

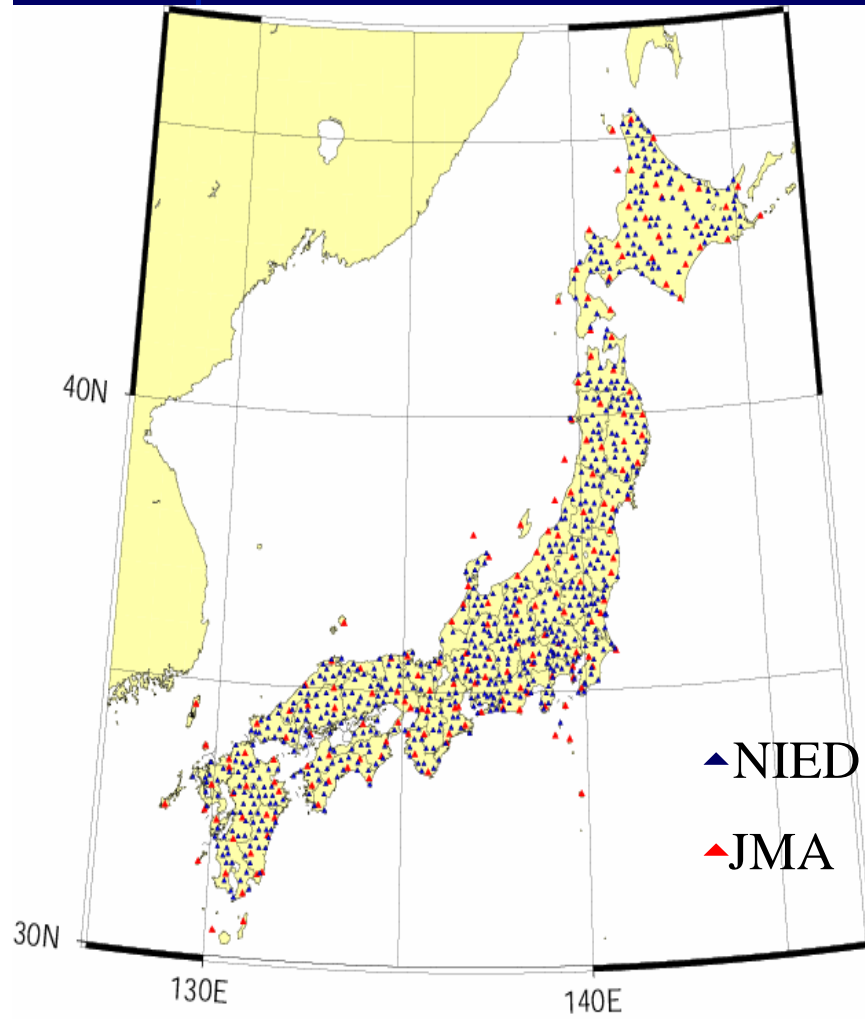
Information Transmission System for Earthquake Early Warning

September 3, 2007

Real-time Earthquake Information Consortium
Yoshinori Rokugo

Earthquake Early Warning System (Up Stream)

:Nationwide Seismometer Network in Japan.



1) Number of Seismometer Distribution:

-NIED:800 points,

-JMA:200 points.

2)The information concentrated to JMA by using IP-VPN or FR (Back-uped by ISDN).

3)Contents of the information:

-Real-time data of the earthquake,

-Hypocenter information;

including Latitude , Longitude, Depth and Magnitude.

