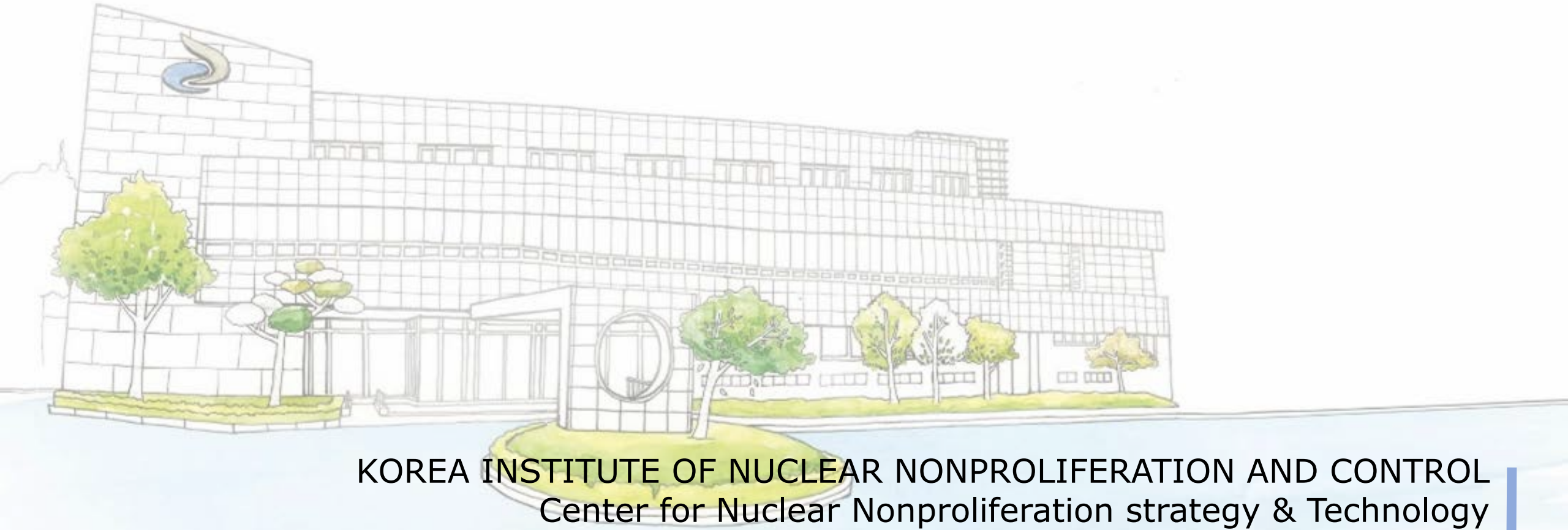
A Study on Decentralized Mobile Wireless Network in Restricted Areas for Denuclearization



KOREA INSTITUTE OF NUCLEAR NONPROLIFERATION AND CONTROL
Center for Nuclear Nonproliferation strategy & Technology
DongYeong Kim

Contents

1. Introduction

- For verifying a denuclearization, the radiation dose and the sample collection should be assessed in the reported or suspected area.
- However, infrastructure such as power or communication is often insufficient or absent.
- Therefore, in order to verify denuclearization, it is necessary to secure its own power grid or communication network.
- We proposed a communication network that is based on the partial decentralized mobile closed network.
- Also, in this result, the performance of the developed device was evaluated using a number of equipment in order to verify the effectiveness of the developed equipment.

1. Introduction

❖ In order to use the communication network in a closed country such as North Korea, the following must be considered.

- ❑ Network bandwidth

  How much data can be transmitted/received while various devices are connected to the network.

- ❑ Security

  Scans all connected addresses to determine the network configuration.

- ❑ Scalability

  In the network, scalability is the property of a system to handle a growing amount of work by adding resources to the system.

- ❑ Coverage

  The coverage of wireless network is the geographic area where the station can communicate.

