National Institute of Information and Communications Technology

Japan-China ICT Forum

PIAX: A Ubiquitous Service Platform based on Overlay Network Technologies

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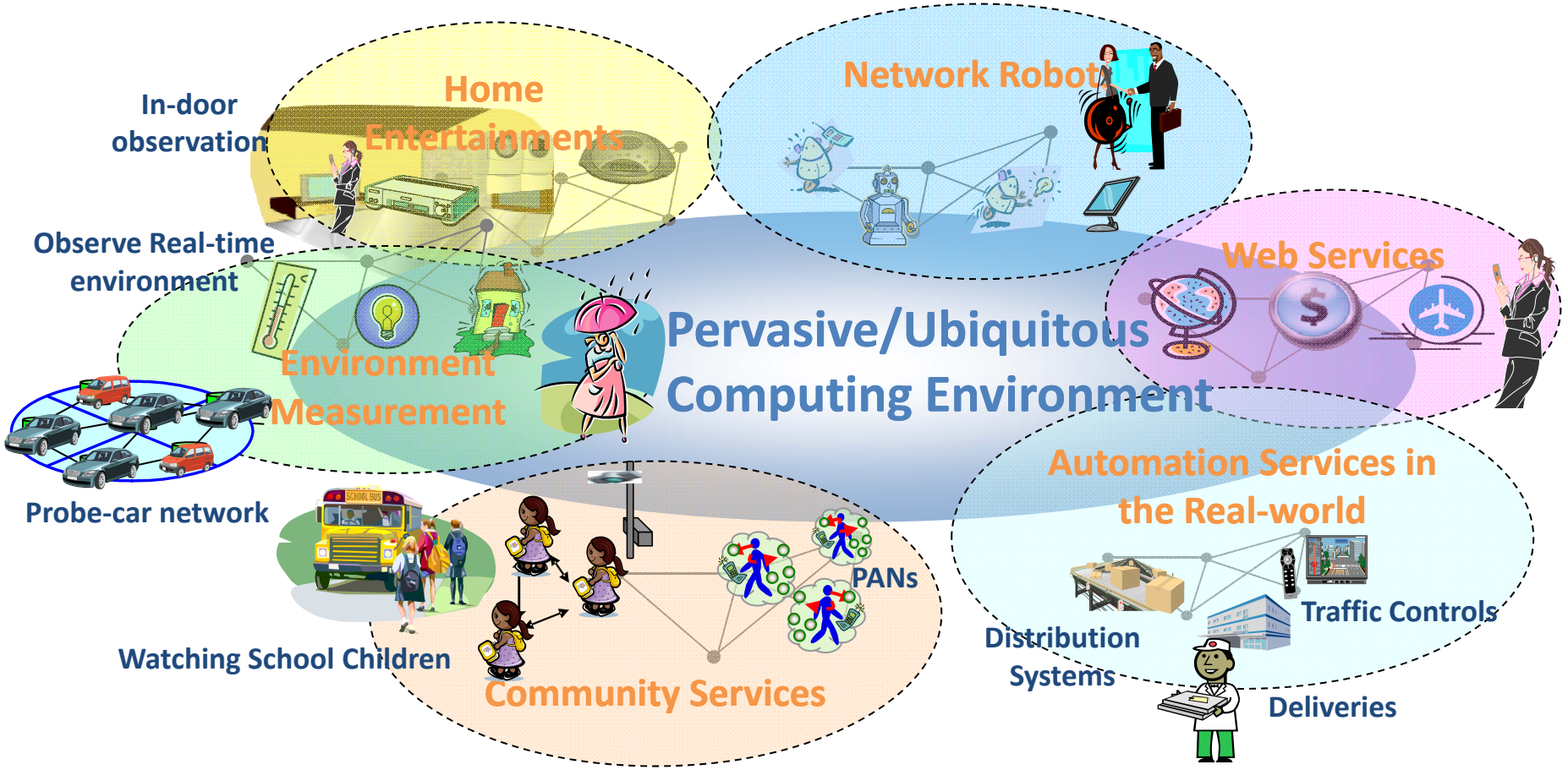
Background