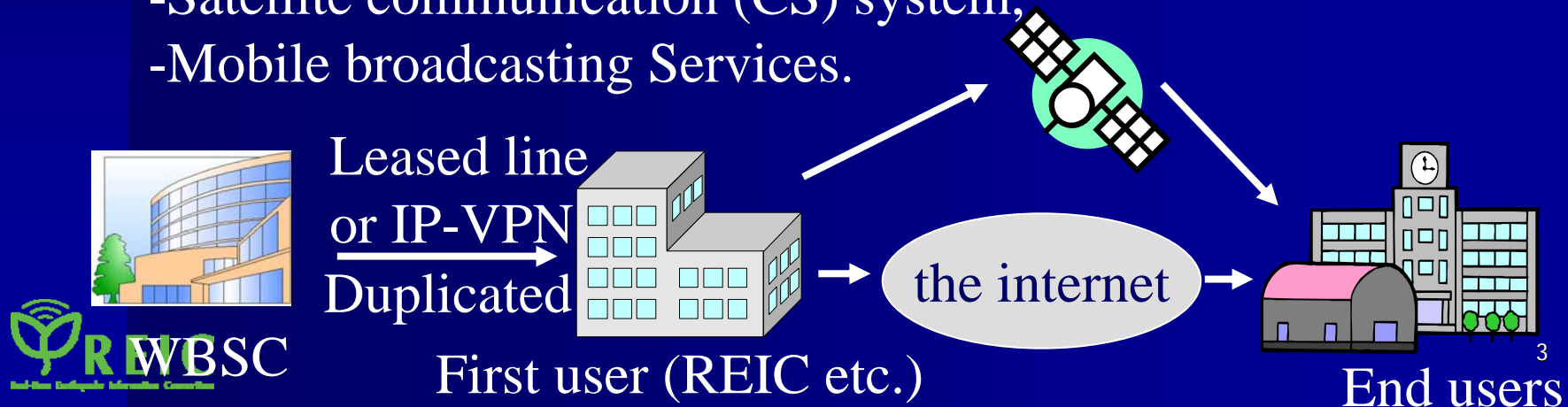
4)Real-time data processing is performed at JMA to calculate Hypocenter parameter from P-waves data.

Earthquake Early Warning System (Down Stream)

EEW is distributed from JMA through WBSC (Weather Business Support Center) to the user by using leased line or IP-VPN.

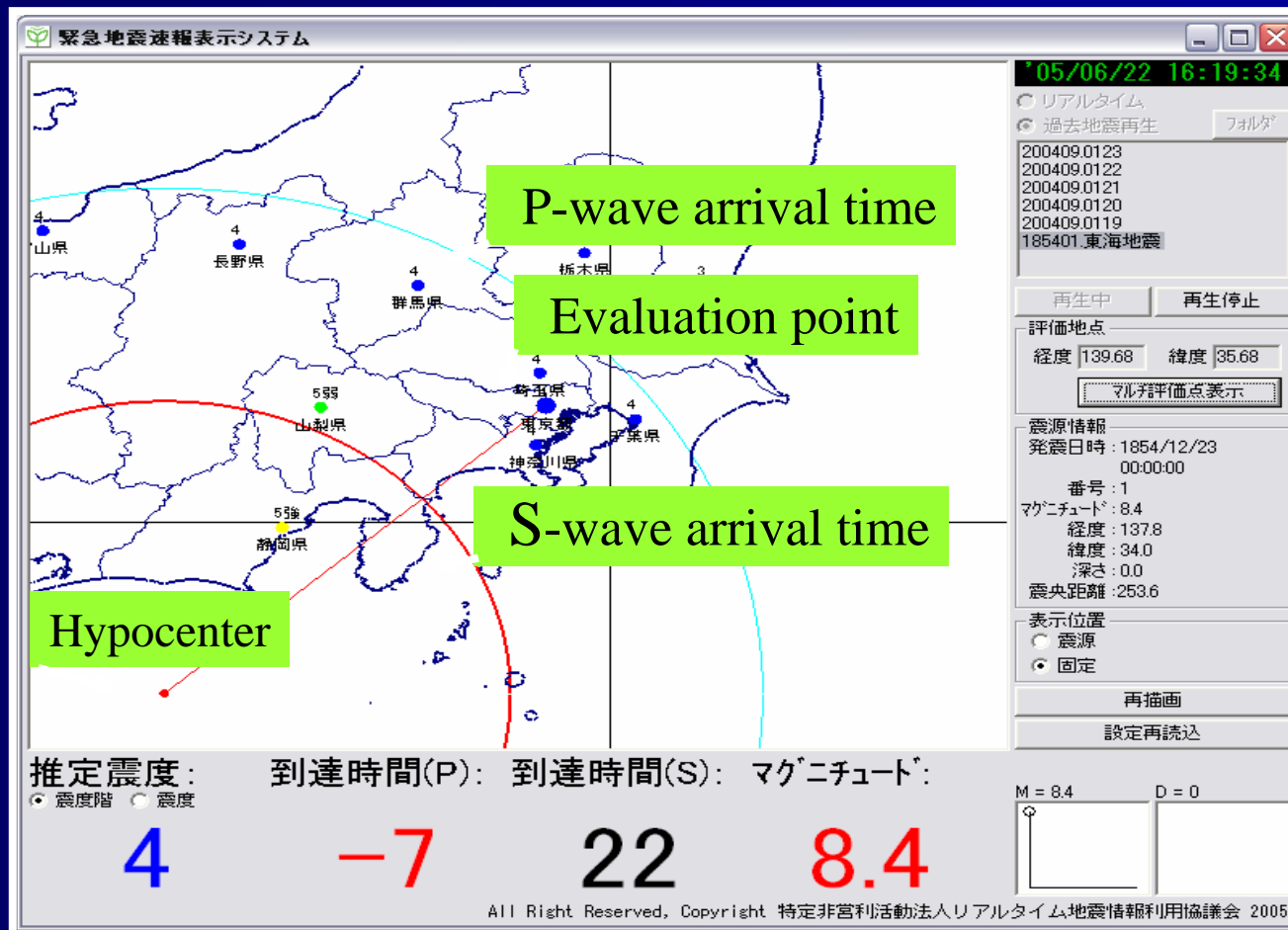
The first users are able to redistribute EEW to the end uses by using several Transmission methods,