- ❑ Electric power supply

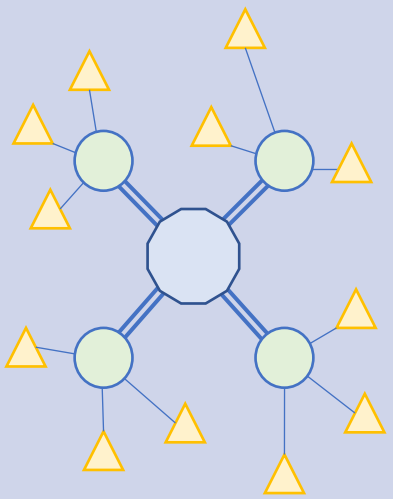
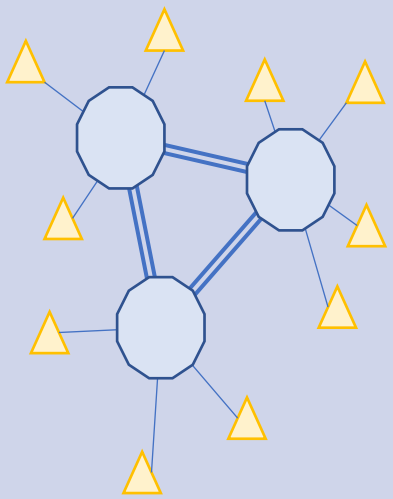
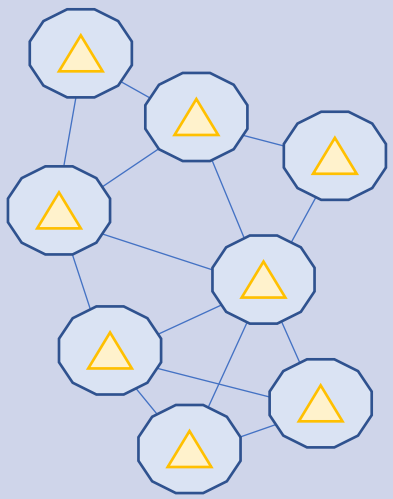
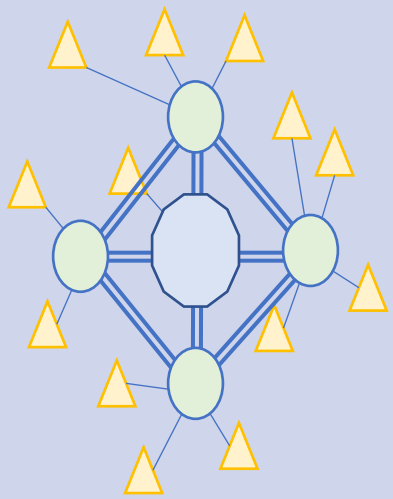
  Sufficient power supply

- ❑ Facility

  Anyone must easily install/establish and operate a communication network.

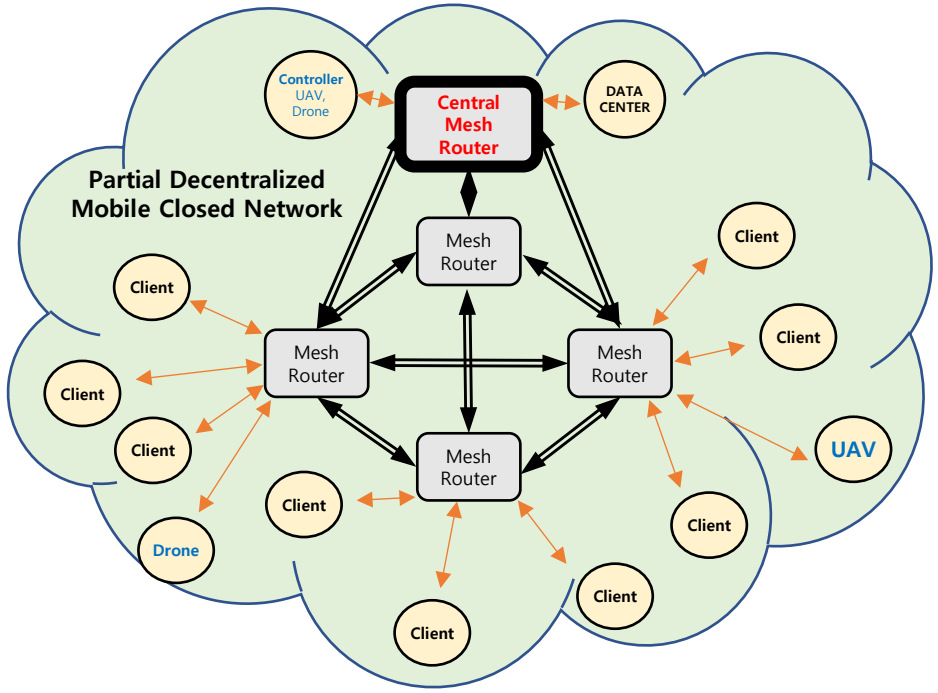
2. Structure and Hardware for the Network

