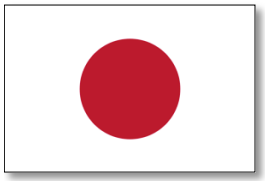

NerveNet

A Regional-Area Self-Dependent Network System Providing Resilient and Secured Local Information Sharing and Communications For Empowering ASEAN

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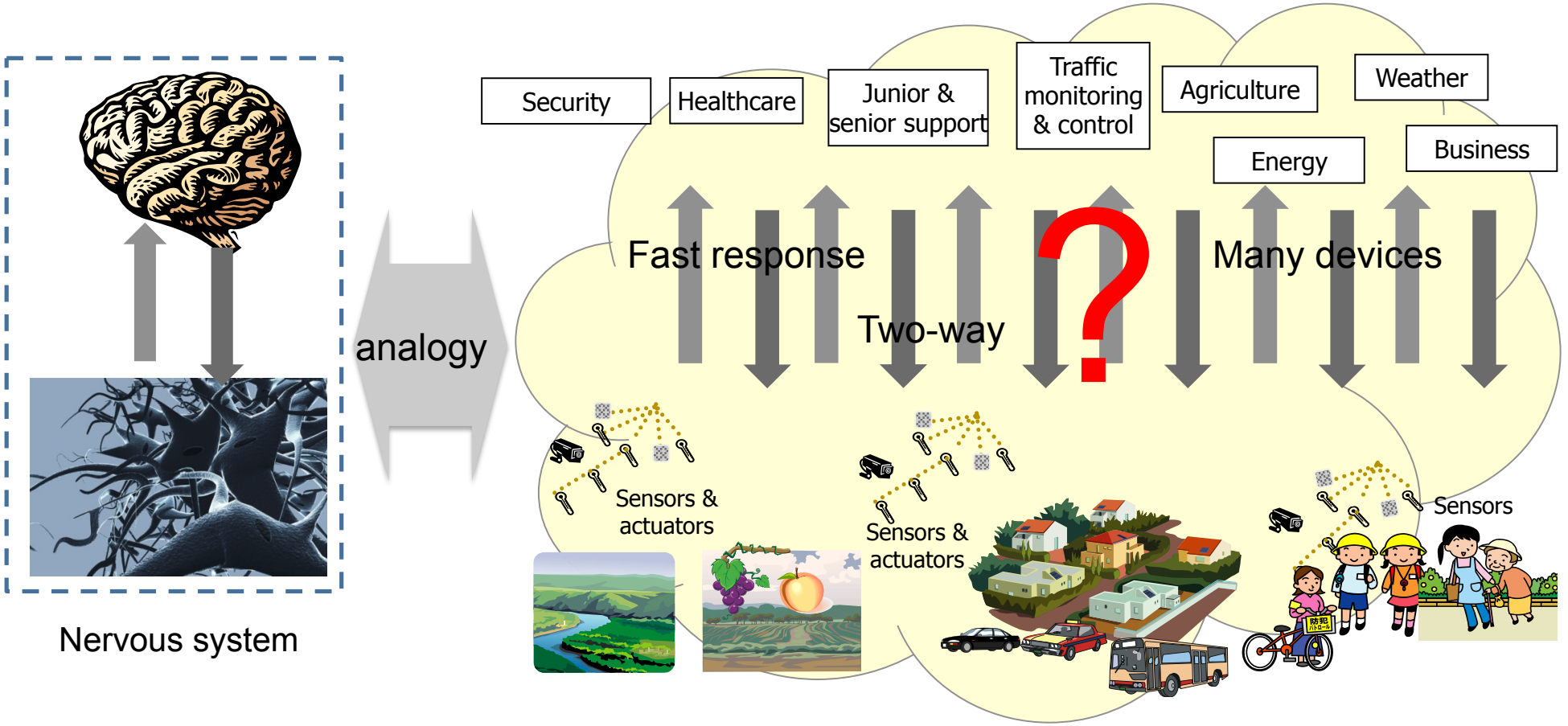
Concept of NerveNet Created in 2006

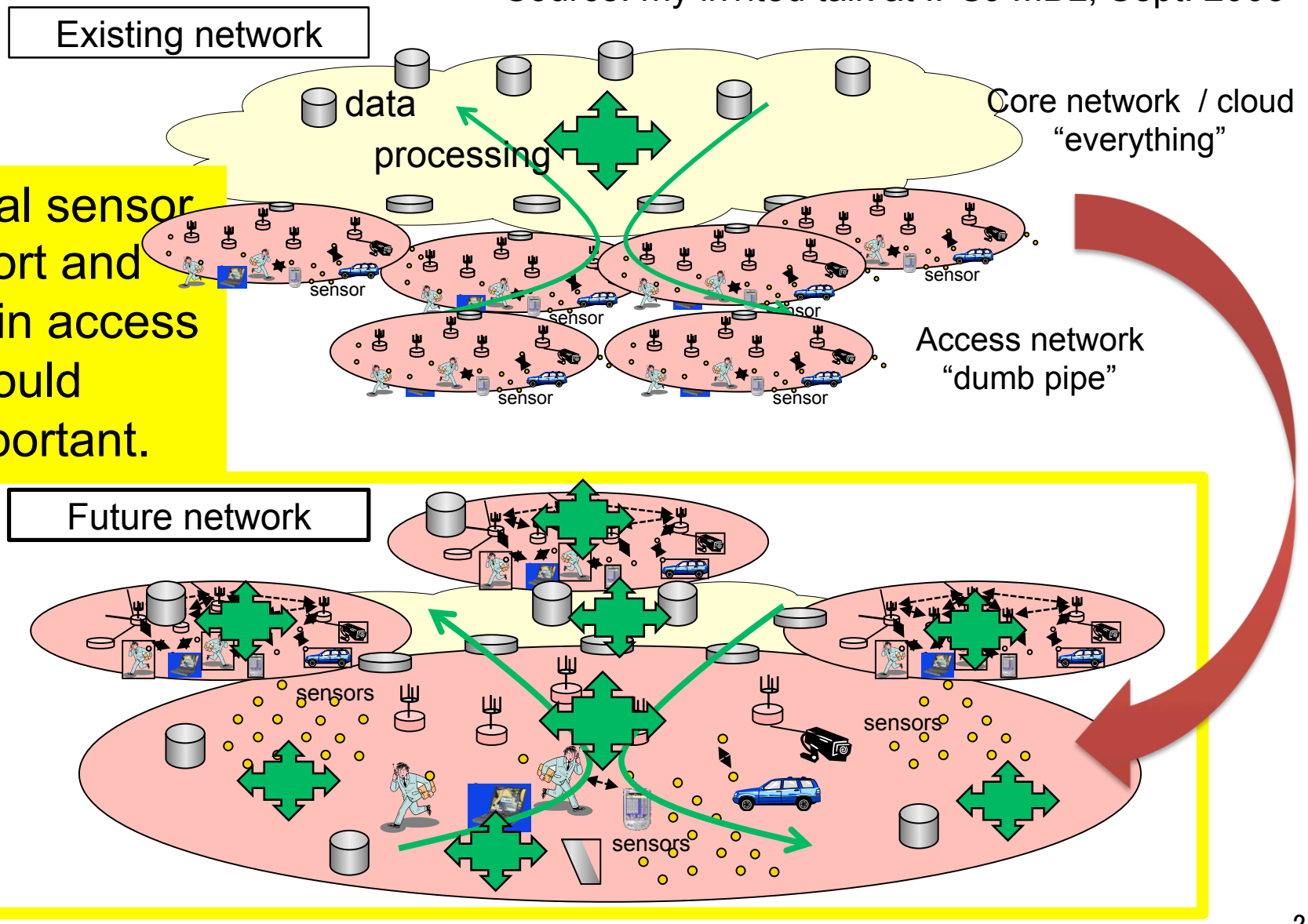
- Access network platform of Future Internet, IoT, and M2M
- Provides context-aware services with use of sensors and actuators
- Analogy to the nervous system of the human beings