- Leased line,
- IP-VPN,
- The internet,
- IP V6 multicast,
- Satellite communication (CS) system,
- Mobile broadcasting Services.

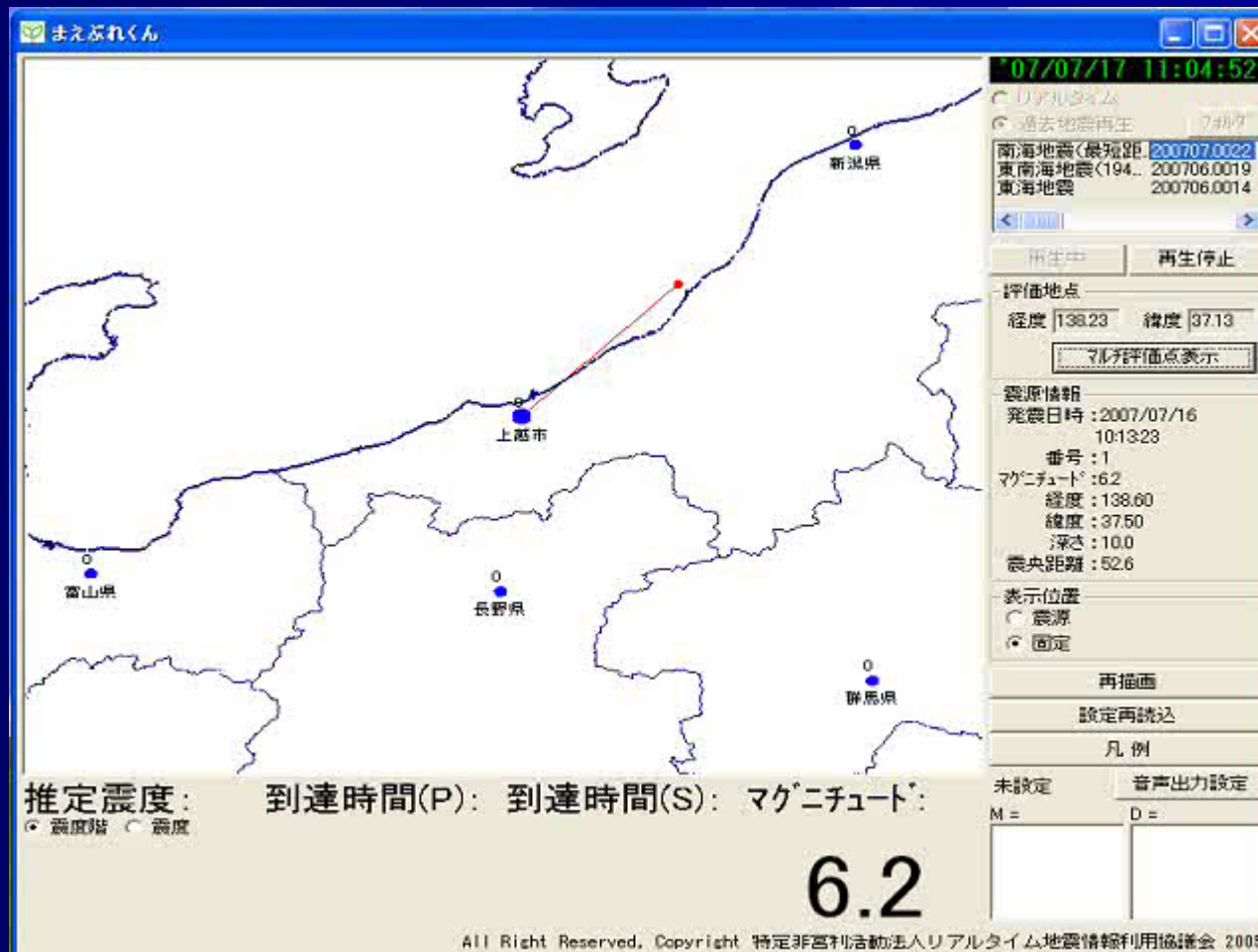


Earthquake Early Warning System (End User System)

End user estimates the seismic intensity (JMA) and