- Pervasive/Ubiquitous Computing Environment

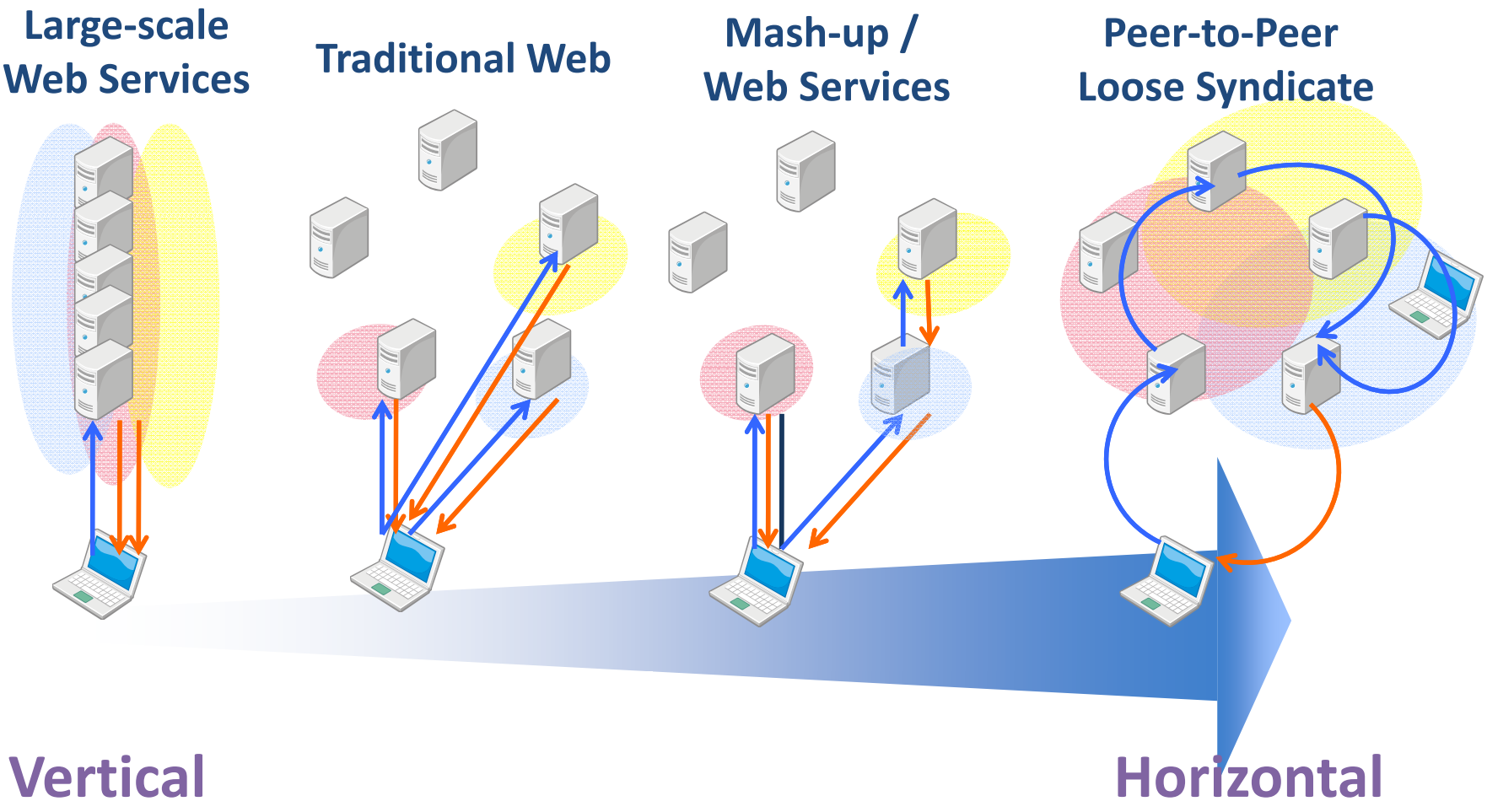


Interoperability of Pervasive Systems

- Vertical Integration
  - Specialized, Closed System
  - Enormous cost for wide-area coverage
  - Centralized, uniformed

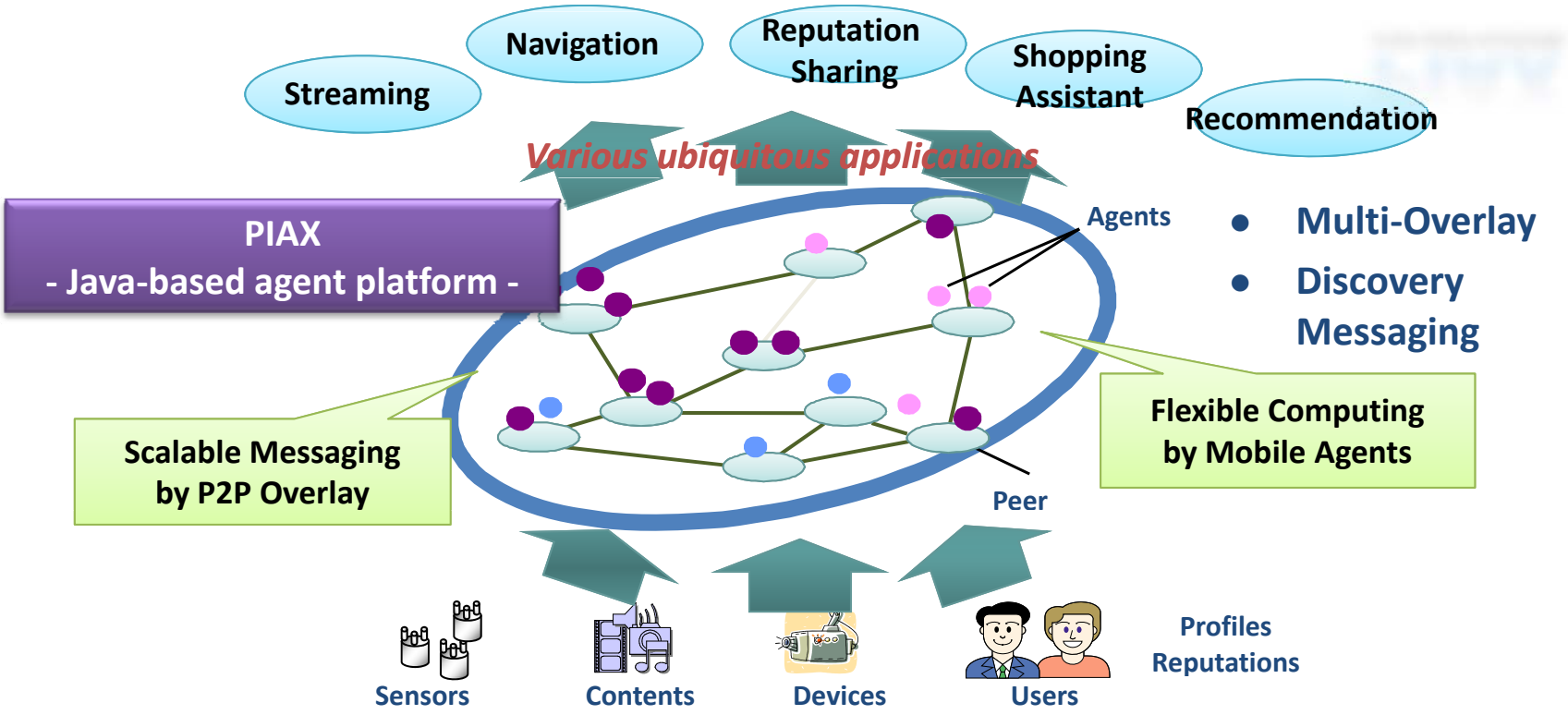
- Horizontal Integration
  - No limit the purpose, Open System
  - Cooperation for wide-area coverage
  - Distributed, diversified

