APAN Sensor Network WG
- 2nd meeting @ Hanoi -

Group Meeting
(2010/08/10)

Chair: Susumu Takeuchi

(NICT, Japan)

Introduction of SensNet WG

- Chair
  - Eui-Nam Huh (KyungHee University, Korea)
- Co-Chairs
  - Lasse Thiem (FOKUS, Germany)
  - Susumu Takeuchi (NICT, Japan)
  - Basuki Suhardiman (ITB, Indonesia)
- Secretariat
  - Reza Khoshdelniat (MIMOS, Malaysia)
- Initial objective
  - Develop a technical environment to exchange sensing data for collaborating tightly between SN testbeds
  - Exchange technical experiences regarding SNs

Today's Agenda

- ## 11:00-12:30 Group Meeting
  - Chair: Susumu Takeuchi
- ## 14:00-15:30 Workshop Session 1
  - Chair: Eui-Nam Huh
  - Title: SensNet Activities
- ## 16:00-17:30 Workshop Session 2
  - Chair: Basuki Suhardiman
  - Title: Agriculture Applications
    - Joint-session w/ APAN Agricuture WG

a) Group Meeting

- WG Activity Discussion
  - Share backgrounds and policy of our activities
  - Arrangement of challenging issues and its scope
  - Future Plan
  - AOB

- Design Issues in Global Sensor Data Sharing (Eui-Nam Huh, KyungHee University, Korea)

b) Workshop Session 1
- SensNet Activities -

1. IP-USN updates & Activities in KOREA (Hyunho Choi, NIA, Korea)
2. 6LoWPAN Applications and Developments for the Internet Of Things (Reza Khoshdelniat / Gopinath Rao Sinniah, MIMOS, Malaysia)
3. X-Sensor ver.2: a mobile-agent supported sensor network testbed (Tomoki Yoshihisa, Osaka University, Japan)
4. MetroWSN - Metropolitan Area Sensor Networks (Thomas Luckenbach, FOKUS, Germany)

c) Workshop Session 2
- Agriculture Applications -

1. A Sensor Data Gathering Framework for Agricultural-Fields: Implementation and Experiment Report (Hideya Ochiai, Tokyo University, Japan)
2. Invited talk: Application development environment of Sensor Service GRID (Kiyoshi Honda, Asian Institute of Technology, Thailand)
3. Invited talk: Data Integration and Analysis System(DIAS) and Sensor Network for Agriculture (Kiura Takuji, NARO, Japan, et al.)

- Concluding Remarks (Susumu Takeuchi)

2nd WG meeting @ APAN 30th Meeting in Hanoi

GROUP MEETING

Agenda of Group Meeting

Review of the 1st Meeting in Sydney

Summary of the Core Meeting
(Backgrounds, goals, and updated charter)

Define Terms of Sensor Network

Grand Design and Challenging Issues

Future Discussion Plan and AOB

Review of the 1st meeting (1/2)

- APAN 29th Meeting in Sydney
  - February 9, 2010 (11:00-17:30)
- Working Group Meeting
  - WG Activity Discussion
    - Sensor data exchange discussion, standard Issues, future plan, etc.
- 2 Workshop Sessions
  - SensNet Infra Technology (4 speakers)
  - SensNet Applications (3 speakers)

Review of the 1st meeting (2/2)

- Impressions
  - Our WG members have varieties of significant researches regarding to SNs and its applications, but our backgrounds and objectives are also varies.
  - When we address to federate SNs as the charter, we have to share our backgrounds.
- What should we do?
  - To establish a formal charter
    - The charter at that time was interim one, so we had to develop it to the formal one toward SN testbed federation.
  - To share backgrounds and define the terms
    - Make the requirements of SN testbed users, application developers, and deployers should be clear.

Review of the 1st meeting (2/2)

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We had a <u>Core Meeting</u> to share our backgrounds and discuss/establish a formal charter

Agenda of Group Meeting

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1st Core Meeting

- Date/Time: May 24, 2010 (13:30-15:30)
- Venue: Imperial Palace Hotel, Seoul
- Participants: WG Chairs and Core Members
- Objective
  - Discuss and establish a formal charter for SensNet WG
- Agenda
  - Share backgrounds, policies, steps of our activities
  - Arranging challenging issues
  - Establish a formal charter (if possible)

Background: Motivation for Charter

- Recently, varieties of projects regarding to Sensor Network and its federation are working (e.g., GEOSS Sensor Web).
  - ➔ What will be the characteristics of our WG?
    - We have to make our activity policy clear to develop our activities.

- Go back to the basics, <u>APAN must be a unique operator community in Asia</u>, so…

Our Goals

1. **Low-cost and easy <u>deployment and management</u> of sensor networks for wide-area coverage**

   – Deployment cost is a barrier, but management cost is a more critical barrier to maintain sensor networks.

2. **Support crucial <u>sensor network applications</u> in Asia-Pacific region**

   – Environmental monitoring (e.g., weather, disaster, pollution, smart grid) would be essential for sustainable development in this region.