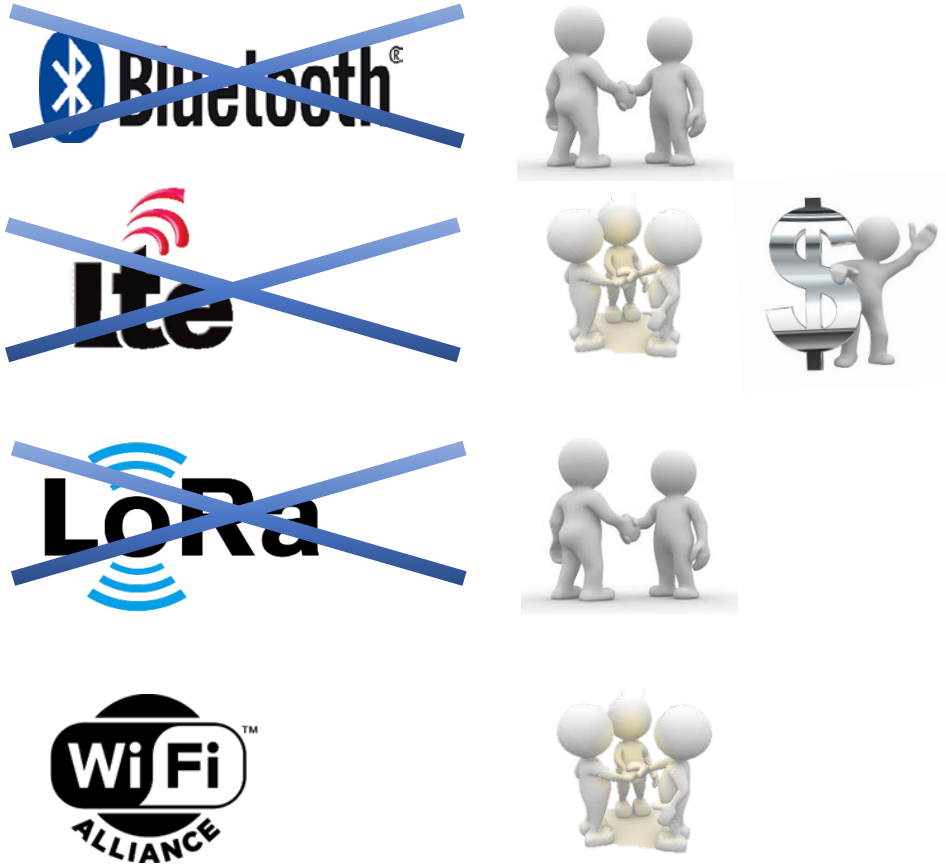
❖ Typical Network

	Centralized Network	Decentralized Network	Distributed Network	Partial Decentralized Network
Band width	↑	↑	↓	↑
Security	↑	↓	↓↓	↑
Period of network check	Need	Often	Every time	Often
Scalability	↓	↑	↑↑	↑
Form				