Vertical & Horizontal Integration

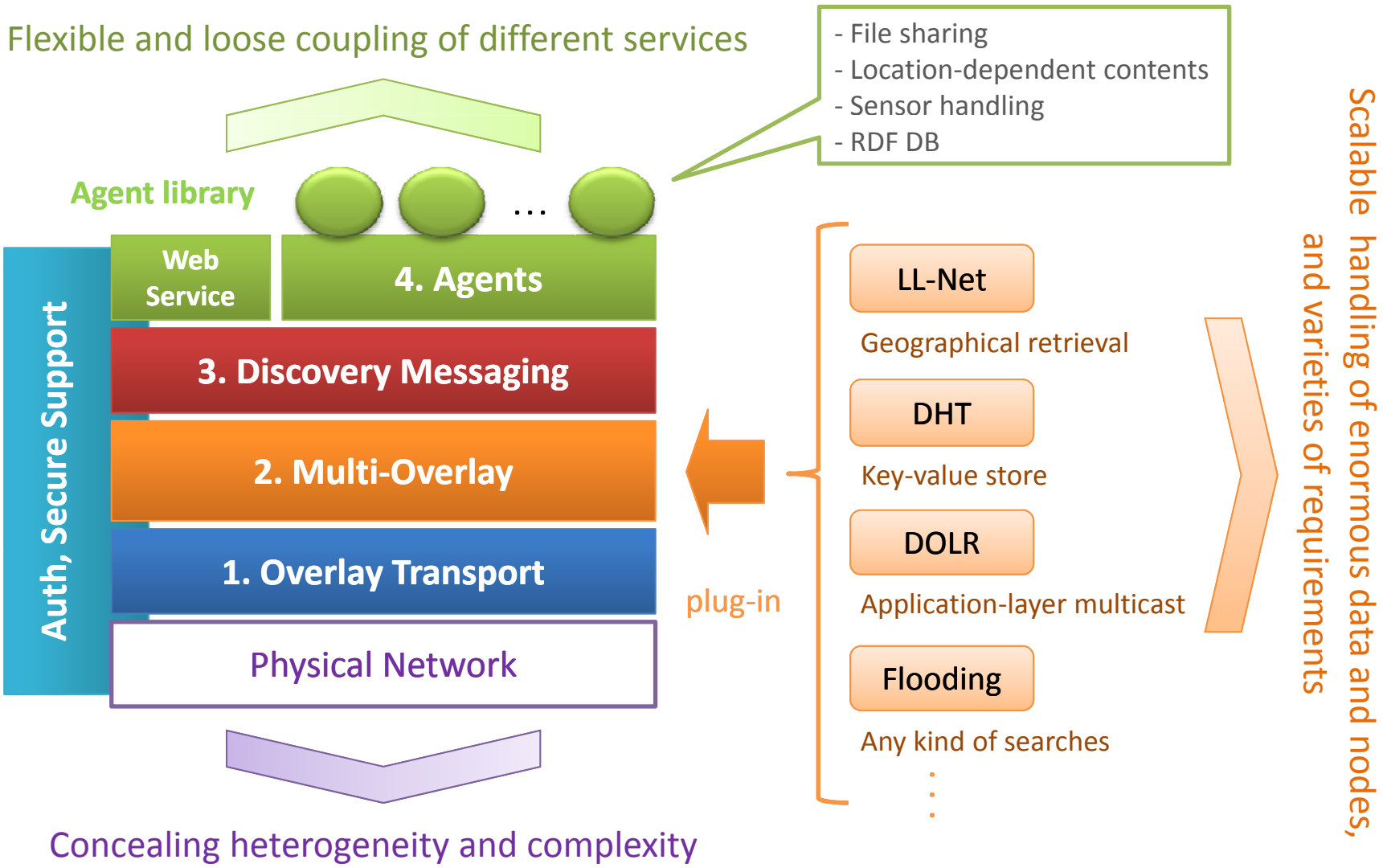


PIAX: P2P Interactive Agent eXtensions

- Java-based platform that integrates:
  - Multiple P2P overlay network functions
  - Mobile agent features

