Development of Mobile Broadband Interactive Satellite Access System based on DVB-RCS in Korea

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1. Introduction

- **Mobile Broadband Satellite service Networks**
  - To provide Internet service, Internal corporate networks to ships, trains, buses, and aircrafts

- **Developed and Developing Systems in ETRI**
  - **Broadband Satellite Access Network (BSAN) system (Ka-band)**
    - Interactive multimedia service for Fixed Terminals
    - Forward channel: DVB-S, 2 ~ 45Mbps
    - Return Channel: DVB-RCS, 128ksps to 4,096ksps

  - **Mobile Satellite Internet Access (MSIA) system (Ku-band)**
    - Internet applications and satellite broadcasting service for vehicles in moving environment for Mobile Terminals
    - Forward channel: DVB-S, 2 ~ 45Mbps
    - Return channel: DVB-RCS over MC DS-CDMA, 32ksps to 384kbps
1. Introduction

- Mobile Broadband Interactive Satellite Access Technology (MoBISAT) System
  - A Ka/Ku-band broadband mobile multimedia access system for satellite TV, video multicasting, internet services
  - Mobile terminals for tele-workers, commuters, crews, and travelers to provide the broadband services for business, information, entertainment, education, and security/safety
  - Forward channel: DVB-S/DSNG, up to 80Mbps
  - Return channel: based on DVB-RCS, up to 10Mbps
  - Maximum moving speed: 1000km/h (Aircraft)
2. MoBISAT System Configuration

MoBISAT Network Configuration

- Service Provider
- Contents Provider

Internet (IP, PSTN, ISDN)

40 Mbps (Ku DBS/DTH)

10 Mbps (Ka)

100 Mbps (Ka)

Hub Station

Satellite TV

Satellite WAN

W-LAN
2. MoBISAT System Configuration

■ Characteristics of MoBISAT

- To provide both Ku-band satellite TV reception and Ka-band two-way high speed internet to the passengers

- Group user terminals with a two-way active phased array antenna on the top of Bus, couch, yacht, cruise and airplane (Long-haul jet)

■ Services

- Internet service
- IP-based multimedia service
- File transfer service
- VOD service
- Multicasting
- VoIP
- VPN, etc
2. MoBISAT System Configuration

MoBISAT System Architecture
2. MoBISAT System Configuration

- **MoBISAT System Specifications**
  - **Ka-band Forward Link Transmission**
    - Specifications: DVB-S/DSNG
    - Modulation Scheme: QPSK/8PSK
    - Transmission Rate: up to 80Mbps
  - **Ka-band Return Link Transmission**
    - Specifications: based on DVB-RCS (Modify some parameters)
    - Modulation Scheme: BPSK/QPSK
    - Transmission Rate: up to 10Mbps
  - **Real Time service Protocol**
    - Real time multicasting and Stream Services
    - VoIP Service and QoS
    - VPN(Virtual Private Network) based on IPsec
3. Satellite Network Gateway System (Hub)

Satellite Network Gateway System Architecture

Satellite Network Gateway Subsystem

Terrestrial Network Subsystem

Gateway RF Subsystem

Satellite

- Multimedia Servers
- Authentication Server

PEP

Router

BTV

MPEG2 Encoder

REMUX

PCR Re-insertion Module

DVB-S Modulator

Gateway RF Subsystem

Satellite Network Gateway Subsystem

- Transmit Data Process Module
- Dynamic Resource Management Module
- Satellite Network Management Module

Receive Data Process Module

Return-Link Demodulate Module

Receive IF Module

Reference Clock Generation Module

Receive-Link Demodulate Module

Dynamic Resource Management Module

Satellite Network Management Module

Gateway RF Subsystem
3. Satellite Network Gateway System (Hub)

- **Dynamic Resource Manager (DRM)**
  - To generate DVB-PSK/SI tables on the basis of DVB-S and DVB-RCS
  - To allocate the bandwidth resources, i.e., time slots/frames and frequencies, corresponding to the request from Terminals

- **Received Data Processor (RDP)**
  - To reassemble the received Traffic burst to IP data
  - To Support ATM cell and MPEG2-TS Traffic burst

