Future Directions for Internet of Things Work

Naming Architecture for Object to Object Communications
<draft-lee-object-naming-02.txt>

77th IETF Anaheim, March 2010

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- Internet of Things and Smart Objects
- Key technical issues for IoT
- What are possible solutions?
- Related activities in IETF/IRTF
- New work items for IoT
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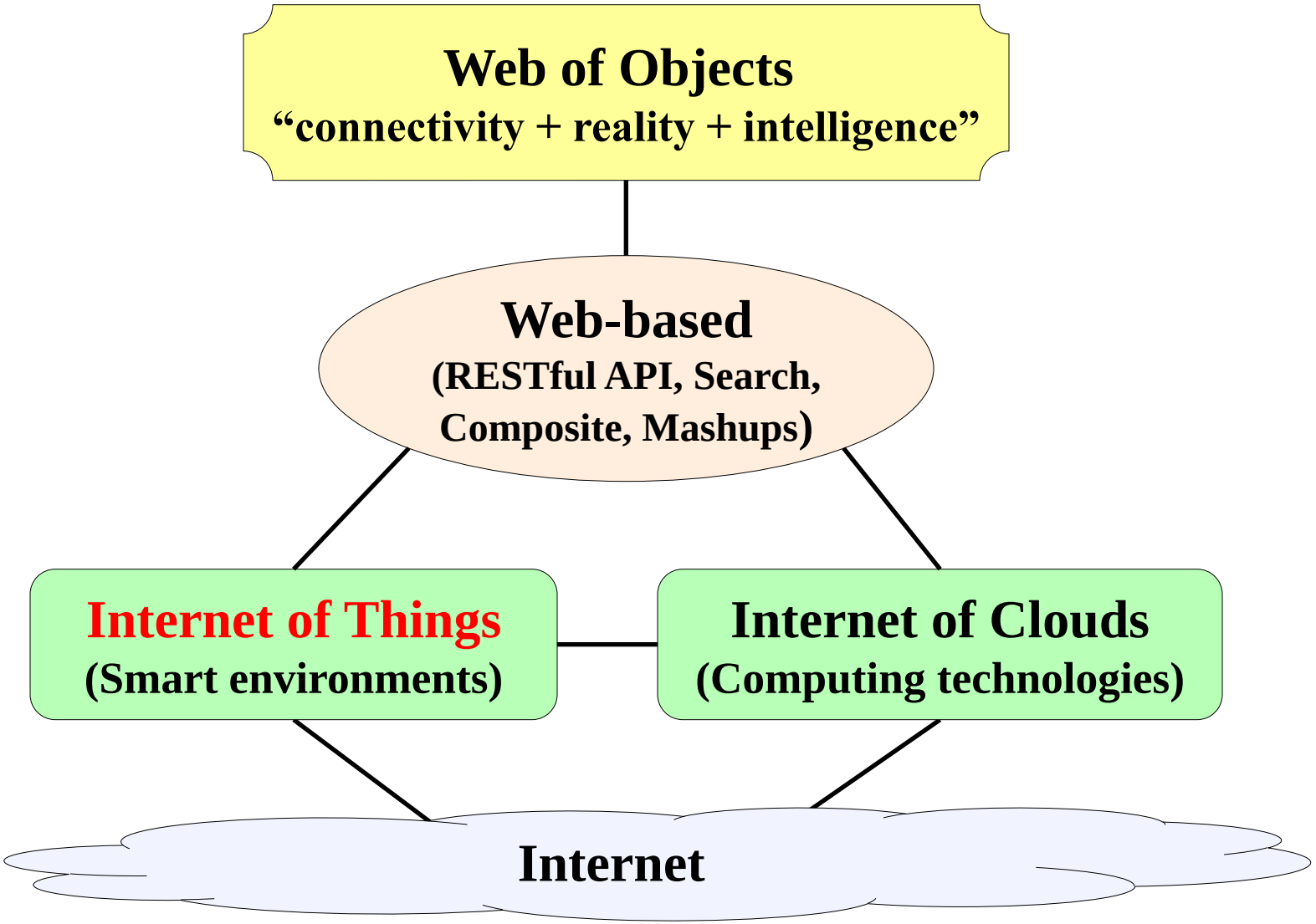
Internet of Things (IoT)



