



National Institute of Information and Communications Technology

The 3rd EU-J Symposium



PIAX Service Platform and its Applications

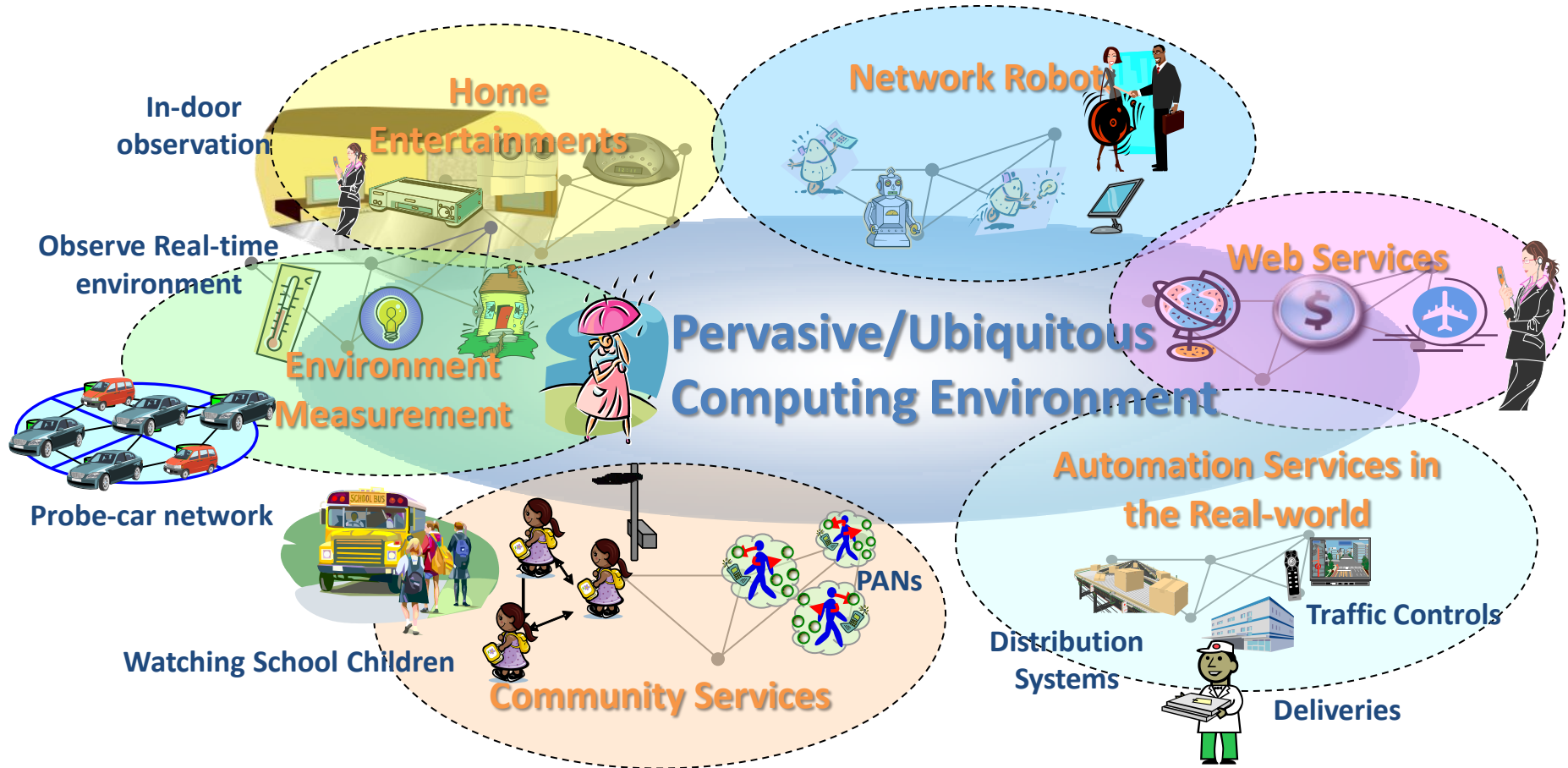


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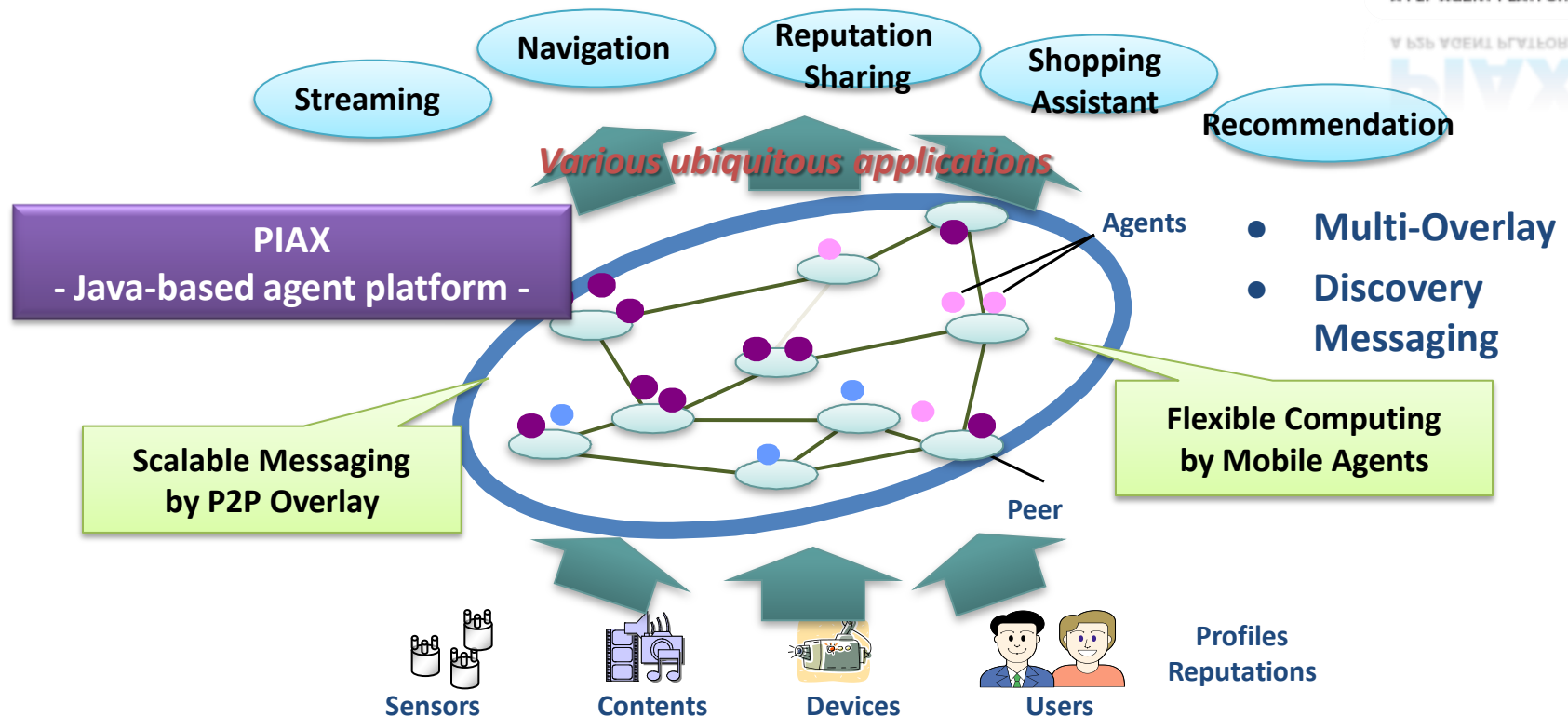
Background

