ICN based Architecture for IoT

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IoT Motivation and Challenges

Popular scenarios

- Smart Homes
  - Policy based seamless interaction between heterogeneous control systems (climate/security/health/entertainment etc.); service composition ; mobility.
- Smart Grid
  - Reliability, Rea-time Control, Secure Communication to achieve energy efficiency
- Smart Transportation
  - Very short Response time Ad-hoc + Infrastructure communication with mobility, secure data collection and exchange
- Smart Healthcare
  - Security/Privacy/Trust, High Reliability, short-communication latency

Scale + Energy + Variable-Context + Open-API:
Service Realization/User Experience

IoT Architectural Requirements

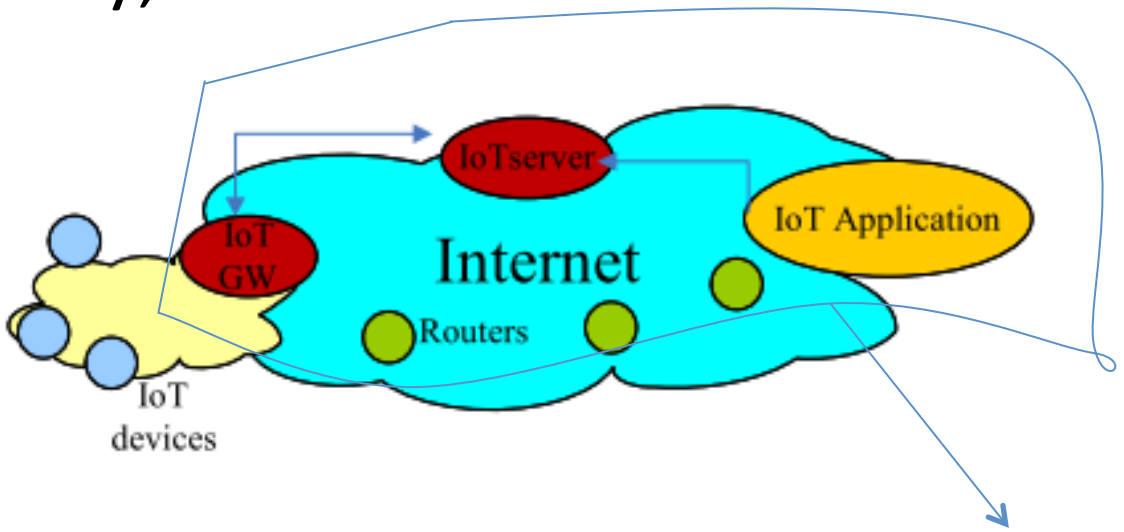
- Naming
  - Application Centric (Secure or not), Persistent considering Mobility, Context Changes.
- Scalability
  - Scale to billions on devices (passive/active), name/locator split, local/global services, resolution infrastructure, efficient context update.
- Resource Constraints
  - Compute/Storage/Bandwidth constrains, Protocols being application/context aware, Infrastructure support (edge computing, polling on demand)
- Traffic Characteristics
  - Separate Local versus Wide Area traffic based on Application logic ; Many-to-Many (Multicasting/Anycasting)
- Contextual Communication
  - Key to create several meaningful IoT services
- Handling Mobility
  - Fundamental Design Criteria

IoT Architectural Requirements

- Storage and Caching
  - Leverage as much as possible being sensitive to application/service producer requirements
- Security and Privacy
  - Takes precedence over any communication paradigm (ICN or not)
- Communication Reliability
  - Application centric (e.g. Health)
- Self-Organization
  - Ability to self-organize in Ad Hoc/Infrastructure setting to discover resources (services/content/users/devices) and Communicate.
- Ad hoc and Infrastructure Mode
  - Seamless transitions between the two worlds, user/application driven.