Trend: From Core to Edge

Source: my invited talk at IPSJ MBL, Sept. 2008

Efficient local sensor data transport and processing in access networks would become important.



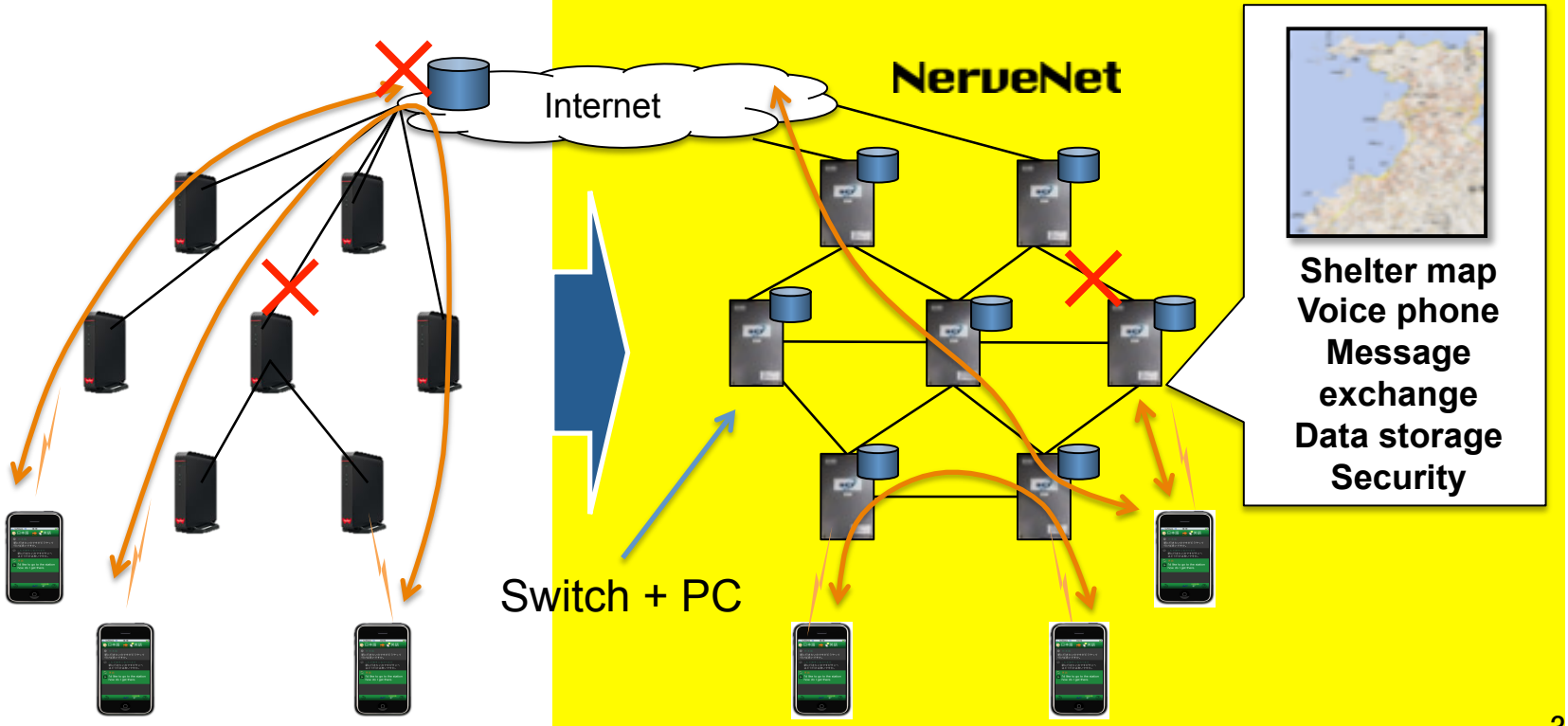
Key Points: Mesh and Distributed

Existing Networks

- Weakness in “networking” because of “tree-topology”:
- Weakness in “service” because of client/server (P2P) architecture:

NerveNet

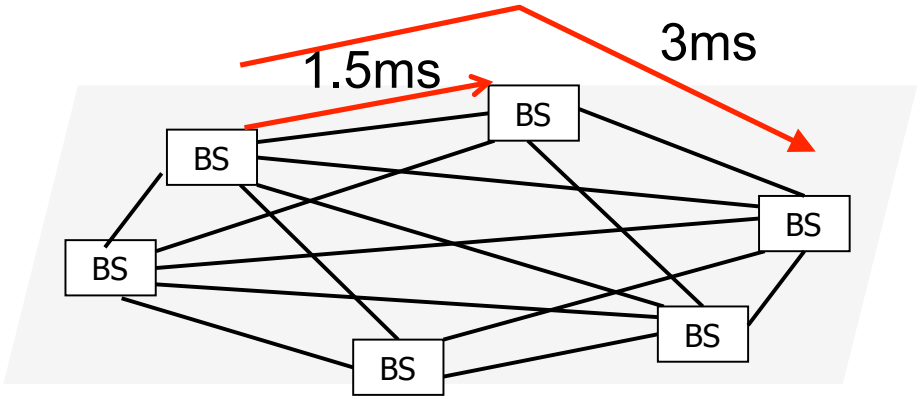
- Mesh-topology: resilient to failures by switching communications on a failed route to another.
- Distributed and in-server architecture: each BS has a DB and service functions such as security, and voice call, and works together, providing services even if disconnected from the Internet.



