



**ITU Kaleidoscope 2015**  
*Trust in the Information Society*

**CONNECTING THE WORLD  
THROUGH TRUSTABLE INTERNET  
OF THINGS**

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# Outline

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- Review of IoT activities in ITU
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  - ITU-T Focus Groups on M2M Service Layer and IMT-2020
  - ITU-T IoT-GSI and Study Group 20
- Key requirements of IoT
- Prospective technologies
  - SDN, network virtualization/softwareization, ICN, mobile edge computing, ID-based communication
- Conclusion

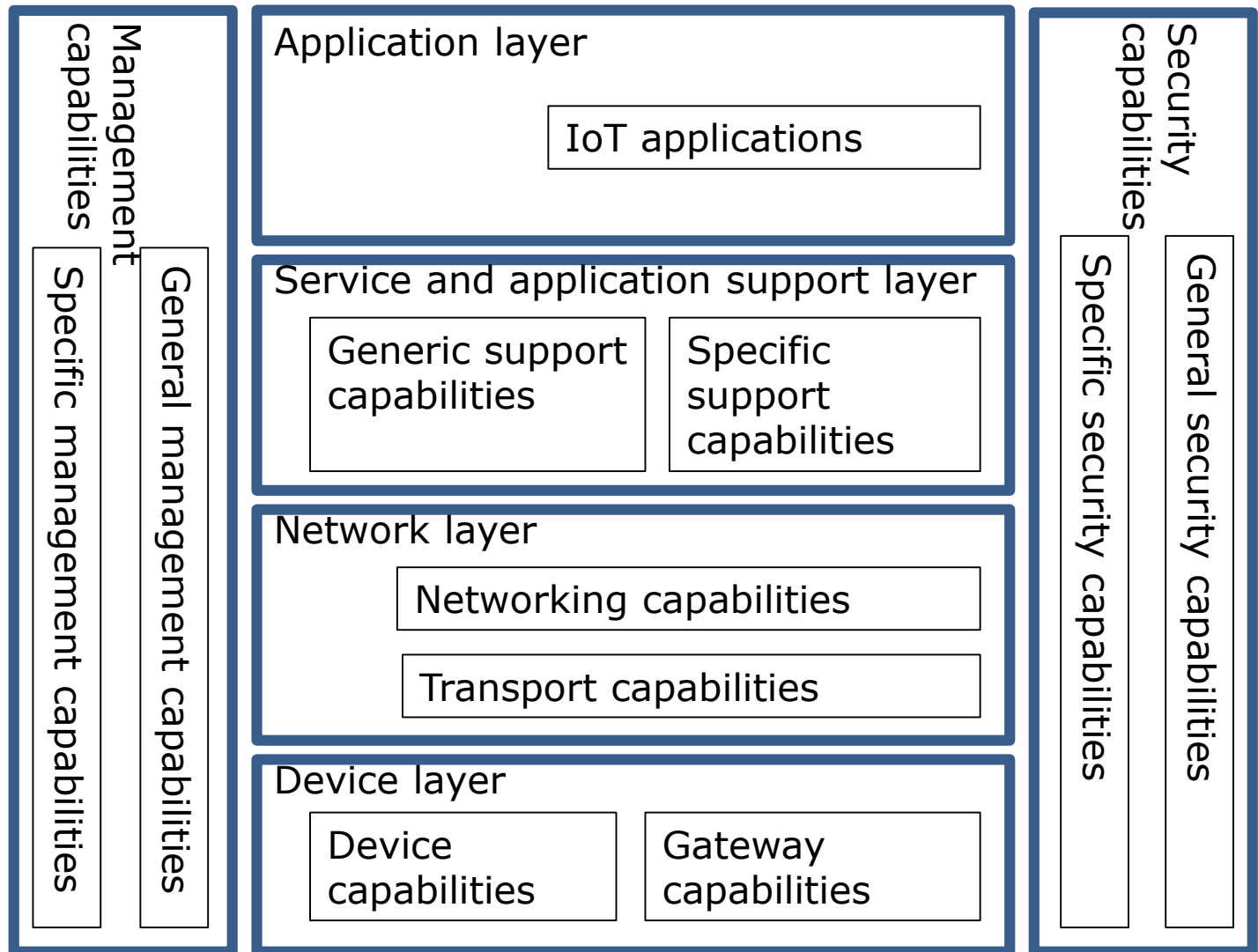
# Introduction

- Humans already (mostly) connected
  - 7 billion mobile subscribers worldwide
- Machine and things getting connected
  - 50 billion connected devices in 2020
  - M2M communication
  - 5G mobile networks
- IoT empowering humans to address numerous challenges of modern society
  - energy and utilities, transport, logistics, healthcare, smart cities, fitness, sports, and public safety
  - making human lives safer, healthier, more efficient and comfortable