SensNet WG Charter (approved in June)

- Goal
  - SensNet WG encourages <u>the collaboration of technical experiences and knowledge regarding SNs</u>, and will develop <u>a scalable, sustainable, and easy-to-deploy technical environment</u> for utilizing collected sensing data among SNs deployed in each country.
- Objectives
  - 1. Encourage SN deployment and federation
    - Exchange SN deployment cases, technical issues and experiences
    - Standardize SN description (access method/policy, specifications, protocols) and application interface (access method, query language) by utilizing external standards
  - 2. Federate for sensing data utilization
    - Develop a federated framework to discovery any resources in heterogeneous SNs for supporting varieties of applications
    - Ensure the scalability of a federated framework that can handle over millions of sensor nodes for realizing low-cost federation

Goal 1: Deployment and Management

- The key notion is a "Federation of SNs"
  - Scalable, sustainable, and easy-to-deploy SN and its federation framework will enable tiny SN testbeds to cover wide-area
    - w/o deploying the massive number of equivalent and/or expensive sensors.
  - This must be the initial concept of our WG.
- But, how are the other SN projects?
  - Do we have another aspect compared to them?

Comparison of Sensor Network Projects

Project	Sensor I/F (interconn.)	Application I/F	Resource mgmt.	Data mgmt.	Deployment
GEOSS Sensor Web	✓ Hetero	✓	✓ C/S?	-	Standard of federation from apps
GSN	✓ Hetero	✓ Web serv.	- middleware	- middleware	Middleware only
IETF 6LoWPAN, ROLL, CoRE	✓ Homo	✓ REST (CoRE)	- I/F only	- I/F only	Standard I/F only
Live E!	✓ Hetero	✓ Web serv.	- C/S (hier.)	✓ Hier. query	App testbed
SENSEI	✓ Hetero	✓ Context-aware	✓ C/S (DS)	- Pub/sub	Standard of federation
KanseiGenie	✓ Hetero	- testbed	✓ Slice (DS)	- Slice	Testbed

✓ : The field on which a project focuses / -: not mentioned

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KanseiC					tbed

Our WG approach must be unique
because we have to focus on Resource Management,
Data Management, and Deployment

Goal 2: Sensor Network Applications

- The key application in Asia is "Agriculture"
  - Environmental monitoring (e.g., weather, disaster, pollution) would be essential for sustainable development in Asian countries, but <u>agriculture must be the eventual application of them</u>.
    - Collaboration between APAN Agriculture WG and SensNet WG must be important
- Then, what will be the characteristics of Asian agriculture?
  - Must affect on our collaboration approach

Center Pivot Irrigation

Large-scale farming methods

Not applicable in Asia

Rice Terraces

Small-scale but tolerant farming methods

http://kyuu-net.com/dantai_data/D163/

Common Concepts and Collaboration

- "Distributed" and should be "Federated"
  - Sensor Network
    - Deploy tiny SNs and federate them to cover wide-area
  - Agriculture in Asia
    - Develop small farms and federate them to increase productivity
- What can SN community do for Agriculture?
  - SNs encourage a lot of small farms to maintain easily by monitoring without manpower
  - ➔ Our WG and AG-WG should collaborate tightly to extract requirements for SNs and develop a federated framework

Agenda of Group Meeting

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(Backgrounds, goals, and updated charter)

Define Terms of Sensor Network

Grand Design and Challenging Issues

Future Discussion Plan and AOB

Necessity of Terms Definition

- Definition of a sensor network is ambiguous
  - If you search [sensor network 🔍] in Wikipedia, you will be transferred to…

Various Ways of Sensor Networks

- Wireless/Wired Sensor Networks are realized
  - Several Wireless Sensor Network (WSN) is available, but weather sensor that equips multiple functions are also networked.
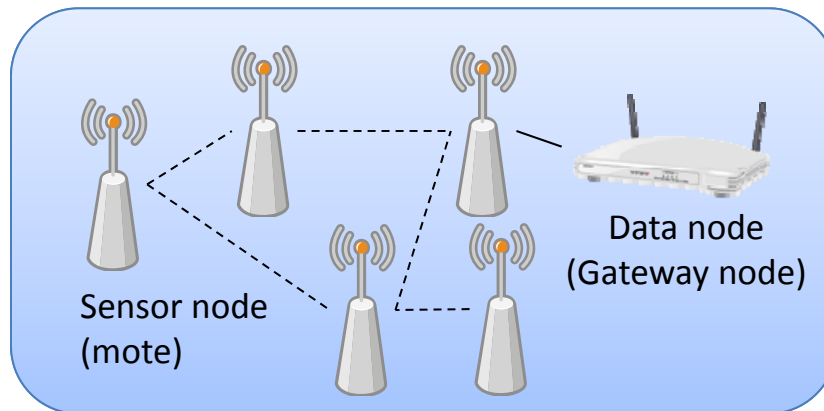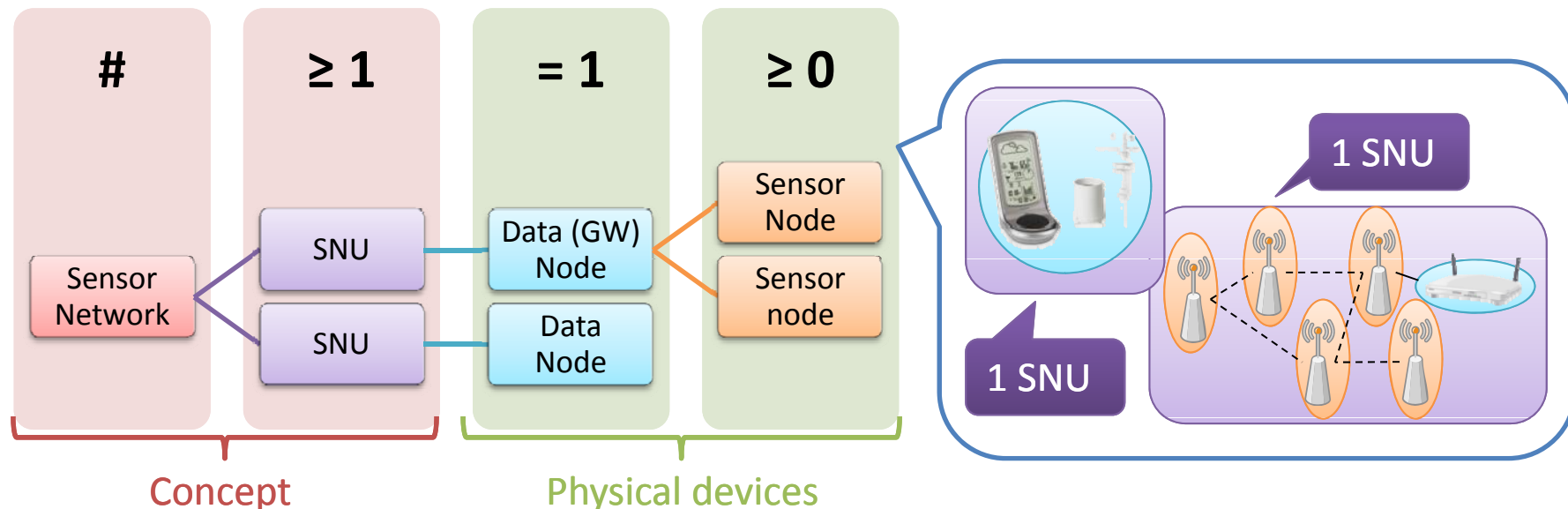