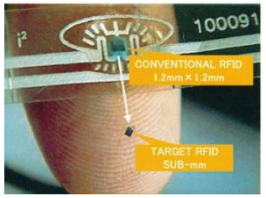
Towards Smart Objects

- Real-time localization on item level
- Protection of trademarks
- Terrorism combat
- Event management (VIP, Ticketing)
- Intelligent clothes

ePC* Objects

- Seamless real-time material and process control
- Documentation of total product life-cycles
- Permanent inventory

Data Objects



- Temperature monitoring of food
- Tire pressure
- Indoor location sensing
- Optical inventory tags with photo sensors

Sensing Objects

- Signaling of use-by date
- Automatic re-order process and pricing
- Alert for health risk
- Advanced announcement of delivery goods

Acting Objects

- Pervasive computing
- Wearable computing
- Smart dust
- Object-to-Object (O2O) communication
- Situation / Localization based services

Interacting Objects

Complexity / Value

time

Sources: Siemens CT / STA / CD S, Mitsubishi Electric Research

** electronic Product Code*

Key technical issues for IoT

A world-wide network of uniquely addressable and interconnected objects, based on standard communication protocols.
Physical entities (end points) + Object identities
= enabler for smart environment

- **Identifying things**
  - Object IDs + Security/Privacy
- **Connecting smart things**
  - Naming and addressing using object IDs and naming system
- **Mobile environments**
  - Resolve “object ID” with “locator” due to change of location
- **Heterogeneous interfaces**
  - No TCP/IP support

What are possible solutions?

Find possible solutions from HIP

- **Why only for hosts**
  - New concept of end points
    - not always humans but may be objects such as devices/machines, and then expanding to small objects and parts of objects
  - Mapping/binding with object identifier
- **Thing/location/application**
  - Relationship with ID/Loc separation
    - Host ID and locator + Extensible to object ID
- **Privacy security**
  - Security association for air interfaces

Related activities in IETF/IRTF

- **Low power consumption**
  - 6LoWPAN (IPv6 header compression)
  - ROLL (IPv6 routing for low power/lossy networks)
  - 6LoWApp BoF (Low power applications)
    - CORE (Constrained RESTful Environments WG)
- **Architectural issues**
  - HIPRG (Host identity protocol research group)
  - RRG (Routing research group)
- **New work items**
  - Smart Grid (bar BoF meeting at 76th IETF)
  - Internet of Things (bar BoF meeting at 77th IETF)
- **Other**
  - GRO BoF (Generic Referral Objects)
    - XMPP

New work items for IoT

- **Framework**
  - Understanding of IoT in the viewpoint of IETF
    - Clear scope of IoT work
- **Architecture for IoT**
  - Naming and addressing to support IoT
    - Resolving “Object ID” and locator
- **Solution spaces**
  - Object identity protocol and ONS (object naming service)
  - Protocols for Web of objects
    - Protocol solutions for “Web-based”

Discussion on future directions

- **Proposal #1**
  - Development of relevant solutions as the extension of HIP in HIPRG
    - Adopt current documents as RG items
- **Proposal #2**
  - Create a new RG for IoT
    - Investigate architectural issues
    - New inputs from relevant work groups of IRTF
- **Other**
  - Find another possible way