- Pervasive/Ubiquitous Computing Environment



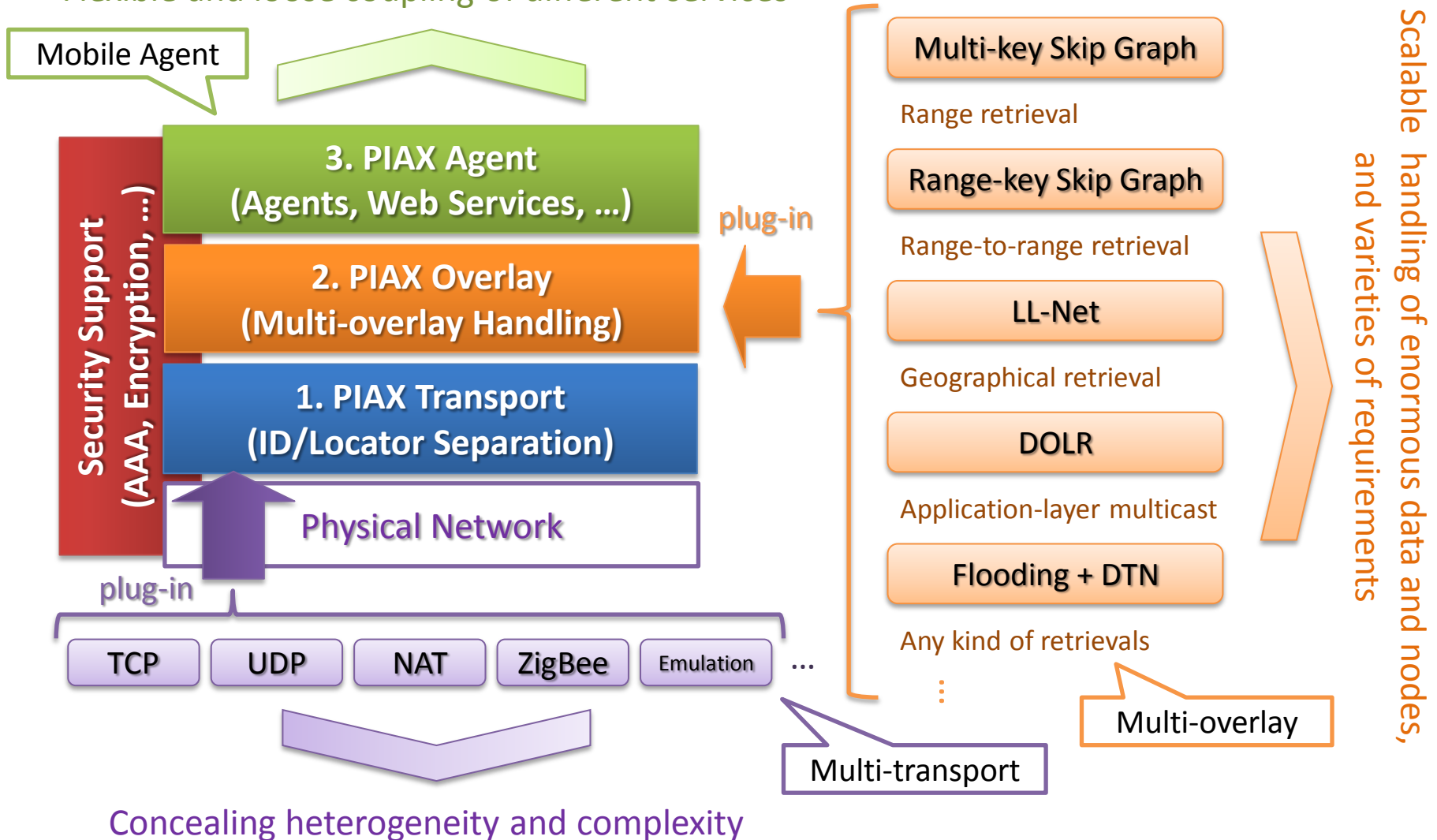
PIAX: P2P Interactive Agent eXtensions

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



PIAX Structure and Features

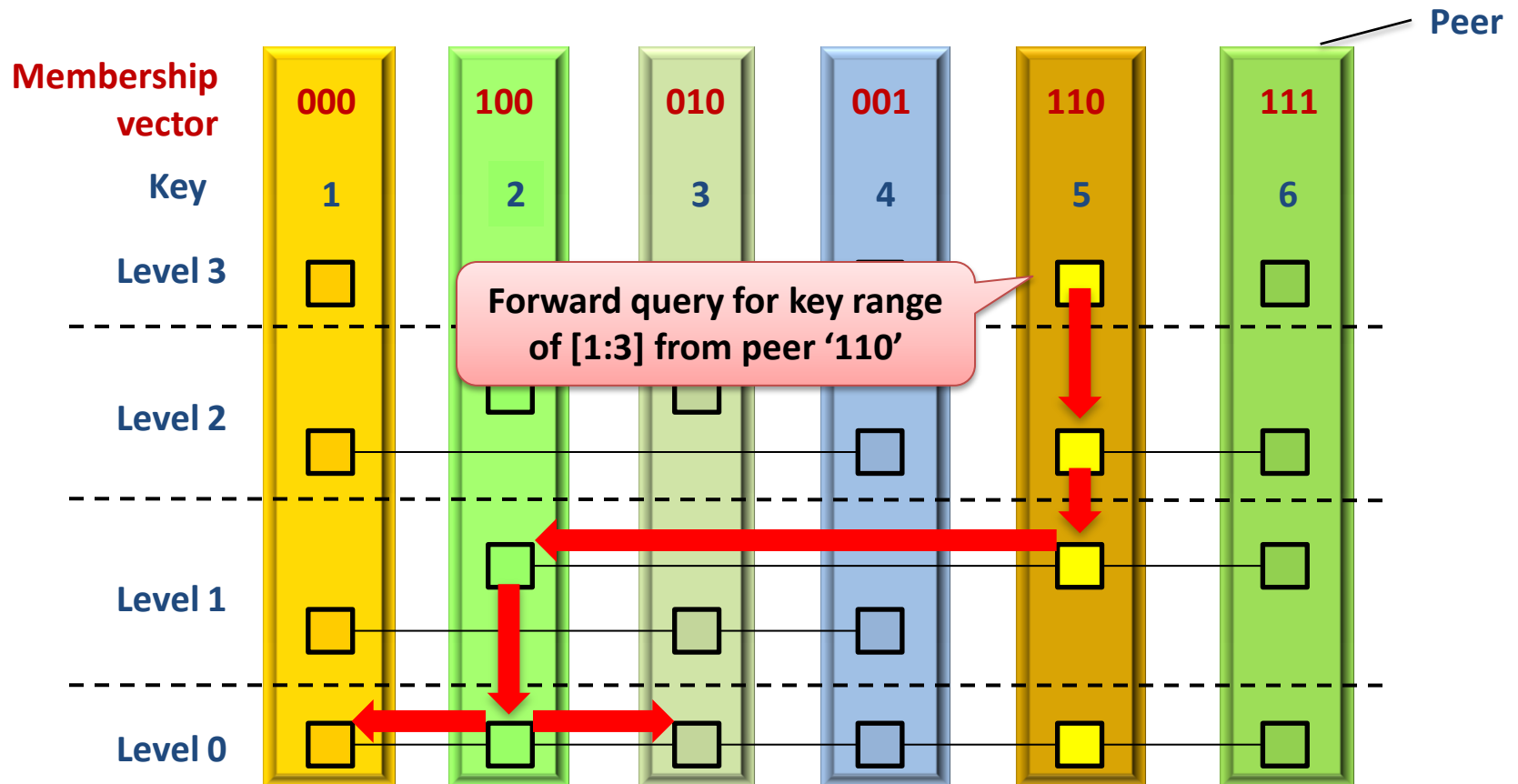
Flexible and loose coupling of different services



Concealing heterogeneity and complexity

Skip Graph for Multi-overlay

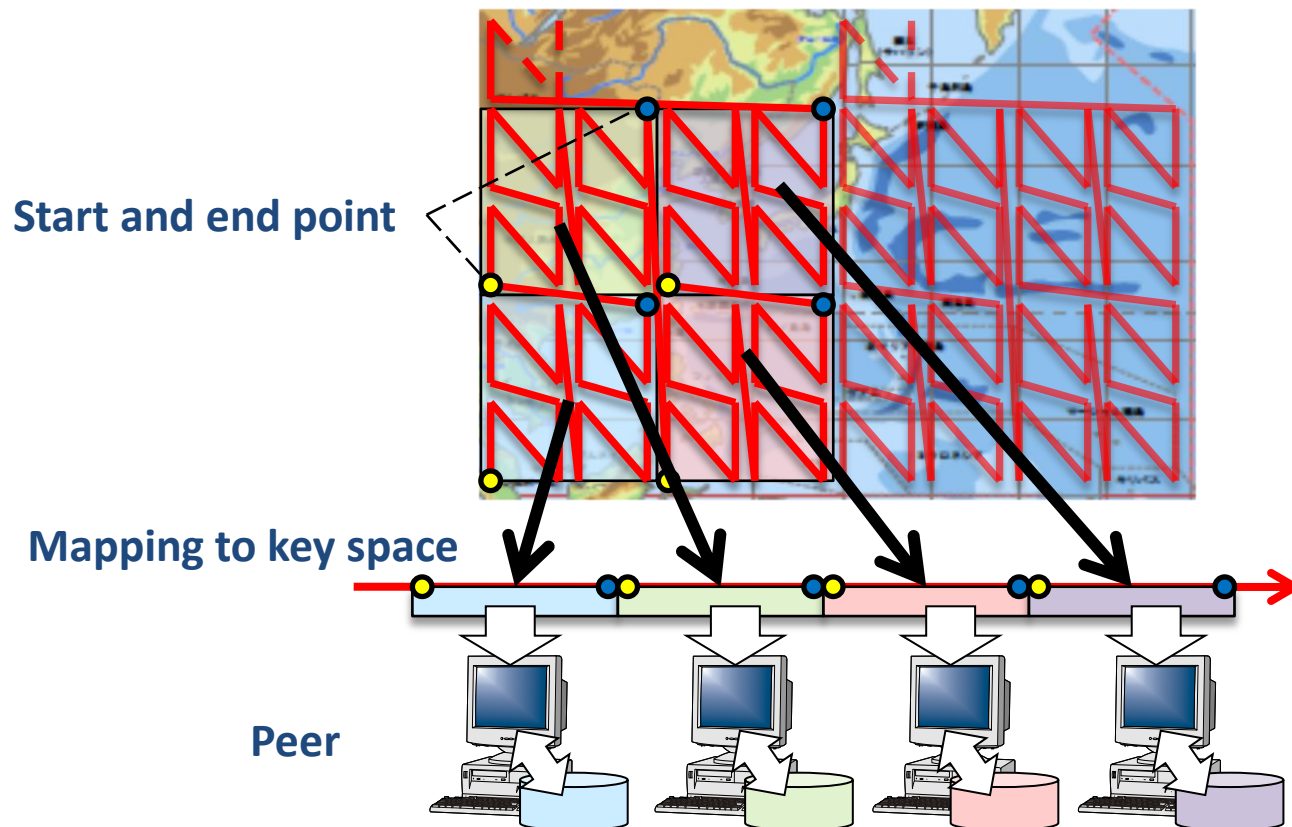
The core overlay network implemented in PIAX is based on Skip Graph that can support range-query.