Legacy IoT systems

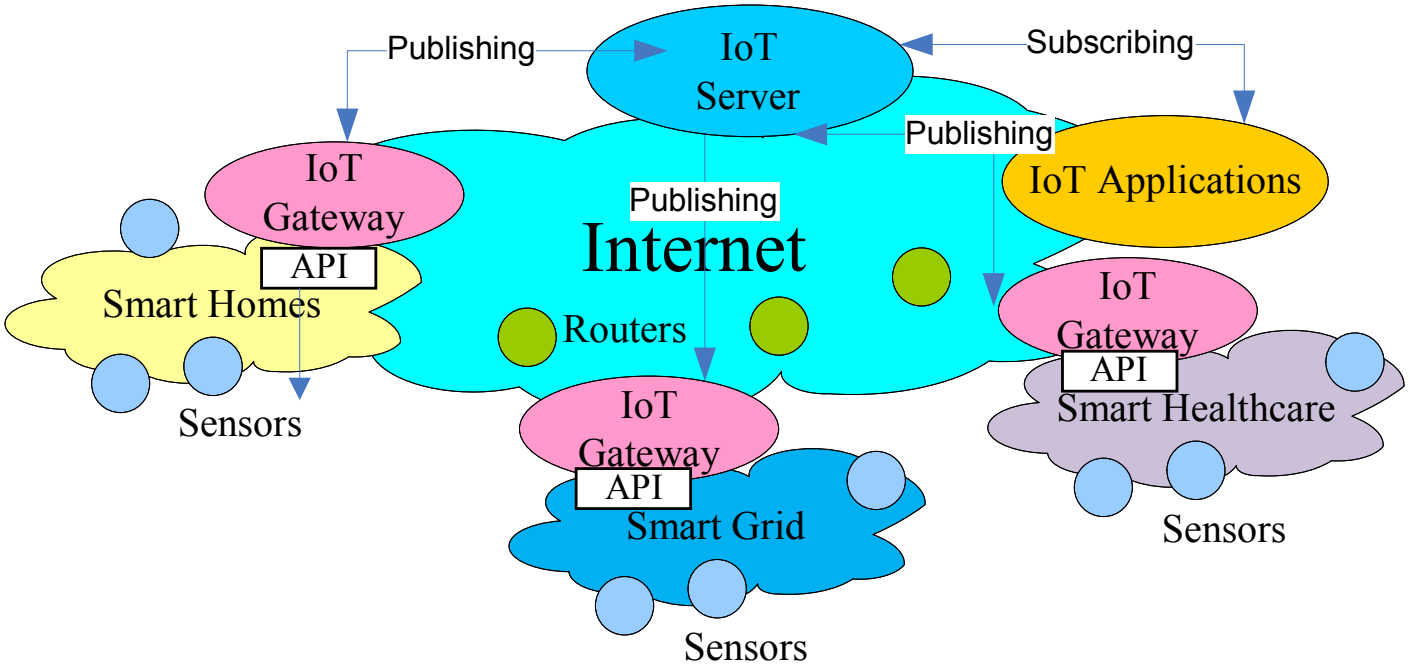
- Silo IoT Architecture (Fragmented, Proprietary), e.g. DF-1, MelsecNet, Honeywell SDS, BACnet, etc
- Fundamental Issues : Co-existence, Inter-operability, Service level interaction



Vertically Integrated

State of the Art

- **Overlay Based Unified IoT Solutions**
- **Coupled control/data functions**
- **Centralized and limits innovation**