# Review of IoT activities in ITU

- ITU's study on **future networks, M2M, and IMT-2020** instrumental for IoT
- ITU-T Y.2060 (2012) Overview of the IoT
  - Thing – an object of the **physical world** (physical thing) or the **information world** (virtual thing), which is capable of being **identified and integrated into communication networks**
  - Device – a piece of equipment with the mandatory **capabilities of communications** and the optional capabilities of sensing, actuation, data capture, storage, and processing
  - IoT – a **global infrastructure** for the information society, enabling advanced services by **interconnecting** (physical and virtual) **things** based on **existing and evolving interoperable information and communication technologies**
  - Adding **fourth dimension of anything** (besides anyplace, anytime, anybody) to communication

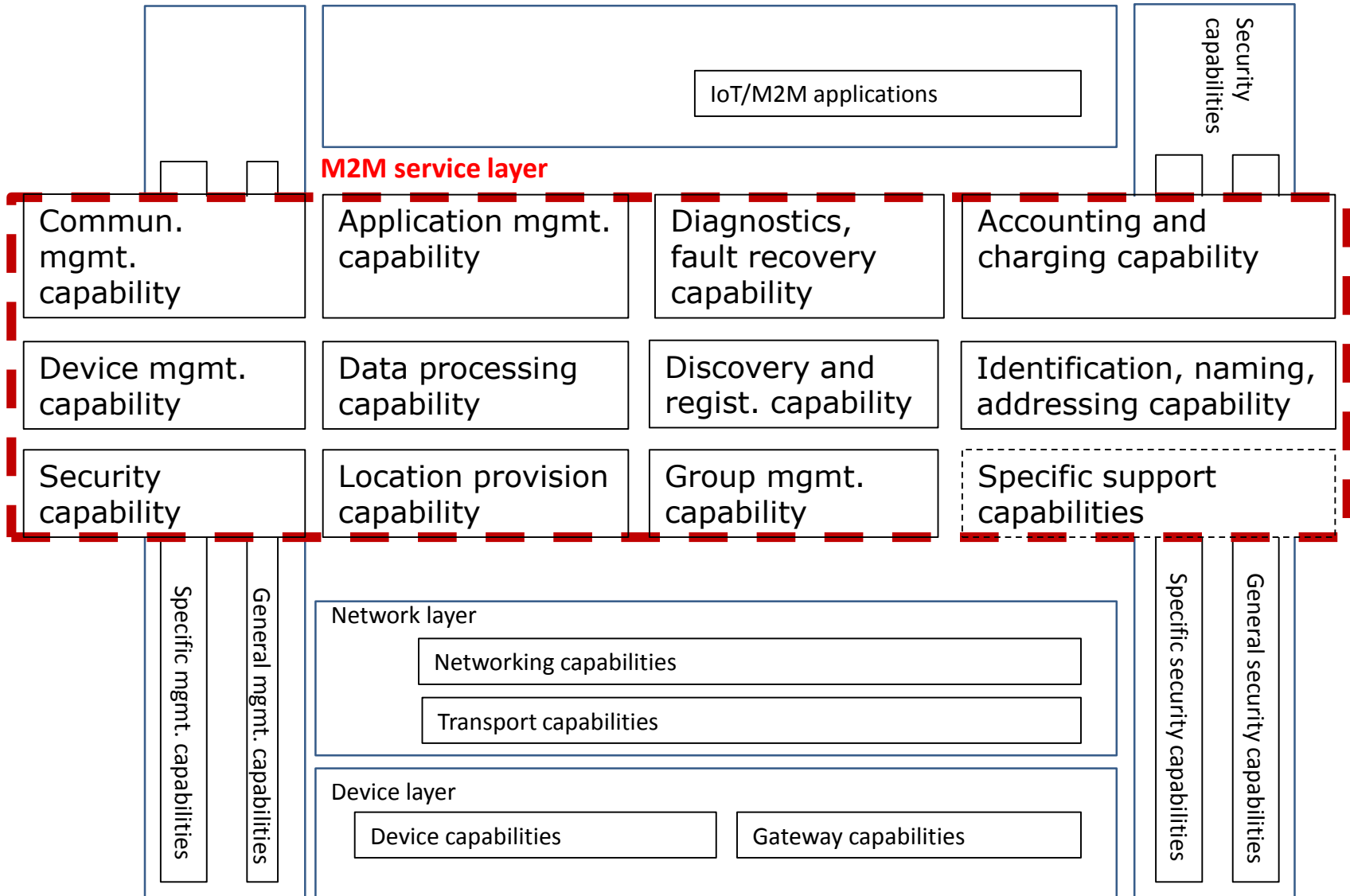
# IoT Reference Model (Y.2060)