Basic Performances

Hop Delay

1.5 msec / hop

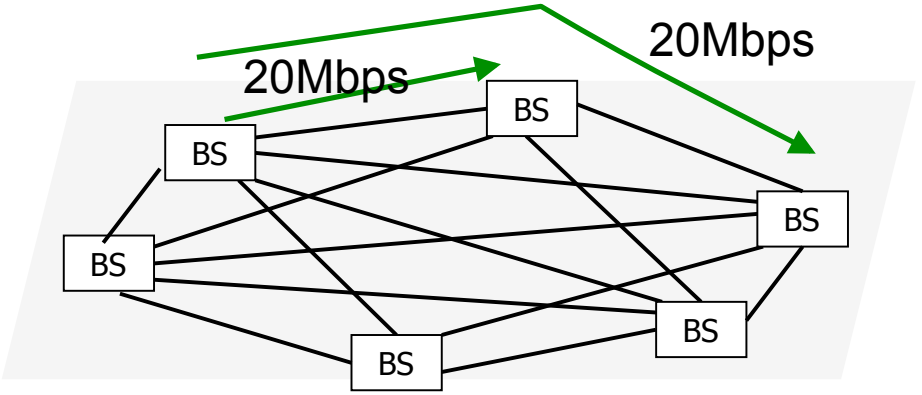


Multihop Throughput

TCP: 20 Mbps

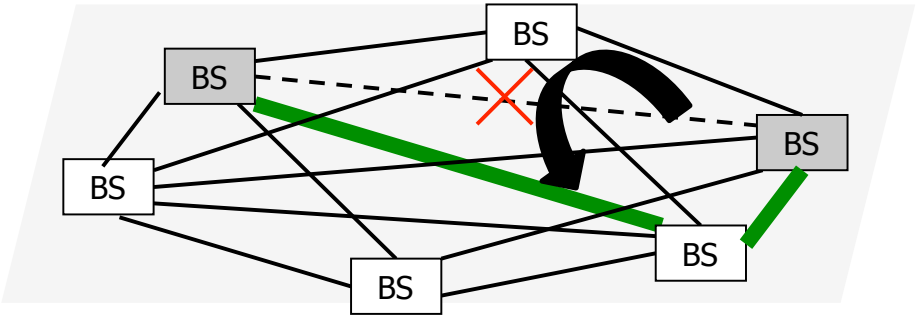
UDP: 25 Mbps

(Physical rate: 48 Mbps)