Wireless Sensor Network (WSN)

Networked weather sensor station ONLY by wire
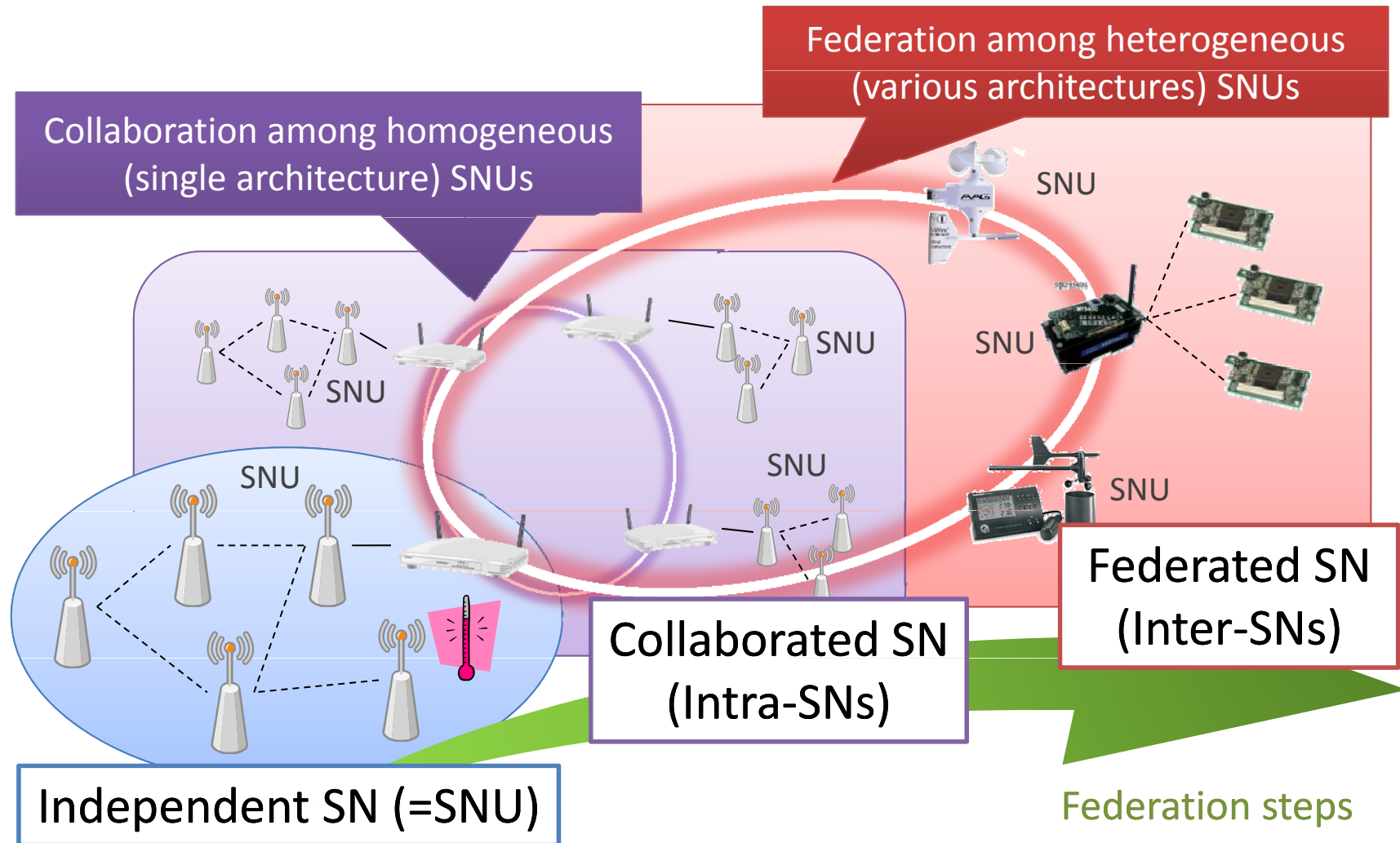
What will be the Concept of SN?