# M2M communication and services

- Focus Group on M2M Service Layer (FG M2M) established in 2012
  - Reviewed related activities undertaken by various SDOs
  - Identified common M2M service layer requirements
  - Specified an architectural framework of the M2M service layer

# M2M Service Layer in IoT Reference Model



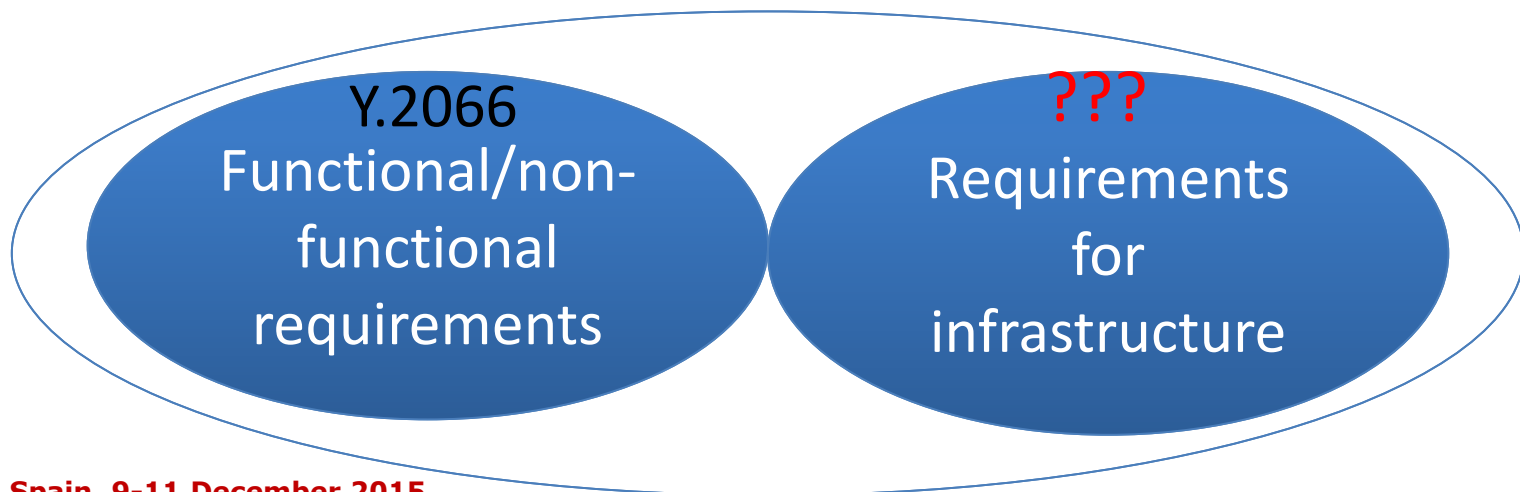
# ITU-T IoT-GSI and SG20

- ITU-T IoT-GSI
  - Providing common platform for experts from various SGs (e.g. SG2, SG3, SG9, SG11, SG13, SG16, SG17)
  - Promoting collaboration with SDOs to harmonize approaches to **unified IoT standards** development worldwide
- ITU-T SG20 established in 2015 June
  - “IoT and its applications including smart cities and communities”
  - Exclusive studies of IoT technologies, services and applications in a single place