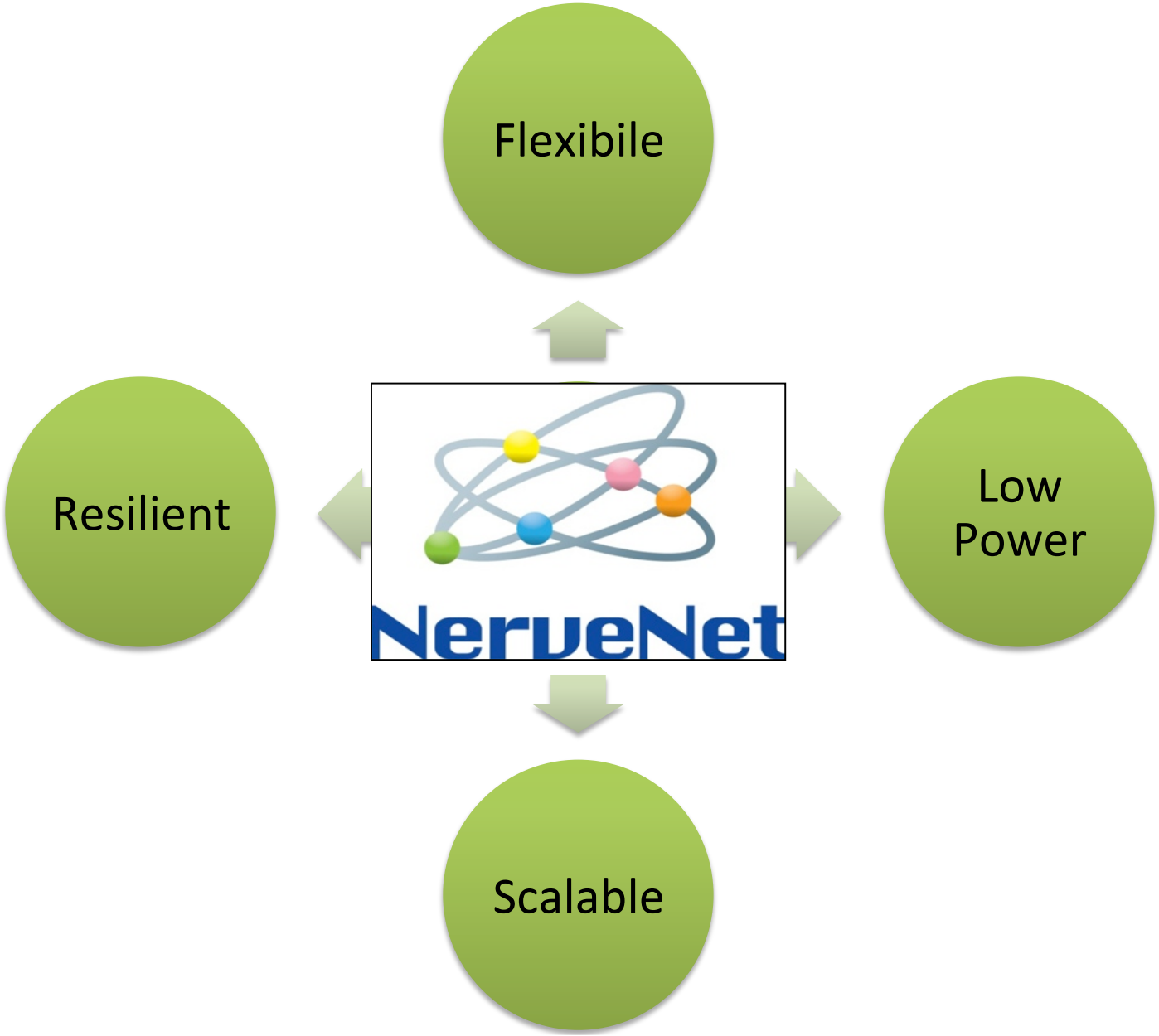


Route Switching Speed

150 msec



Four Features



Flexibility

"Switching" *"Transmission"* *"Switching"*

Portable

Outdoor

Indoor

Satellite

UAV

FWA

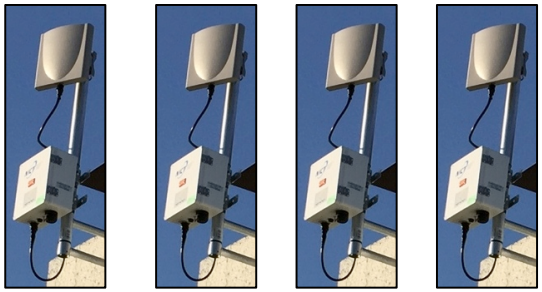
TVWS

Wi-Fi

Optical fiber

Ethernet frame ⟷ Ethernet, CATV ⟷ Ethernet frame

Low Power: Off-Grid Operation

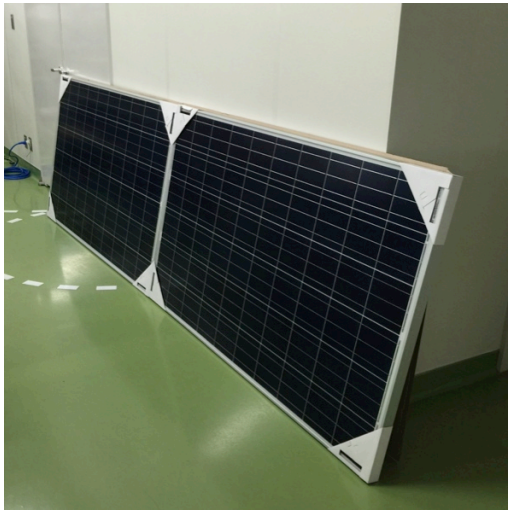


Transmission systems
25 Watt in total

25 Watt

50 Watt

32 - hour continuous operation even if no sun light

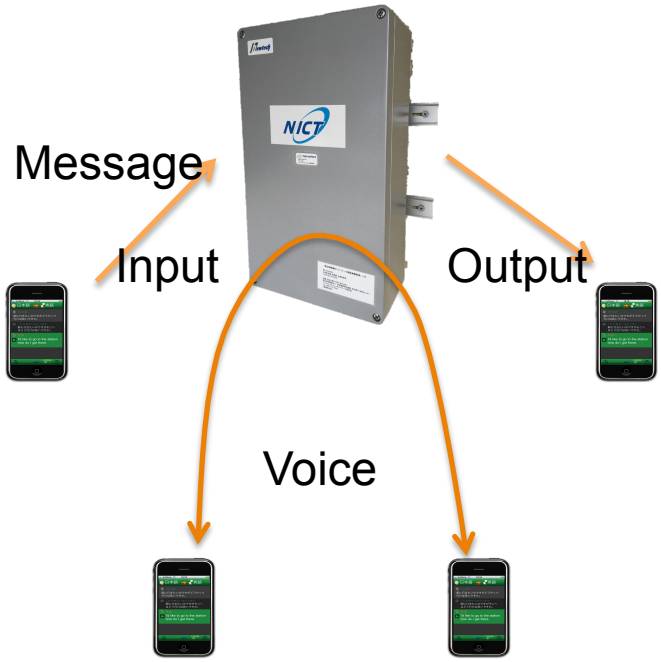


Solar panel (500Watt)

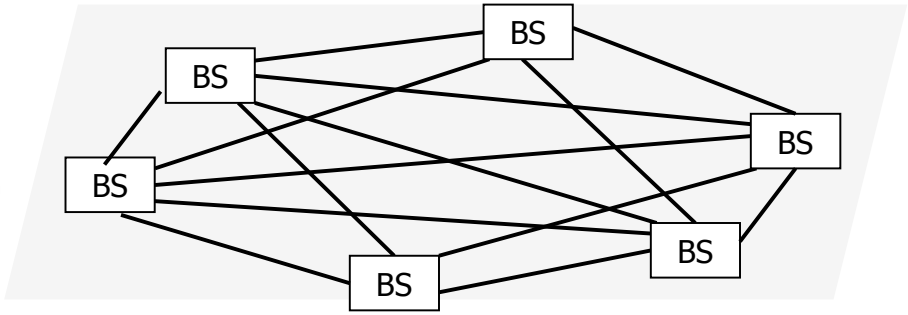
Controller including battery (2kVA)