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

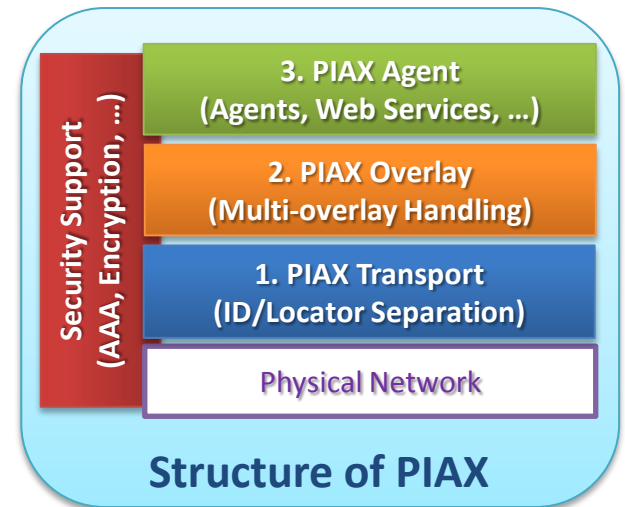
Geographical Key-value Store

- Range-key Skip Graph enables distributed peers to manage location-dependent contents



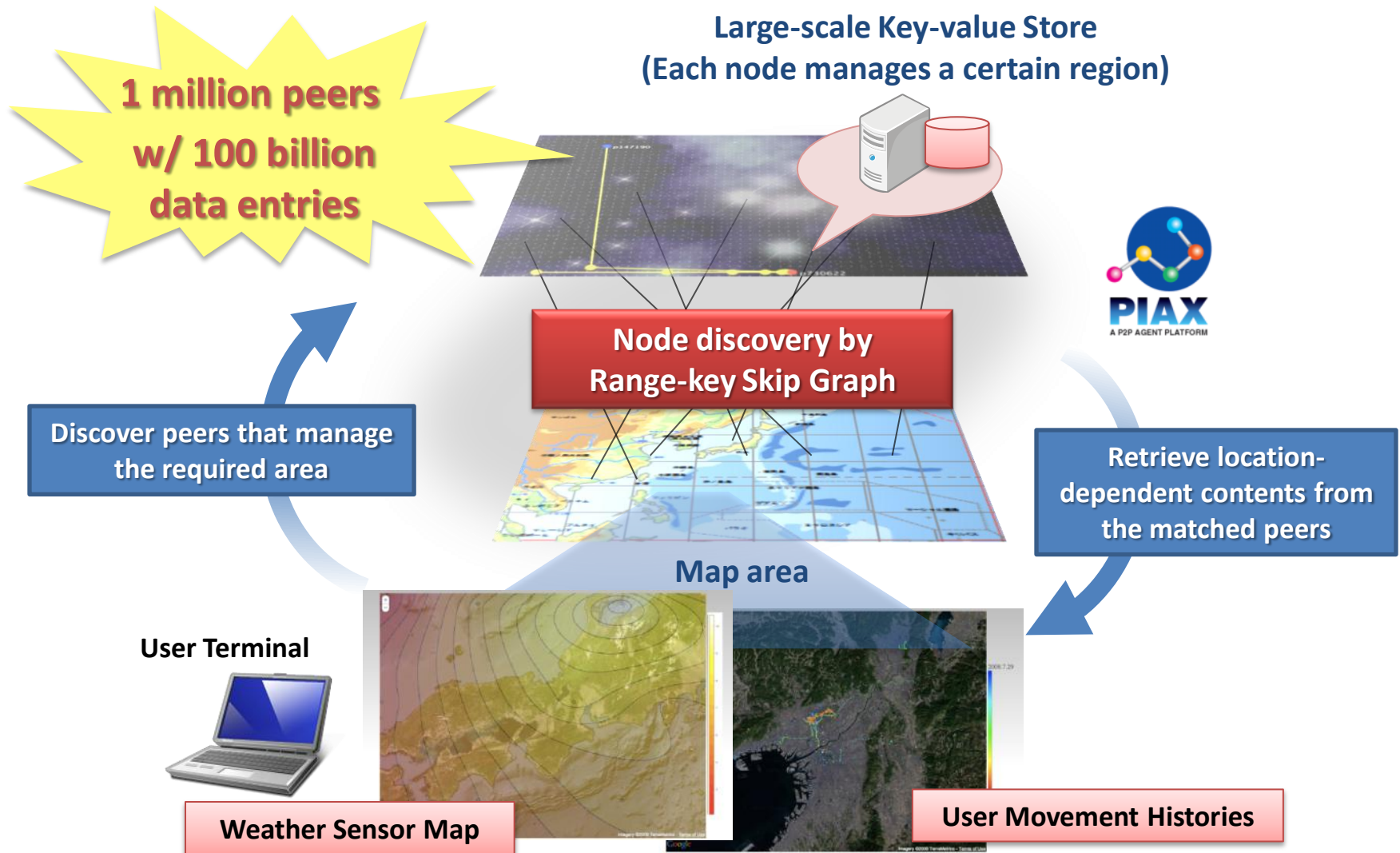
Summarized Features of PIAX

- The features of PIAX are:
 - ■ Flexibility (Mobile Agent)
 - Different kinds of services can be cooperated
 - ■ Scalability (Multi-overlay)
 - Many resources and requirements can be handled
 - ■ Tolerance (Multi-transport)
 - Heterogeneous protocols and devices can be federated



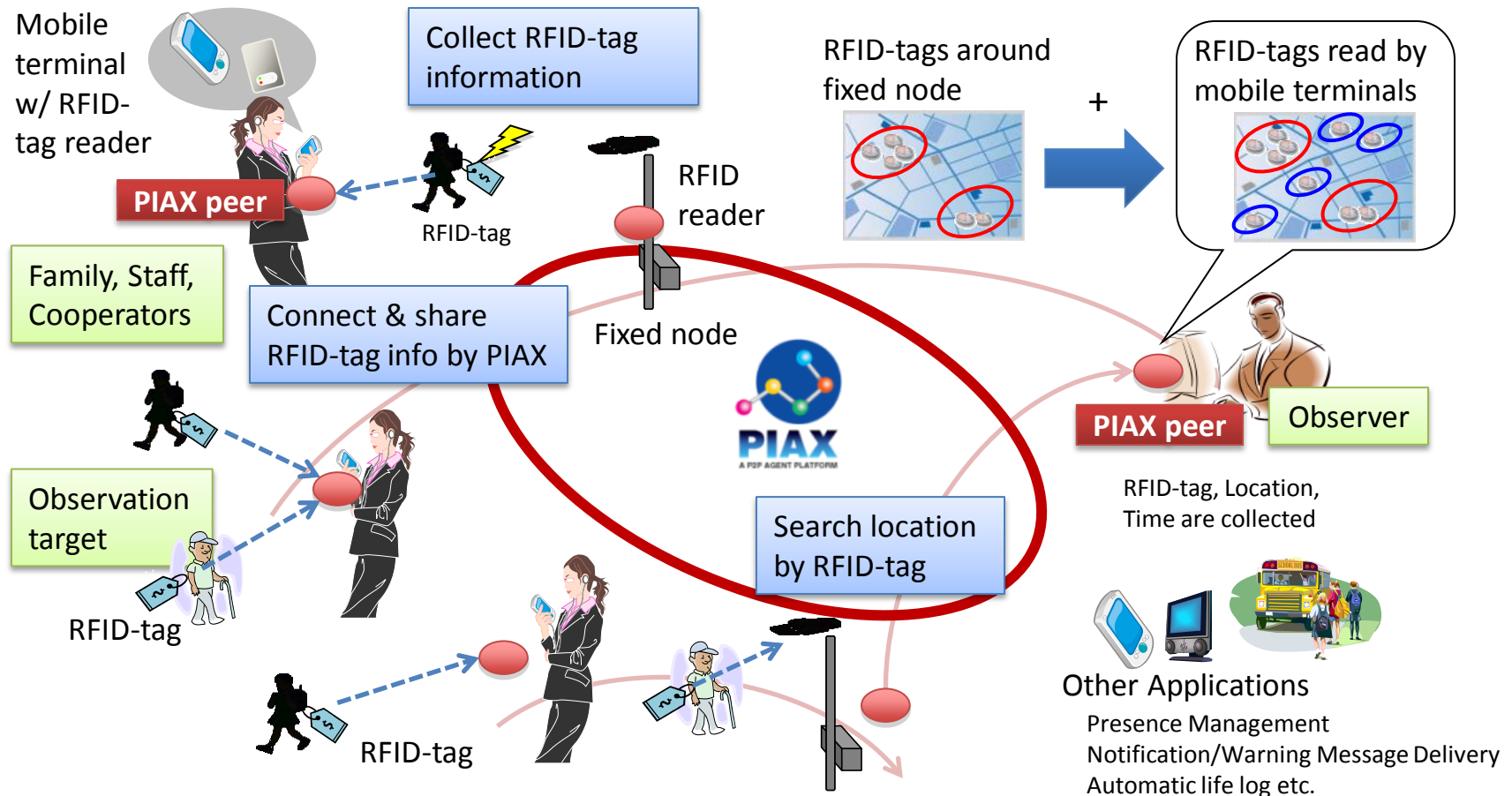
Large-scale intelligent services with heterogeneous devices can be realized over wide-area

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



Ex.2) Server-less Watching Service by 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