2. Structure and Hardware for the Network

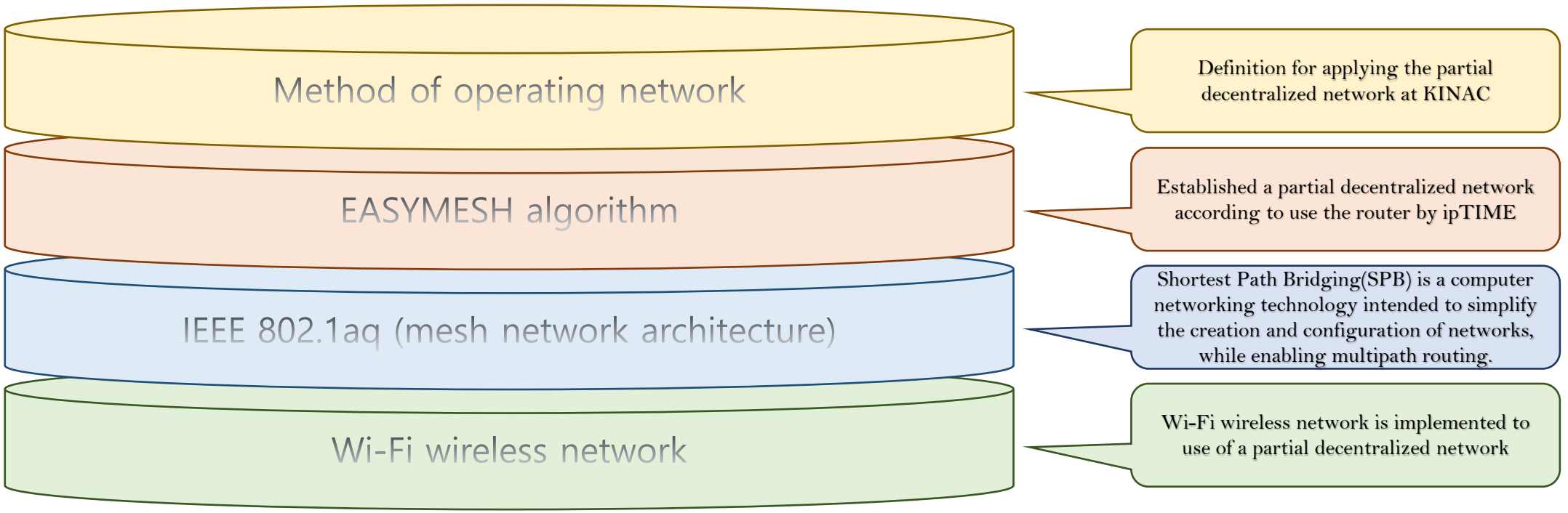
❖ Choose the wireless network





2. Structure and Hardware for the Network

❖ Partial Decentralized Network



2. Structure and Hardware for the Network

❖ Hardware

Central Mesh Router
iptime A9004M

Mesh Router
iptime A3004NS-M

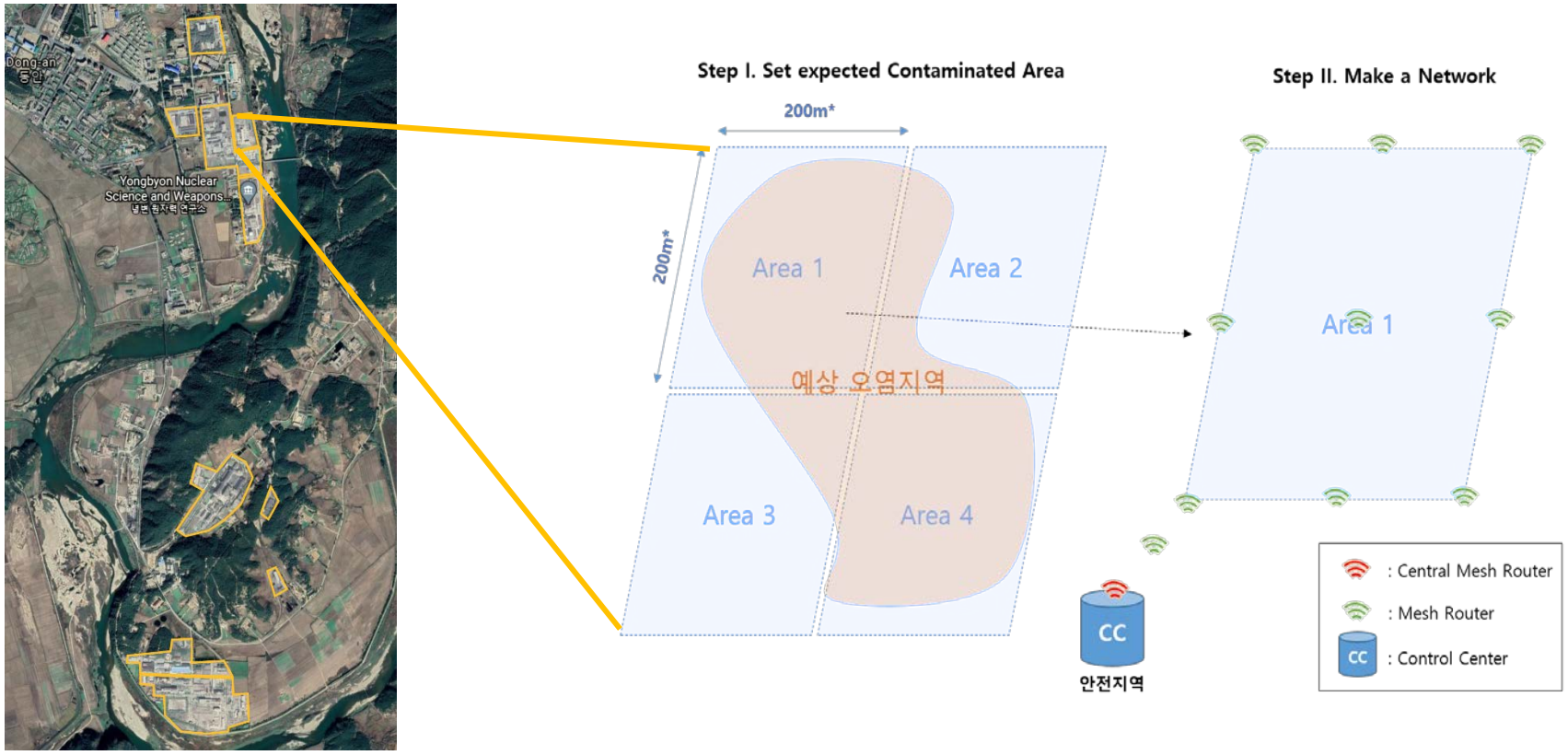
	ipTIME A9004M	ipTIME A3004NS-M
WLAN specification	IEEE 802.11ac	IEEE 802.11ac
EasyMesh	Full Mesh	Full Mesh
2.4 GHz Max. speed	800 Mbps	400 Mbps
5 GHz Max. speed	1733+1733 Mbps (Independent)	867 Mbps

Battery (30,000 mAh;
5V ~ 12V(3A~1.5A);
671 g)

3. Performance Test

❖ Prepare the performance test

❑ The scope of the communication network to be established



* Yong-byon Nuclear Science and Weapons

3. Performance Test

❖ Prepare the performance test

❑ The scope of the communication network to be established

➢ Nakdong River, Gimhae-si (500 m x 500 m)

3. Performance Test

❖ Performance test

- ❑ Is it possible to autonomously expand the wireless network?
- ❑ What is the speed between equipment in the open terrain?
- ❑ What is the field intensity according to the distance in the open terrain?
- ❑ How does the duration of the battery vary while connected to the network?

3. Performance Test

❖ Performance test

- ❑ Is it possible to autonomously expand the wireless network?
  - ➢ Scalability
- ❑ What is the speed between equipment in the open terrain?
- ❑ What is the field intensity according to the distance in the open terrain?
- ❑ How does the duration of the battery vary while connected to the network?

3. Performance Test

❖ Performance test

❑ Is it possible to autonomously expand the wireless network?