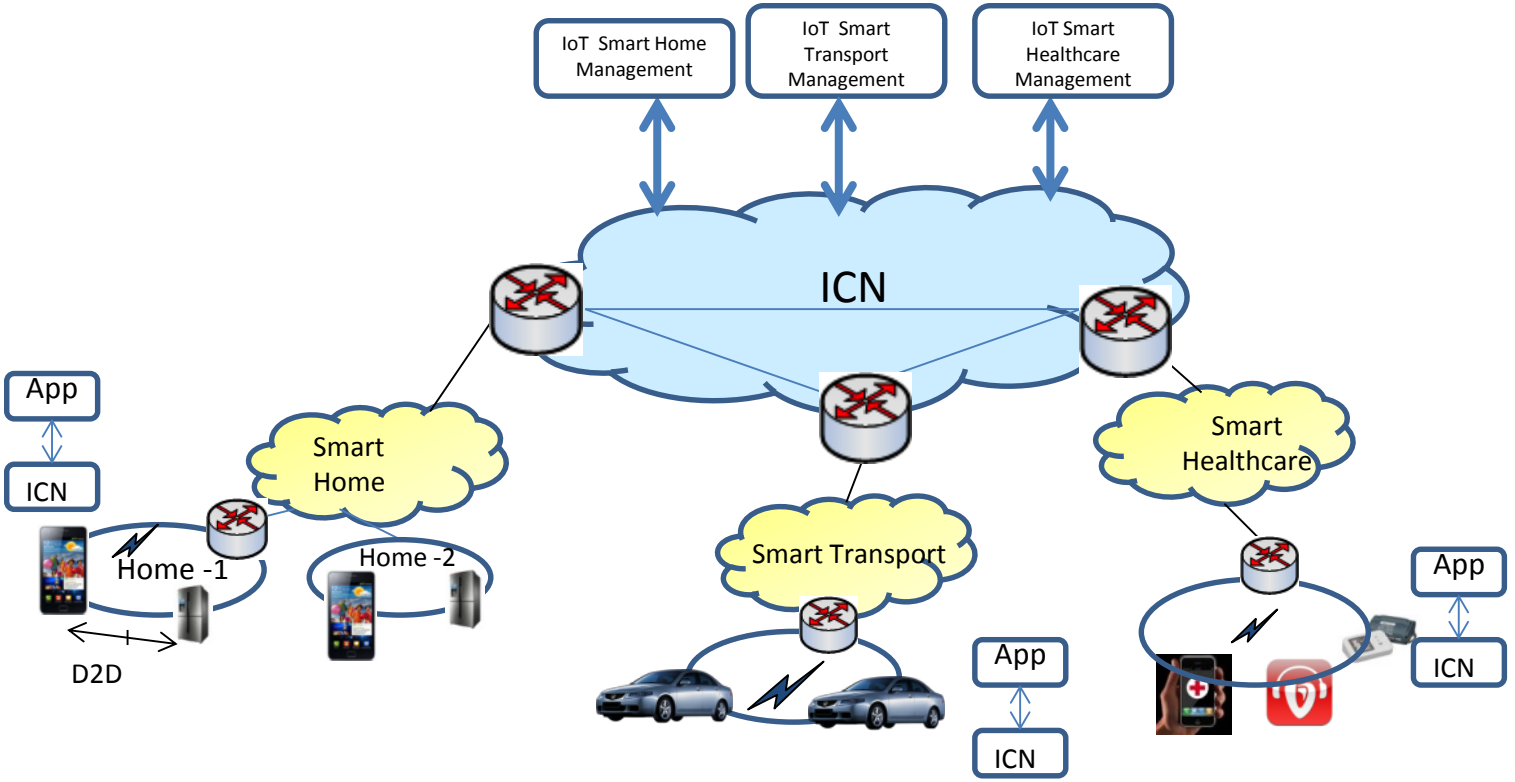


State of the Art

Weaknesses of the Overlay-based Approach

- ***Naming:*** Resources visible at Layer 7
- **Mobility :** Inherited by IP based communication
- ***Scalability:*** Merges control + forwarding path in central servers (bottleneck)
- ***Resource constraints*** **:** Network insensitive to device constraints.
- ***Traffic Characteristics*** **:** Overlaid support for Multicasting (in-efficient & complexity)

Proposed ICN-Centric Unified IoT Platform



- ICN has a potential to influence this emerging area of IoT as a unified platform for interaction between Consumers, ASPs, Network Operators.
    - Potential ICN as Network layer in the edges ?

- Potential technology to glue heterogeneous applications/services/devices (CIBUS)
    - CIBUS [SIGGCOMM, 2013]

- ICN is Contextual, Content Level Security (Access control/Privacy), Multicast/Anycast is naturally enabled.