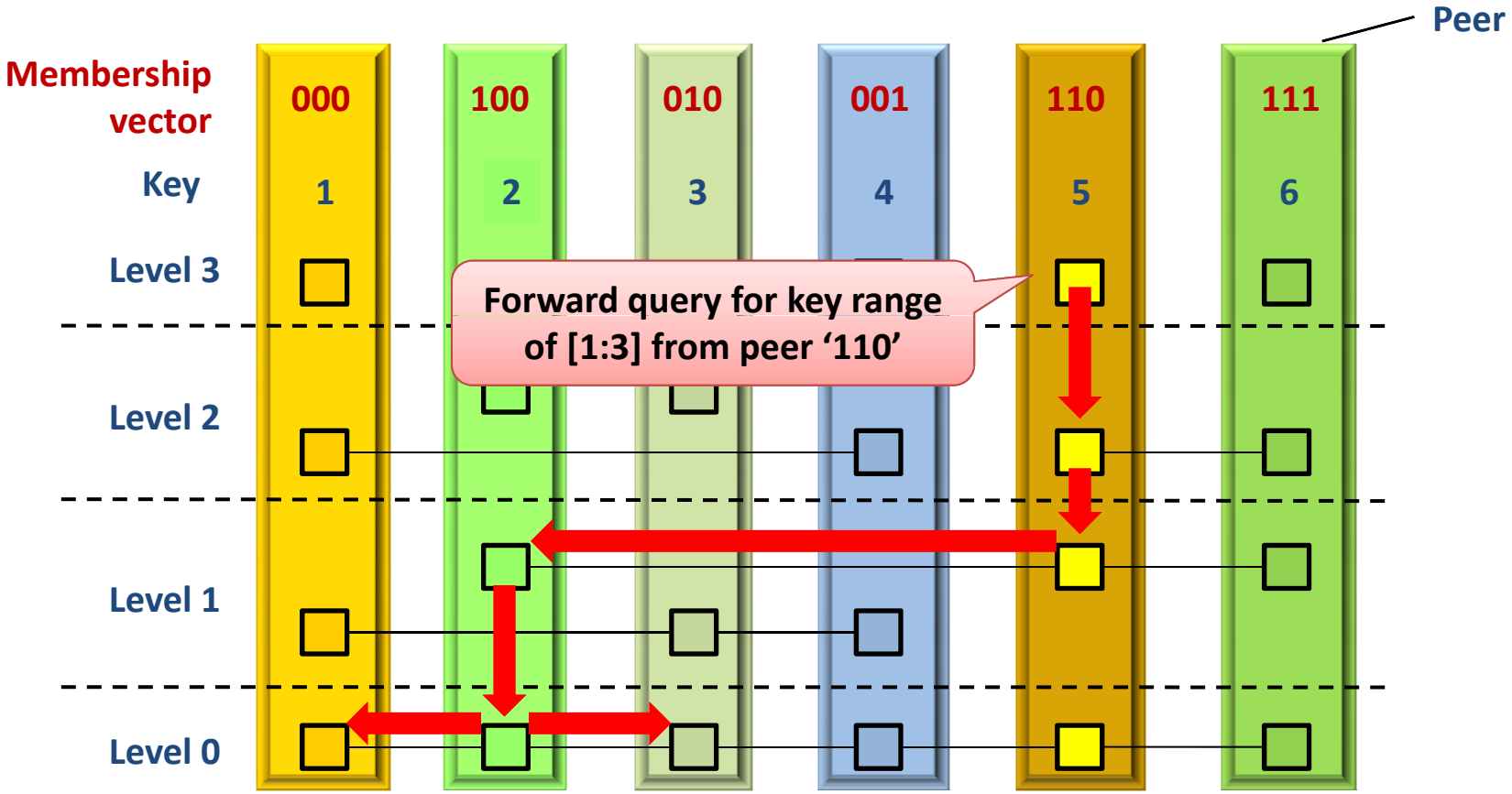


PIAX Structure and Features



Skip Graph

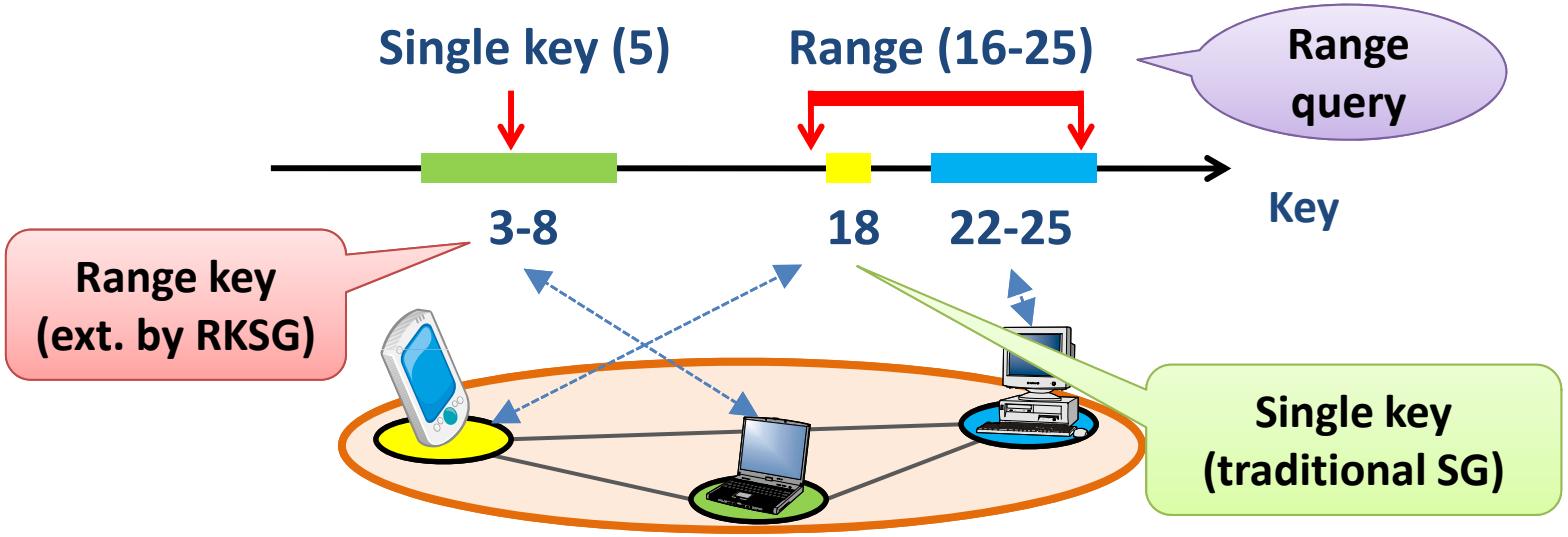
The core overlay network implemented in PIAX is based on Skip Graph that can support range-query.



J. Aspnes and G. Shah, "Skip graphs," *ACM Trans. Algorithms* 3, 4, Article 37 (Nov. 2007).

Range-key Skip Graph

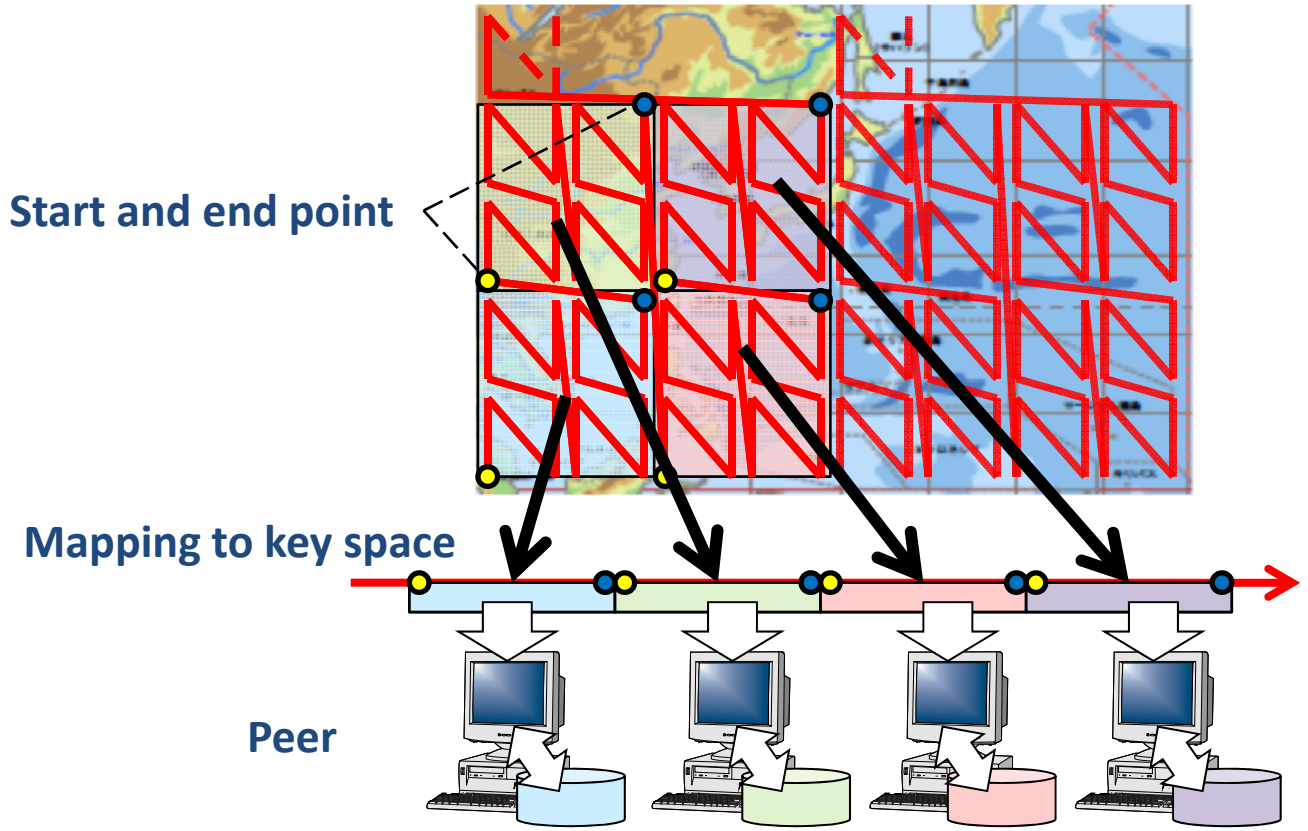
- Handle a ‘range’ as a key in Skip Graph