- General concept for SN should be:
  - Sensors that are connected in the same manner and behaves like a chunk of the sensors will be also called as a **Sensor Network**, *even if they are connected only by wire*
  - i.e., Sensor Network should be a concept that multiple sensors form a network and collect sensing data for a specific purpose by the same manner

Basic Unit of SN: Sensor Network Unit
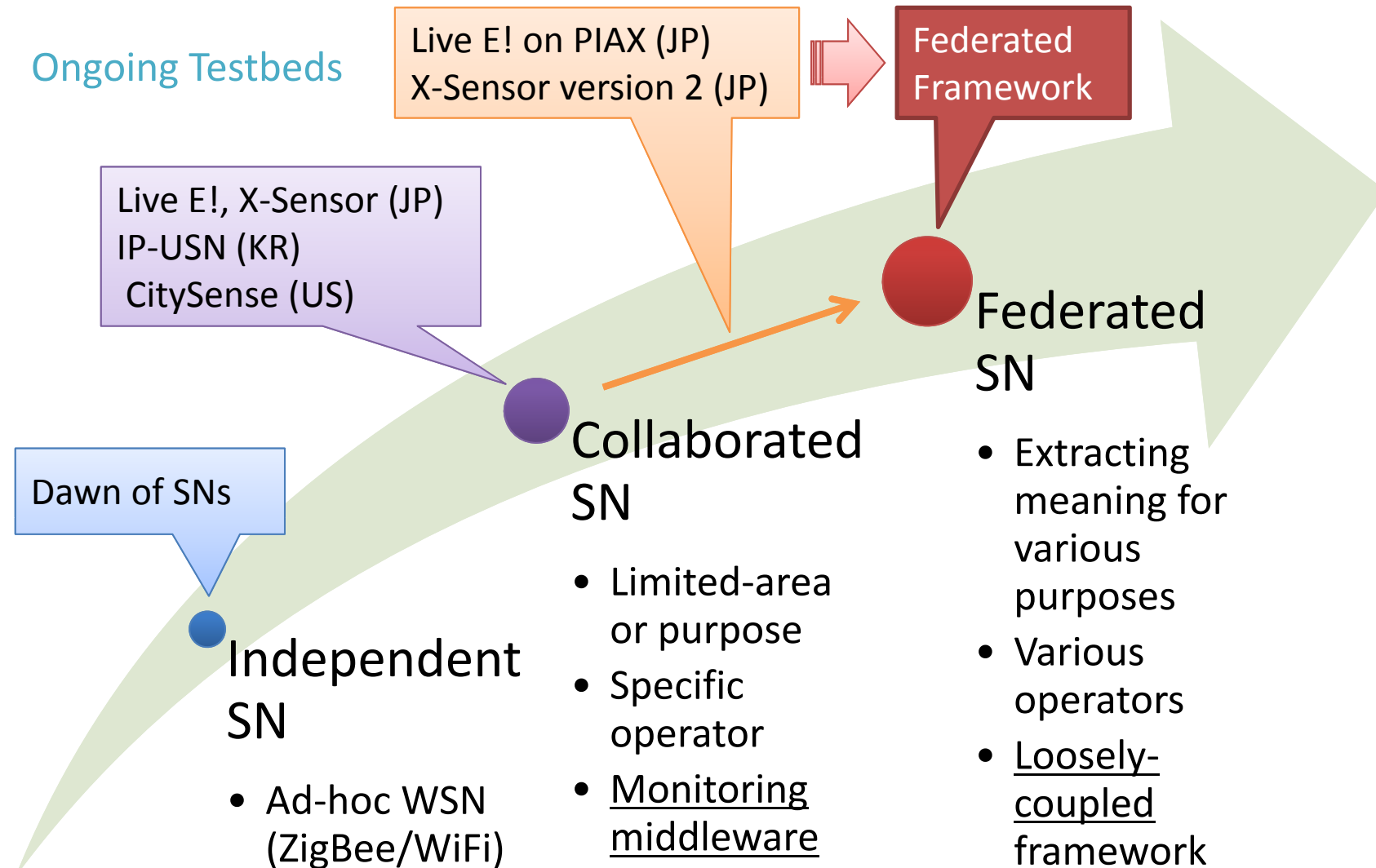
- Definition of a Sensor Network
  - A SN = one or more <u>Sensor Network Units (SNUs)</u>
  - <u>A SNU</u> is a group of sensor(s) that has **ONLY ONE data node**, and **MAY have sensor nodes** (motes)
    - Data node MUST be accessible from others via network and handle the sensing data from managing sensor nodes

Federation of Sensor Network (1/2)

Federation among heterogeneous (various architectures) SNUs

Collaboration among homogeneous (single architecture) SNUs

SNU

SNU

SNU

SNU

SNU

SNU

SNU

SNU

Federated SN (Inter-SNs)

Collaborated SN (Intra-SNs)

Independent SN (=SNU)