Proposed ICN-Centric Unified IoT Platform

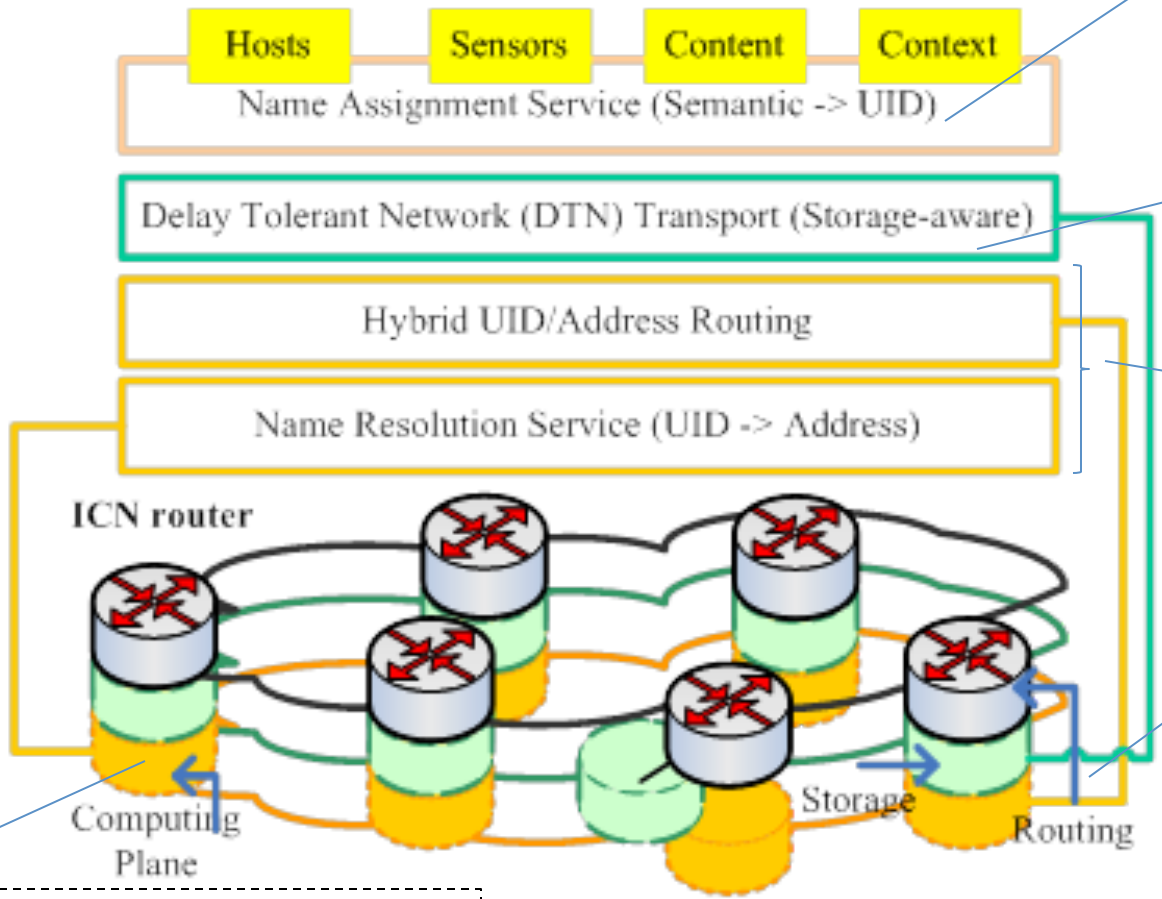
Strengths of ICN-IoT

- Naming
  - Application Centic (Hierarchical/Secure/Hybrid)
- Scalability
  - Name-Location Split, Localizes Communication where required
- Resource Constraints
  - Application aware communication
- Context-aware communications
  - Adaptation at Network Level (at all levels)
- Seamless mobility handling
  - Flexible Name Resolution (Late Binding)

Proposed ICN-Centric Unified IoT Platform

- Data Storage
  - Enables Edge Computing/Multicasting
- Security and privacy
  - Very Flexible (User/Device/Service/Content Level)
- Communication reliability
  - Adaptable to Best Effort to DTN
- Ad hoc and infrastructure mode
  - De-coupling of Application from Transport Layer

