Network Management in IoT/T2T and Parameters to be Monitored

Danping He (Ana) ana.hedanping@huawei.com

Georgios Karagiannis georgios.karagiannis@huawei.com

Joerg Heuer Joerg.Heuer@siemens.com

Vivek Kulkarni vivekkulkarni@siemens.com

What makes T2T different?

Different types of devices

- Different Transmission technologies (e.g. Bluetooth LE, IEEE 802.15.4, PLC, NFC, Ethernet, WiFi,…)
- Different capabilities
  - Personal devices,
  - Sensors, Actuators,
  - Computing devices,
  - Relaying devices
  - Storage devices

Network

- Automation of Things discovery and integration into the system
- T←→ T, T → T(relay, processing) → T
- Things network configuration with different topologies (e.g. Mesh, Star, p2p, Ring, Line…)
- # of devices per Things domain/ per Things administrator

Architecture

- Architectural aspects of Things without human interaction (personal awareness)
- Optimal architecture considering Things capabilities

Application Layer (distributed, interaction)

- Communication relationships (e.g. Automation chains, federations) between Things
- Scheduled interactions Vs. Event driven Vs. Human interaction
- Different Services (e.g. Monitoring, Control, Configuration management, etc.)

What are IoT/T2T network management challenges?

- **'Local' automation to realize self-organizing IoT**
  - **Cooperative communication model:**

    To optimize the connectivity and throughput with minimum energy consumption
  - **Situational awareness is key to effective self-organization in the IoT/T2T**:

    Devices are able to know their neighborhoods as well as their adjacent neighborhoods

- **'Global' automation**
  - **Automated load-balancing**

    To maximize the IoT lifetime and improve throughput.
  - **QoS estimation and improvement**

    The primary concern regarding QoS is achieving deterministic behavior (latency, jitter, etc) for well-known workloads. Scalability / elasticity is second.
  - **Ownership dependency and SLA execution**
  - **Predictive maintenance of IoT/T2T**

IETF activities related to IoT/T2T

IETF WGs

a) **ACE** : **Authentication and Authorization for Constrained Environments**

b) **CORE** : **Restful based CoAP protocol**

c) **DICE** : **Datagram transport layered security,**

d) **6lo** : **IPv6 over networks of resource constraint nodes**

e) **6tisch** : **IPv6 over the TSCH mode of the IEEE 802.15.4e**

f) **Roll** : **Routing over low power loosy networks**

g) **LWIG** : **Light-Weight Implementation Guidance**

Network management IETF/IRTF activities to be considered for T2T RG Network Management

1) **IETF WGs**
   a) Network Configuration (netconf): The NETCONF protocol (RFC 6241) provides mechanisms to install, manipulate, and delete the configuration of network devices. This WG also aims to develop RESTCONF, a protocol based on NETCONF in terms of capabilities, but over HTTP and with some REST characteristics, for accessing YANG data using the datastores defined in NETCONF.
   b) NETCONF Data Modeling Language (netmod): The NETMOD working group has defined the data modeling language YANG, which can be used to specify network management data models that are manipulated by the NETCONF protocol.
   c) Autonomic Networking Integrated Model and Approach (anima): The general objective of this working group is to enable the progressive introduction of autonomic functions into operational networks, as well as reusable autonomic network infrastructure, in order to reduce the OpEx. This WG will develop a system of autonomic functions that carry out the intentions of the network operator without the need for detailed low-level management of individual devices. This WG builds on definitions and design goals, as well as a simple architecture model undertaken in IRTF's Network Management Research Group (NMRG).
   d) MBONE Deployment (mboned): The MBONE Deployment Working Group is a forum for coordinating the deployment, engineering, and operation of multicast routing protocols and procedures in the global Internet, inter-domain and single domain.
   e) Layer Independent OAM Management in the Multi-Layer Environment (lime): The LIME working group will concentrate on the operational challenges in consistent handling of end-to-end OAM and coordination of OAM within underlying network layers.
   f) Operations and Management Area Working Group (opsawg): Misc. topics which don't merit a WG of their own or belong to WGs that have already concluded
   g) Other OPS & MGMT Area WGs: Security (dime, opesec,radext, wpkops), Routing (dnsop, grow, ipfix, lmap, v6ops), eman

