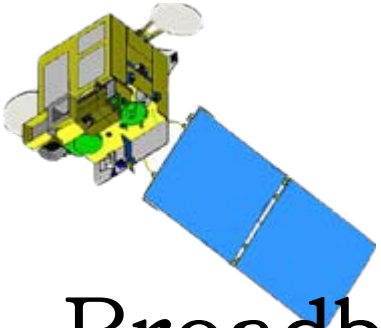


Broadband wireless applications for emergency communications

ITU/ESCAP Regional Workshop on Disaster Communications

2006. 12. 14

NamKyung LEE

Global Area Wireless Technology Research Group
Radio and Broadcasting Research Laboratory

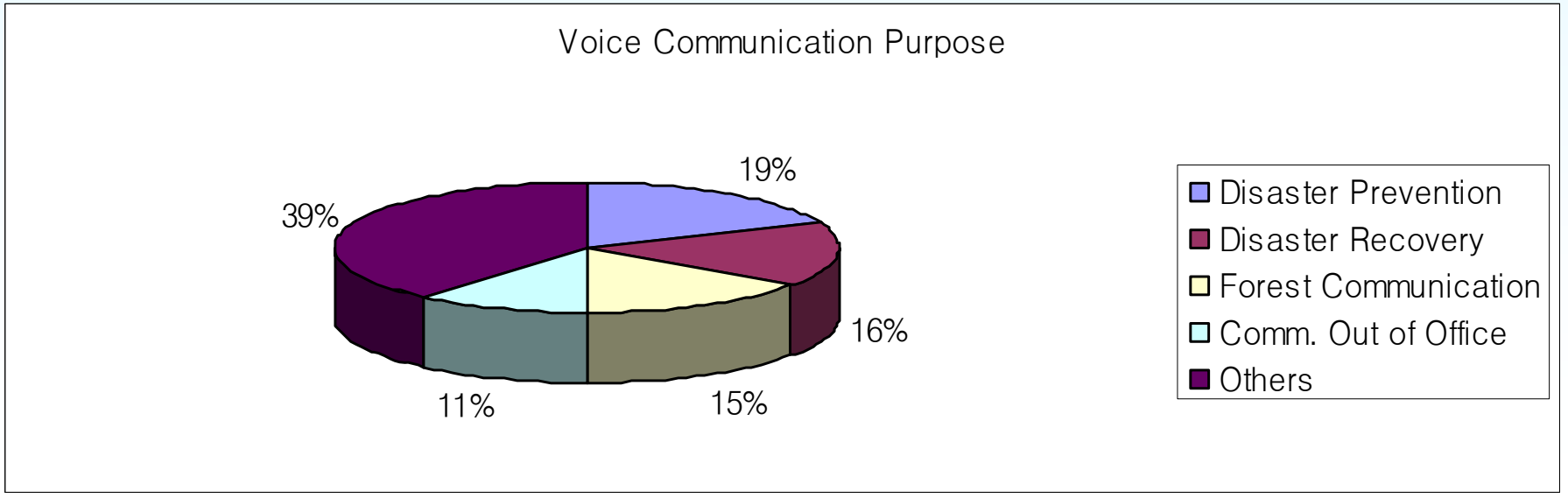
ETRI
Electronics and Telecommunications Research Institute

Contents

1. Overview

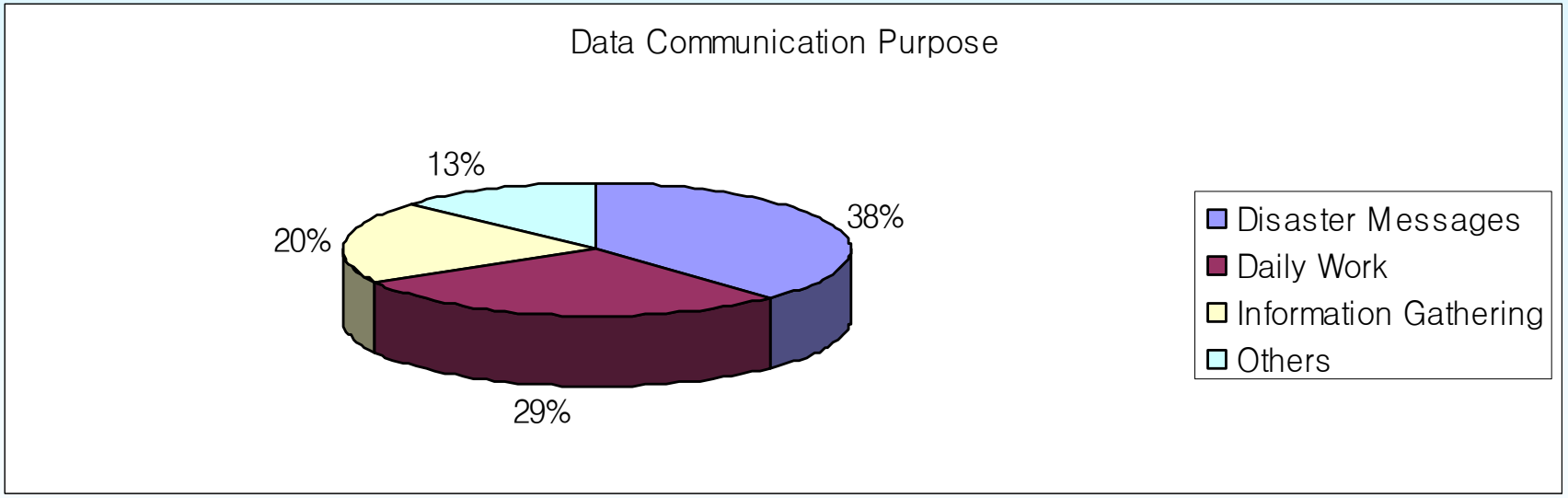
What are applications? (1/4)

- Ratio between Voice and Data = 60:40
- Ratio between Wire and Wireless = 60:40
- (This is the only ratio of number of systems, not bandwidth)
- (This is the only statistics in Korea, not world-wide)
- (But Data and Wireless are increasing)
- Voice Communication Purpose Applications



What are applications? (2/4)

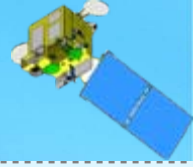
Data Communication Purpose Applications



- Others of voice comm. are emergency calls, railway, airport, ocean traffic management, poaching detection, parking management, …
- Others of data comm. are forest fire surveillance, railway, airport, quarantine, location tracking, …

  (variety of applications)

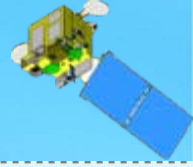
1. Overview



What are applications? (3/4)

- Korean police recently began a short data service such as criminal search using TETRA
  - Beginning of data service means data application will increase more in near future

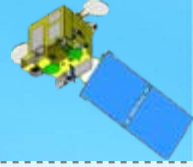
- MESA (broadband Mobility for Emergency and Safety Applications) Scenario
  - Day-by-Day: routine scenarios present in everyday life (like monitoring, surveillance…) that have high predictability and require an ordinary operational resources deployment (in terms of personnel and means allocated)
  - Emergency: specific events characterized by medium predictability (that imply the acknowledgement of factors of possible danger) and require additional operational resource deployment
  - Disaster: specific, unpredictable events that require extra-ordinary (national, international) operational resource deployment



What are applications? (4/4)

MESA Applications

- Criminal justice services: Automated criminal history and low enforcement records systems and providers
- Emergency management or disaster recovery agencies
- Health services: Emergency Medical Services (EMS), Disaster Medicine
- Fire services
- Land and natural resource management: Wildlife management
- Search and rescue activities
- Coast guard services
- Airport/stations/tube/… security
- Humanitarian assistance
- Hazardous materials and related public safety services
- Correctional institutions
- Transportation

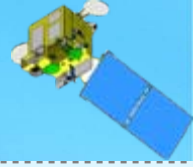


What are communication technologies? (1/6)

Satellite (in Korea)

- **Observation - KOMPSAT series (1/2/…), COMS (Communication, Oceanic and Meteorological Satellite)**
- **Communication**

Name	Frequency (GHz)	World-Wide	Korea
UHF	<1	Search And Rescue Military	- (DMB, …)
L	1~2	MSS, DMB, …	- (Cellular)
S	2~4	MSS, DMB, …	SDMB, …
C	4~8	Commercial, …	-
X	8~12	Military, Fixed and Mobile Communication, …	Koreasat5(Military)
Ku	12~18	Fixed Satellite Service, Mobile Satellite Service	Koreasat(2)/3/5 - DBS, DTH
K	18~27	Fixed Satellite Service, Mobile Satellite Service	Koreasat3 COMS (2008 Launch)
Ka	27~40		
V	40~75	Experimental	-



What are communication technologies? (2/6)

Terrestrial

- CDMA2000, GSM(GPRS, UMTS), …
- WiFi - 802.11, WiMAX – 802.16 (WiBro – 802.16e), MBWA (802.20)
- Bluetooth, UWB, ZigBee
- TETRA Release1(/2), Project25(/34), TETRAPOL, …