➢ Mesh network(form A to C) transmits and receives faster than individual network(A to B).

A-C Directly A-B-C Mesh connection

	Transmission (Mbps)	Reception (Mbps)
A – – – – C	1.5 ~ 8.0	0.3 ~ 1.4
A – – – – B	1.7 ~ 5.0	1.2 ~ 6.0
A – B – C	16.0 ~ 48.0	9.0 ~ 28.0

3. Performance Test

❖ Performance test

❑ We use a central mesh router and 12 mesh routers at 500 m by 500 m.

3. Performance Test

❖ Performance test

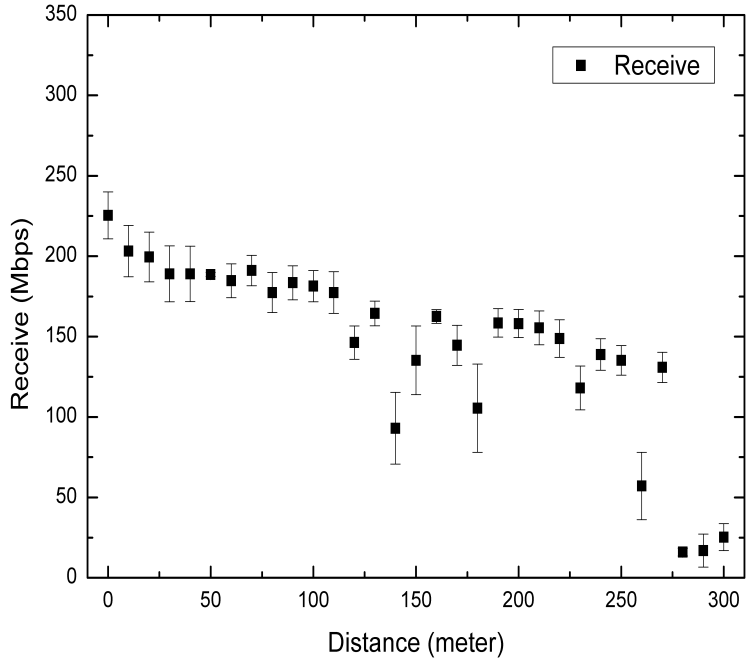
- ❑ Is it possible to autonomously expand the wireless network?
- ❑ What is the speed between equipment in the open terrain?
  - ➢ Band width
- ❑ What is the field intensity according to the distance in the open terrain?
- ❑ How does the duration of the battery vary while connected to the network?

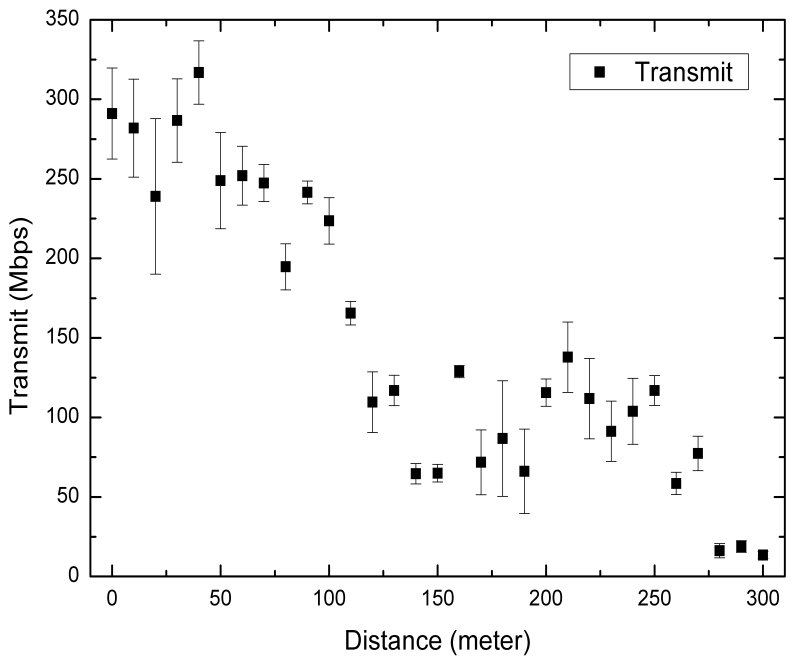
3. Performance Test

❖ Performance test

❑ What is the speed between equipment in the open terrain?