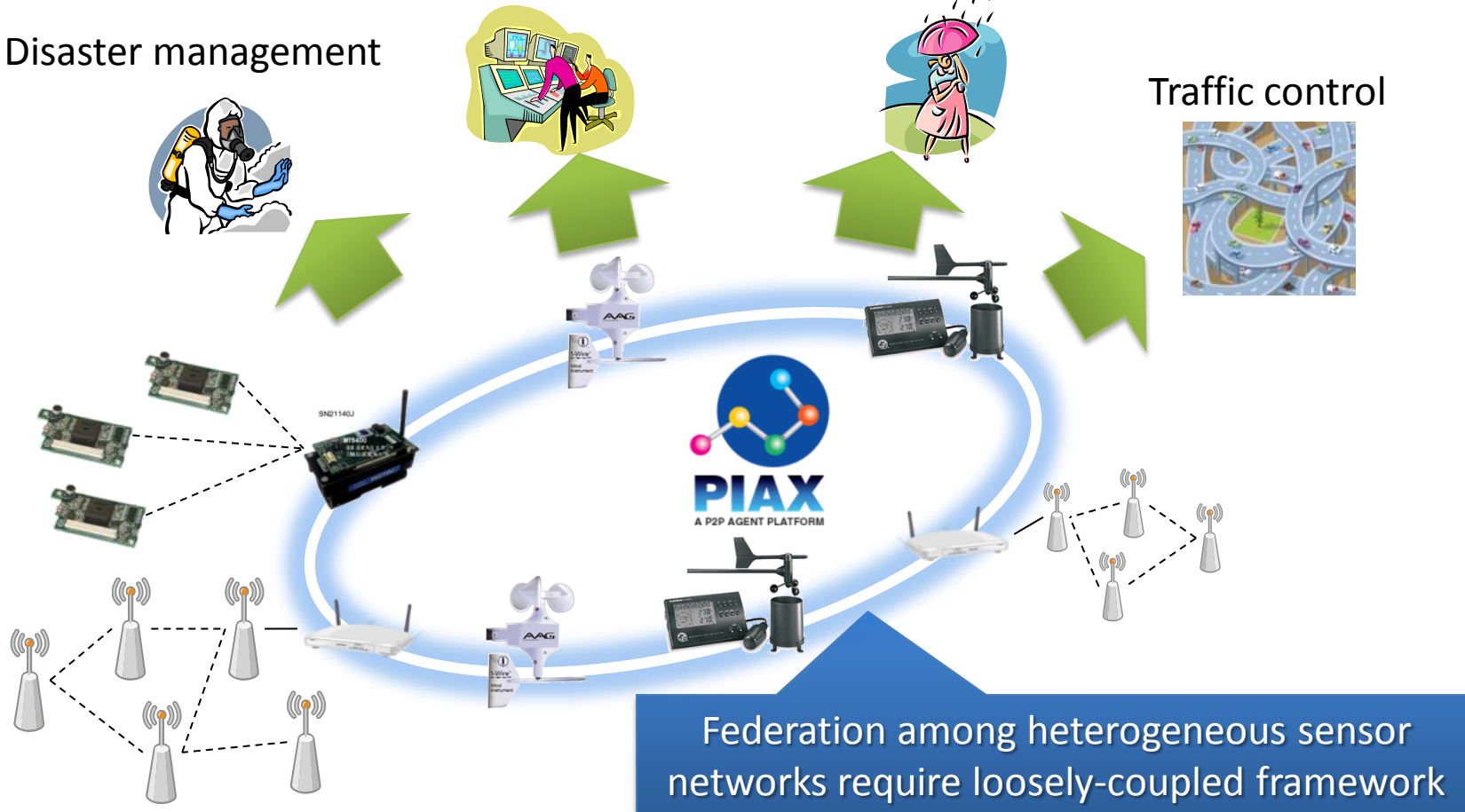
Wide-area and large-scale applications

Facility management

Weather observation

Disaster management

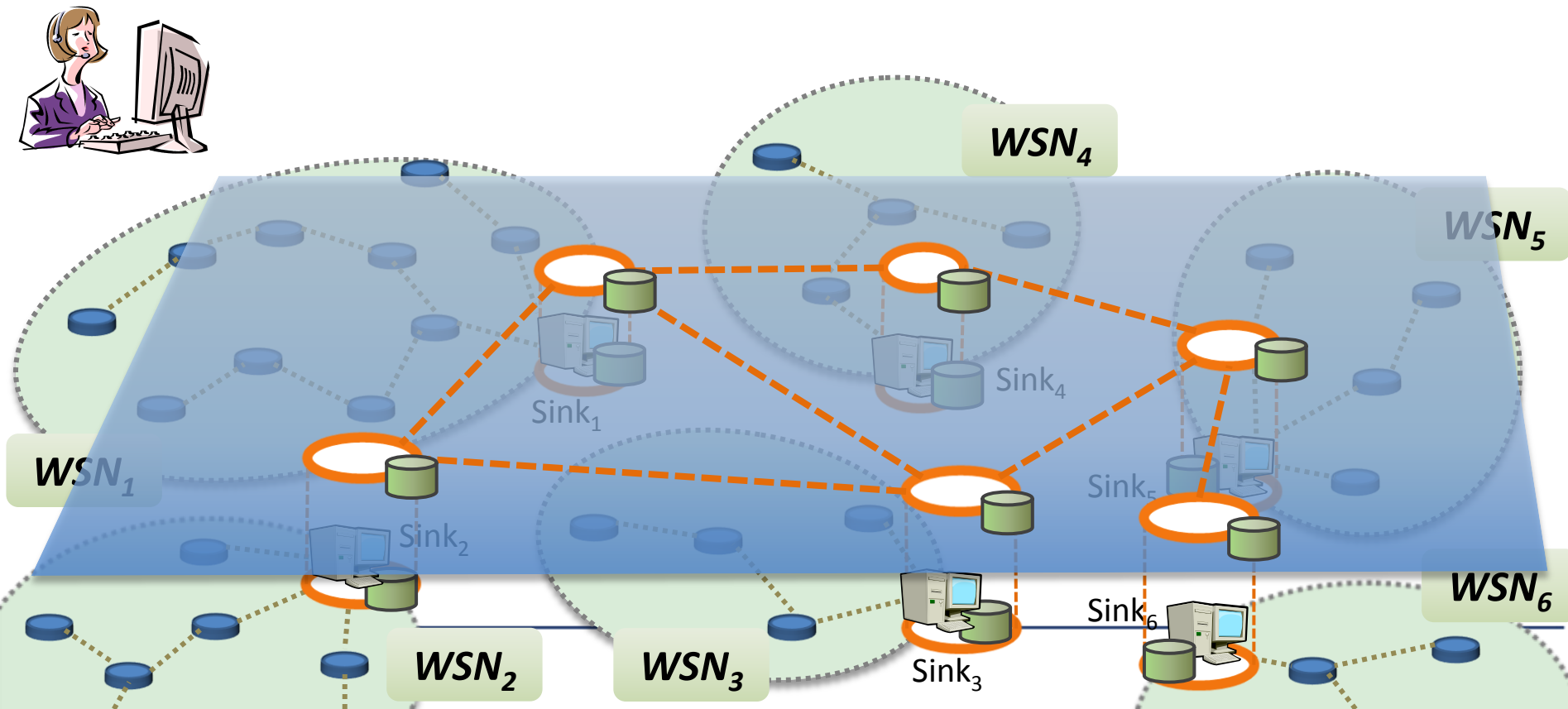
Traffic control



Federation of Large-scale Sensor Network

Sensor Network Overlay Platform by utilizing Multi-overlay and Mobile Agent

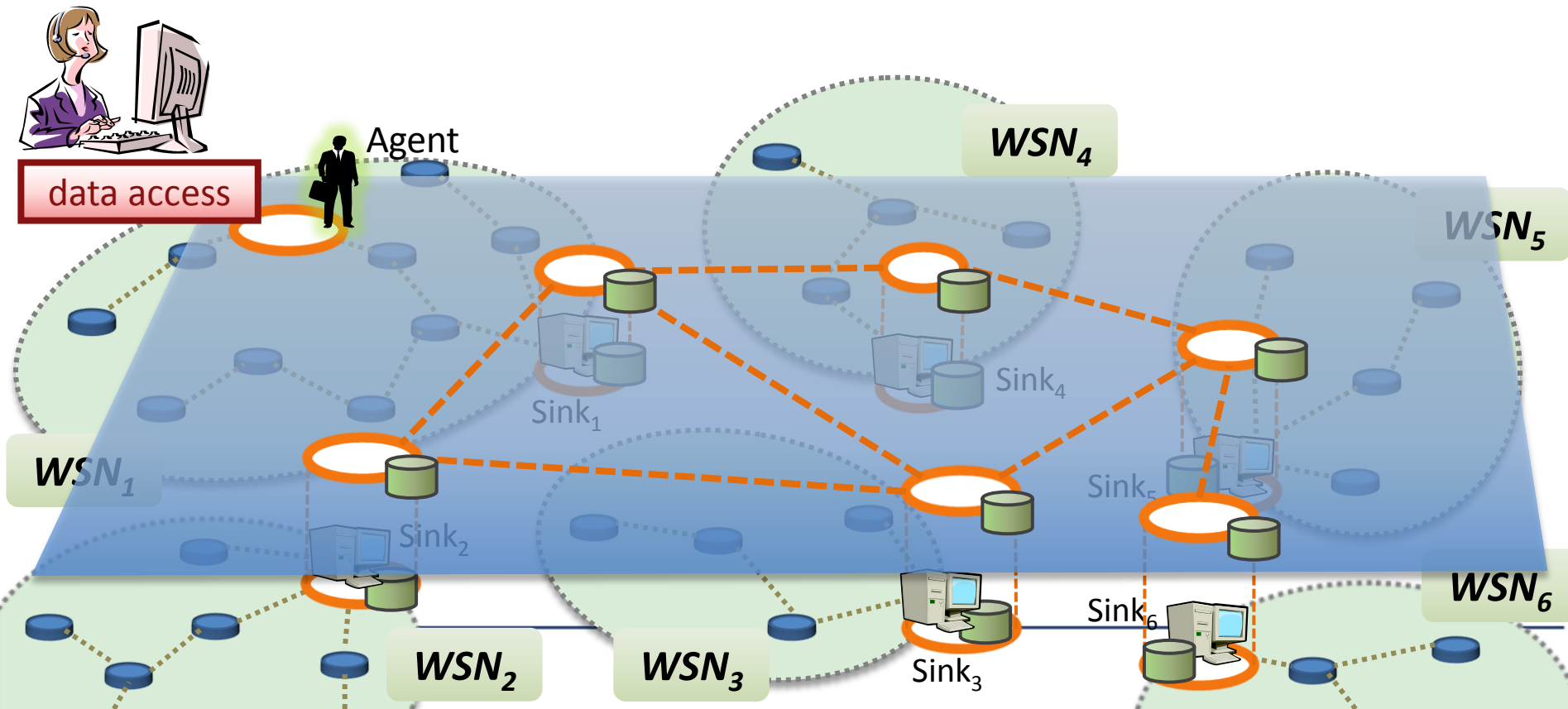
- Constructs a P2P network connecting sinks.
- The user generates a mobile agent, which travels to particular sinks, processes sensor data, and returns the results.