Broadcasting

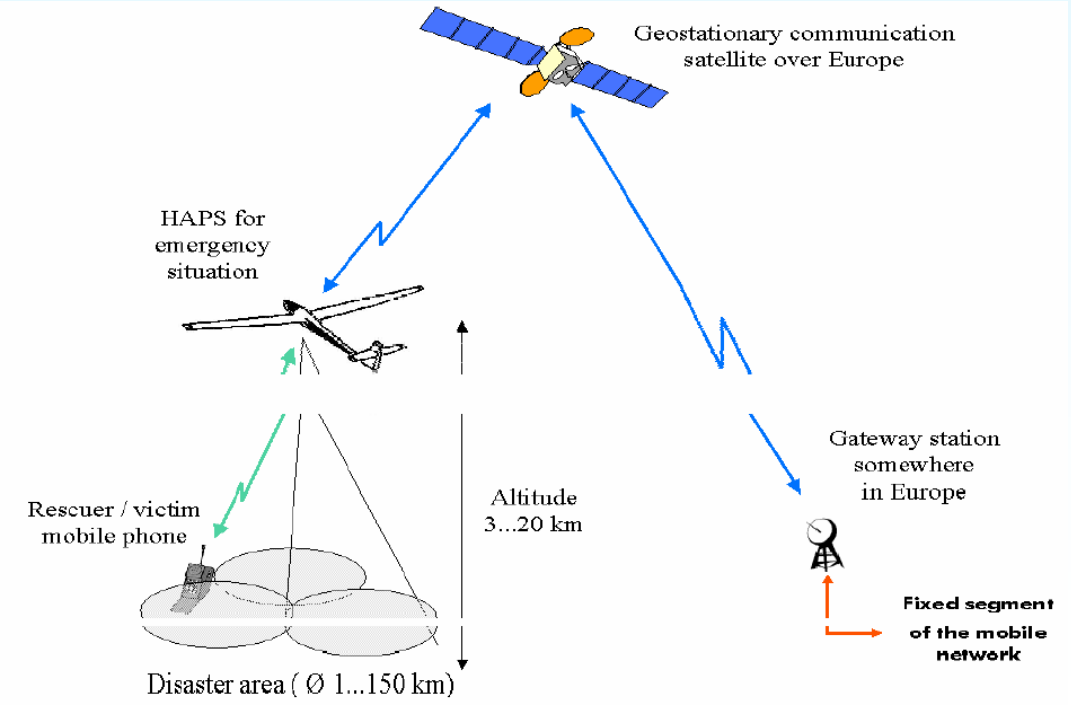
- Digital Video Broadcasting (Digital Multimedia Broadcasting in Korea)
- But not described more in this presentation

What are communication technologies? (3/6)

International Examples

CRIES (Communication Recovery In Emergency Situation)

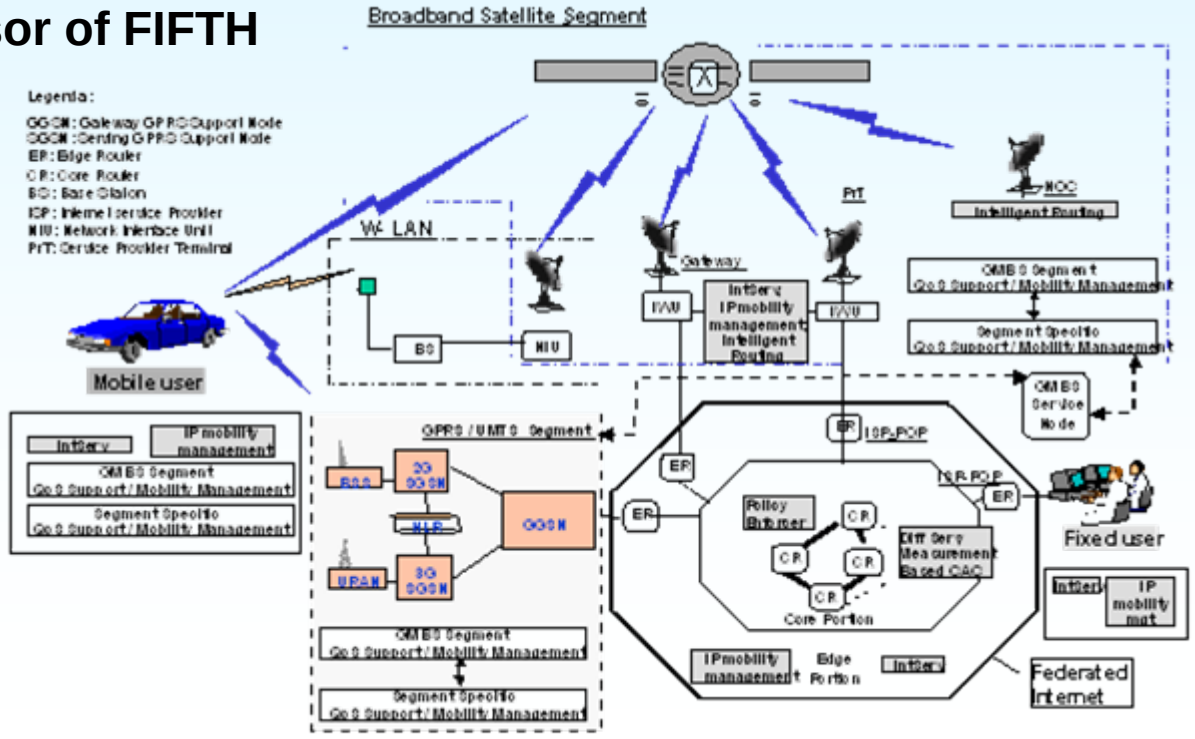
- CRIES (Communication Recovery In Emergency Situation): A satellite based system for communication recovery and monitoring in emergency situation and natural disaster, Jean-Didier Gayrard and Nicolas Chuberre, 2002,
- IMT2000



What are communication technologies? (4/6)

International Examples

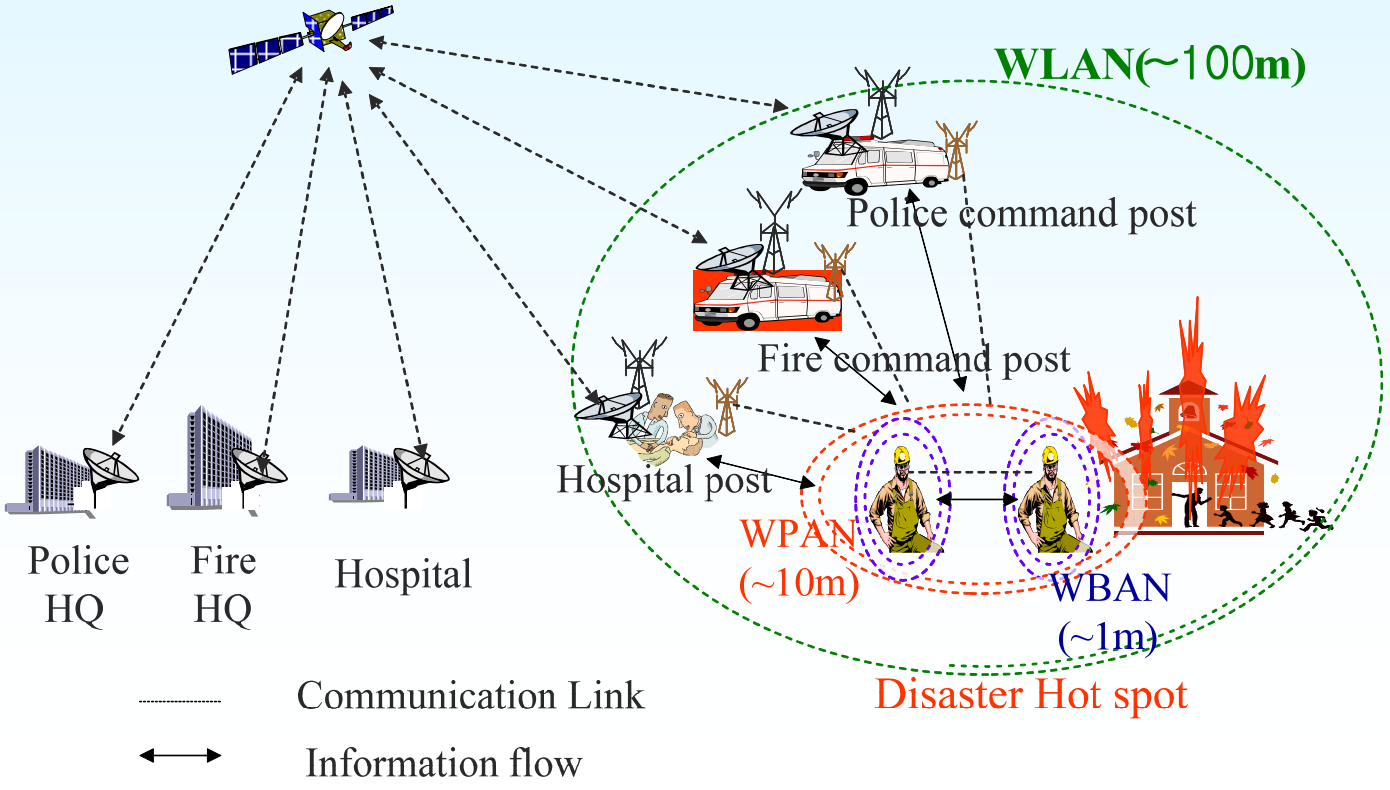
- **SUITED(multi-segment System for broadband Ubiquitous access to InTErnet services and Demonstrator)**
  - UMTS, GPRS, W-LAN, and Ka band Satellite
- **Predecessor of FIFTH**