- Usage examples:
  - Discover a provider that covers a certain place as a service area
  - Connect and federate intra-resources among the different organizations (e.g., databases, sensor networks)

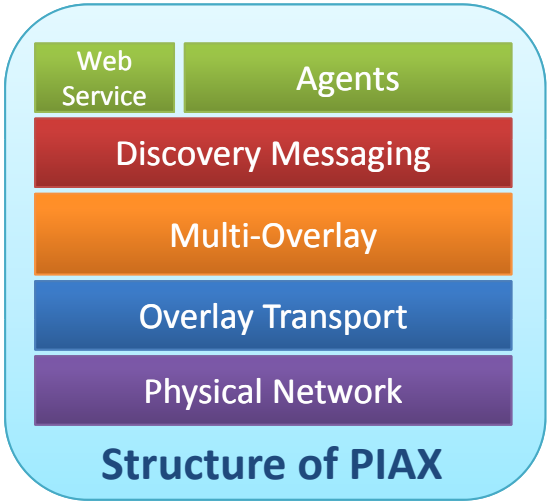
Geographical Key-value Store

- RKSG's range-query enables distributed peers to manage location-dependent contents



Summarized Features of PIAX

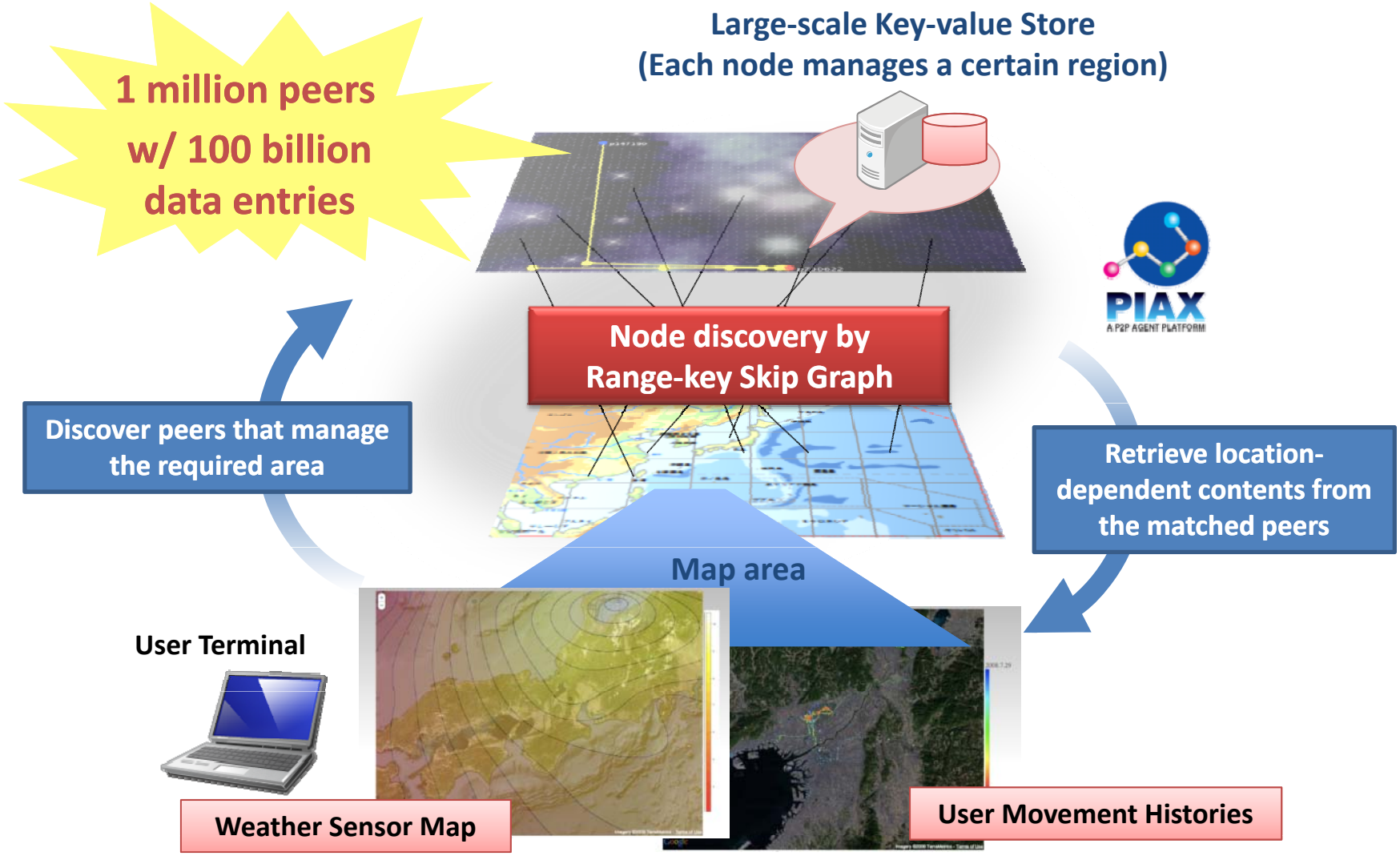
- The features of PIAX are:
  - Flexibility
    - Different kinds of services can be cooperated
  - Scalability
    - Many resources and requirements can be handled
  - Tolerance
    - Heterogeneous protocols and devices can be federated