Proposed ICN-Centric Unified IoT Platform



- Name space mgmt.
- Resource Discovery

- Communication Reliability

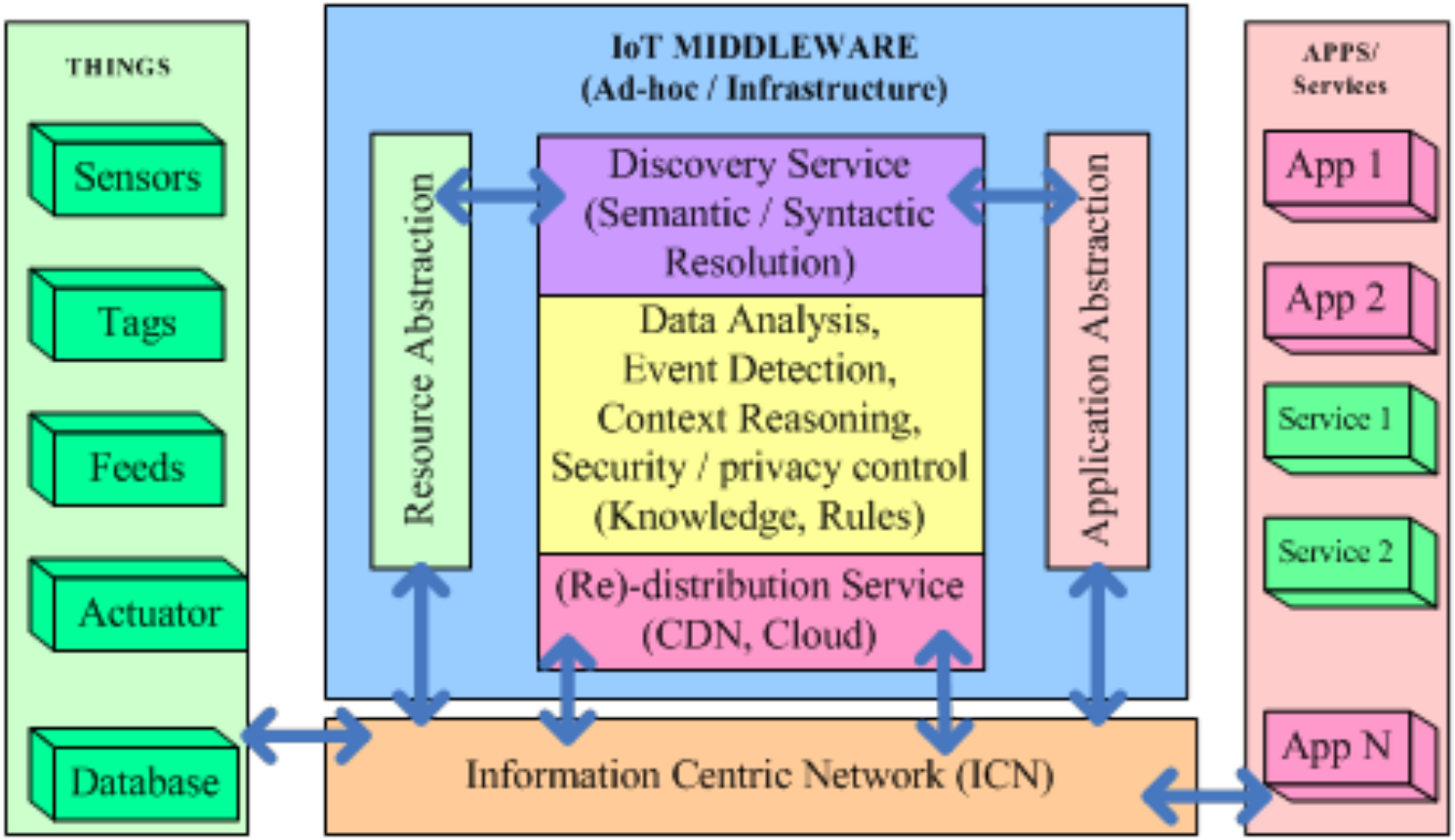
- Scalable Name Resolution System
- Mobility