What are communication technologies? (5/6)

International Examples

Using Wireless LAN

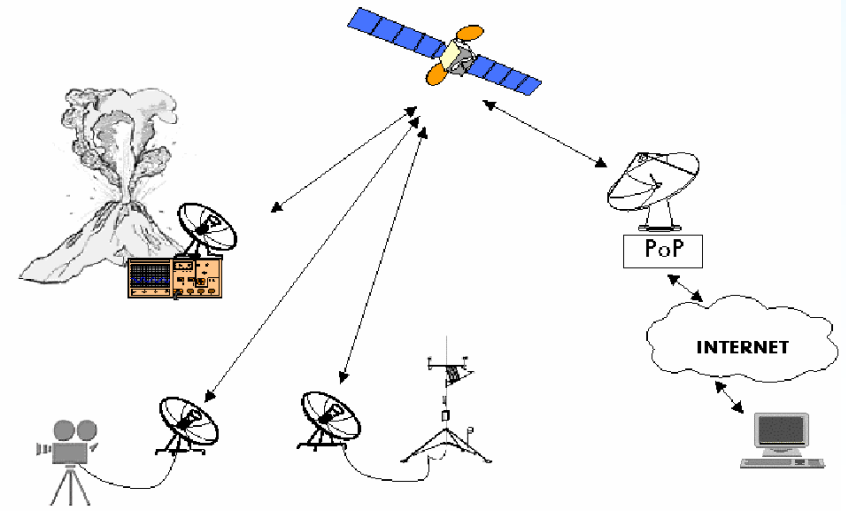


What are communication technologies? (6/6)

International Examples

A lot of European examples (in the web)

- REMSAT (Real-time Emergency Management via Satellites)
- Telemedicine
  - » Distributed Environment for Medical Simulation projects: MULTIMED
  - » Emergency Consultation projects: SECOM, IEMN, MIST, DELTASS (Mobile Field Hospital and Search and Rescue component), TELANY (Emergency component), I-DISCARE, NESA
  - » Tele-consultation projects: SHARED, EUROMEDNET, RCST
  - » Clinical Research projects: WEBGMS
  - » Access to Patient Multimedia Data Base projects: HERMES, TELANY (Medtronic component)
  - » Continuing Medical Education projects: EMN, SANTTSUR, MAYFLOWER, SM@RT, SKYMED, HPS IN SURGERY, HPS IN HOME
- …



2. Korean Status

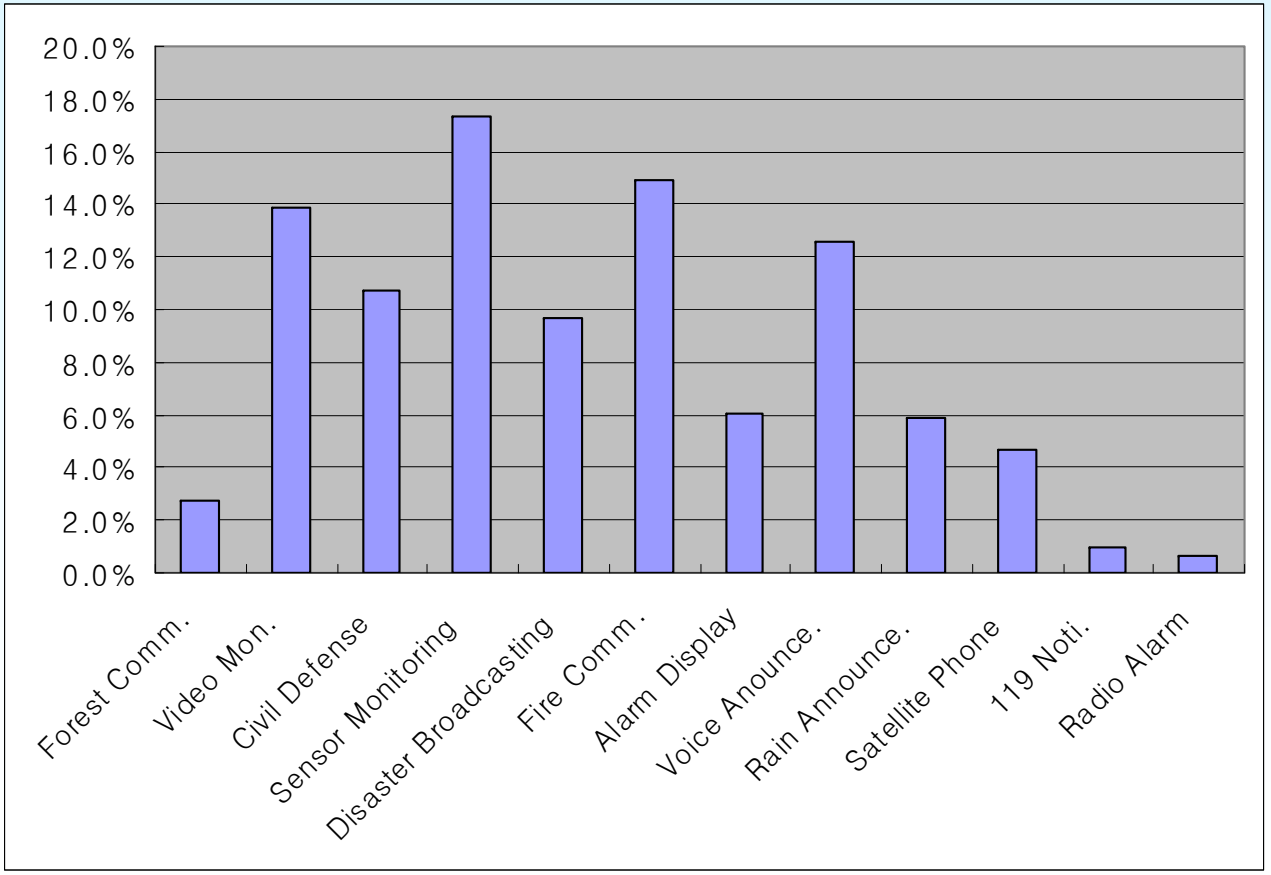
National Communication Systems for Disaster (1/2)

Analysis by Usage

- ✓ Alarm Alerting Systems are more than 45%
- ✓ Monitoring systems are more than 31%.
- ✓ More than 60% are using wired infra.

- ✓ (ETRI Analysis with NEMA, 2006)

* NEMA: National Emergency Management Agency



2. Korean Status

National Communication Systems for Disaster (2/2)

Categorized Analysis by Area

✓ **Monitoring**

- •Information at the terminal is important
- •Sort as two type, Video and SCADA according to Bandwidth properties