- **A Bank of Return Link Demodulator (RLD)**
  - To perform feed-forward burst-mode demodulation
  - To distinguish and extract the information from Common Signaling Channel burst, Acquisition burst, Synchronization burst, and Traffic burst
### Demodulator Features & Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demodulation</td>
<td>QPSK/BPSK Burst Demodulator</td>
</tr>
<tr>
<td>Symbol Rate</td>
<td>0.512Msps(8ch), 1.024Msps(4ch), 2.048Msps(2ch), 4.096Msps(1ch), 5Msps(1ch)</td>
</tr>
<tr>
<td>Channel Bandwidth</td>
<td>6.144MHz</td>
</tr>
<tr>
<td>Spectrum Shape</td>
<td>Square Root Raised Cosine (Roll-off factor=0.35)</td>
</tr>
<tr>
<td>Channel Coding</td>
<td>Concatenated RS and Viterbi, Turbo</td>
</tr>
<tr>
<td>Traffic Burst Type</td>
<td>ATM Cell(1,2,4)/MPEG2-TS</td>
</tr>
</tbody>
</table>
| Channel Received Signal Metrics | - Time of Arrival  
                          | - SNR (E_s/N_0)  
                          | - Frequency Offset |
4. Satellite Mobile Terminal

Satellite Mobile Terminal Architecture

SMT subsystem

- Ka-Band Forward Receive Module
- Navigation and Clock Generation Module
- Applications
- TDM Transmit Module
- Data Process Module
- Platform
- IP (traffic), section (PSI/SI)
- Ext. I/F
- Ethernet
- TV out
- A/V

APA subsys.

PEP

STB

OS

WWA

Ext. I/F

Platform

APA subsys.

TV out
4. Satellite Mobile Terminal

- **Satellite Mobile Terminal Characteristics**
  - A group Terminal, which provides a lot of users with multiple channels of multimedia services
  - **Data Processing Module**
    - To set up and manage the interactive internet service according to the procedures defined for system
    - MAC process (log-on/off), assigned resource management and network sync
  - **Ka-band Forward Link Receive Module (for communication)**
    - To receive the Forward Link Data, which contains DVB-S/RCS PSI/SI tables and communication data
    - PID Filtering and Forward Link Signal (FLS) processing
  - **Ku-band Forward Link Receive Module (for broadcast such as TV)**
    - To receive the Forward Link broadcast Data
    - To translate MPEG2-TS packet to IP data
4. Satellite Mobile Terminal

- **TDMA Transmission Module**
  - To perform the DVB-RCS transmission
  - MoBISAT Modulator Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Access Scheme</td>
<td>MF-TDMA</td>
</tr>
<tr>
<td>Tx Symbol Rate</td>
<td>512K ~ 5Msps</td>
</tr>
<tr>
<td>Frequency Hopping Range</td>
<td>± 10MHz around Center Frequency(</td>
</tr>
<tr>
<td>Modulation</td>
<td>QPSK/BPSK</td>
</tr>
<tr>
<td>Channel Coding</td>
<td>Based on DVB-RCS standard(including Turbo coding)</td>
</tr>
<tr>
<td>Traffic Burst format</td>
<td>IP packets over ATM cell/MPEG2-TS</td>
</tr>
</tbody>
</table>
4. Satellite Mobile Terminal

- Mobile Antenna
  - To use Reflectors and Phased Array Feed
  - To use Hybrid Tracking Mechanism
    - Sub-reflector motion
    - Electrical Beam Scanning
  - Multi-channel TX/RX Active Channel Block
  - Mechanically Stabilized Structure
  - Compliance of Military Environment spec
# Mobile Antenna Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>- TX : 30.1 ~ 30.9 GHz&lt;br&gt;- RX : 20.3 ~ 21.1GHz&lt;br&gt;- Ku-band DBS is Optional</td>
</tr>
<tr>
<td>Antenna Gain</td>
<td>- TX : 47dBi&lt;br&gt;- RX : 44dBi</td>
</tr>
<tr>
<td>Antenna EIRP</td>
<td>51dBW</td>
</tr>
<tr>
<td>Tracking Range</td>
<td>EL ±25°, Az 360°</td>
</tr>
<tr>
<td>Tracking Speed</td>
<td>90°/sec</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>600W</td>
</tr>
<tr>
<td>Dimension</td>
<td>1700mm(D) x 1700mm(H)</td>
</tr>
</tbody>
</table>
4. Satellite Mobile Terminal

- **Small Mobile Antenna**
  - To reduce Antenna Size
  - EIRP : 40.0dBW
  - Size : 650mm(D) x 200mm(H)
5. System Implementation
6. Conclusion

- MoBISAT systme is developed for satellite TV, Video Multicasting, Internet service to Mobile Vehicles

- The System will support mobile broadband multimedia service by using satellite

- Services on moving
  - Internet service, IP-based multimedia service
  - File Transfer
  - VOD, Multicasting, Real-time streaming
  - VoIP, VPN, etc

- System Demonstration will be held on December, 2005