Transport Technology for Microwave Environment
What is Microwave Environment Transport (Warp) Technology? (Part 1)

- People use various types of microwaves in their daily lives. Familiar examples include televisions, radios, and cell phones. Recently, even game consoles, wireless LANs, use radio waves.

- Microwaves enable communication without a physical connection via wires. However, the only way to send waves over a long distance is to increase the transmission power of the terminals, resulting in an increase in power consumption and radio interference among systems using these waves.

- Microwave Transport (Warp) technology enables transport of an electromagnetic environment, using only a small area, to a distant location via an IP (Internet Protocol) network. This means that two distant locations can share the radio environment virtually.

- For example, television waves received at home, cell phone waves, and waves for a wireless LAN, can all be transported via an IP network to your hotel room. This is virtually the same environment as the one at home.

- If the microwave environment transport technology is adaptively applied, the situation would no longer require terminals and users to adapt to the radio environment, but would allow the environment to adapt to the terminals and users.
What is Microwave Environment Transport (Warp) Technology? (Part 2)

- Microwave transport technology will be useful for microwave observation and monitoring systems, and have applications in communications and broadcasting.
- For example, if an LEO satellite, while orbiting around the Earth, detects microwaves and sends this information collectively to the ground, the usage of the waves in local areas would be visible (see reference 3).
- Microwaves emitted in each area on the globe can also be regarded as energy emission, which might be helpful for an environmental observation.
- In the future, manned moon bases will be built and microwave systems will likely be implemented. If so, this technology could be an effective way to deploy microwave-enabled systems onto several IP-networked bases at one time.
A Life Achieved by Microwave Transport Technology

From the life terminals/users adapt to the microwave environment
To the life terminals/users are provided with a microwave environment that fits them

MINI (Microwave/IP conversion Network Interface)

- User “A” (Microwave monitoring)
- User “B” (Broadcasting)
- User “C” (Telephoning)
- User “D” (Internet access)
What happens if Microwave Transport comes feasible?

“Private Femtocell” appears in a hotel room abroad

Microwave Environment in a private room (domestic)
- 3G, 3.5G, 3.9G, 4G cell-phone
- WiMAX
- Broadcasting (Digital, Analogue)
- Wireless LAN device (11b, 11a, 11n, …)
- The other proprietary specifications devices

Microwave Environment in a hotel room abroad
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- The same wireless device as usual
- The same contents as usual
- The same usage & address as usual
- Geographical separation is invisible

Microwave Transport over IP network

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Applications of Microwave Environment Transport
- Communications, Broadcasting, Remote sensing … -

Microwave/IP conversion Network Interface (MINI)

Radio astronomy station

SIP server

Ground IP network

Environment in the area “A” ≡ Environment in the area “B”

Remote Microwave analysis / monitoring

Information from Ubiquitous devices

Optical data relay satellite

Optical IP network in space

Observation satellite

Environment in the area “B” ≡ Environment in the area “A”

Microwave/IP conversion Network Interface (MINI)
Basic Configuration & Technical Issues

- Broadband RF frontend, Fast & high-resolution ADC/DAC
- Compression of data traffic
- High accuracy time & frequency synchronization among connected microwave environments
- Compensation for packet loss and data error
(Reference 3) Microwave Observation Systems with LEO

① Store data; then independently and in bursts, transmit microwave status data using multi-antennas while orbiting.

② Send the stored data from the satellite to ground stations through a fast optical downlink.

③ Analyze the microwave conditions of target areas with high accuracy using fast processors located on the ground network.
Application of Microwave Transport Technology at Lunar Bases

- Share the microwave environment among remote bases at low cost
  - Reduce the infrastructure implementation costs for microwave applications
  - Enhance the flexibility of networks for microwave applications
  - Eliminate unnecessary microwave radiation in irrelevant areas.
The microwave application environment on the ground (current or new services, and radio equipment for ground use) can be instantly usable at remote space locations.