# Requirements of IoT

- ITU-T Y.2066 specifies non-functional and functional requirements
  - Non-functional: related with implementation and operation
  - Functional: applications support, service, communication, devices, data management, etc.
- However, lacking technological requirements of IoT infrastructure



# Requirements of IoT infrastructure

- Sharable
- Trustable and reliable
- Service-aware, data-aware, user-centric
- Scalable naming, numbering, identification
- Location-independent heterogeneous communication
- Open and standard APIs

# Prospective technologies

- Software-defined networking
- Security and privacy protection
- Network softwarization and information-centric networking
- Mobile edge computing
- Naming and identification schemes
- ID-based communication

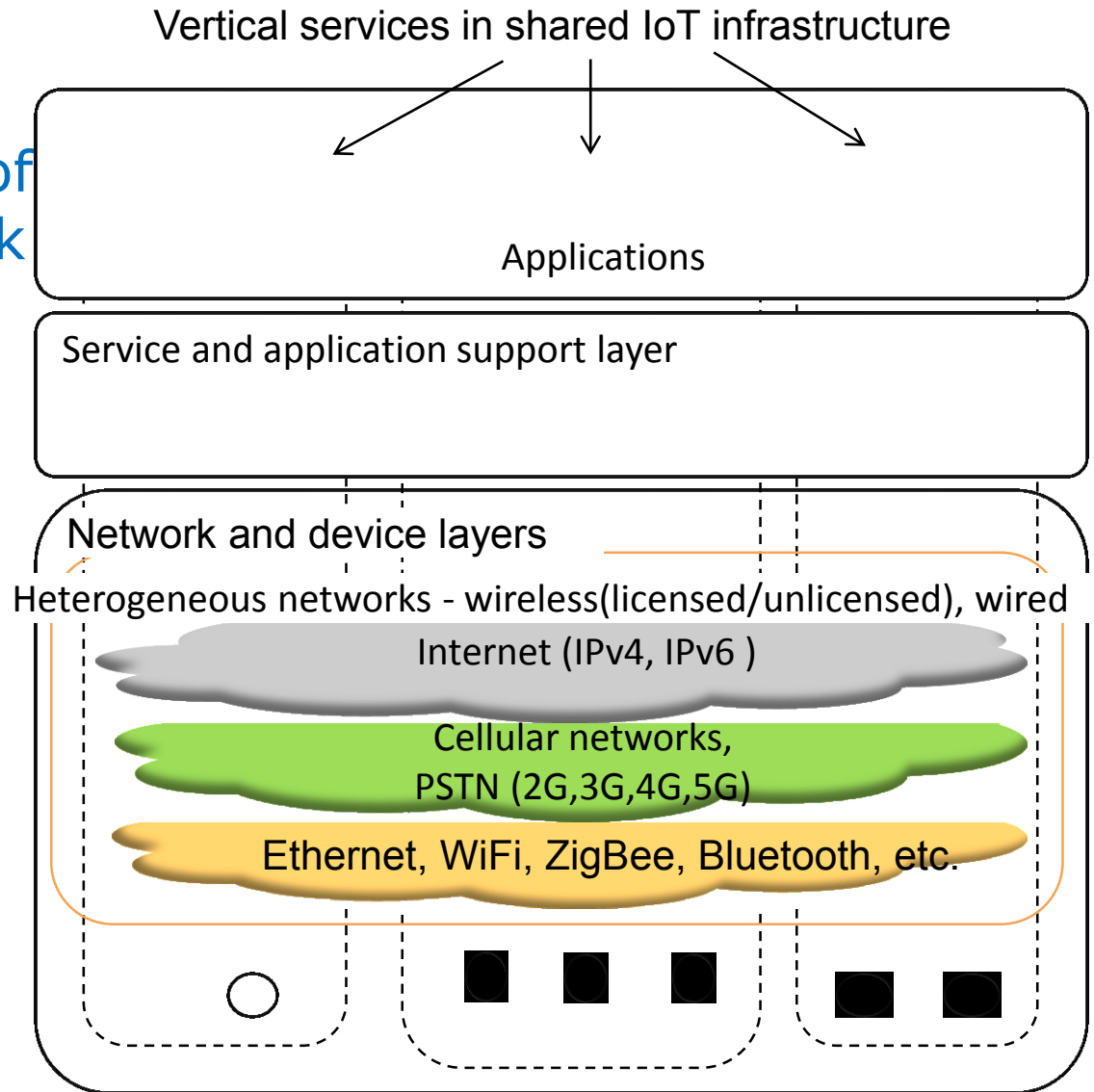
## Requirements

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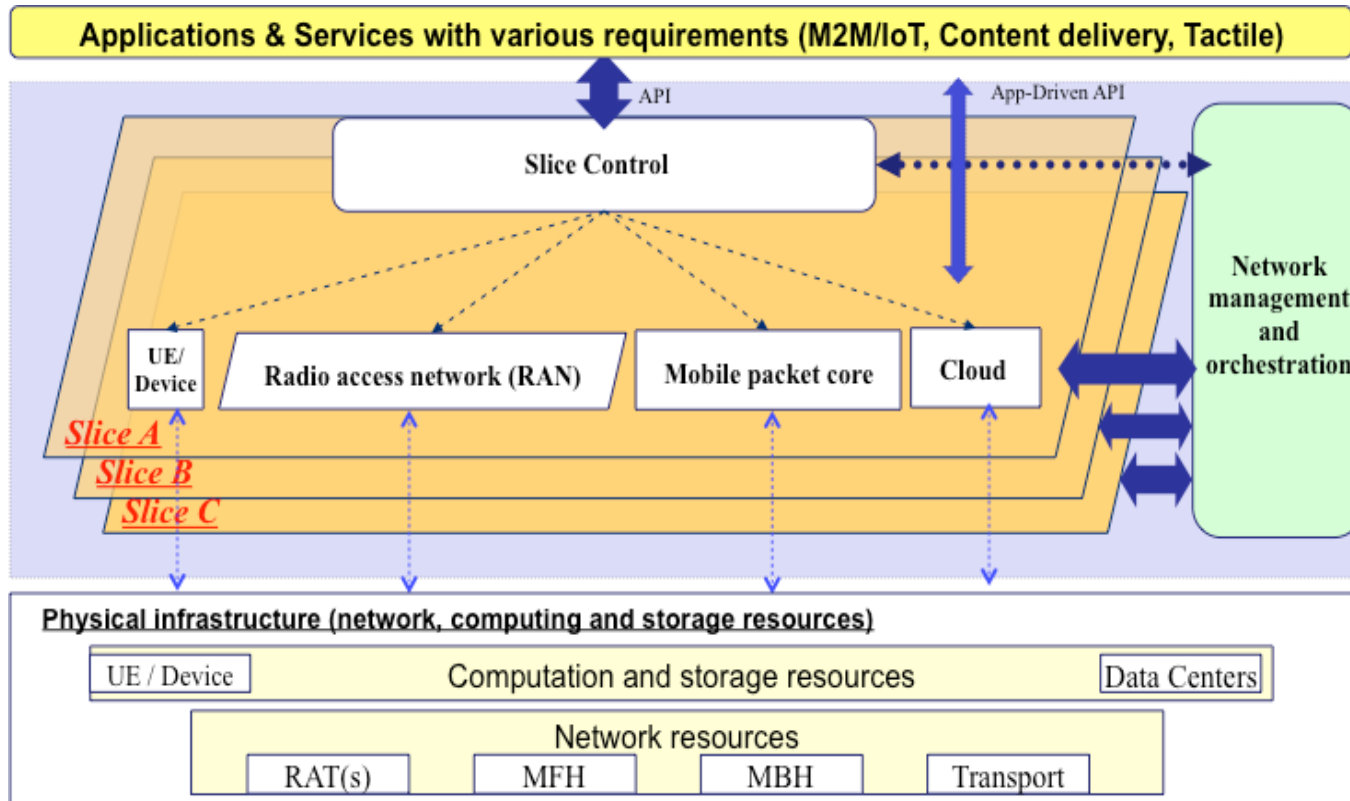
# Leveraging SDN/NFV

- Vertical and horizontal slicing of virtualized network resources
- Service isolation
- Related work
  - ITU-T Y.3011
  - ITU-T Y.3300



# Network Softwarization

- Approach to quick rollout of new networking technologies and services through programming the slices