Federation steps

Federation of Sensor Network (2/2)

Ongoing Testbeds

Live E! on PIAX (JP)
X-Sensor version 2 (JP)

Federated Framework

Live E!, X-Sensor (JP)
IP-USN (KR)
CitySense (US)

Dawn of SNs

Federated SN

- Extracting meaning for various purposes
- Various operators
- Loosely-coupled framework

Collaborated SN

- Limited-area or purpose
- Specific operator
- Monitoring middleware

Independent SN

- Ad-hoc WSN (ZigBee/WiFi)

Agenda of Group Meeting
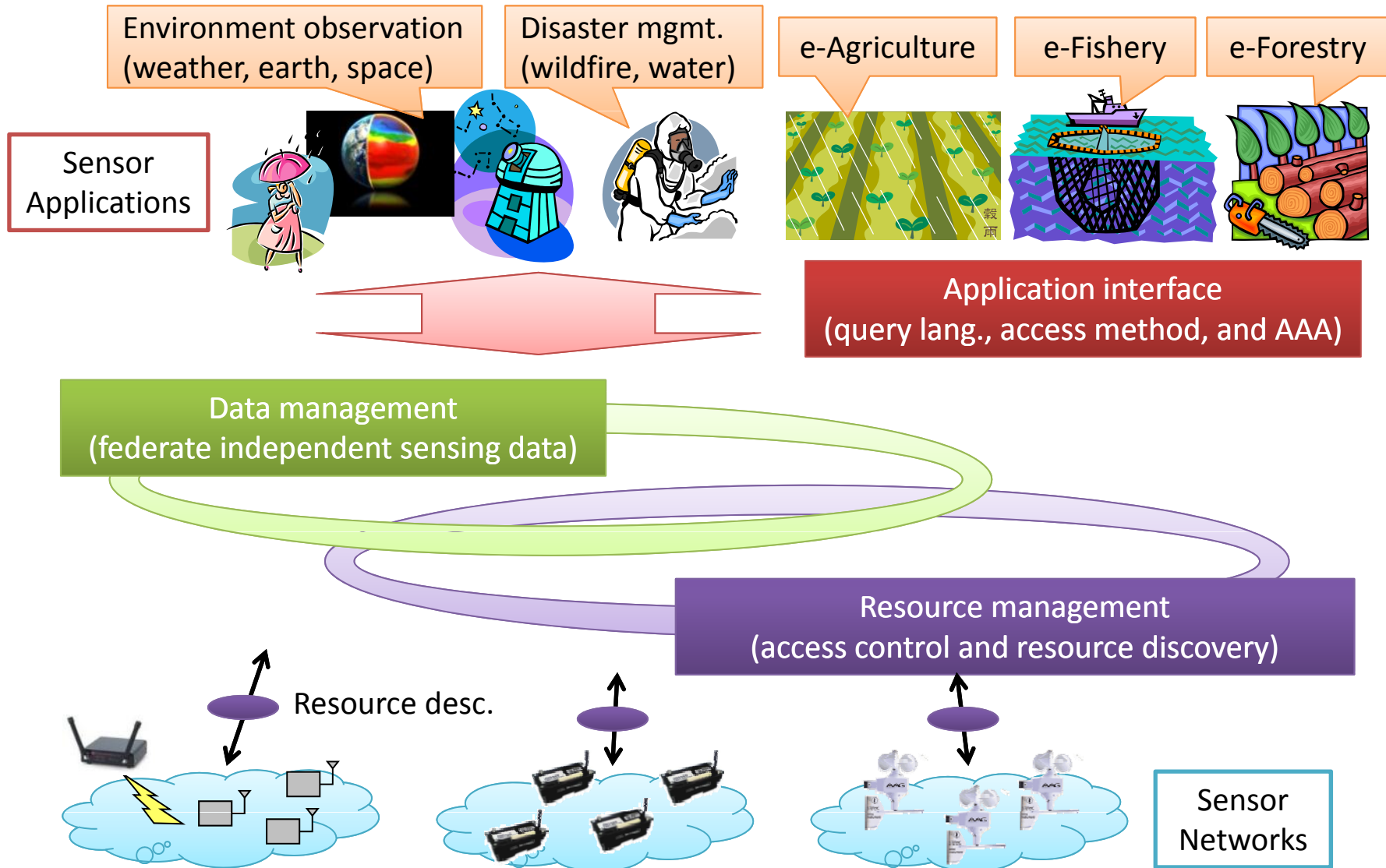
Review of the 1st Meeting in Sydney

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Define Terms of Sensor Network

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Grand Design (Conceptual Model)

Sensor Applications

Environment observation (weather, earth, space)

Disaster mgmt. (wildfire, water)

e-Agriculture

e-Fishery

e-Forestry

Application interface (query lang., access method, and AAA)

Data management (federate independent sensing data)

Resource management (access control and resource discovery)

Resource desc.