Thank you for your attention

Q&A

Appendix

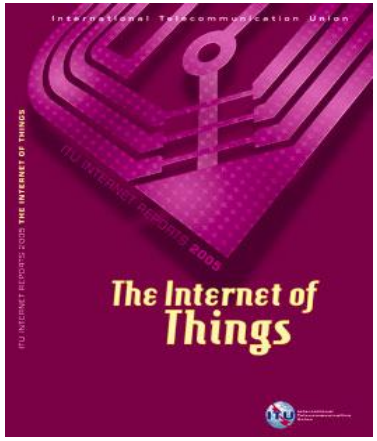
– Slides at 76th Hiroshima meeting –

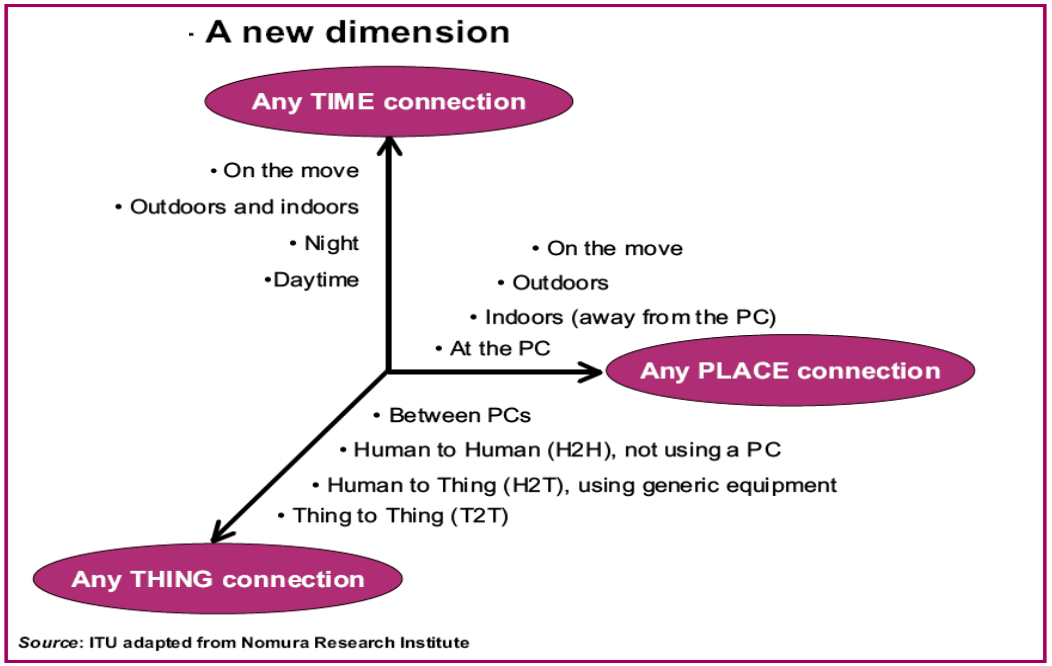
Ubiquitous connectivity

Ubiquitous Computing + Ubiquitous Connectivity

Internet of Things

Web of Things





ITU-T Y.2002