- Caching/Storage
- Multicasting

- In-network Computing

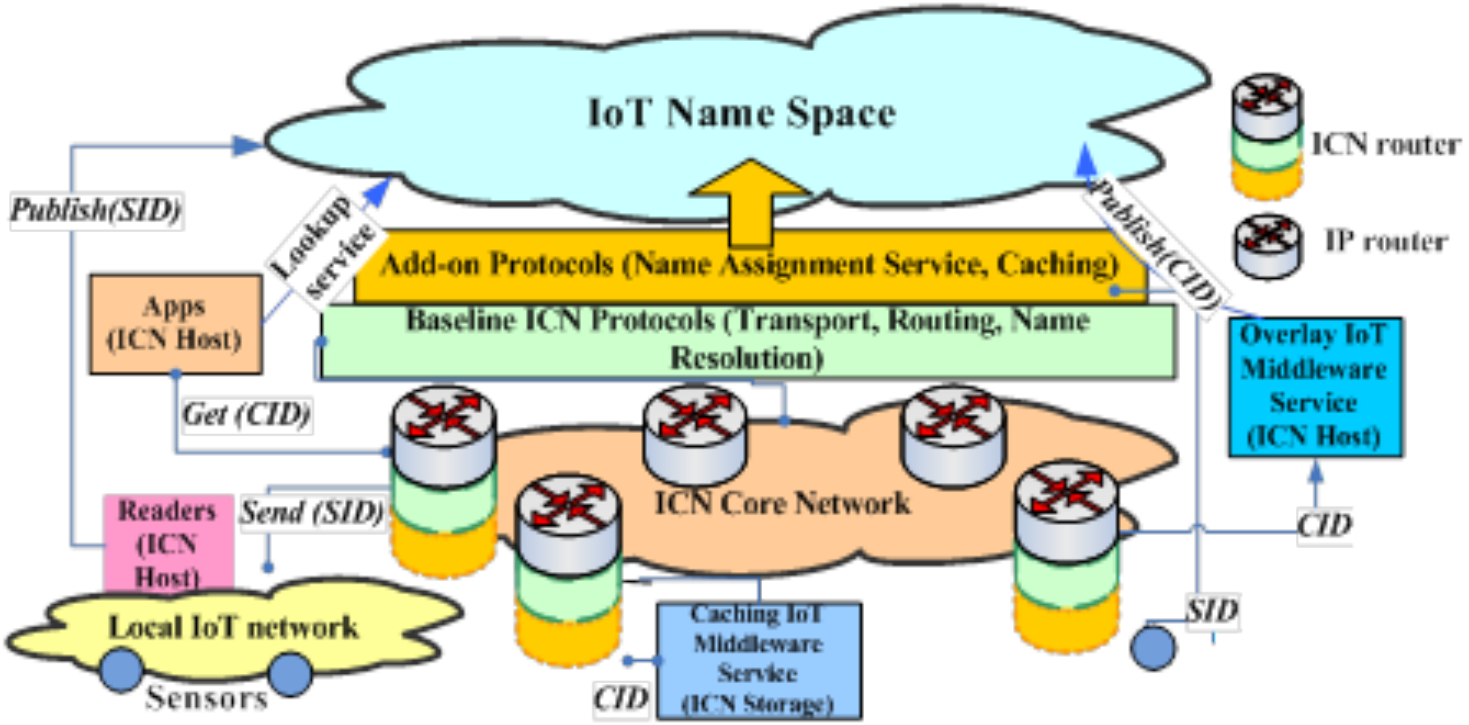
Proposed ICN-Centric Unified IoT Platform