Sensor Networks
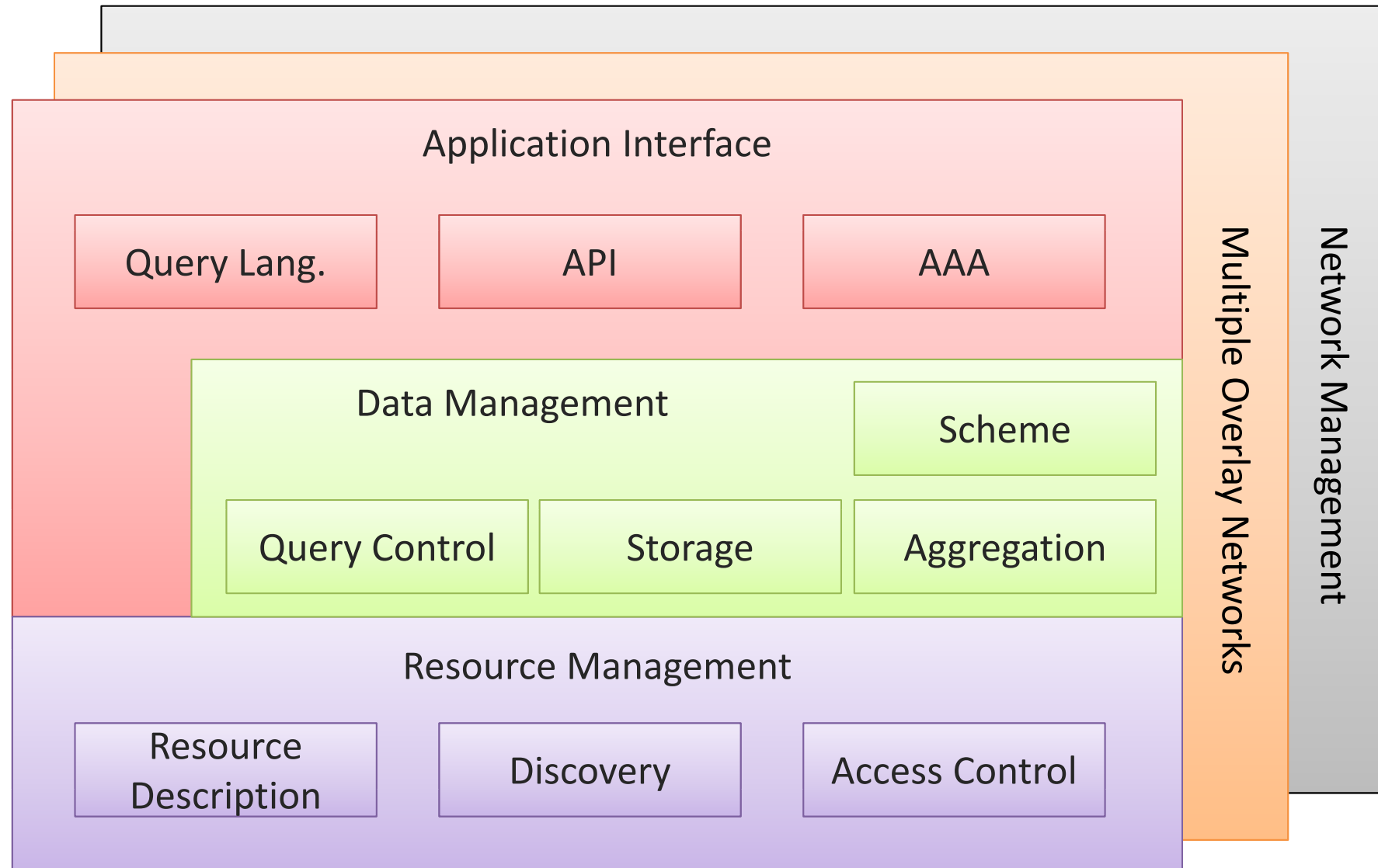
Collaboration with Other Projects

Collaborating w/
APAN Agriculture WG,
Natural Resource WG,
and GEOSS Sensor Web

Derived from
existing standard,
RESTful I/F etc.

Derived from
existing standard,
OAuth etc

Collaborating w/
industrial area

Function Blocks and Challenging Issues

Application Interface

Query Lang.	API	AAA

Data Management

		Scheme
Query Control	Storage	Aggregation

Resource Management

Resource Description	Discovery	Access Control

Multiple Overlay Networks

Network Management

Detailed Functions (1/5)

- # Resource management

  - ## Resource Description

    - Describe <u>sensors specification</u> that include data type, observation method and interval, access method, data management method, etc.

  - ## Discovery

    - Find appropriate sensor(s) based on the sensor ID

  - ## Access Control

    - Handle an access for each resource according to each domain's management policy

Detailed Functions (2/5)

- # Data management

  Data Management | Scheme

  Query Control | Storage | Aggregation

  - ## Aggregation
    - Collect sensing data from sensor node

  - ## Storage
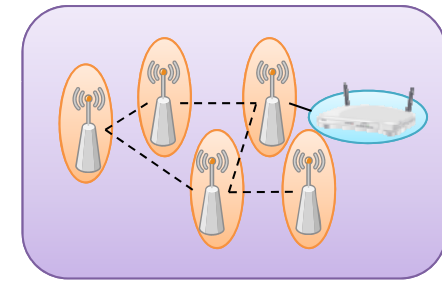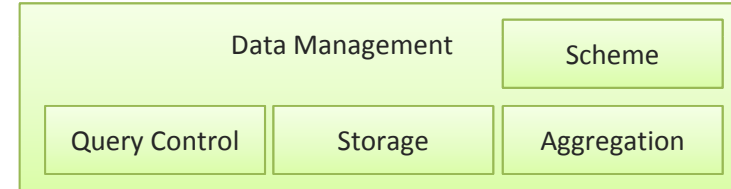   - Store sensing data in each data node