Scalability

Single Operation

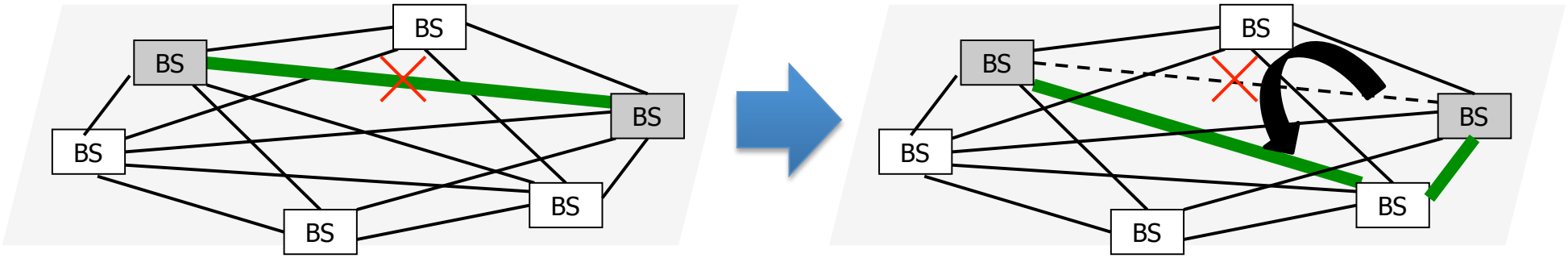


Area Operation
Up to 100 BSs

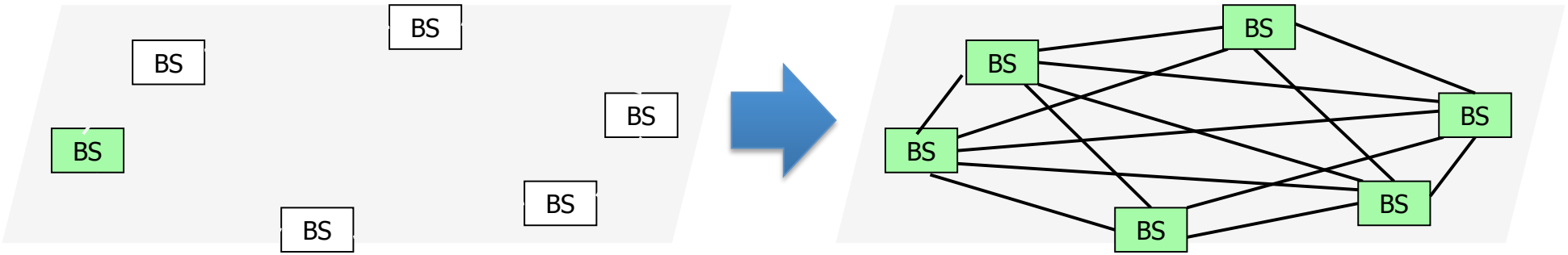


Resiliency

Auto and Fast Route Switching



Auto Restart without Manual Re-Configuration



Distributed Data Management

Distributed data management layer

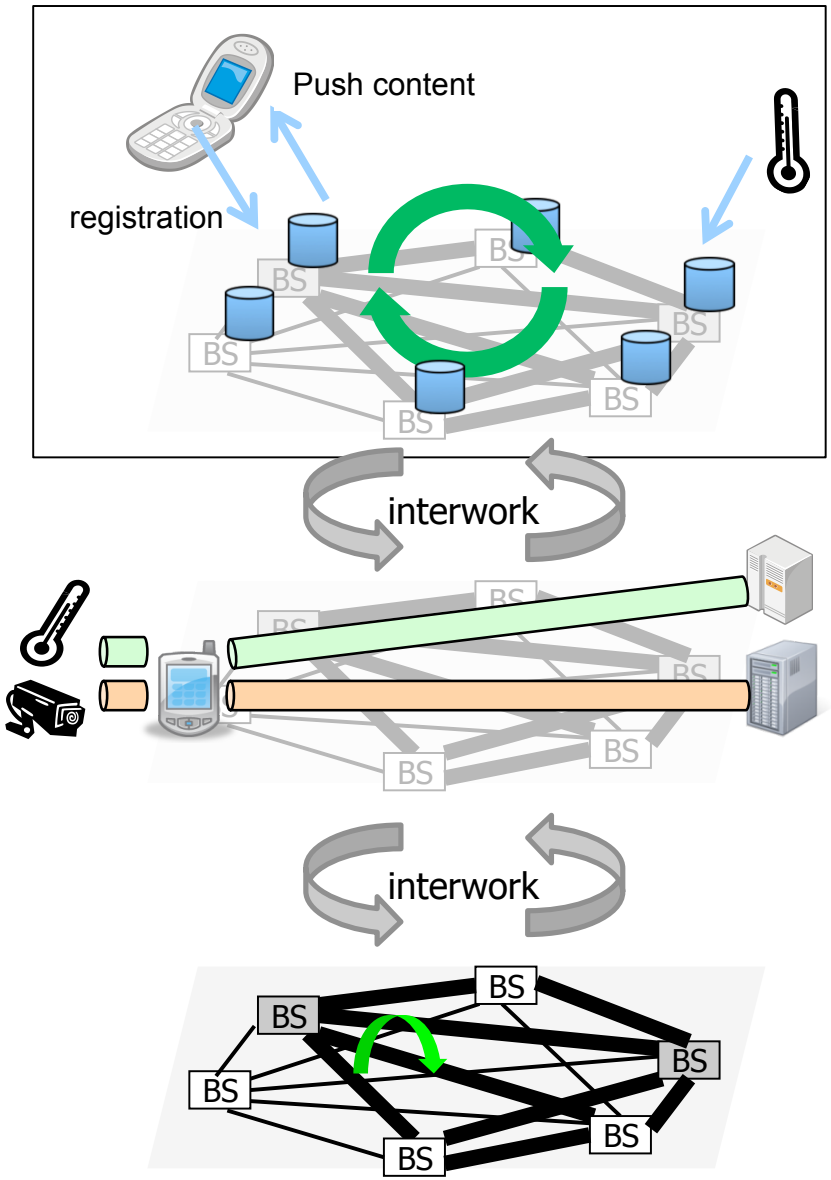
- Database and processing in each BS
  - Control & Management
  - Data Sharing

Communication control and management layer

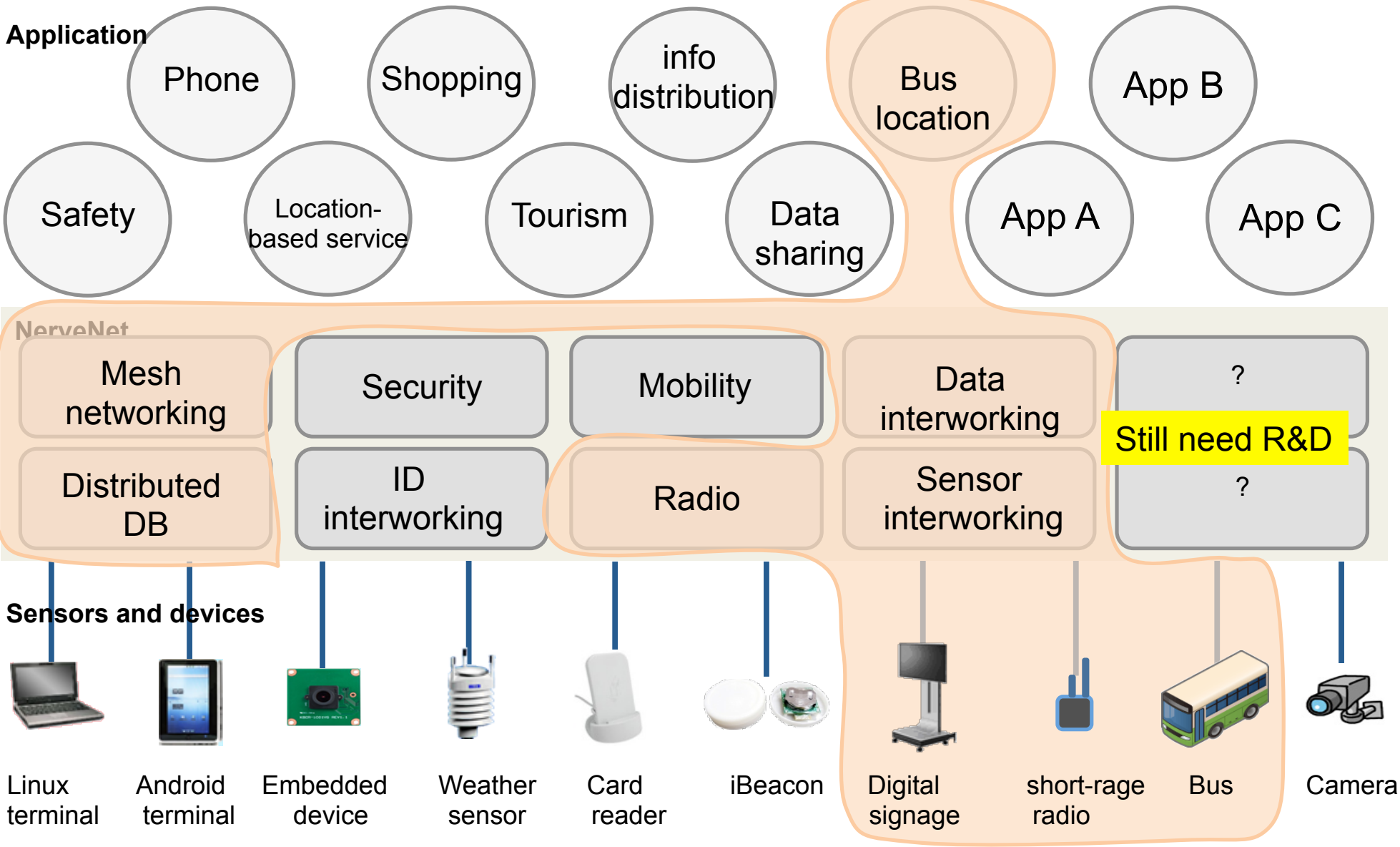
- Assign dedicated tunnel for communication
- Access authentication