Ubiquitous Networking
Object to Object communications

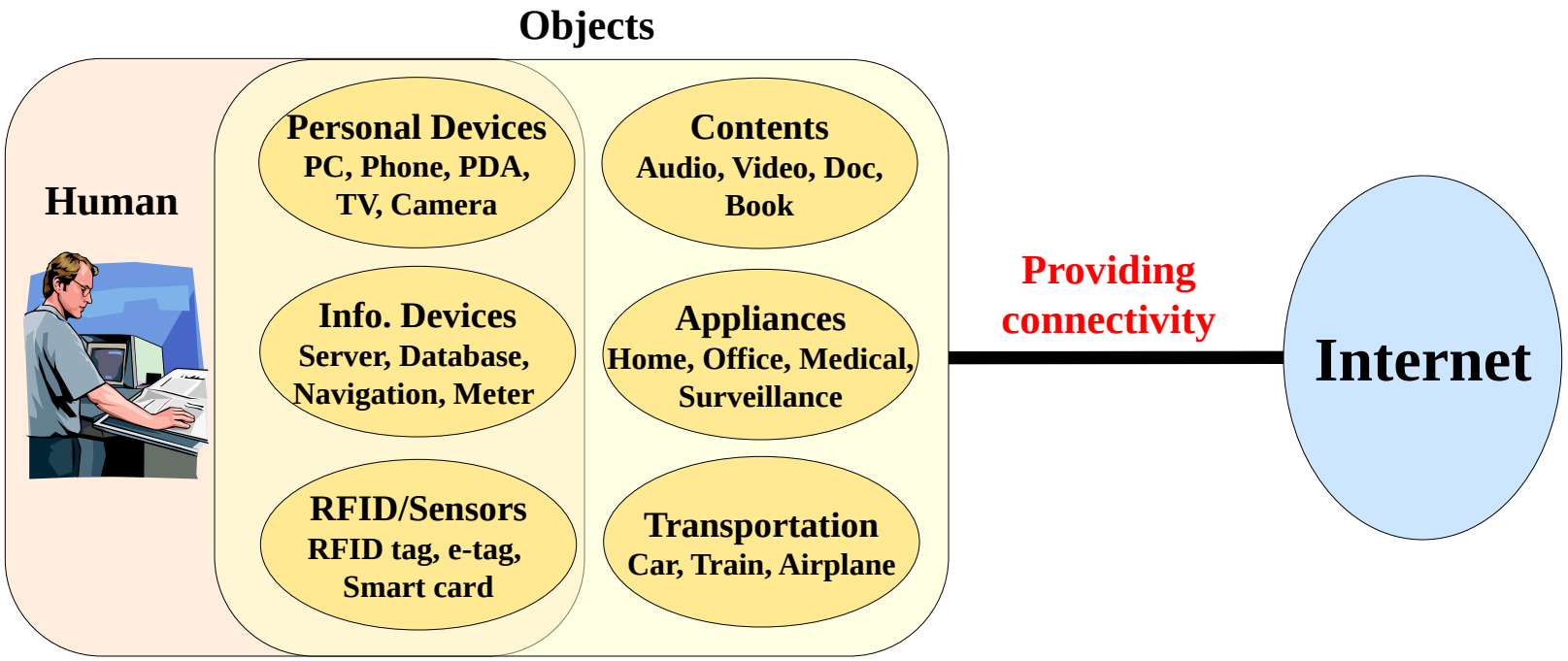
The concept of object

❒ Objects

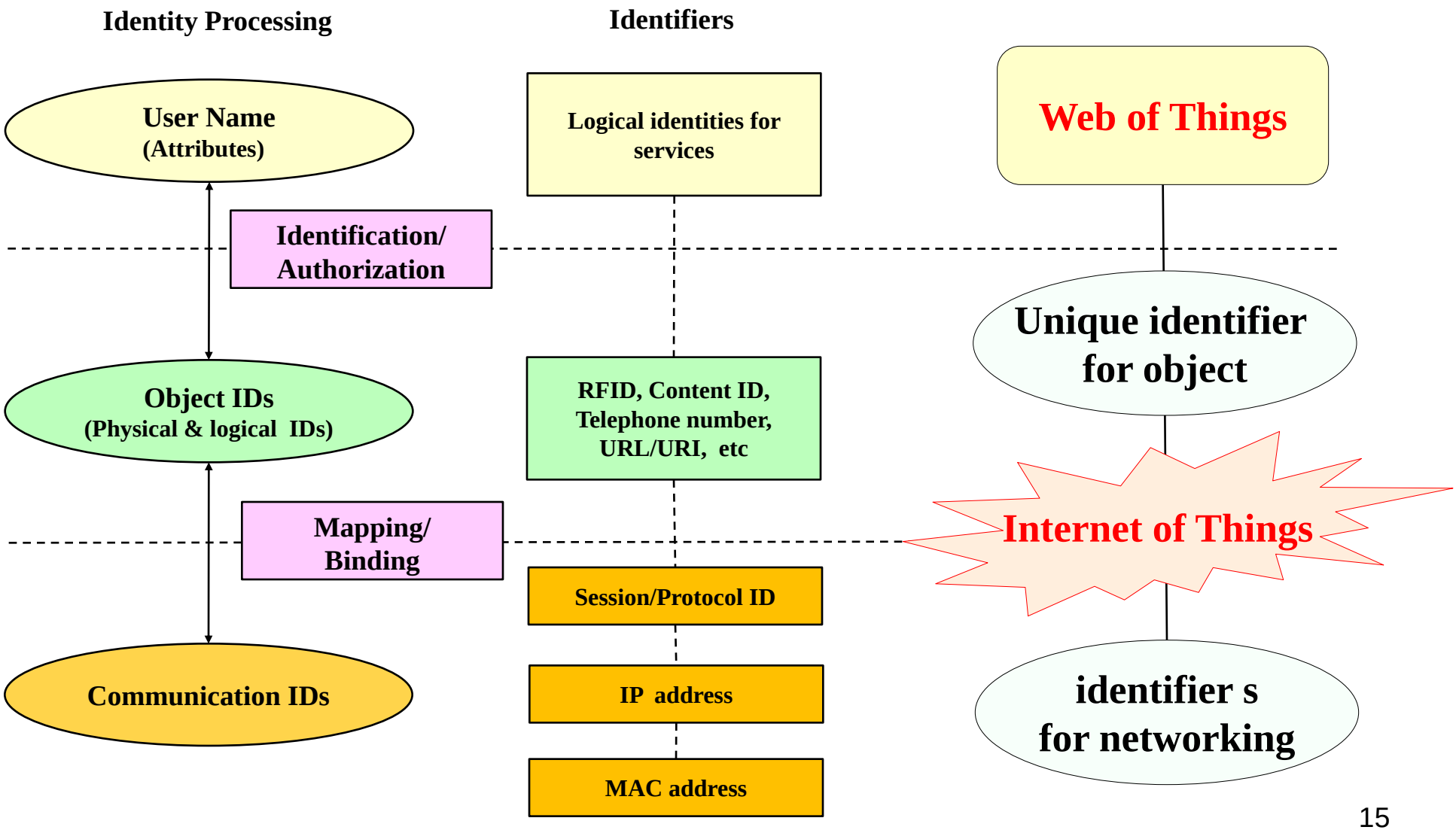
- include terminal devices (e.g. used by a person to access the network such as mobile phones, Personal computers, etc), remote monitoring devices (e.g. cameras, sensors, etc), information devices (e.g. content delivery server), products, contents, and resources.

Ubiquitous connectivity vs. object

- **How to identify object to provide "connecting to anything"**
  - To develop "object identity protocol"