Structure of PIAX

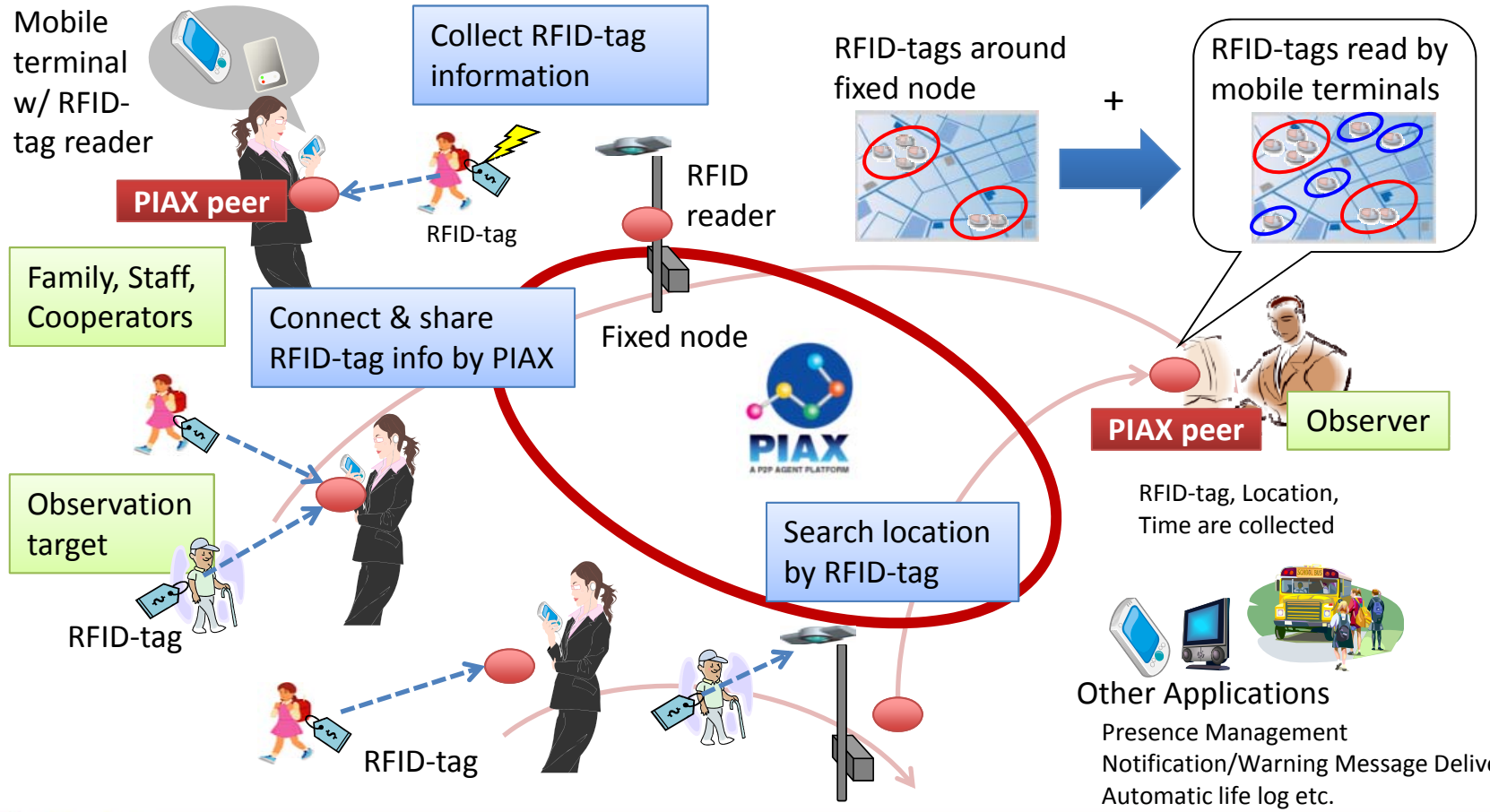
Large-scale intelligent services with heterogeneous devices can be realized over wide-area