Federation of Large-scale Sensor Network

Sensor Network Overlay Platform by utilizing Multi-overlay and Mobile Agent

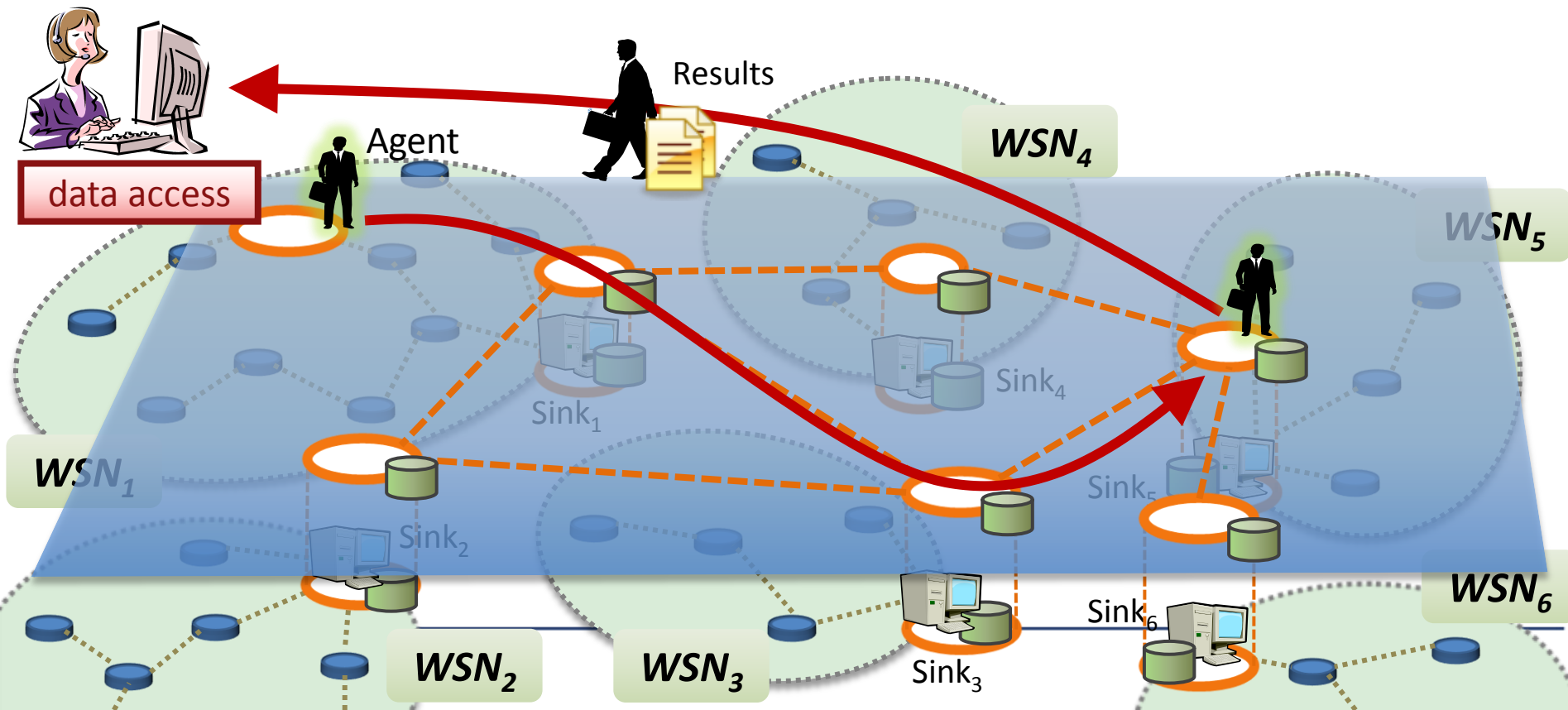
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Federation of Large-scale Sensor Network

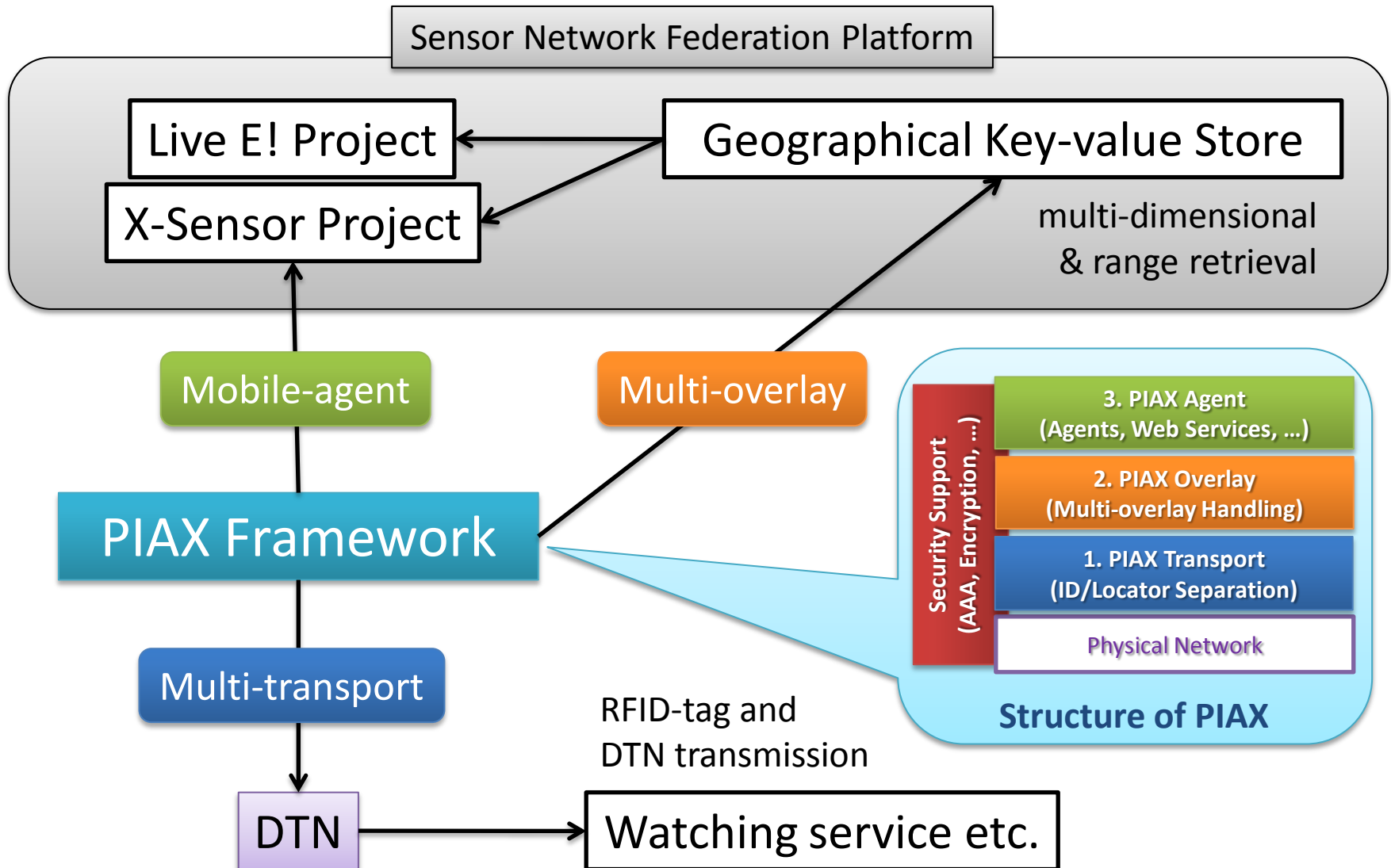
Sensor Network Overlay Platform by utilizing Multi-overlay and Mobile Agent