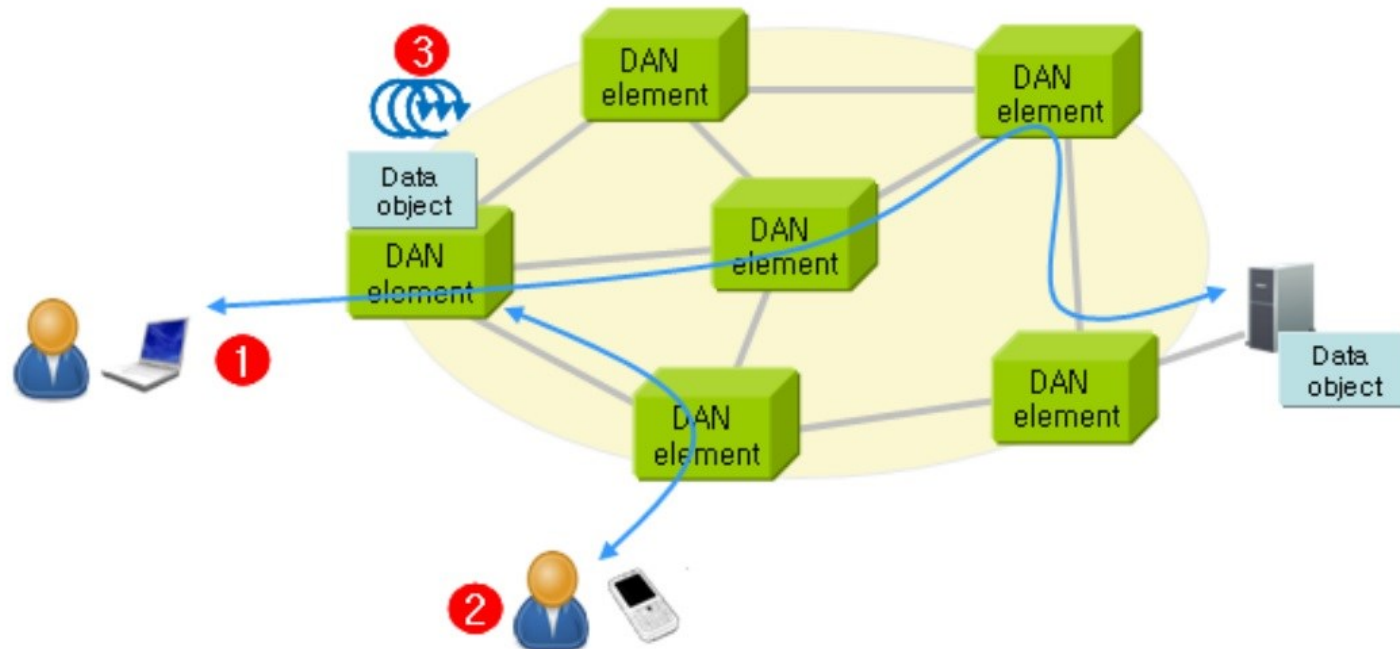


Network softwarization view in IMT-2020

(Source: FG IMT-2020 Deliverable)

# Data-aware or information-centric networking

- Technology for efficient handling of massive IoT data
- Integration of huge number of heterogeneous devices
- Trust contained in data
- Related work
  - ITU-T Y.3033