Ex.1) Large-scale & Wide-area Data Sharing



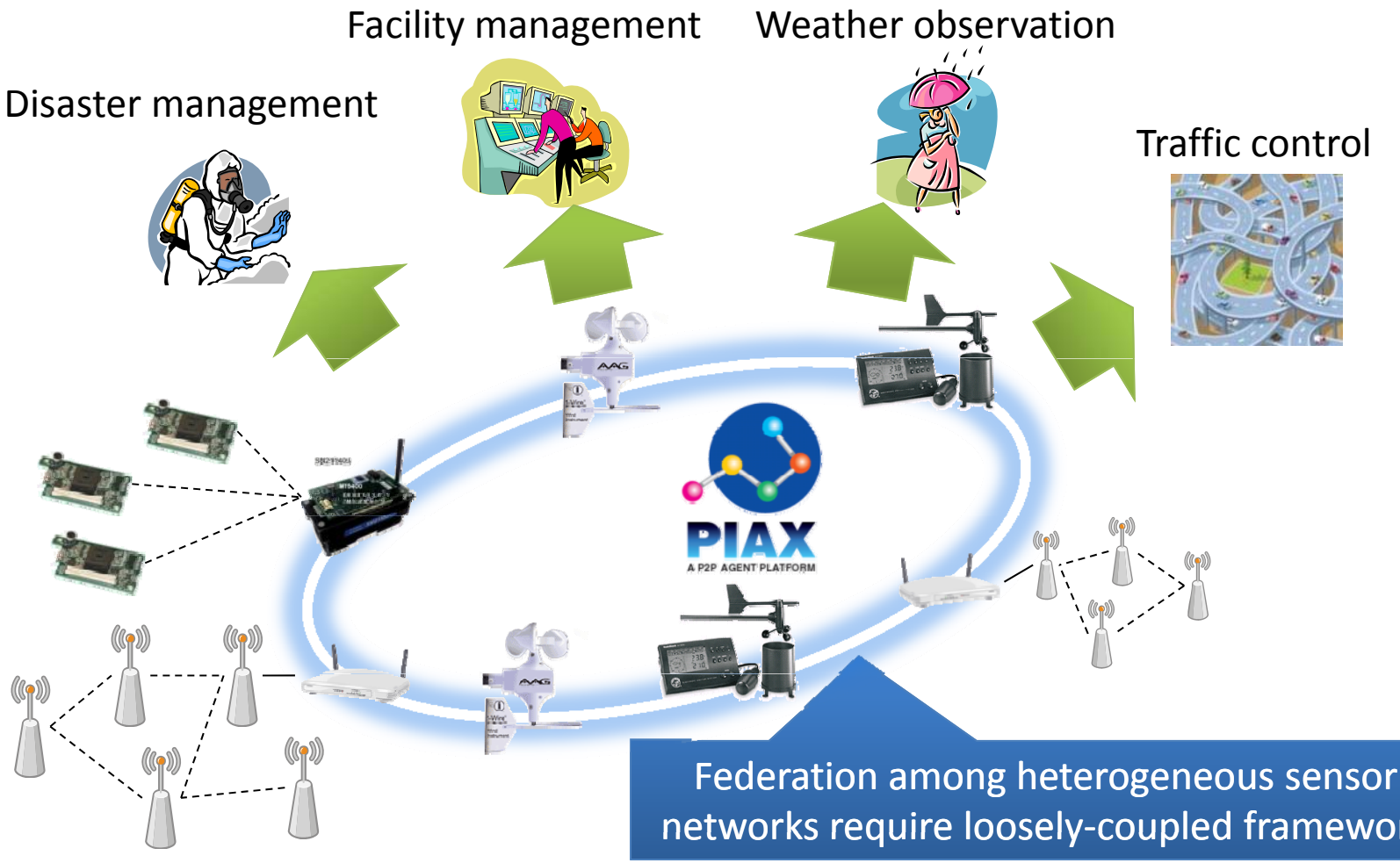
Ex.2) Server-less Real-time Location Search w/ RFID-tags

- Mobile terminals with RFID-tag reader collects RFID-tag info and records location
- The mobile terminals are connected via PIAX and share RFID-tag information
- Observers can search RFID-tag info to estimate the location of target person

