

of Personally Identifiable Information (PII)

- Any data that identifies an individual or from which identity or contact information of an individual can be derived

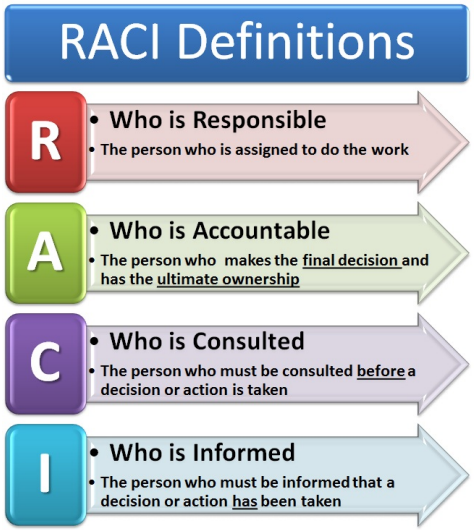
Privacy Management Sequence



Privacy by Design

OASIS

OASIS Privacy by Design Documentation for Software Engineers (PbD-SE) TC



RACI Chart for OASIS PbD-SE Methodology (WIP)

PbD-SE Methodology Step	Documented Activity	Software Engineer	Privacy Resource	Project Mgmt.	Mgmt.	Third Party	User
3.1 Assess Organization-al Readiness	Document Privacy Policy Document	C	RAC	C	AC	I	C
	Document Privacy Roles/Training Program in Organization	I	RA C	C	AI	I	I
3.2 Scope Privacy Requirements & Reference Architecture	Document Functional Privacy Requirements & hooks to Reference Architecture	RA	RA C	AC	AI	RA I	C
3.3 Conduct Risk Analysis on Use Cases	Document Business Model with Personal Data Flows	C	RAC	C	AC	C	-
	Document Risk analysis (incl. threat models, PIA)	C	RA C	C	AC	C	-
3.4 Identify Privacy Resource Allocation	Document privacy resource allocation to SE team	I	RAC	R	AI	I	-
3.5 Create RACI for Producing Artifacts	Document RACI assignment to artifact production	RC	C	RAC	AI	-	-
3.6 Customize Privacy Architecture	Document Privacy Architecture	RA	AC	AC	AI	I	-
3.7 Conduct Periodic Review	Document Review of Artifacts throughout the PDLC	RA	C	RAC	AI	-	-
3.8 Execute Code Testing & Privacy Evaluation	Document testing and evaluation for privacy usability - **metrics**	RA	RC	RAC	AI	-	C
3.9 Create Retirement Plan	Document plan for retirement of software solution	C	RAC	RAC	ACI	I	I
3.10Sign-off	Document sign off with checklist	RAC	RAC	RAC	AC	-	-

Summary

- IoT is not always on – it's mostly off
- Not all data sent to the cloud
- IoT is not about adding connectivity to all things
- IoT is about how sensors, devices, things, and services can be integrated to create value
- Value is created by making sense of data, turning it into knowledge and meaningful action
- Access to data shall have differential restrictions