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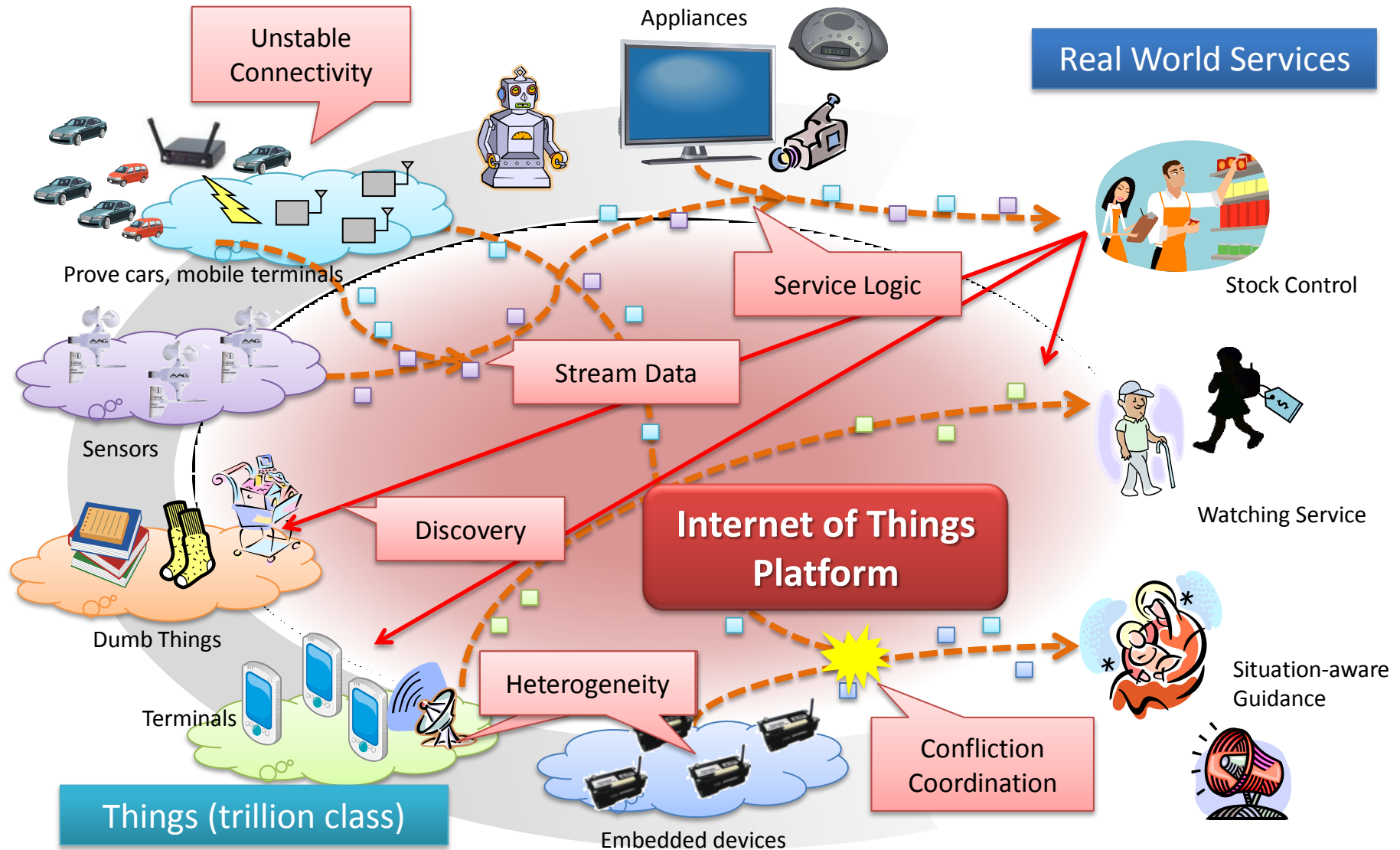


CONCLUSION AND FUTURE PLAN

Relationships of Our Projects



Future Plan: Internet of Things PF



Challenging Issues of IoT PF

- Trillion class things should be connected, federated, and operated by service logics
 - Assumption
 - Energy efficiency, data and device management cost, and security must be issues for the platform because of its scale
 - Issue 1) Retrieval of Things
 - Content-centric, 4 dimensional retrieval, zero/self-configuration
 - Issue 2) Encapsulating diversity of Things
 - Things and its transport description, scale-out framework
 - Routing optimization over unstable network
 - Issue 3) Federate and control Things by service logic
 - Real-time in-network handling (e.g., aggregation, complement) of stream data from Things
 - Service logic description and control Things
 - Issue 4) Ensuring security for diversified providers/users
 - AAA: Authentication, Authorization, Accounting

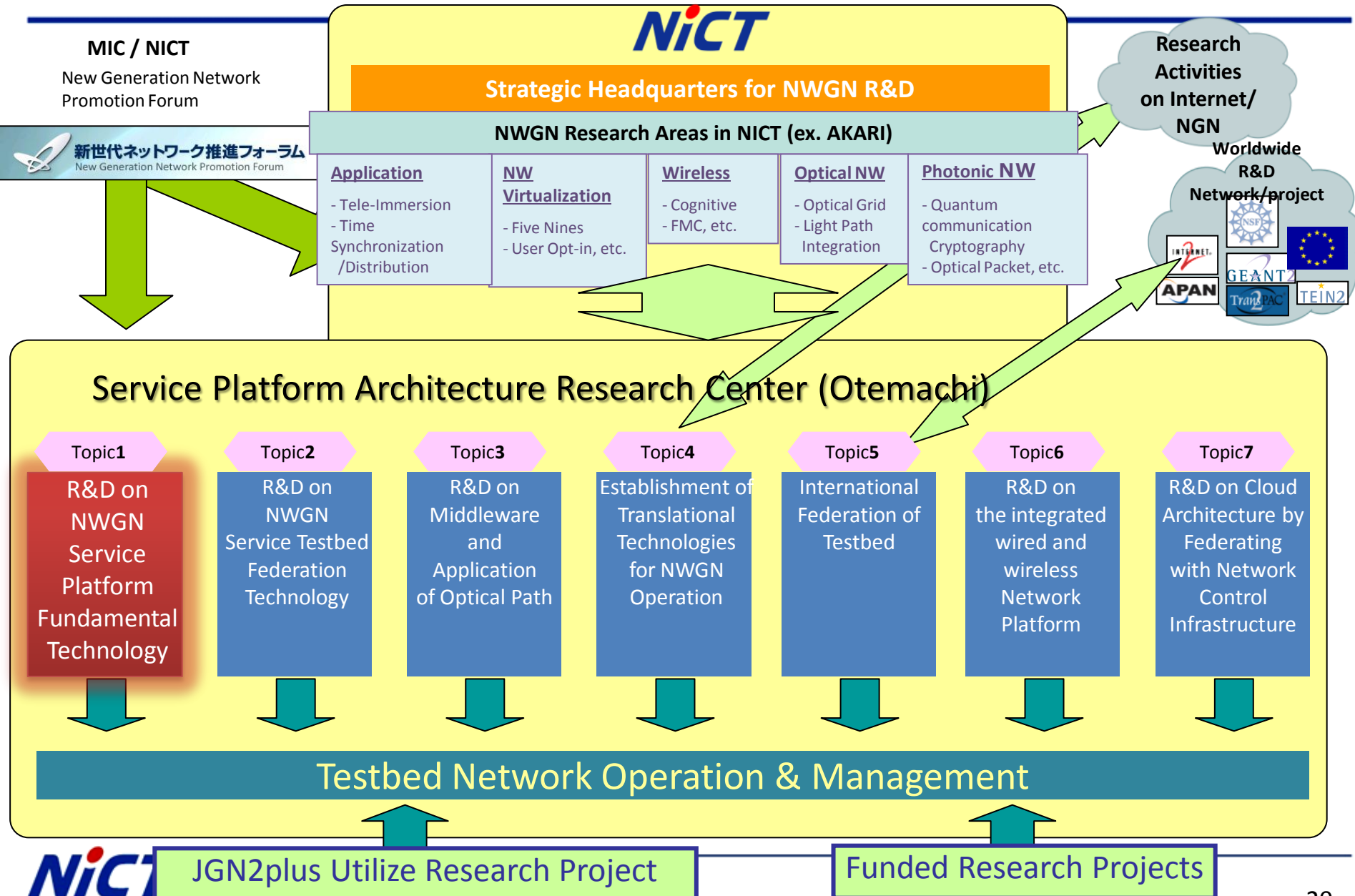
Conclusion

- PIAX: A P2P Agent Platform
 - Integrate P2P structured overlay network and multiple transports with mobile agent platform
 - Flexible and scalable coupling of ubiquitous services with concealing heterogeneity of networks are realized
 - Examples:
 - Large-scale and wide-area data sharing
 - Sensor network federation and its prototype
 - Plan to utilize PIAX framework for IoT PF
 - Please visit <http://www.piax.org/en/> for more information.