➢ In the range of 100 to 200 m, a large speed difference occurred due to environmental factors in the open terrain.

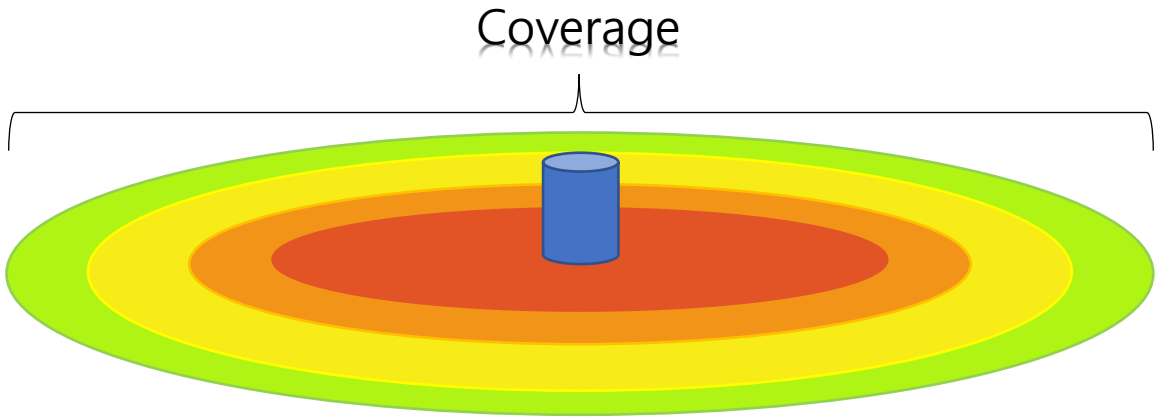




3. Performance Test

❖ Performance test

- ❑ Is it possible to autonomously expand the wireless network?
- ❑ What is the speed between equipment in the open terrain?
- ❑ What is the field intensity according to the distance in the open terrain?
  - ➢ Coverage
- ❑ How does the duration of the battery vary while connected to the network?



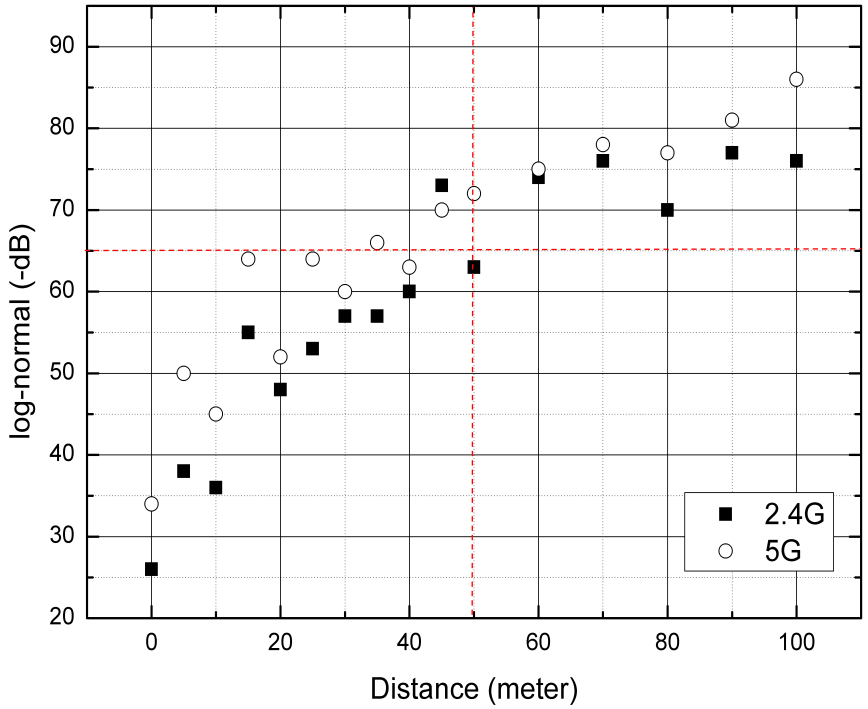
3. Performance Test

❖ Performance test

❑ What is the field intensity according to the distance in the open terrain?