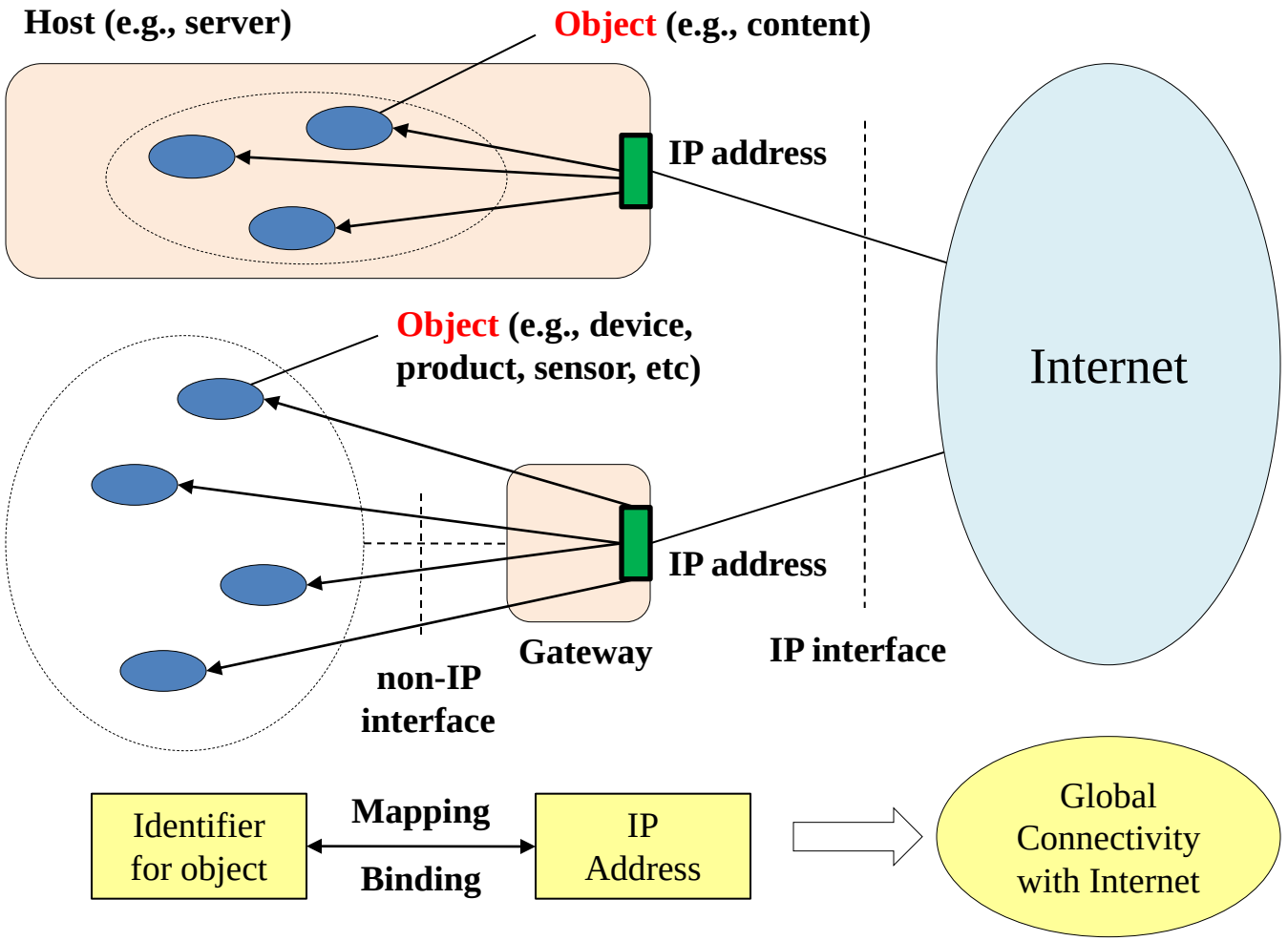


Layered architecture for identity processing



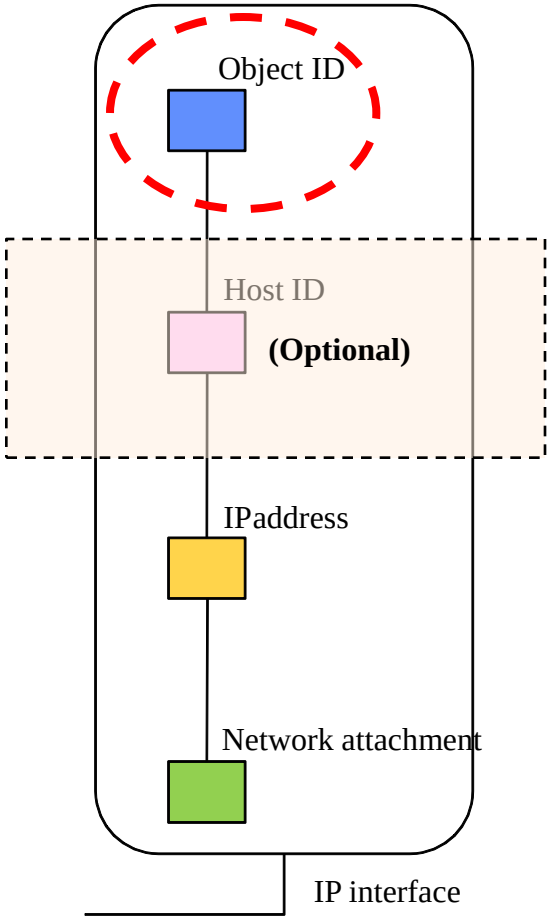
Conceptual diagram for providing connectivity to objects