  - ## Query Control
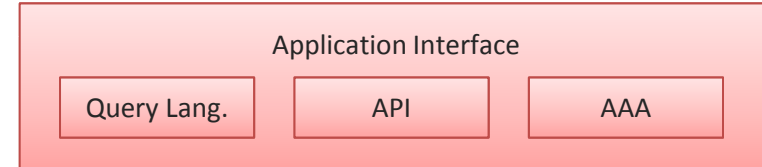   - Retrieve sensing data that is stored in data node

  - ## Scheme
    - Describe structure, attribute, relationships, etc. of the stored data

Detailed Functions (3/5)

- ## Application Interface

  - ### Query Language & API

    - Provide service description and methods to retrieve sensing data

      - A partial query is delivered to Resource mgmt. layer directly, and others are distributed to Data mgmt. layer

  - ### AAA

    - Provide authentication, authorization, and accounting (if necessary) function to mediate SN users and SN deployers

Application Interface

| Query Lang. | API | AAA |

Detailed Functions (4/5)

- ## Multiple Overlay Networks

  Multiple Overlay Networks

  - Support various kinds of access methods over distributed sensing data <u>w/o any servers</u> by constructing structured overlay networks over data nodes

    - Required access methods are:
      - Single sensor node or data node query
      - Location(region)-based query
      - Country-level query
      - Etc.

Overlay Network

Data node

Sensor node
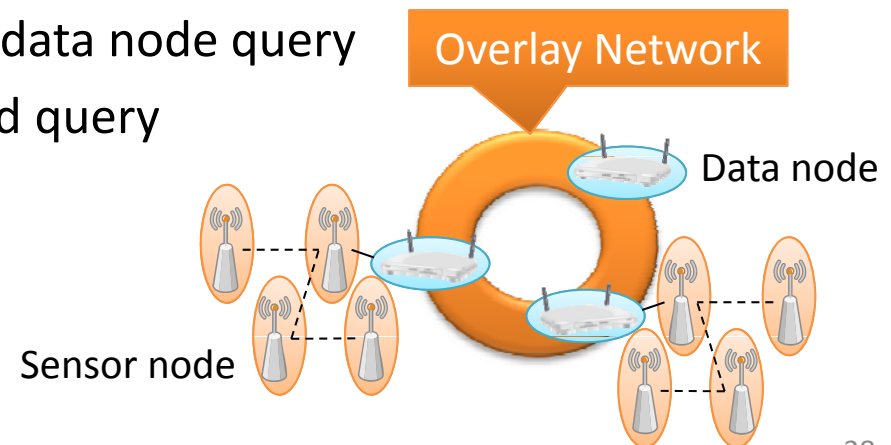
Detailed Functions (5/5)

- ## Network Management

  Network Management

  - – Provide transport layer to support several protocols and network-related functions
    - Locator: IPv4, v6, ZigBee, Bluetooth, …
    - Service Discovery: UPnP, network-monitoring-based routing, mDNS, …
    - Transmission: store & forward (DTN), flooding, …

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How should we address the issues?

- Ref: Open Geospatial Consortium/AIP Phase 3
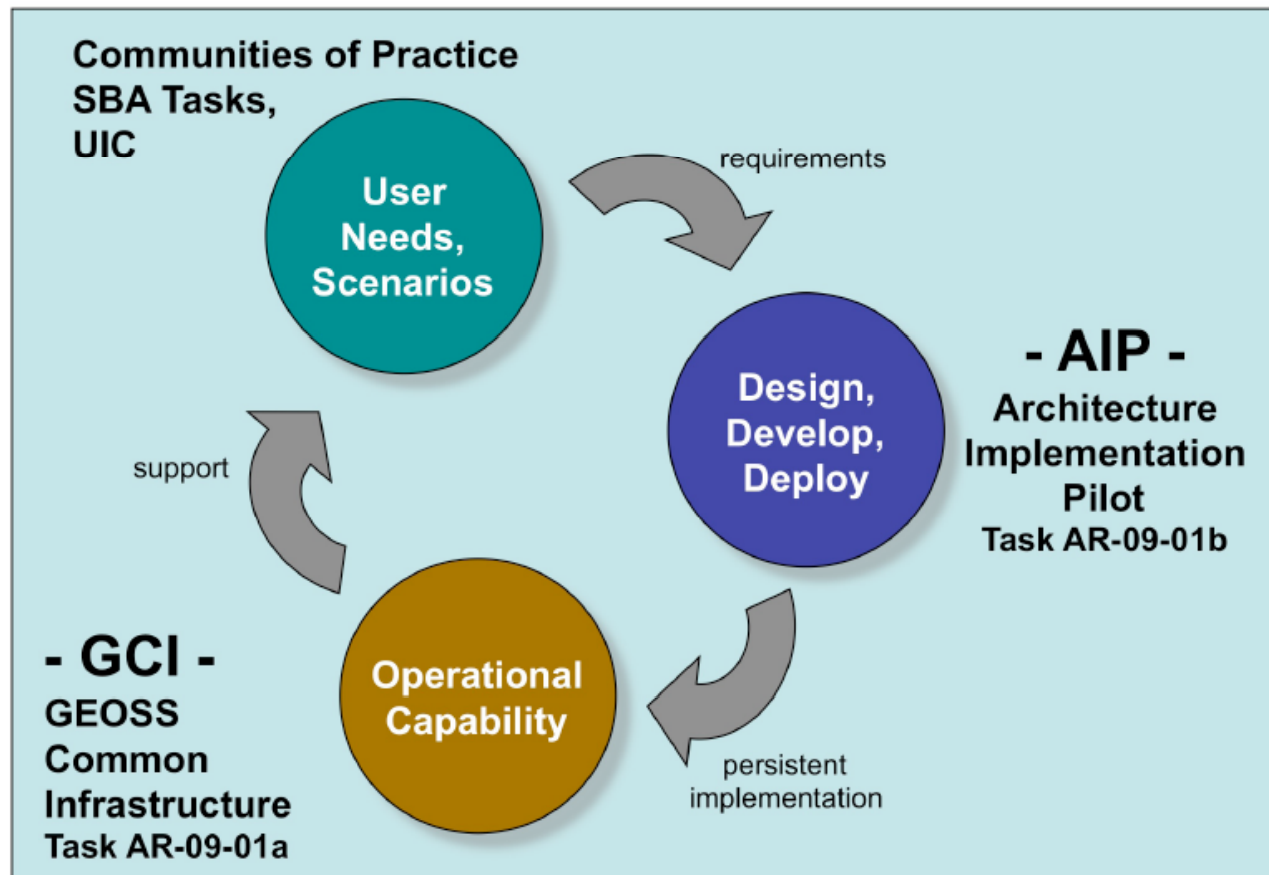
Figure 1 – AIP Context in GEO Tasks