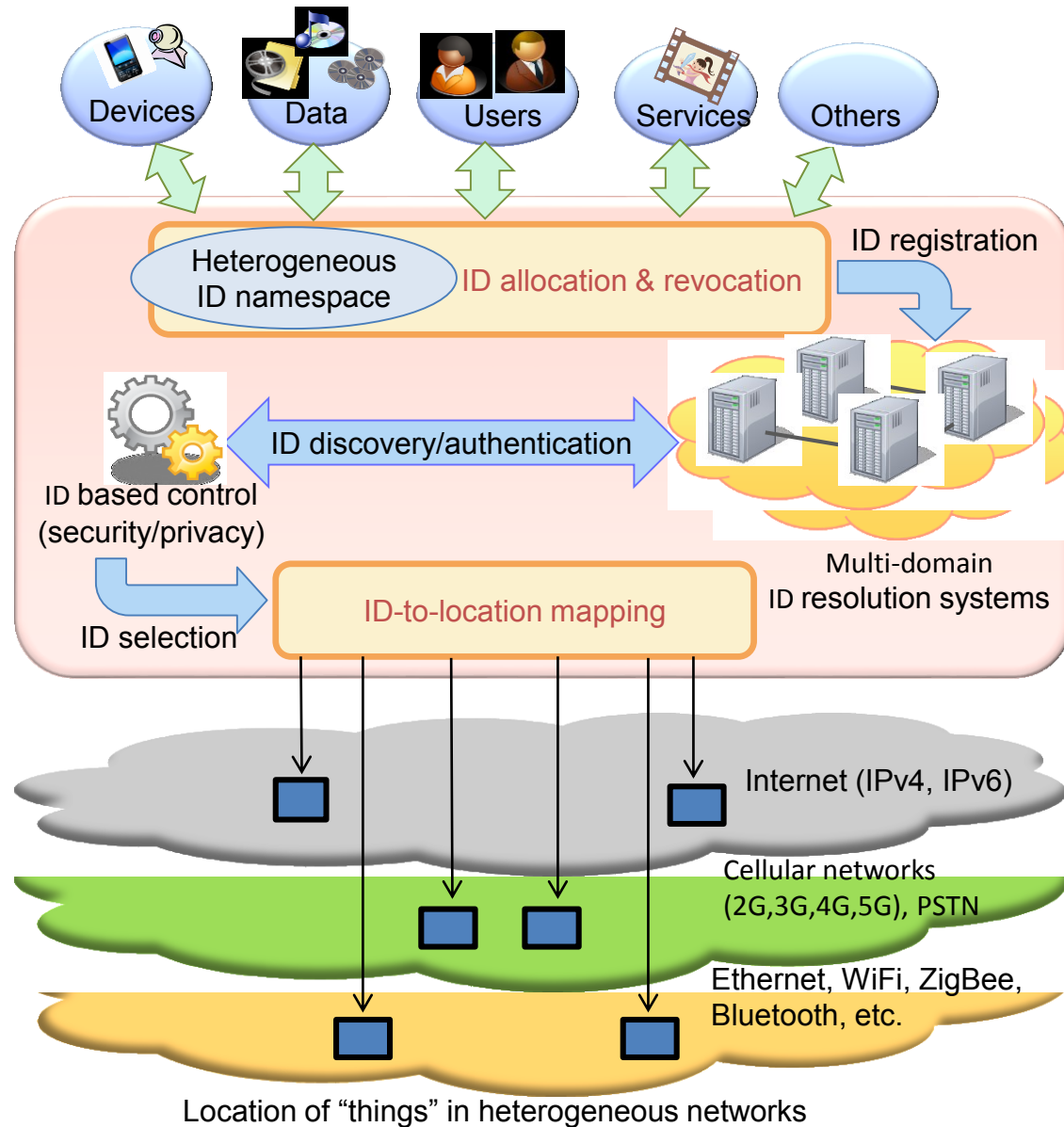


# Mobile Edge Computing

- Provisioning in-network processing (together with required data) functions closer to end user devices
  - Mobile cloud
- Reduces service response latency
  - e.g. automated driving
- Reduces data volume transaction
- Lightens end user device functionality
  - Enabling economically and technologically massive deployment