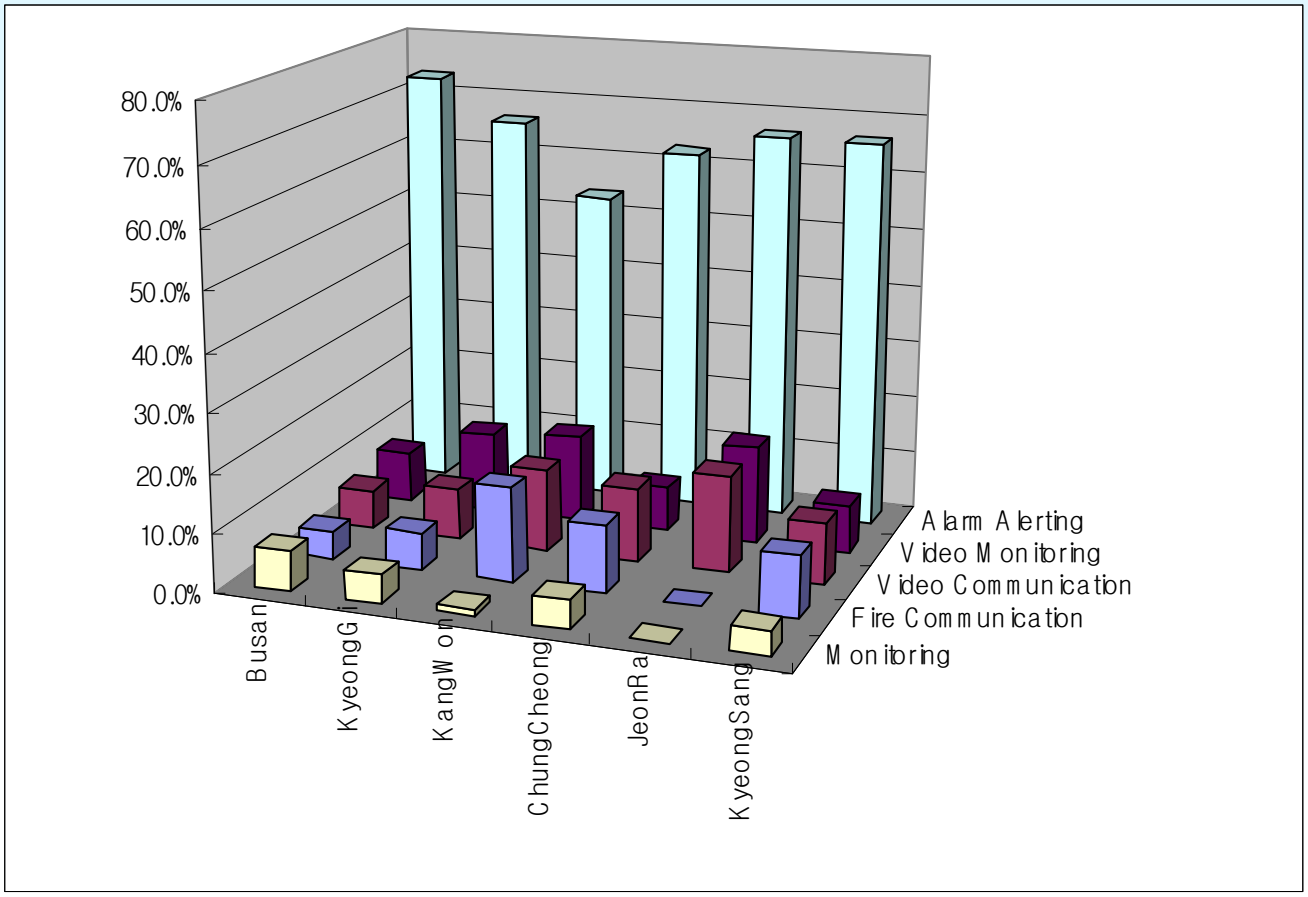
✓ **Alarm Alerting**

- • Broadcasting Nature

✓ **Communication**

- •Symmetrical Information Flow
- •Sort as Fire and Video according to applications

Communication Infra for Authorities to Citizen is dominant

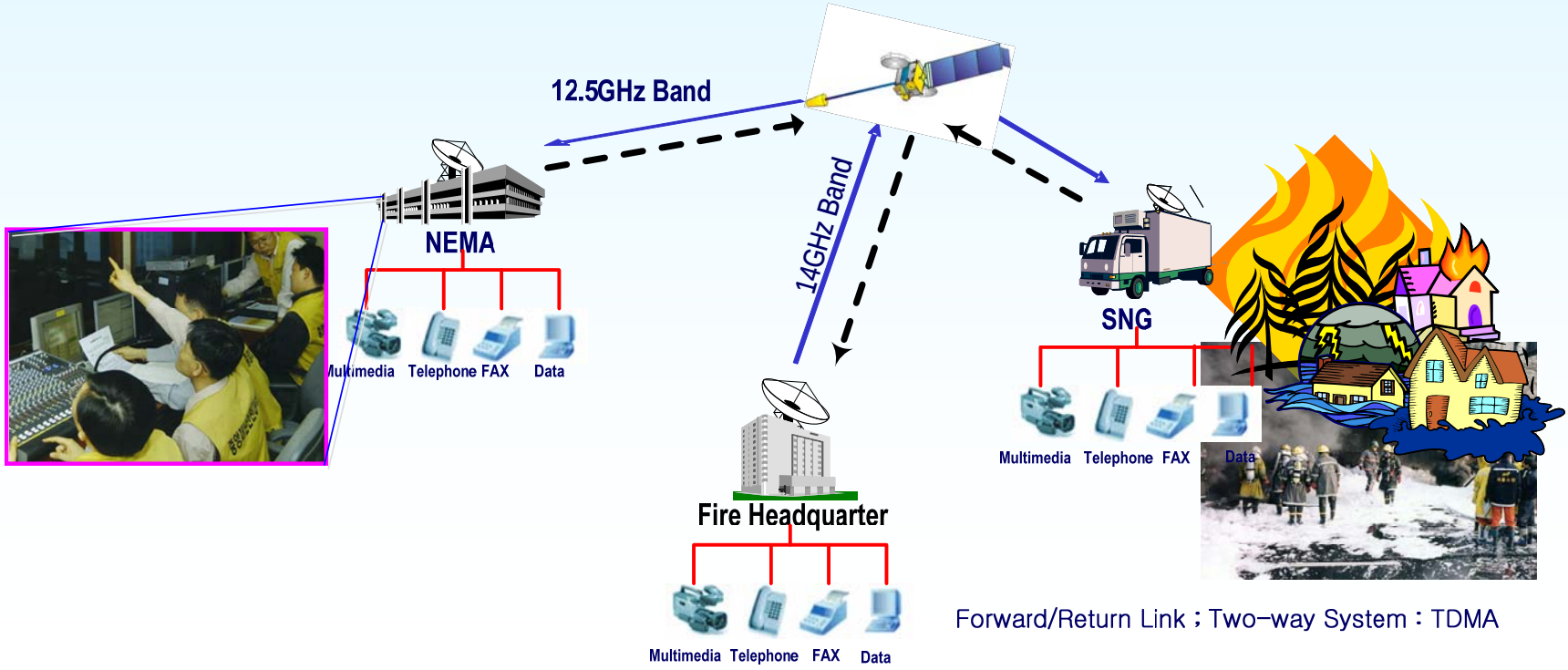


2. Korean Status

National Satellite Communication Systems for Disaster (1/3)

Disaster Communication Usage

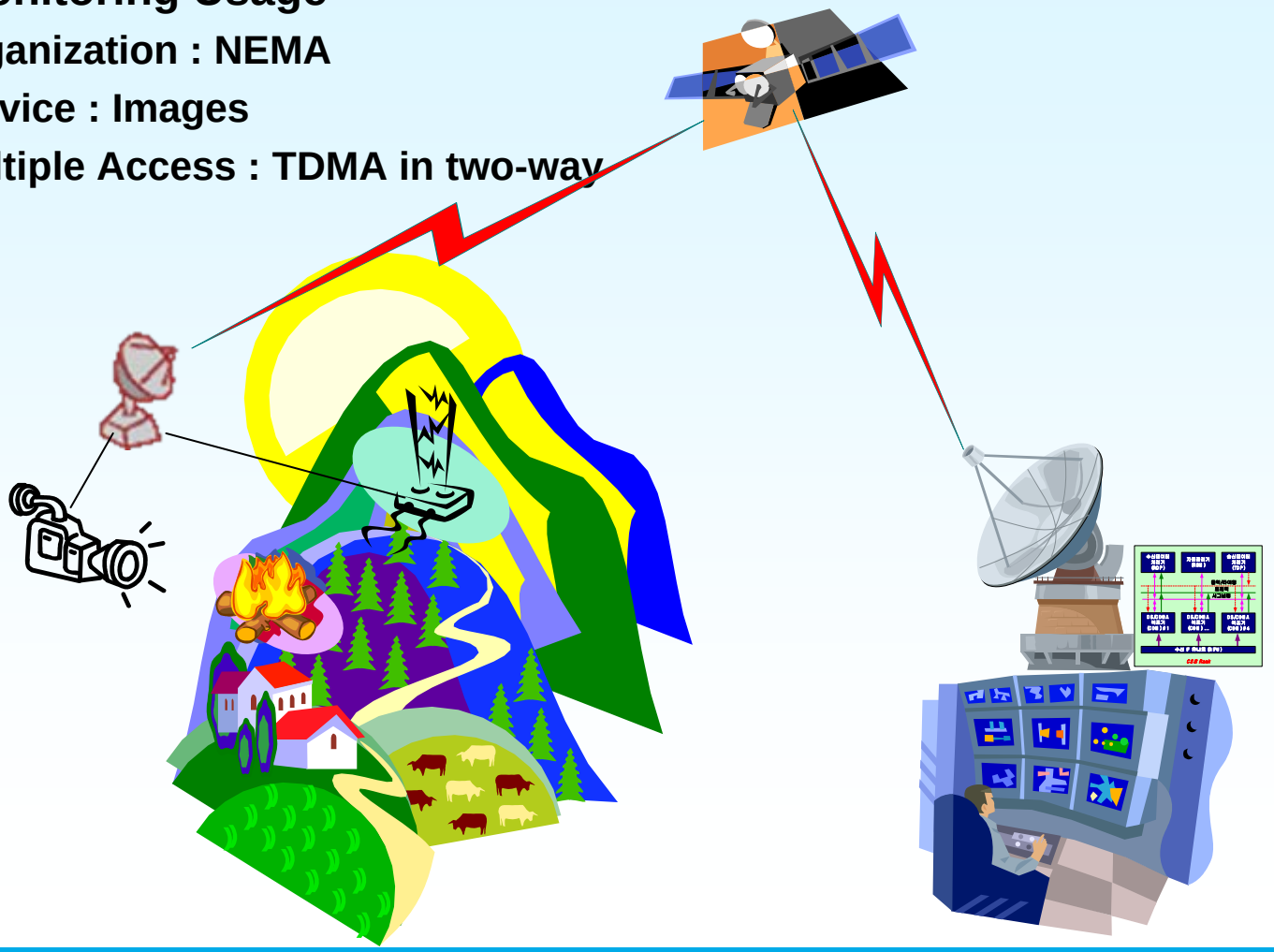
- Organization : NEMA
- Service : voice, facsimile and data transmission
- Multiple Access : TDMA in two-way



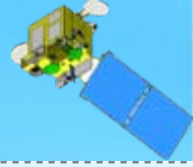
National Satellite Communication Systems for Disaster (2/3)

Disaster Monitoring Usage

- Organization : NEMA
- Service : Images
- Multiple Access : TDMA in two-way



2. Korean Status



National Satellite Communication Systems for Disaster (3/3)

Civil Defense Alarm Usage

- Organization : NEMA
- Service : Alarms

Communication Network Backup Usage

- Organization : MOGAHA (Ministry Of Government Administration and Home Affairs)
- Service : Government Communication Network Backup

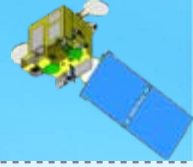
KEPC (Korea Electric Power Corporation) uses SCADA for utility monitoring (power plant etc.)