Transmission layer

- Configure multiple logical routes
- Fast switching in a distributed manner



Different View of NerveNet As a Platform

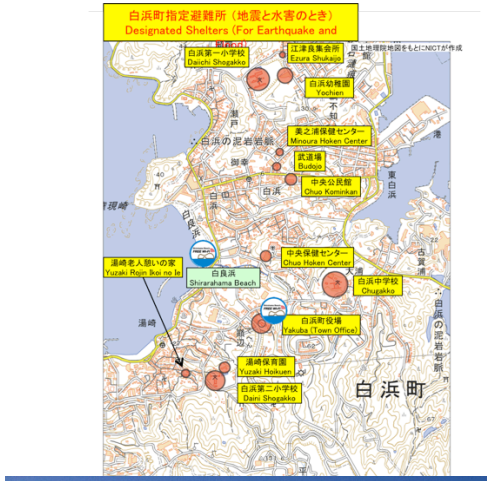


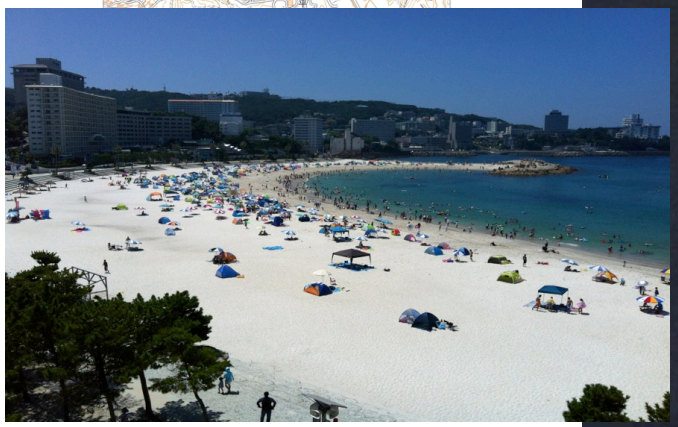
An Integrated SYSTEM or PLATFORM

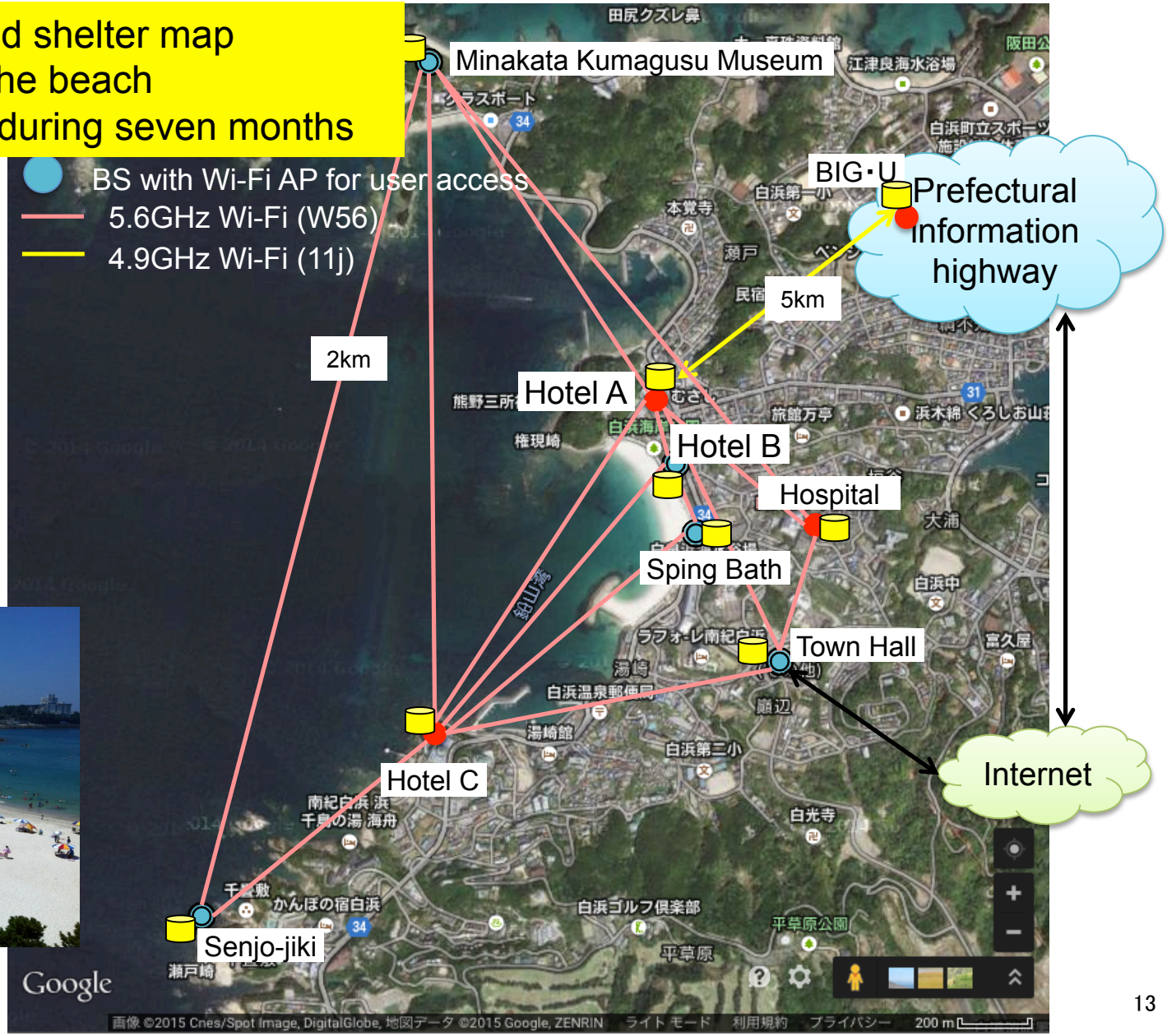
Function	NerveNet	Wi-Fi	Wireles Mesh	ZigBee	FWA	Intranet	Radius/ LDAP	VOIP	IP-VPN	Firewall
Mgmt from remote	○	○	△	△		○				
Auto configuration	○		○	○						
Auto restart	○		○	○	△					
Broadband	○	△			○	○				
Wire and wireless	○					○				
Firewall	○						△			○
Multi-ID mgmt / authentication	○	○					○			△
Path assign (SIP)	○							○		
IP VPN (secure encryption)	○								○	
L2 VPN (VLAN tunnel)	○		△		△	○				
Device-to-device	○									
Data sharing b/w basestations	○									
Data sharing b/w devices	○			△						
Apps	○			△				○	△	
Initial cost / BS in USD	15000	5000-	10000	500-	15000-	50000-	50000-	50000-	2000-	40000-

Field Test in Shirahama Town of Wakayama Pref. in Japan
Disaster Prevention and Internet for Tourists

- 9 BSs, providing localized shelter map
- 4 Wi-Fi areas including the beach
- Registered Users: 4000 during seven months