Discussion and Organization Steps

Phase 1: Analyze Requirements
(derived from sensor application users and sensor devices inc. already-deployed SN)

Phase 2: Grand Design
(discuss sustainable architecture and arrange challenging issues)

Phase 3: Sub Working Group (each for issues/domains)

Metadata/API	Resource mgmt.	Data mgmt.	Etc...

Phase 4: Implementation & Deployment
(develop federated framework and SNs, deploy, maintain...)

feedback

* Estimated 4 years to accomplish

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AOB: Next APAN meeting etc.

- Proceedings of the APAN 30th Meeting
  - Speakers today have rights to submit your papers
    - http://www.apan.net/meetings/Hanoi2010/30th_APAN_Call_for_Papers.php
- Future meetings
  - APRICOT-APAN 2011 (3rd meeting)
    - http://www.apricot-apan.asia/
    - 1 Group Meeting, 2 Workshop Sessions ??
  - Should have 2nd core or small meeting by the next APAN?
- Collaboration means
  - Prepare wiki-based web site (postponed)
  - Please join our SensNet ML and discuss in details
    - http://www.apan.net/wg/sensor.php

Conclusion

- Our WG should:
  - Focus on resource management, data management, and deployment to realize low-cost federation of tiny sensor networks
    - ➔ Proposed "Grand Design" will be a good starting point to discuss the federated framework
  - Extract requirements of AG-WG for SNs for supporting crucial sensor network applications in Asia-Pacific region
    - ➔ Will have a joint-session as Workshop Session 2

Let's move on to the next talk…

2nd part of Group Meeting

DESIGN ISSUES IN GLOBAL SENSOR DATA SHARING (EUI-NAM HUH)

Workshop Session 2

CONCLUDING REMARKS OF 2ND MEETING

a) Group Meeting

- WG Activity Discussion
  - Share backgrounds and policy of our activities
  - Arrangement of challenging issues and its scope
  - Future Plan
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2. Invited talk: Application development environment of Sensor Service GRID (Kiyoshi Honda, Asian Institute of Technology, Thailand)

3. Invited talk: Data Integration and Analysis System(DIAS) and Sensor Network for Agriculture (Kiura Takuji, NARO, Japan, et al.)

- Concluding Remarks (Susumu Takeuchi)

FYI: Related Sessions

- ## 09:00-10:30, August 11 (Wednesday)
  - e-Research Area Discussion
    - Agriculture WG and Natural Resource WG will be integrated as e-Research WG

- ## 09:00-12:30, August 13 (Friday)
  - Agriculture WG
    - Relationship between ICT and agriculture will be discussed

Proc. and Future Meetings

- Proceedings of the APAN 30th Meeting
  - Speakers today have rights to submit your papers
- Future meetings
  - 2nd Core should be planned by the next APAN
    - Discuss the approach for the next APAN meeting and allocate responsibility each for nation
  - APRICOT-APAN 2011 (3rd meeting)
    - http://www.apricot-apan.asia/
    - 2 Group Meetings, 1 Workshop Session
      - In the Group Meetings, we have to divide discussions into small groups, and share at the end of the Group Meetings.

Call for Participation

- Collaboration means
  - Prepare wiki-based web site
    - Due to the graduation of the responsible student, the plan is postponed… a volunteer is required ☺
  - Please join our SensNet ML
    - http://www.apan.net/wg/sensor.php
    - We will announce the further meetings or discussions.
    - If you would like to contribute our WG, please join it and attend the further discussions!!

APRICOT-APAN 2011
www.apricot-apan.asia

APRICOT-APAN 2011
WWW.APRICOT-APAN.ASIA

Main Conference: 21-25 Feb, 2011
Workshop: 15-19 Feb, 2011

Hong Kong Convention and Exhibition Centre

THANK YOU FOR JOINING TODAY!
SEE YOU IN HONG KONG!