KOWACO (Korea Water Resources Corporation) adopts SCADA for monitoring dams

…

✓ **Disaster Communication system (NEMA) and Communication Backup system (MOGAHA) have same applications (Video Conference, Voice Communication Support, …), but not compatible**

2. Korean Status

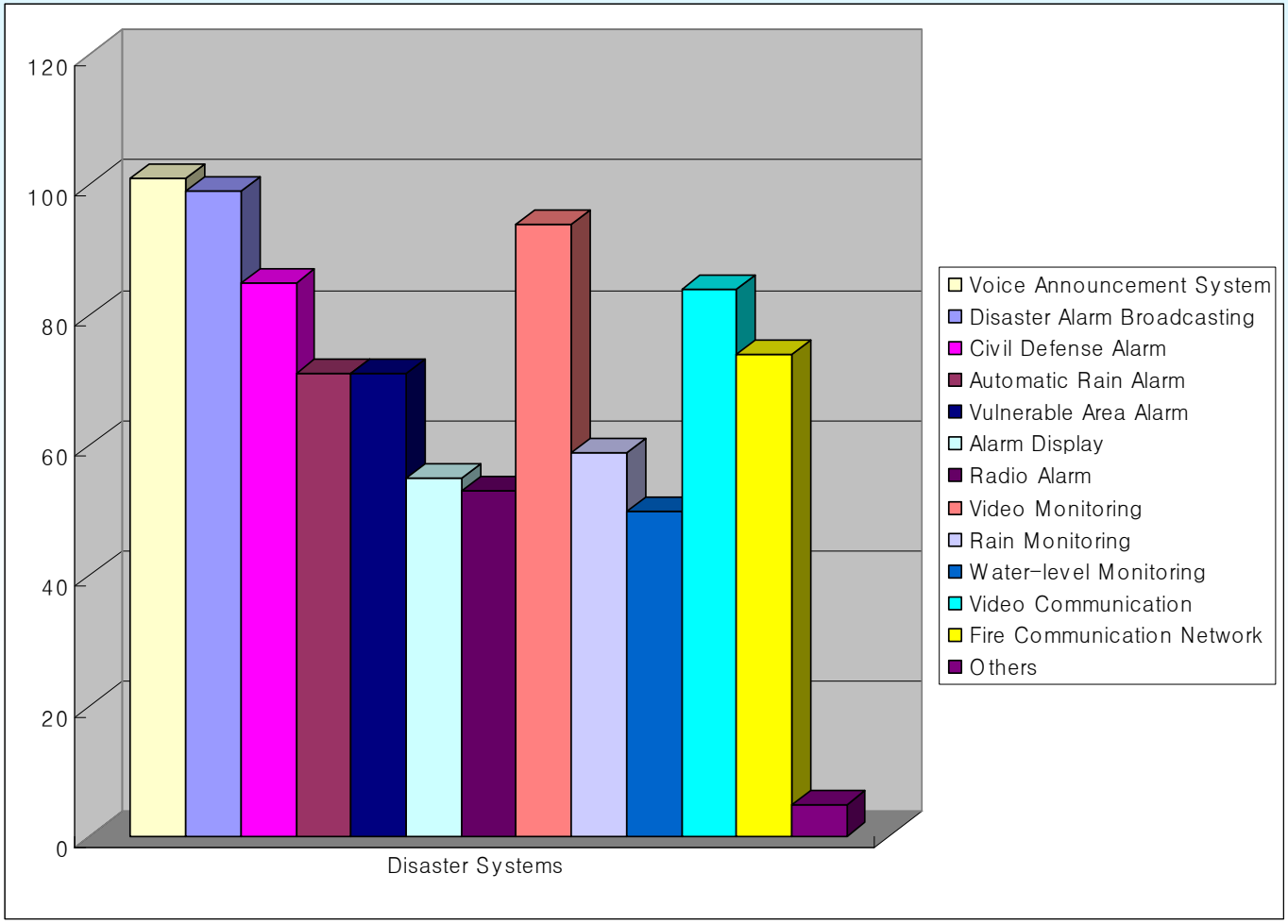


- **National Wireless Communication Systems for Disaster**
  - **Most wireless communication equipment are operating in non-standardized manner.**
  - **NEMA is trying to set up TETRA, a European standard, as a major voice wireless communication infra**
    - **TTA (Telecommunication Technologies Association), a Korean standardization organization, Standardized in 2003**
    - **Tracing TETRA release 2**

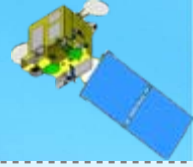
Future Needs Forecast of Satellite Communications for Disaster

- ✓ Remote Video Monitoring Systems
- ✓ Video Communication Systems
- ✓ Fire Communication Network (Back-up, Interoperation with terrestrial systems)
- ✓ Integrated Alarm Systems
- ✓ Monitoring Systems except Video

✓ (ETRI's survey with NEMA, 2006)

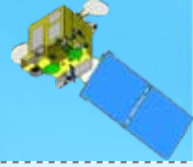


2. Korean Status



- **Problem Statements of Satellite Communications for Disaster**
  - **Expensive Equipment**
    - About $50,000 (Ku) satellite comm. terminal
    - $10,000 ~ 20,000 E1 class modem (?)
    - $150 telephone modem
  - **High Cost of Frequency Lease**
    - About $50,000 (Ku)/MHz/Month
    - $5,000 E1 line (?)
    - About $30 telephone line
  - **No Expert to operate and maintain systems**
    - Cities, District offices, etc only have 1 or 2 dedicated
  - **Enhancing Mobility**
    - Digital SNG Vehicles
  - **No Compatibility between systems used for similar purposes**
  - **Enhancing Disaster Recovery Functionalities**
  - **(Interoperability)**
    - NEMA is deploying Digital Trunked Radio Systems as TETRA

3. Technical Review



Considering the current problems

Cost Problems

- **Low Cost Solution**
  - Standardization also can be one of alternatives
- **Simple and Easy to Use**
- **Compact**

Mobility

- **Mobile/Transportable/Portable**
- **Accelerated Processing and Deployment**
- **Quick Installation and Tear-down (Minutes to Hours)**

Standardization

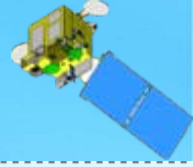
- **Can encourage interoperability and lower cost**

* ETRI is now trying to set up DVB-S/RCS as TTA (Telecommunication Technology Association) standard

Interoperability

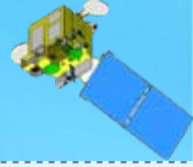
- Wireless Networks
- Wire Networks

3. Technical Review



- **Considering Future Trends**
  - **IP Based Networks**
    - **Quality of Service**

- **Considering COMS**
  - **Fade Mitigation Techniques for Ka system**
    - **Adaptive Modulation (including MAC processing and Modulation Identification)**
    - **Operating at Low SNR Environments**



What is COMS?

◈ Objectives

Satellite Communication Mission

- In-orbit verification of developed communication technologies
- Experiment of wide-band multi-media communication service

Ocean Monitoring Mission

- Monitoring of marine environments around the Korean peninsula
- Production of fishery information (Chlorophyll, etc.)
- Monitoring of long-term/short-term change of marine ecosystem

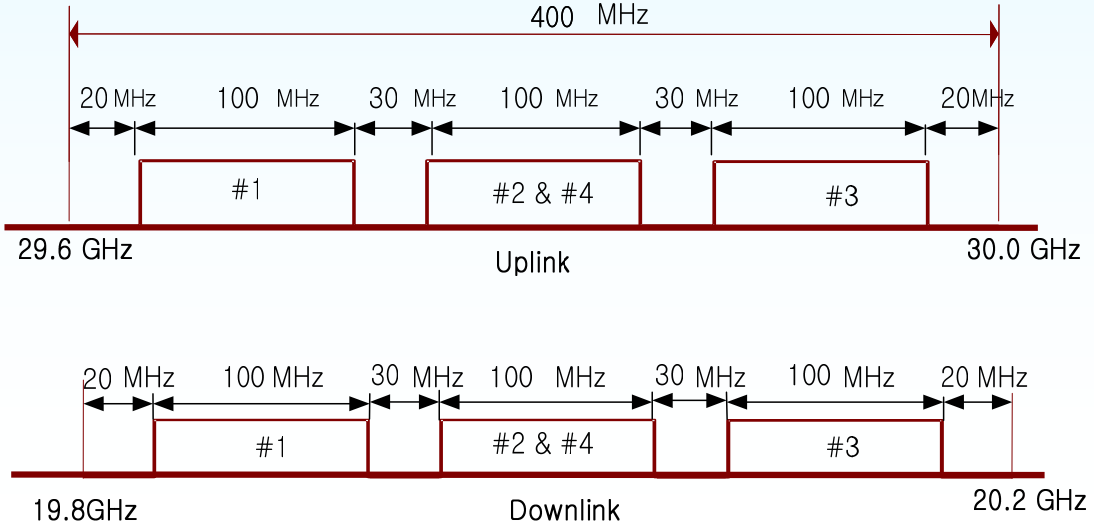
Weather Monitoring Mission

- Continuous monitoring of imagery and extracting of meteorological products
- Early detection of special weather such as storm, flood, yellow sand
- Monitoring of long-term change of sea surface temperature and cloud

What is COMS?