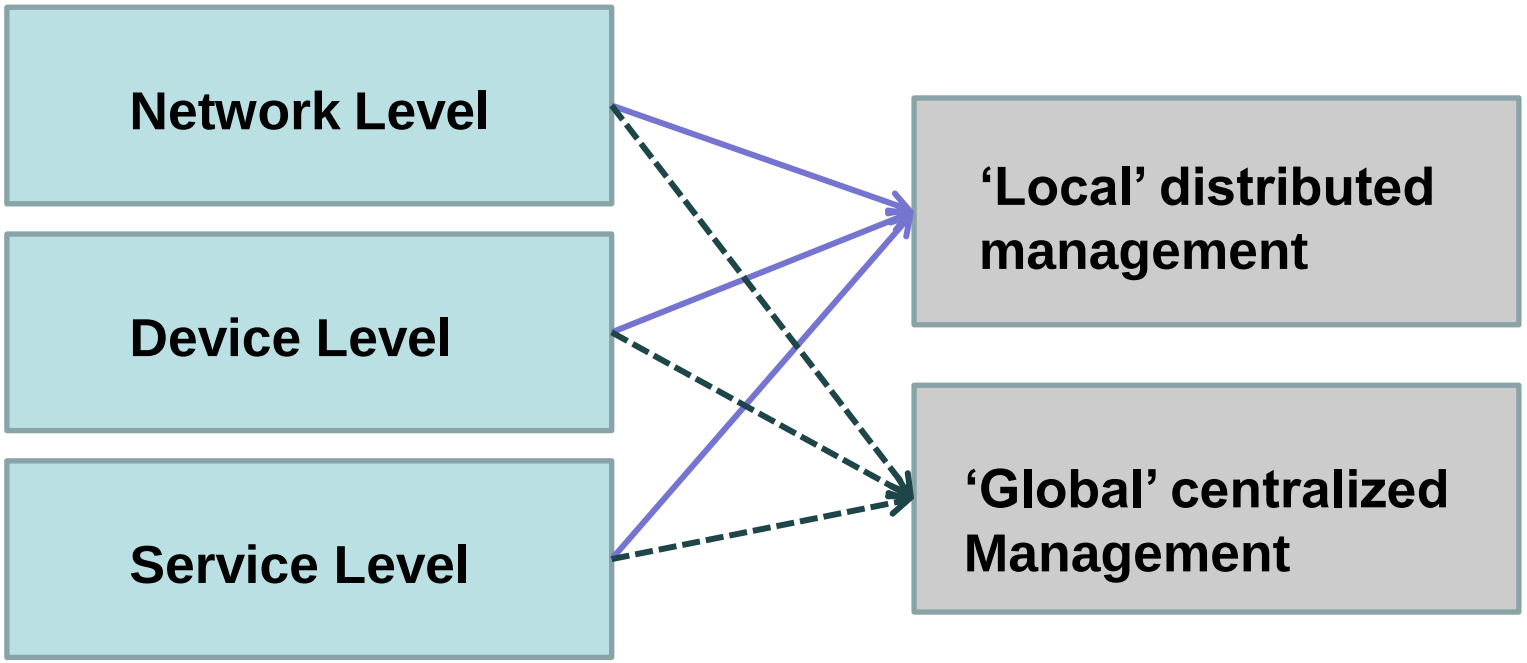
2) **IRTF RGs**
   a) Network Management Research Group (NMRG): focus will be on higher-layer management services that interface with the current Internet management framework (e.g. communication services between management systems, which may belong to different management domains, as well as customer-oriented management services)

Use cases

- **Building automation**
  - Smart energy: HVAC system, Lighting system
  - Security surveillance: fire/smoke detection, intrusion detection, tracking
- **Smart Grid**
- **Smart Logistic**
- **Smart Home**
- **Smart Vehicle**
- **Industrial automation**
- **Health Monitoring**

…

Categories of to be Monitored T2T related Parameters



Network Management Parameters?

- Device quantity
- Connectivity
- Routing information
- Traffic load
- Scheduling of report
- Link quality
- Event log and report

…

Device Management Parameters?

- ID,IP, ownership
- Power mode
- Energy related parameters (e.g. Energy MIBs defined by EMAN)
- Location
- Functionality(type, metric, period/event triggered)
- Generated data amount
- Neighbor/parent/sink
- Duty cycle
- Antenna parameter: tx power, channel, etc
- CPU, memory
- Firmware (version, upgrade)
- Event log

…

OMA defines device Management Objects

Service management parameters?

- Operator
- Owner
- Valid duration
- ACL policy
- Credential material

…

More issues for a good design

- A standard network management architecture?
- Security of network management?
- Light weight due to heterogeneity?
- Modelling of the parameters? Yang, W3C, MIB/OID?
- Reuse/profile of existing protocols?
- Cross layer use of parameters and cross layer interface?

What is the long-term vision on IoT/T2T research opportunities?

Heterogeneous technologies to enable convergent networks:

By using possible radio resources nearby, different communication technologies can cooperate together to deliver highly efficient and green communications

Hybrid communication paradigm:

By seamless combining multi-hop short-range communication technologies and cellular communication technologies could improve the E2E throughput and the reduce cost of large-scale deployment

Data processing awareness:

Sensor data processing techniques such as compressive sensing and data fusion that could significantly reduce the sensor data volume. Therefore, designing a communication paradigm with data processing awareness for future IoTs /T2Ts could provide huge benefits.

Social and economic awareness:

Usually, sensors or smart things are owned by public, organizations, or individuals. Therefore social and economic behaviors of users, and other types of policies (e.g., incentive, resource pricing, and social-aware privacy) defined by network service providers, and sensor data providers should be considered in the IoT/T2T design

Thank you!

Any comments?