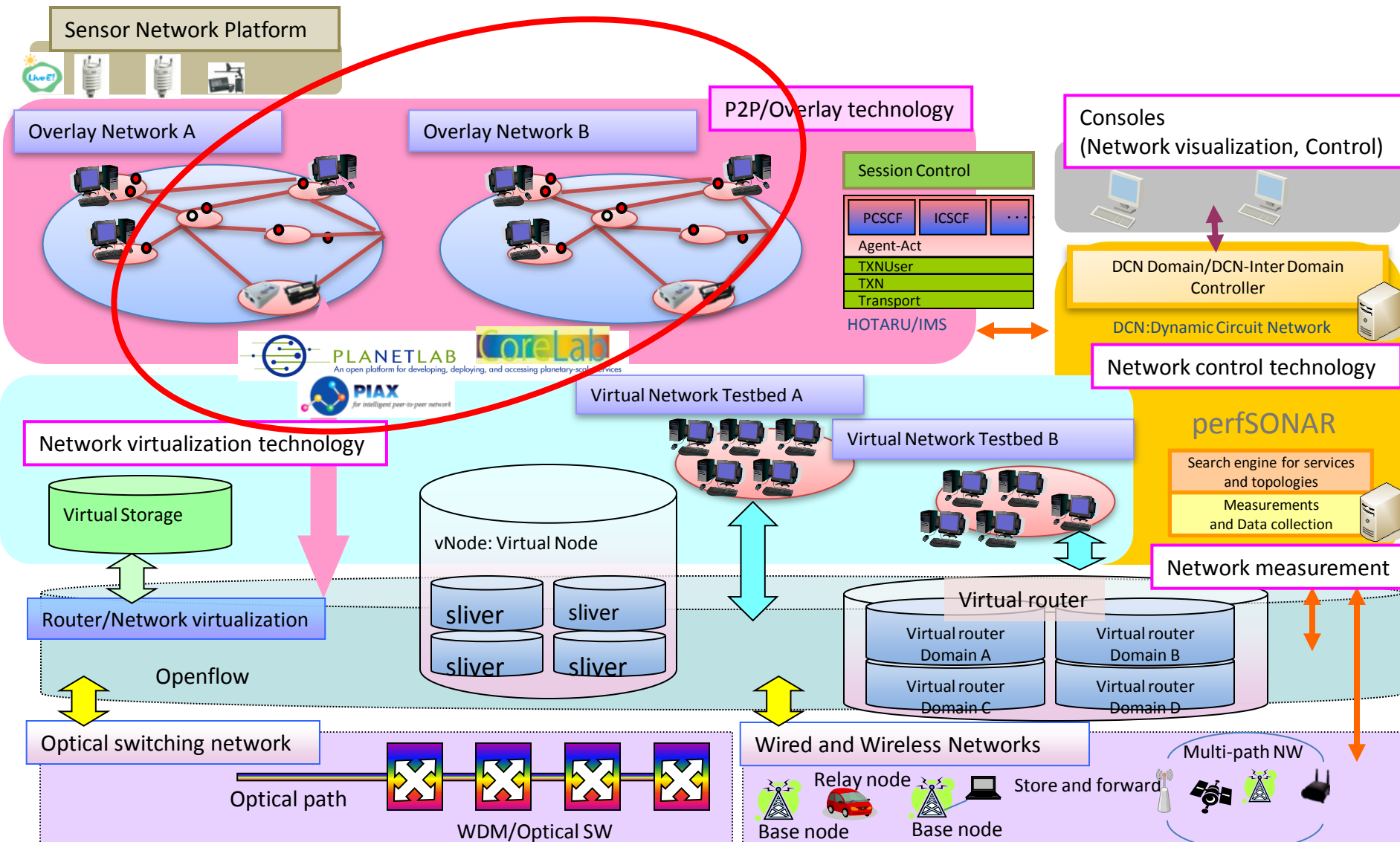


:: APPENDIX ::

Research Project Supported by NICT Otemachi



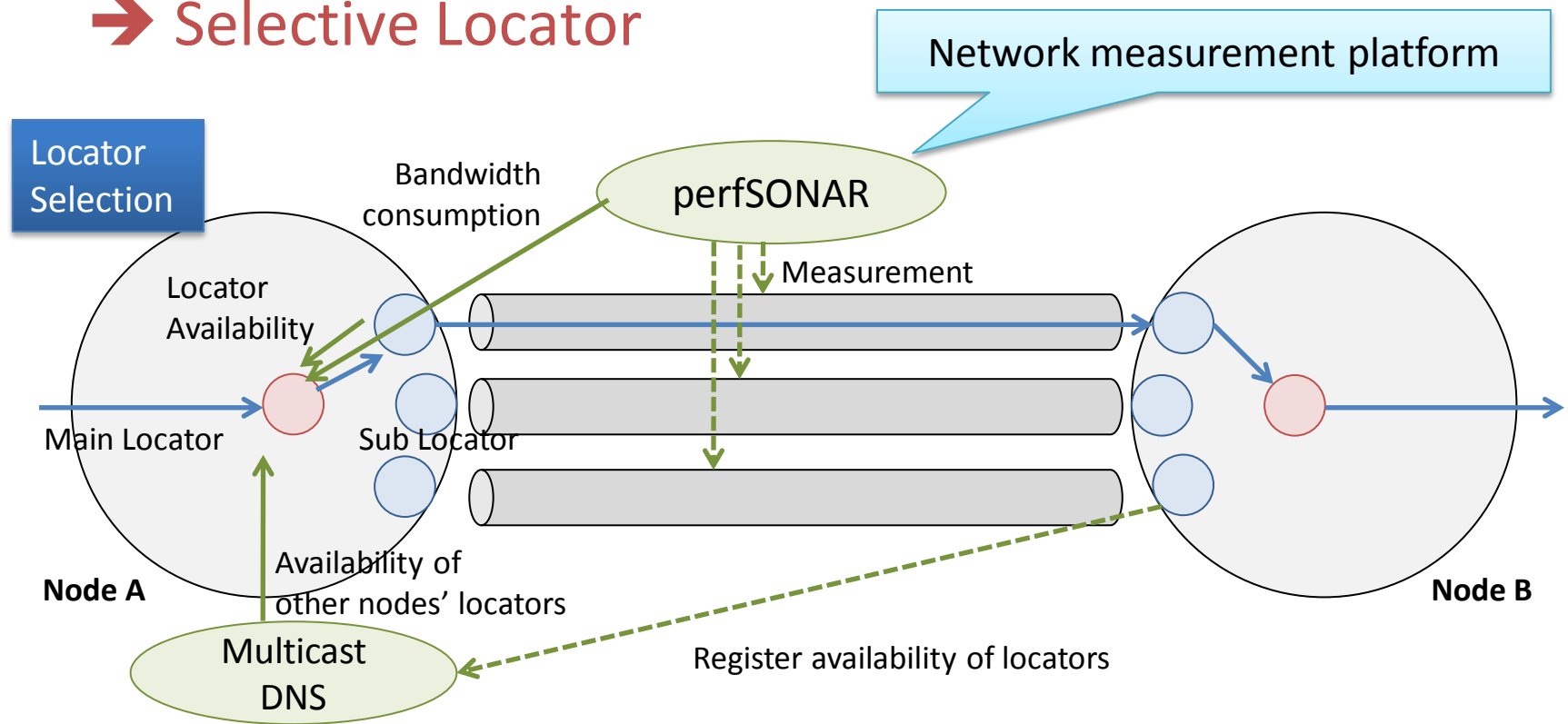
Service Platform in JGN2plus (Near Future)



Selective Locator for Multi-transport

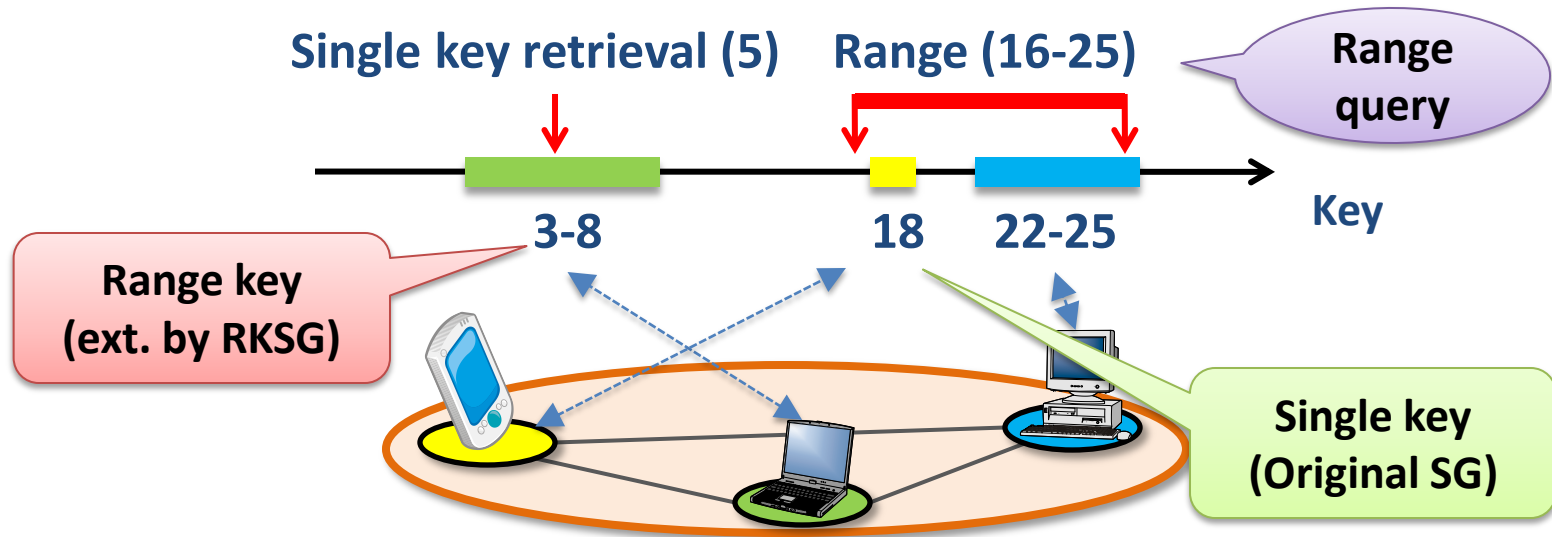
- When a node has several transports (links), locator should be selected appropriately