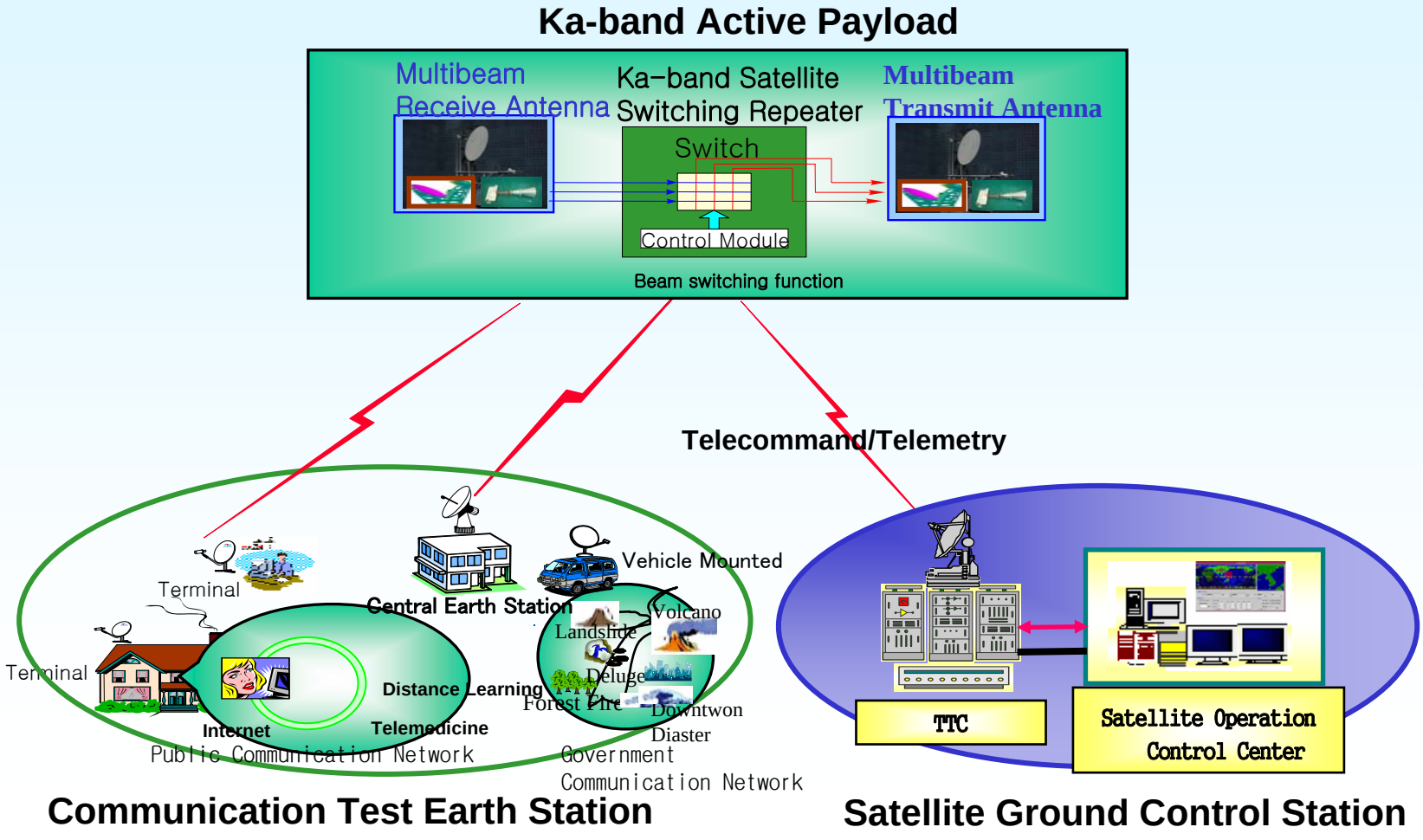
- Satellite communication system of COMS consists of
  - multi-beam switching COmmunication Payload System (COPS), Satellite Geostationary orbit Control System (SGCS), Communication Test Earth System (CTES)
- Expected to be used for disaster communication

- Launch: At the end of 2008
- Frequency:
- Coverage: Korea (South, North)
- Orbit: 128.2°
- EIRP: 58dBW
- G/T: 13dB/°K



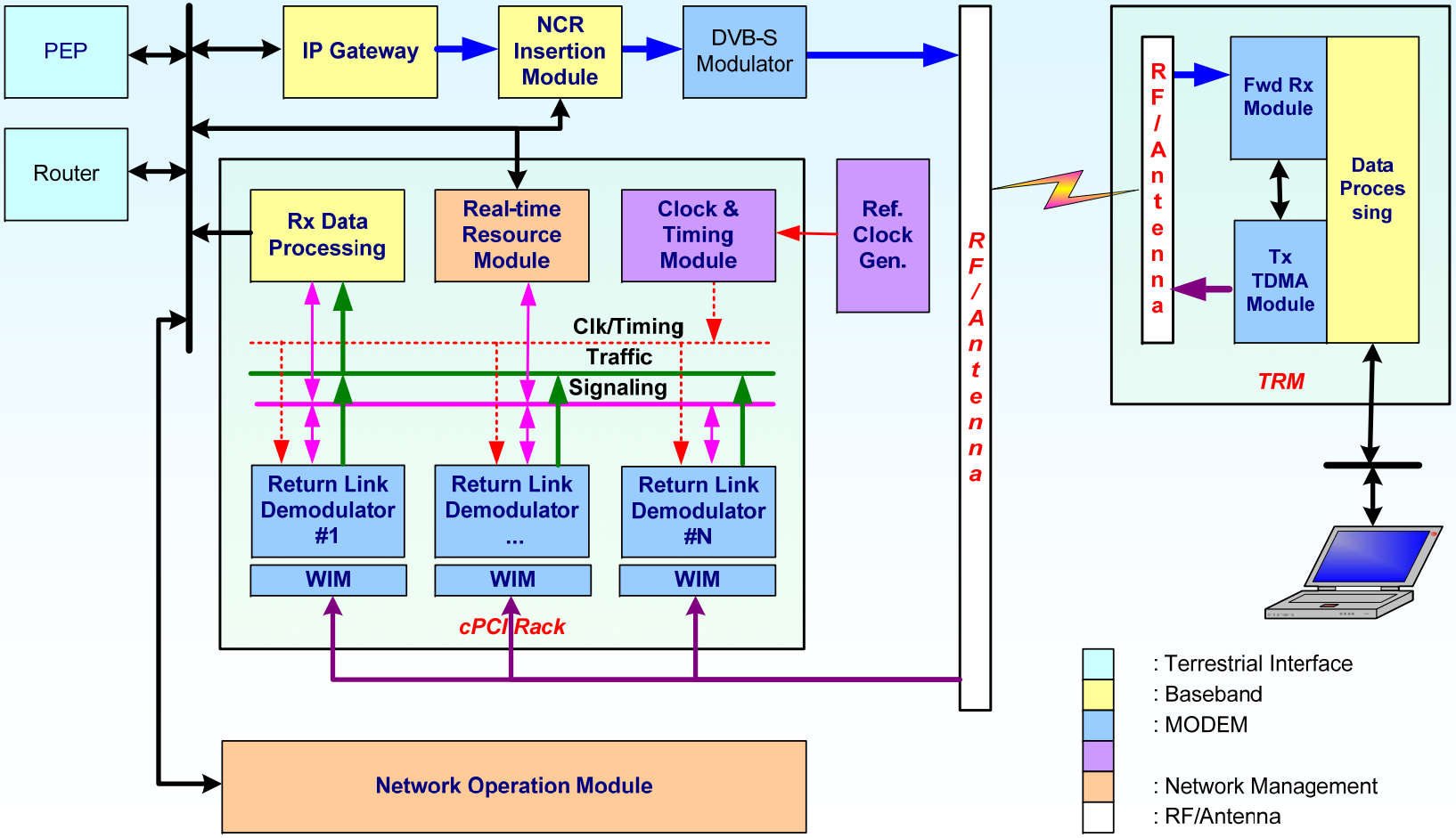
What is COMS?

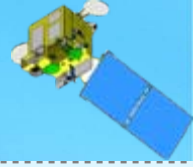
System Configuration



What is COMS?

CTES Configuration (for the Multimedia Broadband Demonstration)

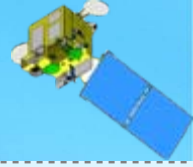




What is COMS?