- Consider relationship between host and object



Object mapping – extension of stack architecture

- **Objects in a host**
  - New naming space for object
    - Object ID – Host ID – IP address
  - Use object ID instead of Host ID
    - Object ID – IP address
  - Security association with IP address

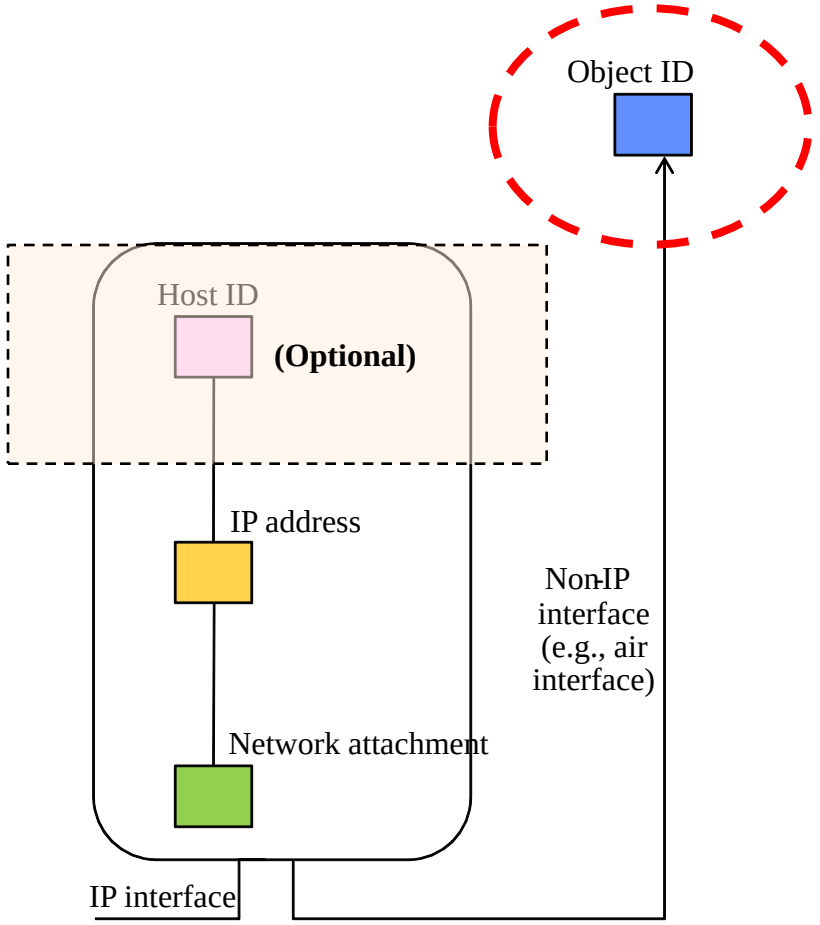


(a) Direct mapping (Objects in a host)

Object mapping – extension of stack architecture

Remote objects

- How to associate Host with IP address and Object with air interface
  - IP address – remote object ID
- Security association



(b) Indirect mapping (remote objects)