➔ Selective Locator



Range-key Skip Graph

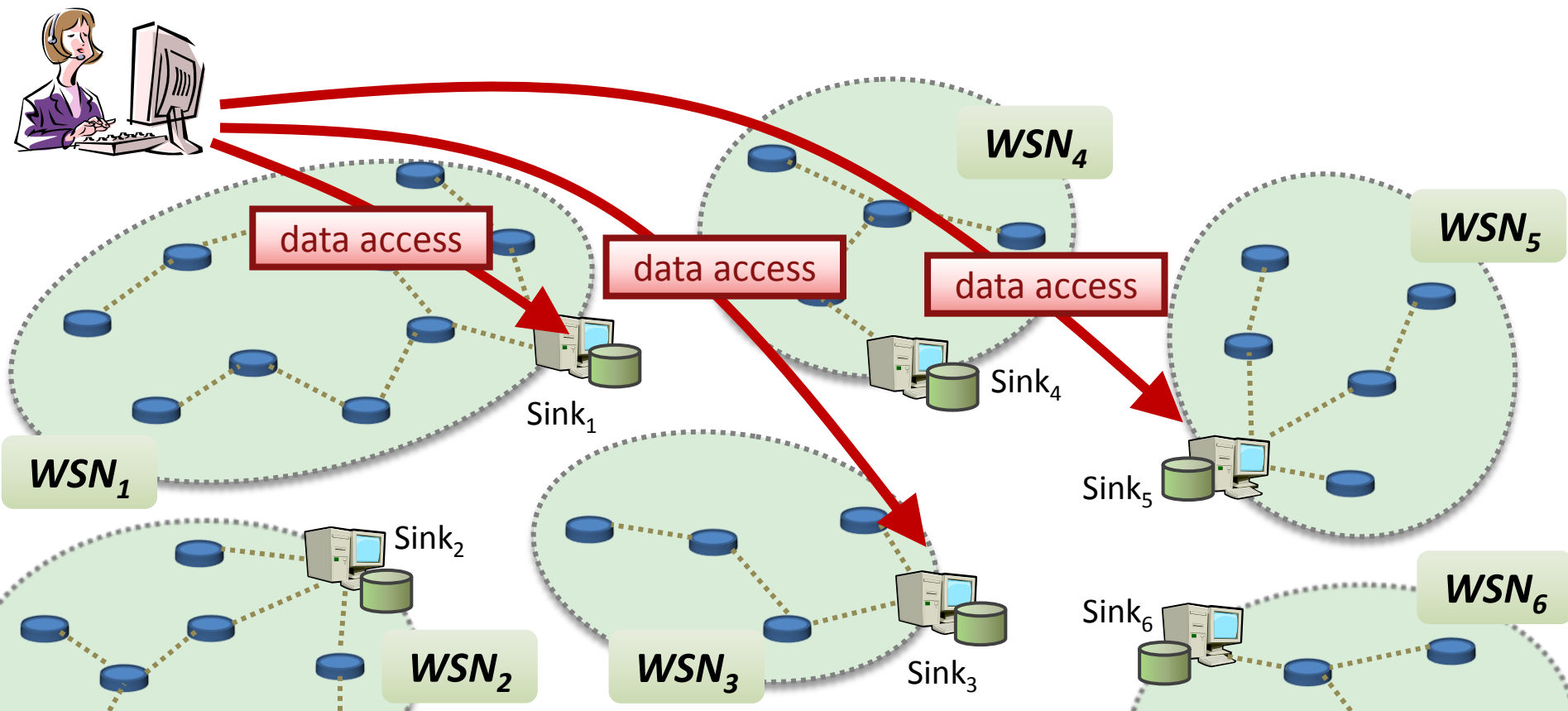
- Handle a 'range' as a key in Skip Graph



- 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)

Background

- Realizing a large-scale sensor network is difficult because of its scale and heterogeneity

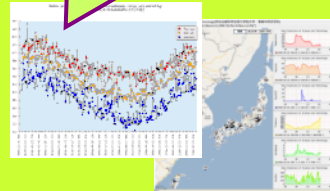


Live E! Project

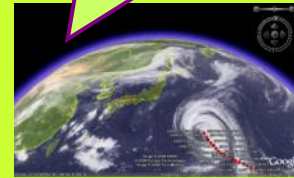
Disaster Management



Science



Education / Agriculture



Facility Management



Applications

Multi-Attribute search

Sensor & Overlay

Live E! on PIAX

In-Network Data Processing

Multi-Domain Sensor Networking

Data Management

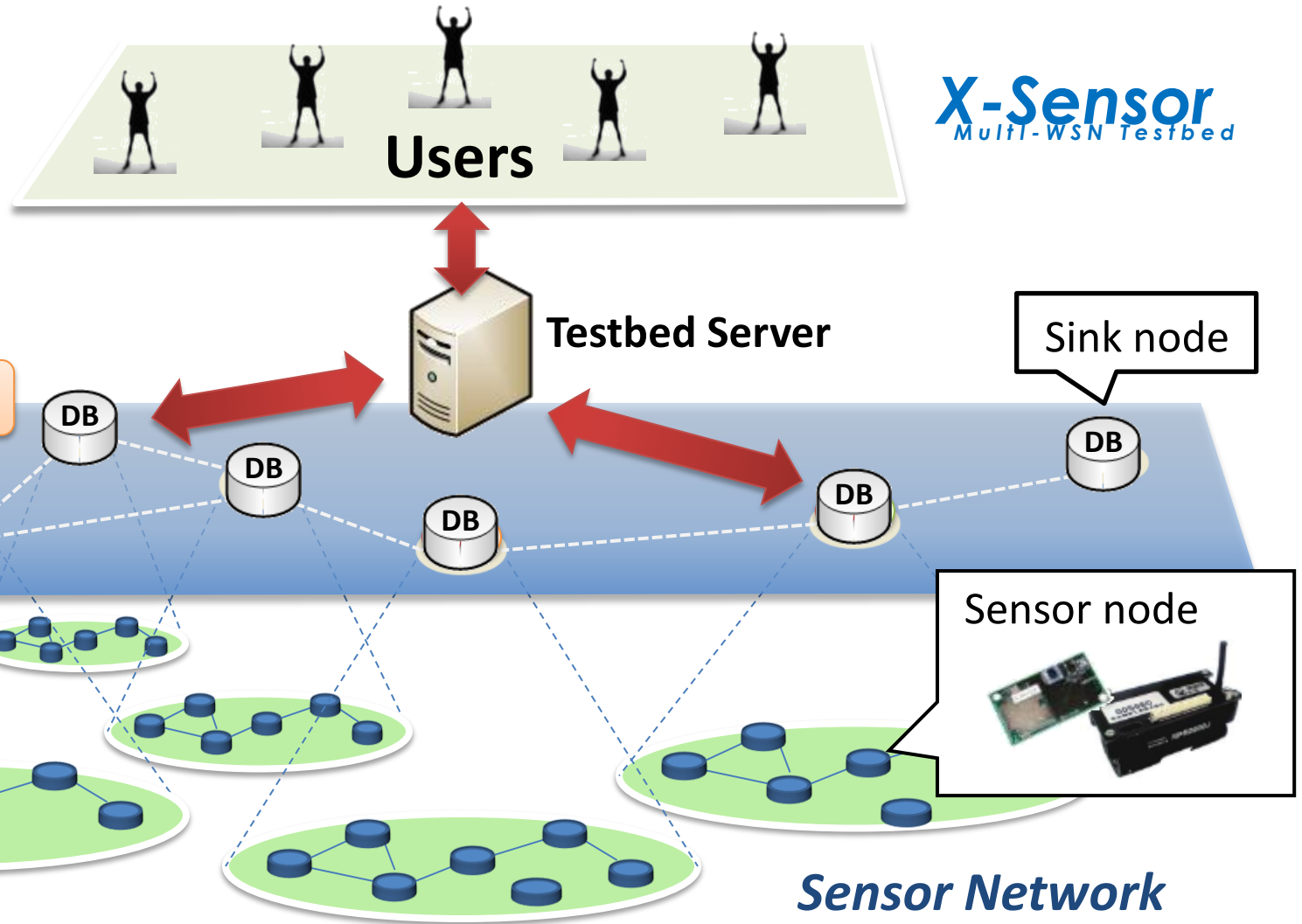
Delay Tolerant Network

Embedded gateway

Sensors



X-Sensor Project



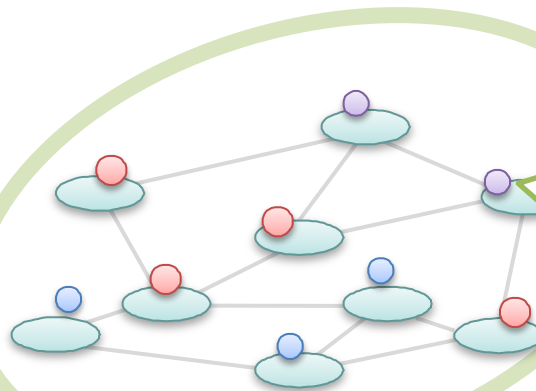
Live E! on PIAX

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

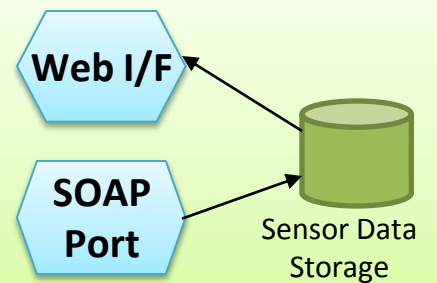


Browse deployed sensors
on Web browser

PIAX Overlay Network



Live E! Agent on PIAX



Web I/F

20 PIAX Peers with Live E! sensors



Live E! Weather Sensor
Station



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

PIAX-based Sensor Overlay Network Platform

- PIAX can support scalable data management on Federated SNs
 1. Sustainability
 - Sensor agent platform and hybrid overlay network will help to tolerate unstable situations
 2. Scalable data retrieval
 - Structured overlays and multiple overlay networks handling will help to handle distributed sensing data efficiently
 3. Efficient data aggregation
 - Distributed data fusion by overlay roaming agents will help to avoid collecting all raw sensing data



Ongoing projects: Live E! on PIAX, X-Sensor v2

Towards Sensor Overlay Network Platform