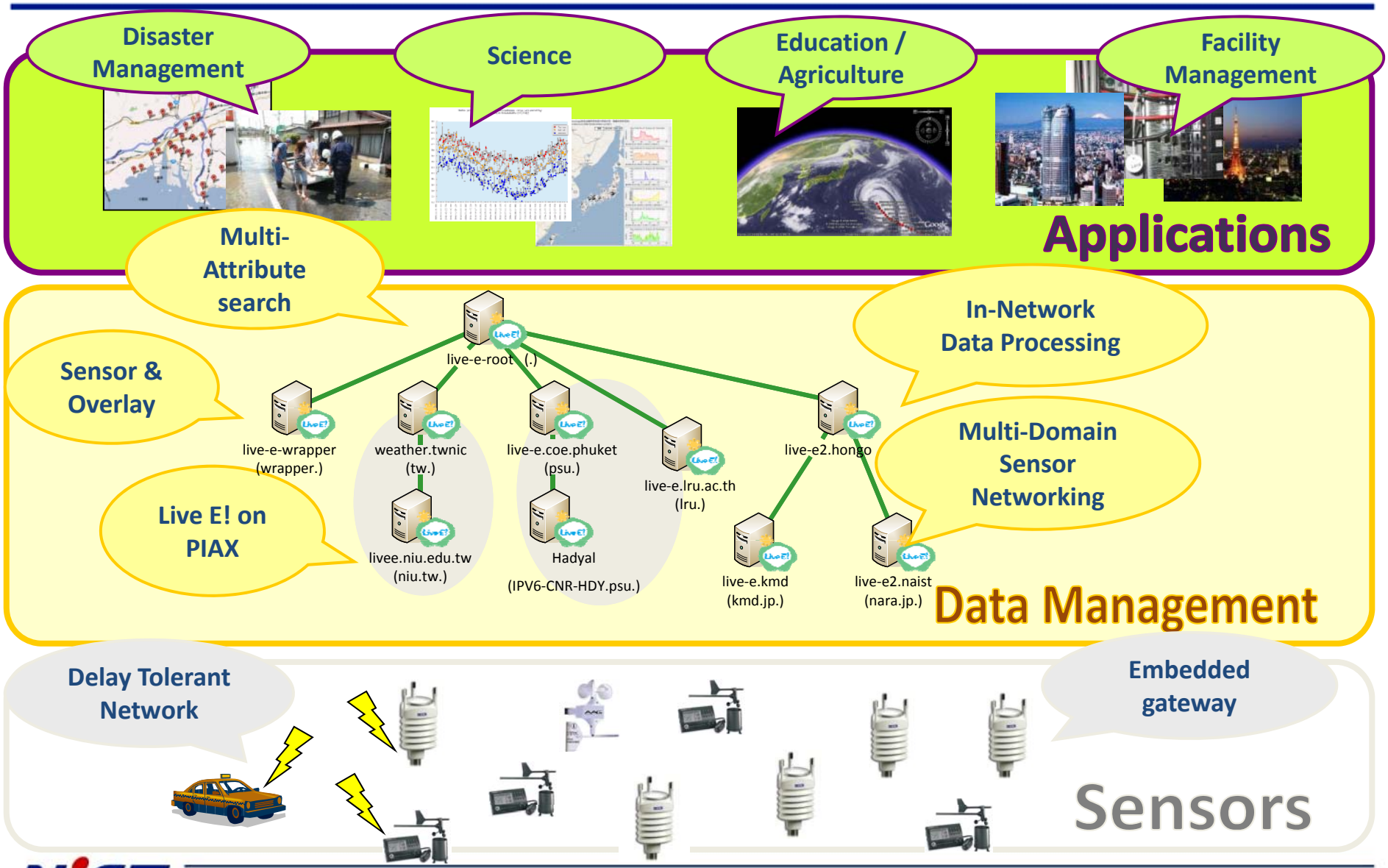


Ex.3) Sensor Network Federation

Wide-area and large-scale applications



Live E! Project



NiCT

Live E! on PIAX

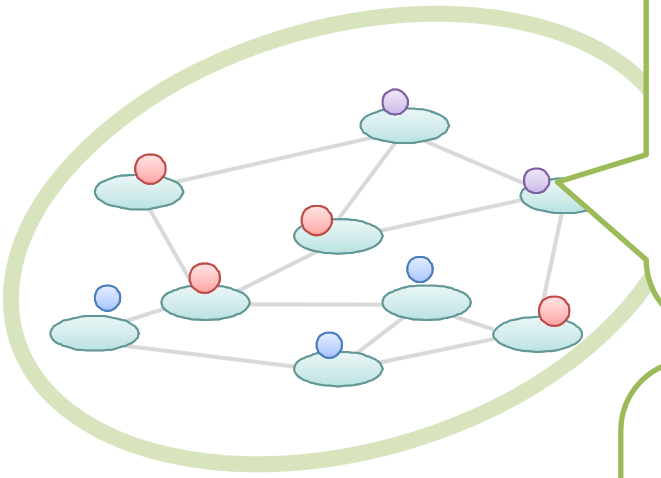
- Developed an agent for enabling other PIAX agents to connect Live E! sensor stations by SOAP protocol

Browse deployed sensors on Web browser

Web I/F

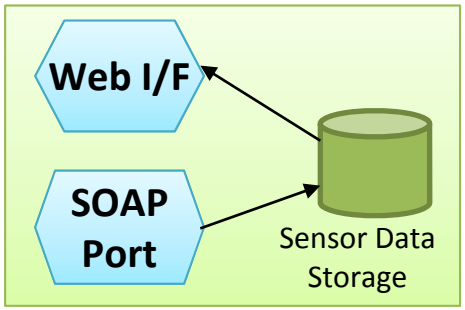
SOAP

PIAX Overlay Network



20 PIAX Peers with Live E! sensors

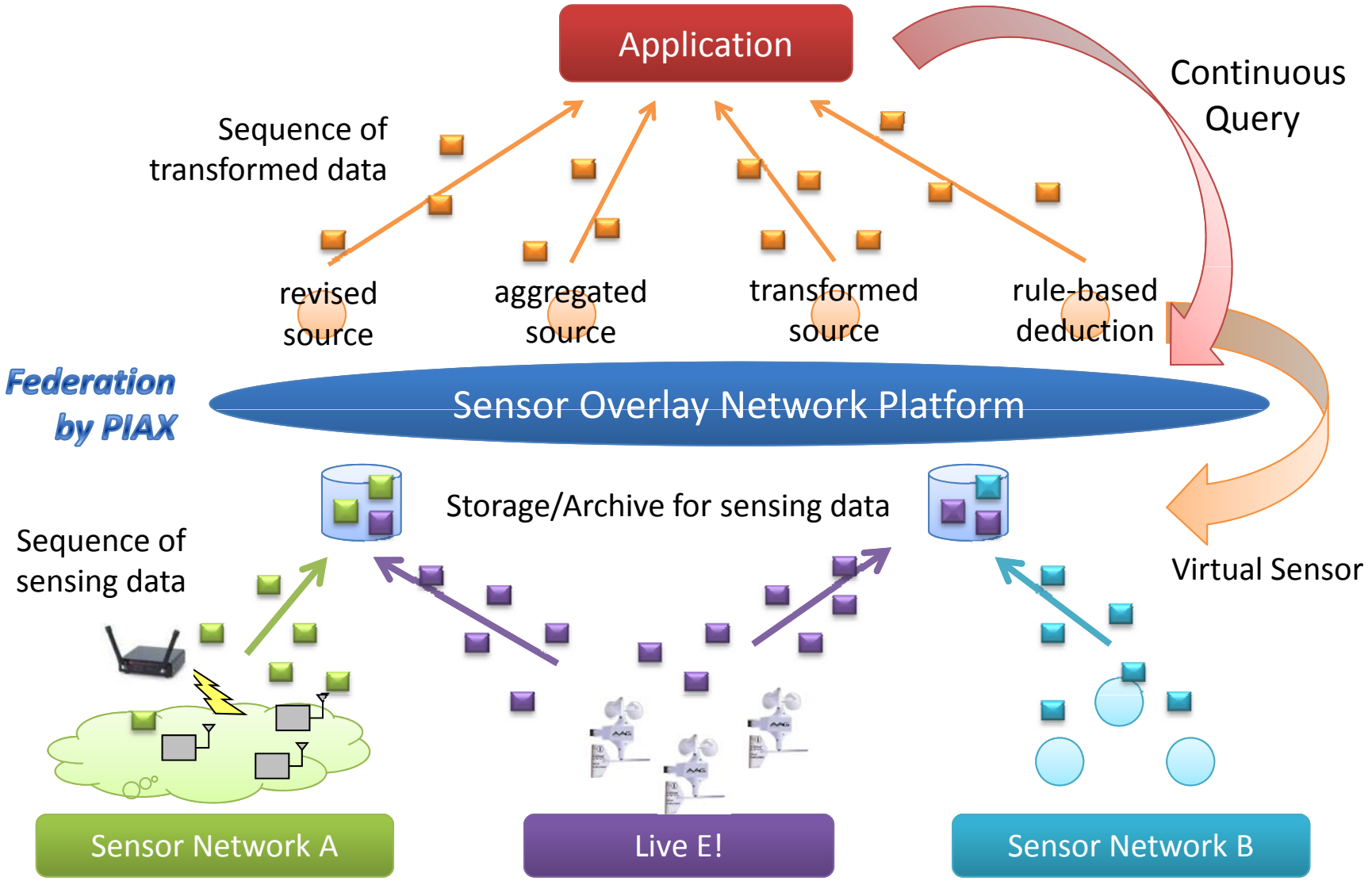
Live E! Agent on PIAX



Live E! Weather Sensor Station

SOAP I/F
Sensors:
- Temperature
- Humidity
- Raindrop
- Wind speed etc.

Towards Sensor Overlay Network Platform



Conclusion

- PIAX: A P2P Agent Platform
  - Integrate P2P structured overlay network with mobile agent platform
    - Flexible and scalable coupling of ubiquitous services with concealing heterogeneity and complexity of networks and devices is supported
  - Examples:
    - Large-scale and wide-area data sharing
    - Sensor network federation and its prototype

➢ Please visit http://www.piax.org/en/ for more information.