➢ There is a point where the connection strength is significantly weakened, which is the criterion for adding a router.

➢ In the results, the distance between the router and client should not exceed 100 m(-80 dB) considering the field intensity in the figure.



3. Performance Test

❖ Performance test

- ❑ Is it possible to autonomously expand the wireless network?
- ❑ What is the speed between equipment in the open terrain?
- ❑ What is the field intensity according to the distance in the open terrain?
- ❑ How does the duration of the battery vary while connected to the network?
  - ➢ Electric power supply

3. Performance Test

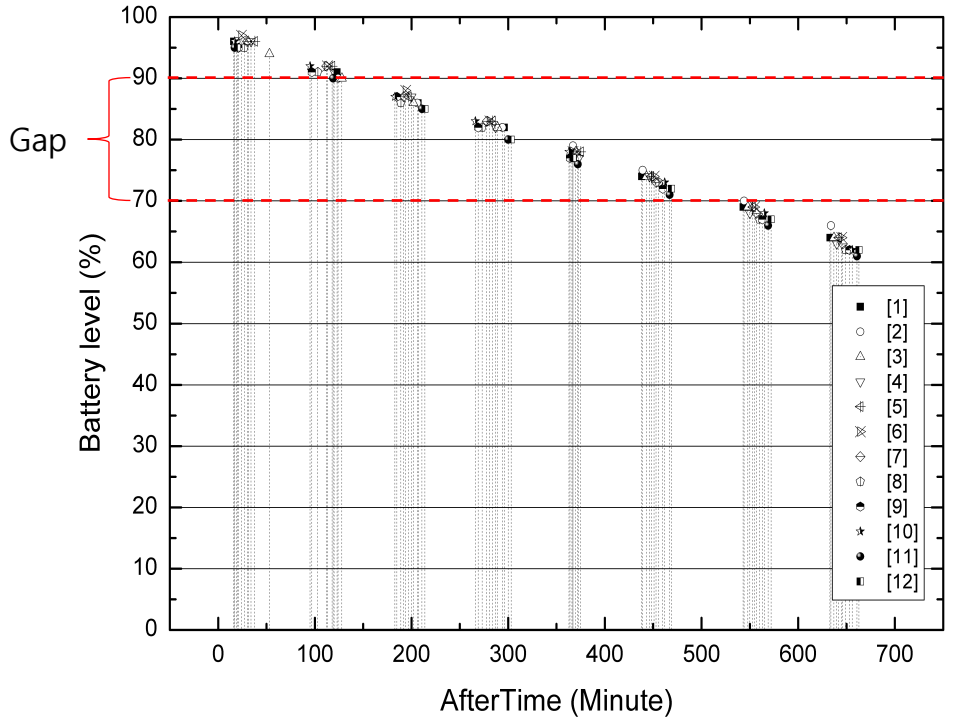
❖ Performance test

❑ How does the duration of the battery vary while connected to the network?

- ➢ Performance test : battery
- ➢ Observation of battery's variation during about 700 minute
- ➢ 90 % → 70 % (about 400 min)
- ➢ Result : Max. 2,000 min

*Duration may vary depending on the usage environment.

Battery (30,000 mAh;
5V ~ 12V(3A~1.5A);
671 g)



4. Conclusions

- When the denuclearization situation occurs, there is a high possibility that the target region will not be able to receive support for a variety of basic infrastructures such as electricity and communications etc.
- In this study, it aims to secure technology and development of equipment that can be quickly on figure an absent wireless network, in order to operate various wireless based equipment in unknown areas.
- In addition to denuclearization situation, scalability that can be used in various similar environments is secured.

Thank you