# New naming and identification scheme

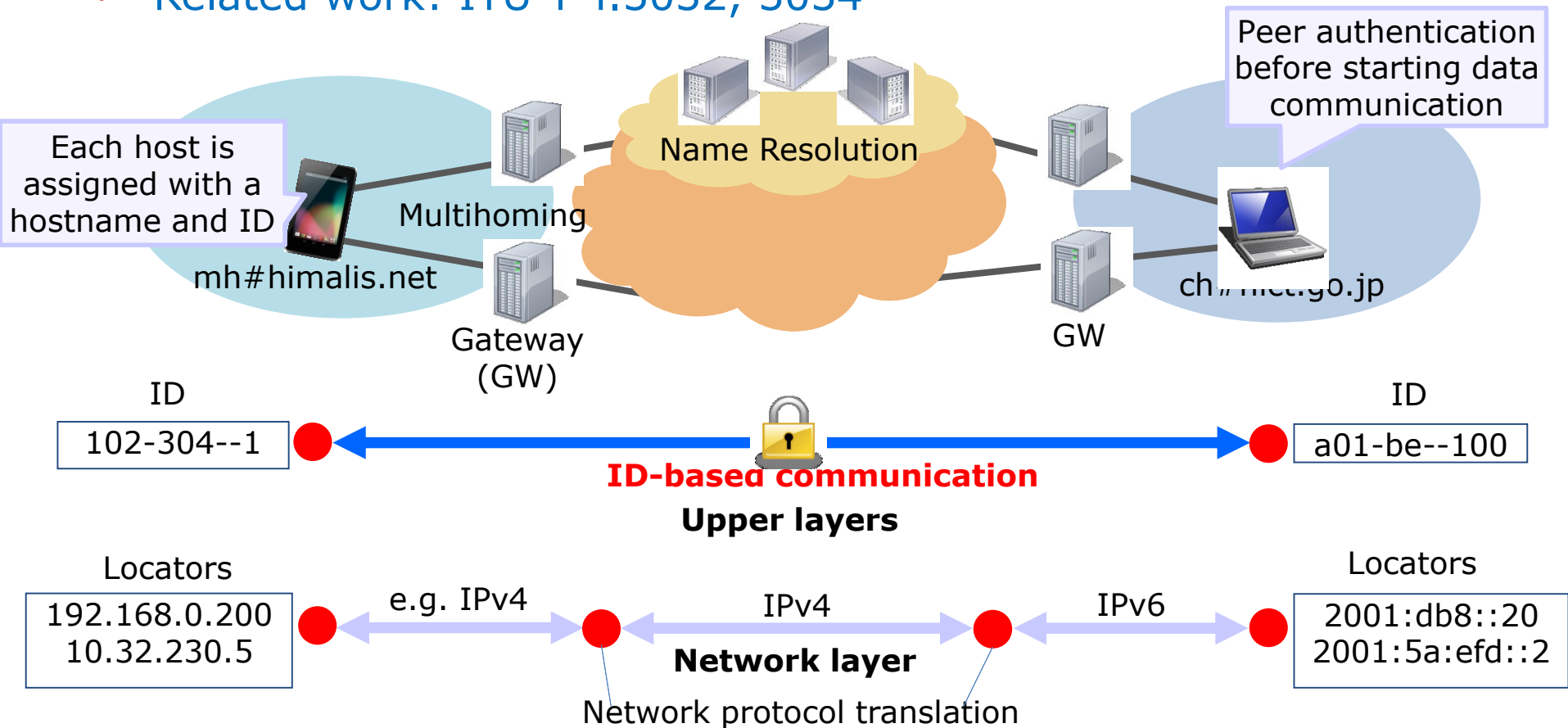
- IDs assigned to various *things* – devices, data or content, users, services, and others (e.g. application software, storage or computing resources)
- Mapped to underlying heterogeneous network locations
- Related work
  - ITU-T Y.3031





# ID-based communication

- Interconnecting heterogeneous devices and communication technologies
- Location-independent communication
- Related work: ITU-T Y.3032, 3034



# Trust, security, privacy

- Five dimensions of trust: availability, reliability, performance, security, privacy
- Three domains in IoT trust:
  1. Platform
    - Generic and service specific functionality
      - e.g., hiding identity in private/personal data
  2. Network
    - Encrypted pipe
    - Location privacy
  3. Storage or cloud
    - Several issues as discussed in previous sessions

# Summary

- IoT has been an important field of research and standardization
- Reviewed IoT related activities of ITU
- Identified the key requirements and prospective technologies for realizing trustable and reliable IoT infrastructure
  - SDN, NFV, network softwarization, ICN, naming/identification, ID-based communication
- Future work
  - Study of architectures and mechanisms for interworking of component technologies, and deployment issues

# Standardization perspectives

## Related Study Groups and Questions:

ITU-T SG13 Q14 – SDN, NFV, Network softwarization

ITU-T SG13 Q15 – ICN, ID-based communication

ITU-T SG20 – IoT services and applications

ITU-T SG13, SG17 – IoT security, trust

ITU-T SG2 Q1, SG13, SG17 – Naming, numbering and identification

Thank you !

Questions?