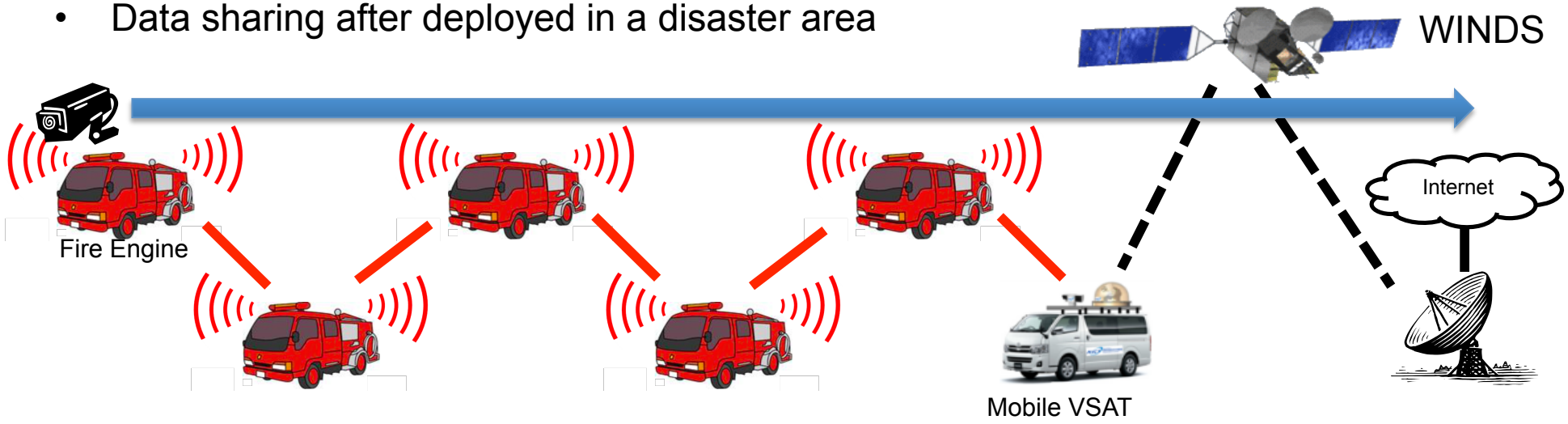




Inter-Vehicle Video Transmission

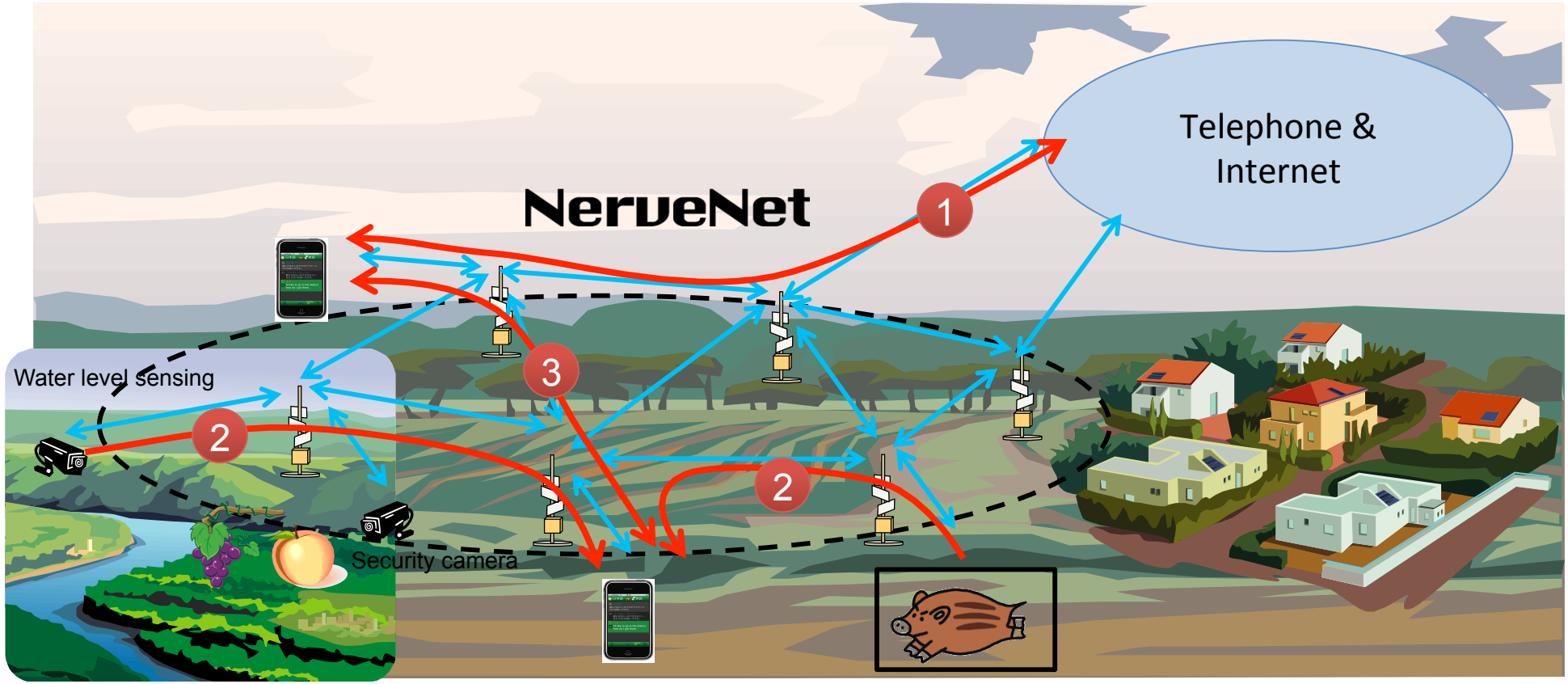
10Mbps high-resolution video transmission over 10 vehicles and the satellite link