- The ICN-IoT Service Middleware



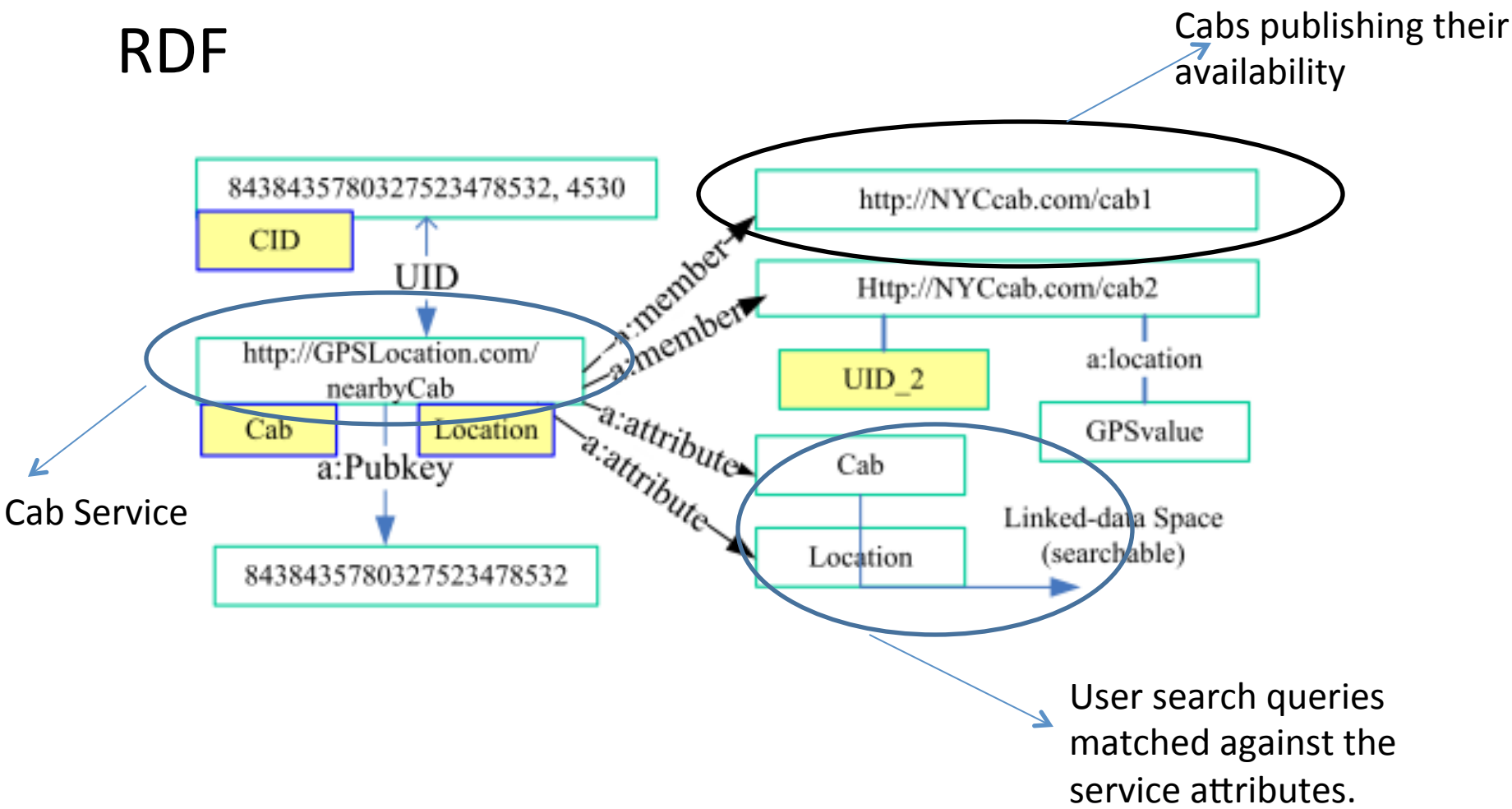
Proposed ICN-Centric Unified IoT Platform

- ICN-IoT Data and Services



Proposed ICN-Centric Unified IoT Platform

- ICN-IoT Scenario: Location context service in RDF



Proposed ICN-Centric Unified IoT Platform

- Location context application scenario