CTES Performances

- BER performance
  - **Internet BER based on internet should be less than 10^{-6}**
- Transmission Data Rate
  - **Internet based forward link data rate**
    - » **Public Network : Max 35Msps, BPSK, QPSK**
    - » **Government Communication Network : Max 5Msps, BPSK, QPSK**
  - **Internet based return link data rate**
    - » **Public & Gov. Communication network : Max 4Msps, BPSK, QPSK**
- Operation Performance
  - **Hub subsystem should be initialized within 10mins**
- Availability
  - **Link availability should be more than 99.7% (Japan 99.8%)**
- System Life Time
  - **COMS System lifetime should be more than 10 years**
- Extensions of **DVB-S** and **DVB-RCS** standards



- **DVB-S/DSNG and DVB-RCS**
  - **Assume High Reliability**
    - Long Latency for re-connection (5~7 sec)
    - Constant Bit Rate Assignment
  - **Different formats between Forward and Return channel**
    - Because of broadcasting purpose
    - Needs On Board Processing
  - **Less Consideration of Mobility**
    - Must consider the possibility of interference
  - **But the only standard that can adopt internationally**
    - Mobile RCS was discussed in the working group, only implementation guideline was updated
    - DVB-S2 now considering mobility, so there may be a update chance
    - PPDR will be an attractive RCS application

Mobility

Mobile Antenna

- ETRI History (more than 10 years)

✓ **Broadcasting Antenna (successfully commercialized)**

Transportable Antenna

- Key factor: Low cost
- Patriot $30,000 (Mobile?), Advantech, …

$300,000(?)

$500(?)

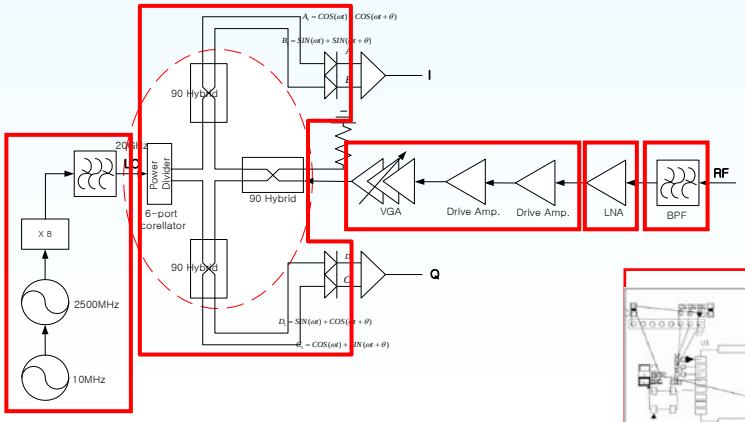
ETRI Trial ($70,000?)

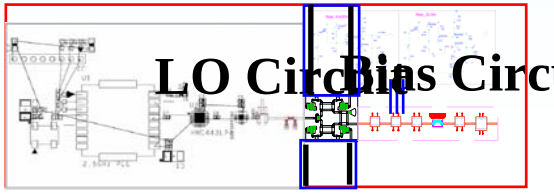
Low Cost and Easiness Antenna (Auto-tracking, Position Sensing, …)

Mobility

Portable Terminal

- Antenna (e.g. Microstrip Patch)
- **Integrated Terminals**
  - **RF Components (Direct Conversion Receivers, HPA+BUC)**
  - **High Performance Demodulator with reasonable complexity**
  - **Low Power Baseband Processing (e.g. H/W DEMUX + IP_reassembly + TS_Encapsulation)**



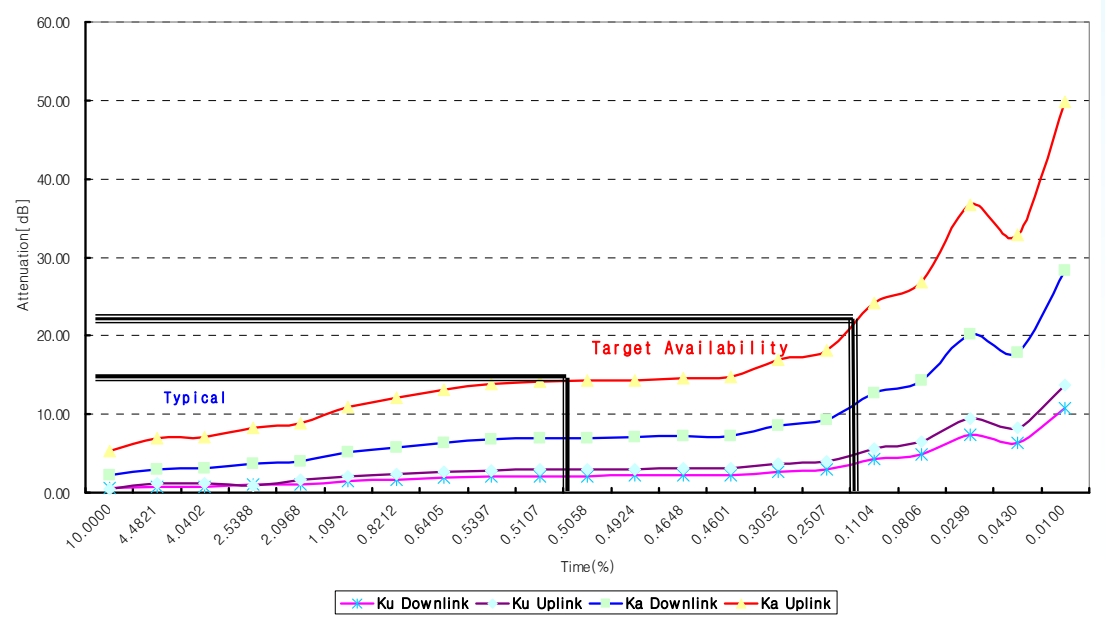


Design Example of Direct Conversion Receiver (Analog Type)

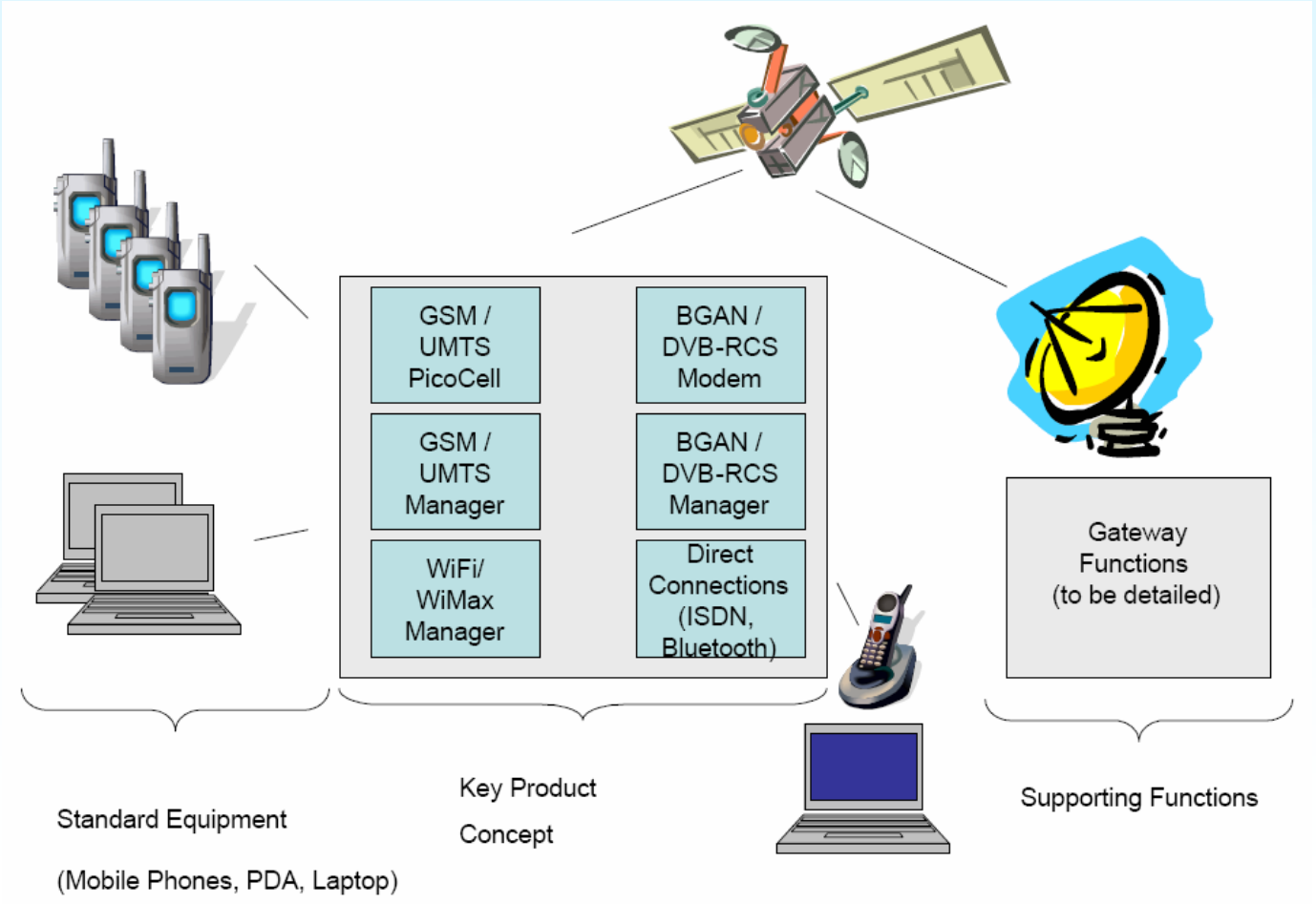
Fade Mitigation

Terminal Case Example (Antenna - 1.2m, Power - 10W)