- Data sharing while moving
- Data sharing after deployed in a disaster area



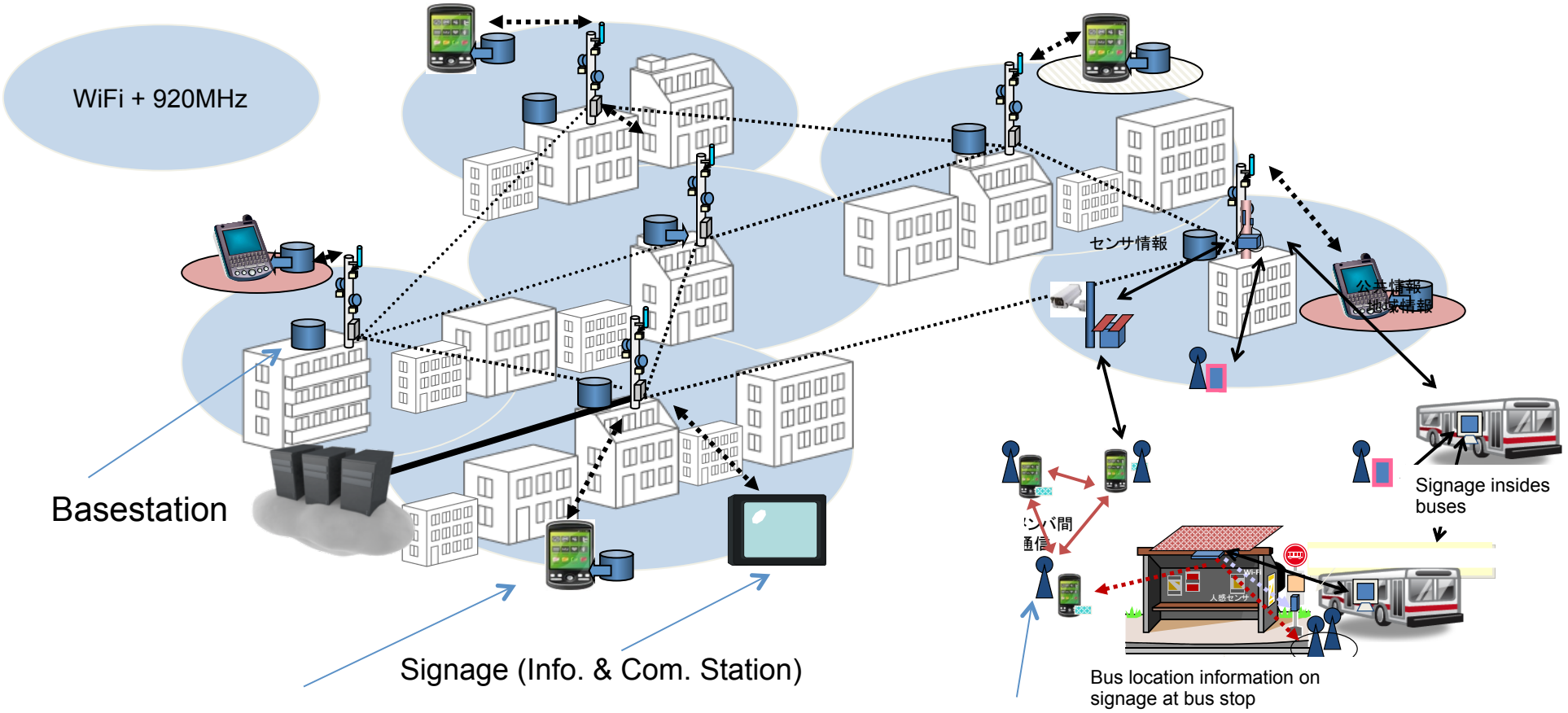
Use Cases in Rural Area

1. Universal access (a solution for USO in Cambodia, Indonesia…)
2. Land security and adhoc network after disaster (for Indonesia and Philippines)
3. Local communications (for ASEAN)
4. Inter-island network (for Indonesia, Philippines, and Malaysia)



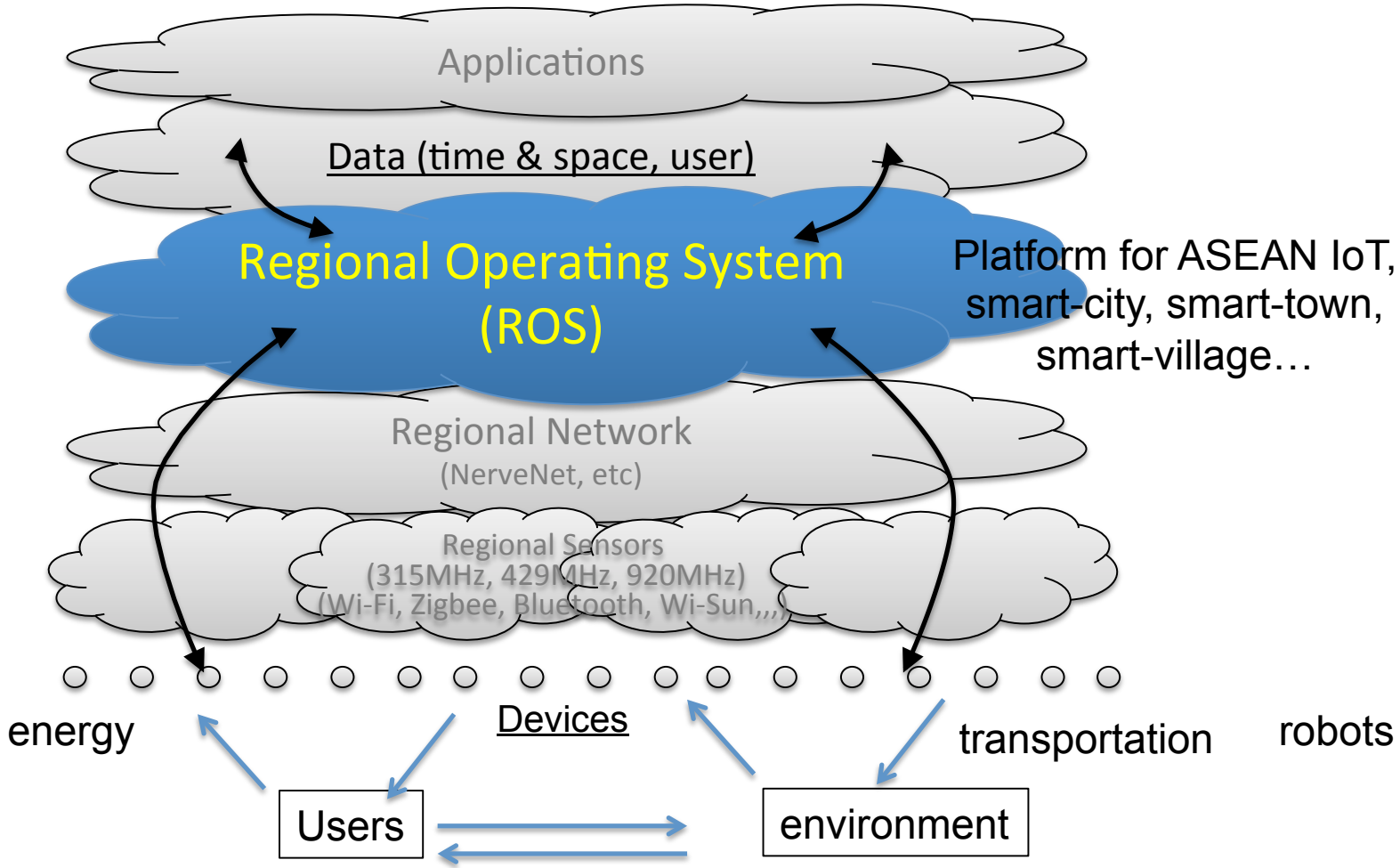
Use Cases in Urban Area

Regional or Dedicated, Resilient, Secure Intra-Network
Campus, Enterprise, Sensing and Actuation, Digital Signage,
Smart Grid (Energy Information Network)



Future Research Direction
- Towards Regional Operating System (ROS) -

- Operates and manages social infrastructures using social Bigdata to provide social services in an automatic and efficient way



NerveNet

- A regional-area network for resilient local information sharing and communications without the use of the Internet in emergency situations.
- Provides packet transmission and applications using distributed database among all the basestations over a mesh network.
- Tolerant to link disconnections and system failures and likely to continue providing applications compared with existing Internet-depend, tree-topological network systems

- Provides efficient, low-latency, local sensor data transport in the context of sensor network, IoT, and M2M
- Could provide multiple-point-to-multiple-point communications more efficiently than existing networks, contributing to realize a true IoT or M2M world.