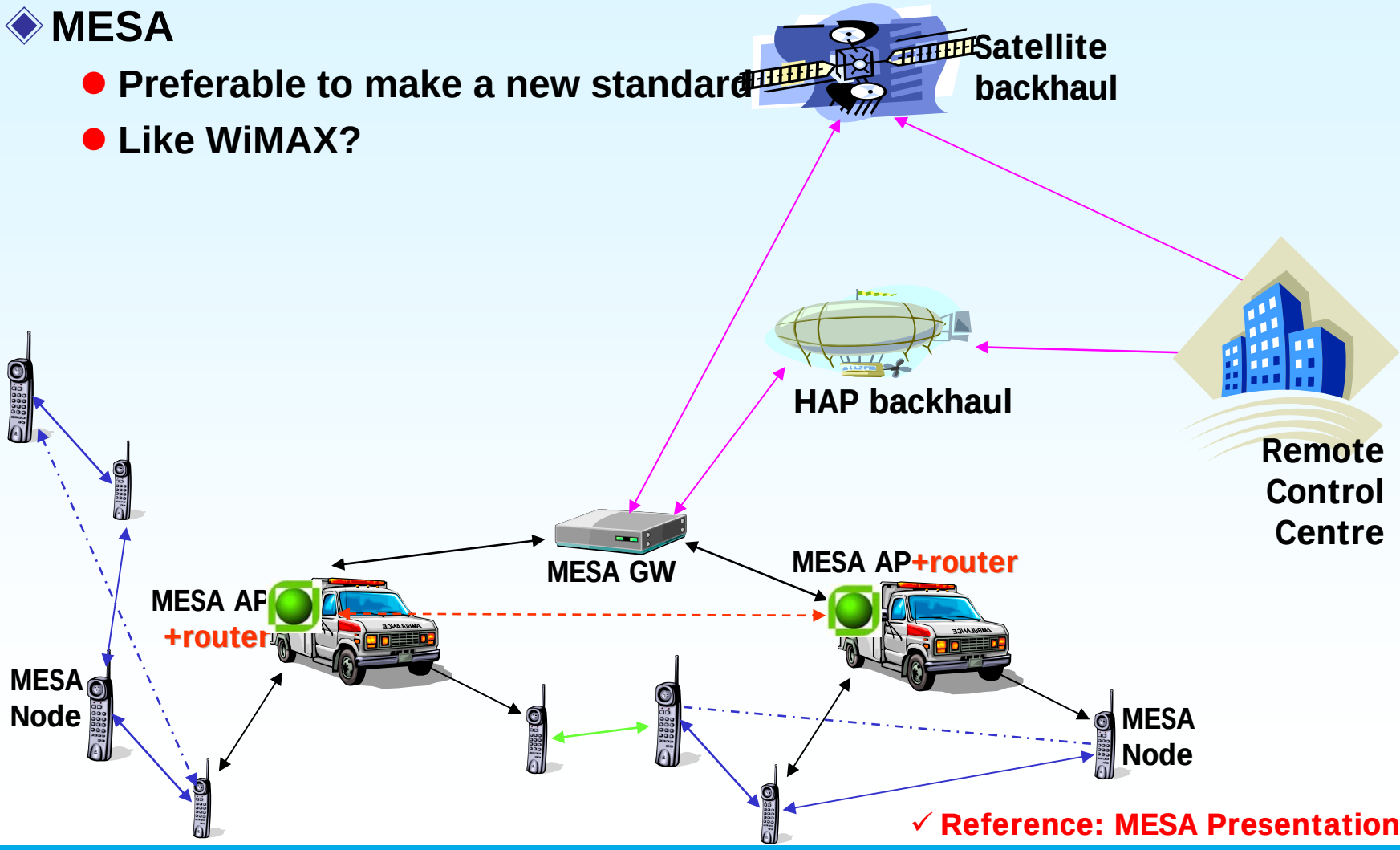
- Power Control : 2Watt <-> 10Watt (7dB Gain)
- Adaptive Modulation (QPSK/BPSK) (3dB Gain)
- Coding Rate (Turbo, 6/7->1/3) (4dB Gain)
- Turbo Synchronization (3dB Gain)
- Tx Rate (5Msps -> 0.5Msps) (10dB Gain)
- Total Gain : 27dB



- **Interoperability**
  - **TETRA (Example: A European Project WISECOM)**



- **Interoperability**
  - **MESA**
    - Preferable to make a new standard
    - Like WiMAX?

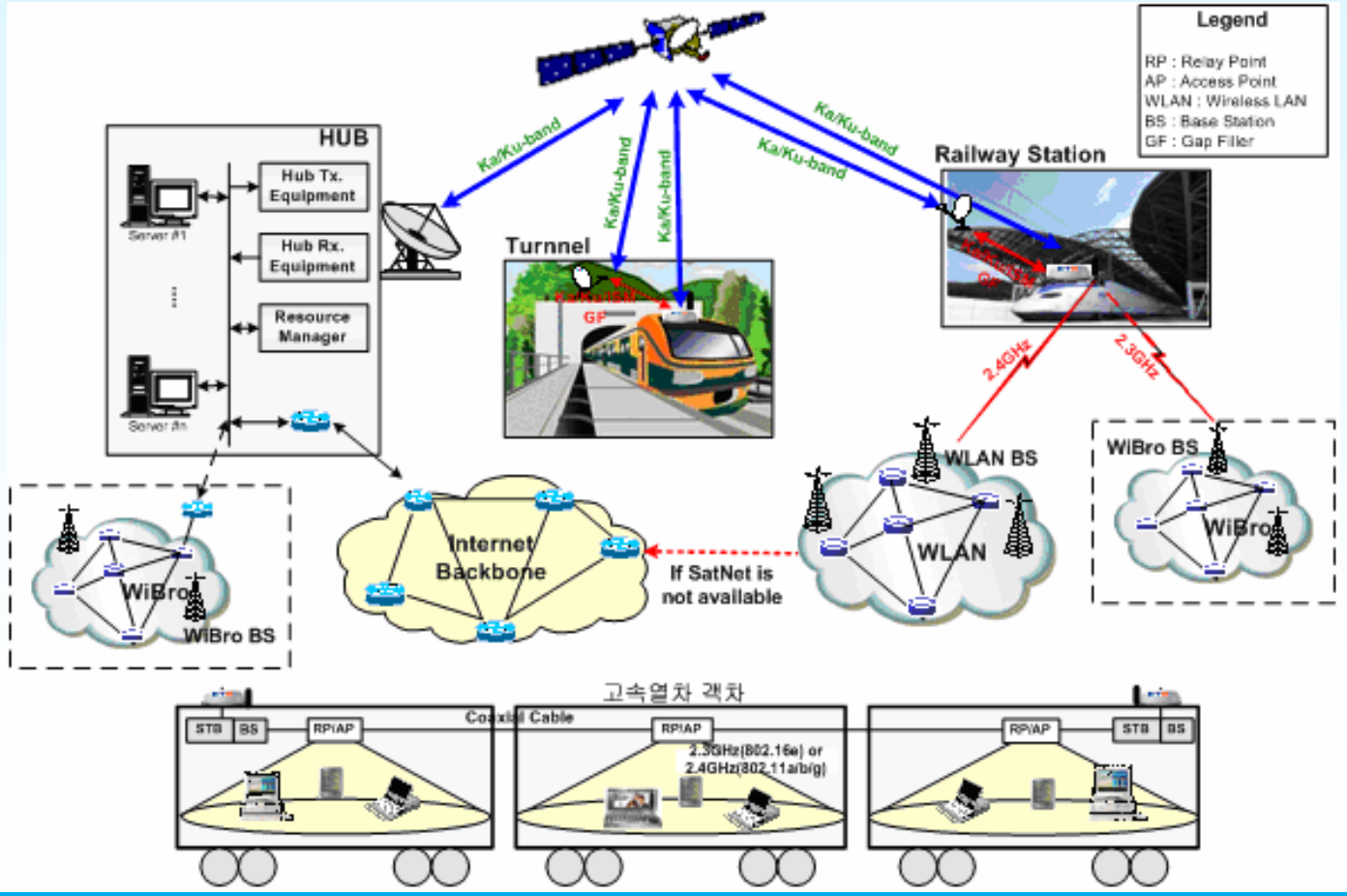


✓ Reference: MESA Presentation

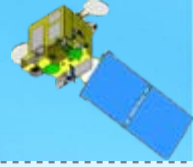
Interoperability

ETRI development (on going)

- WiBro/WLAN as a commercial service, but can be used for DC



4. Conclusions



- **Survey of disaster communications in Korea reveals that most of authorities are very interested in the broadband solutions.**
  - **Similar results expected for other nations**

- **Making wireless standards for disaster communications (not only terrestrial, but also satellite) and using them are very important.**
  - **To lower the cost and to have the interoperability**
  - **Because broadband wireless disaster will come to us soon**

- **To level up to the safe comfortable Asia**
  - **Trying to develop the new spectrum (e.g. 5GHz, 30GHz, …)**
  - **Trying to develop broadband wireless technologies in a standardized manner (good and cheap)**

  are also important

감사합니다 (Thank You)

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