the arrival time of S-wave by using Attenuation Relationship and Travel-Time Table.

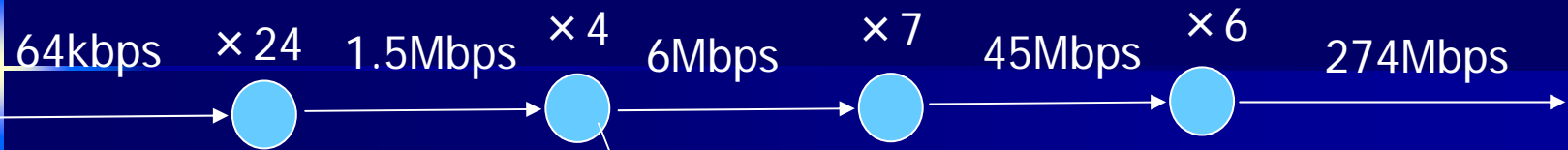


新潟県中越沖地震(2007,07,16)



Digital Hierarchy

North American (PDH)



European (PDH)



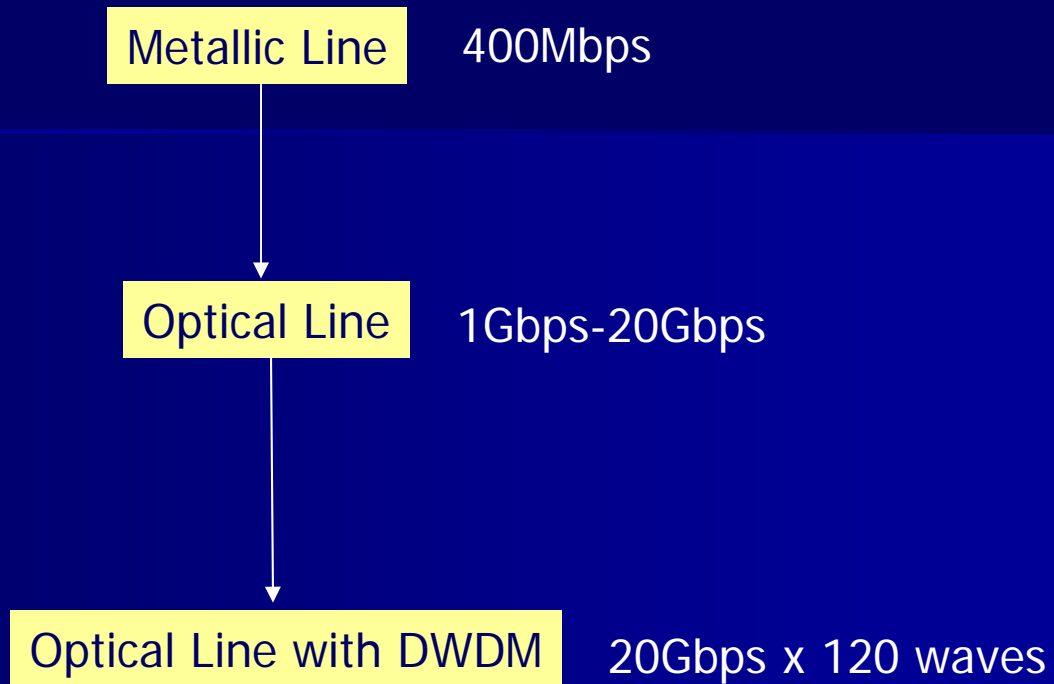
Japanese (PDH)



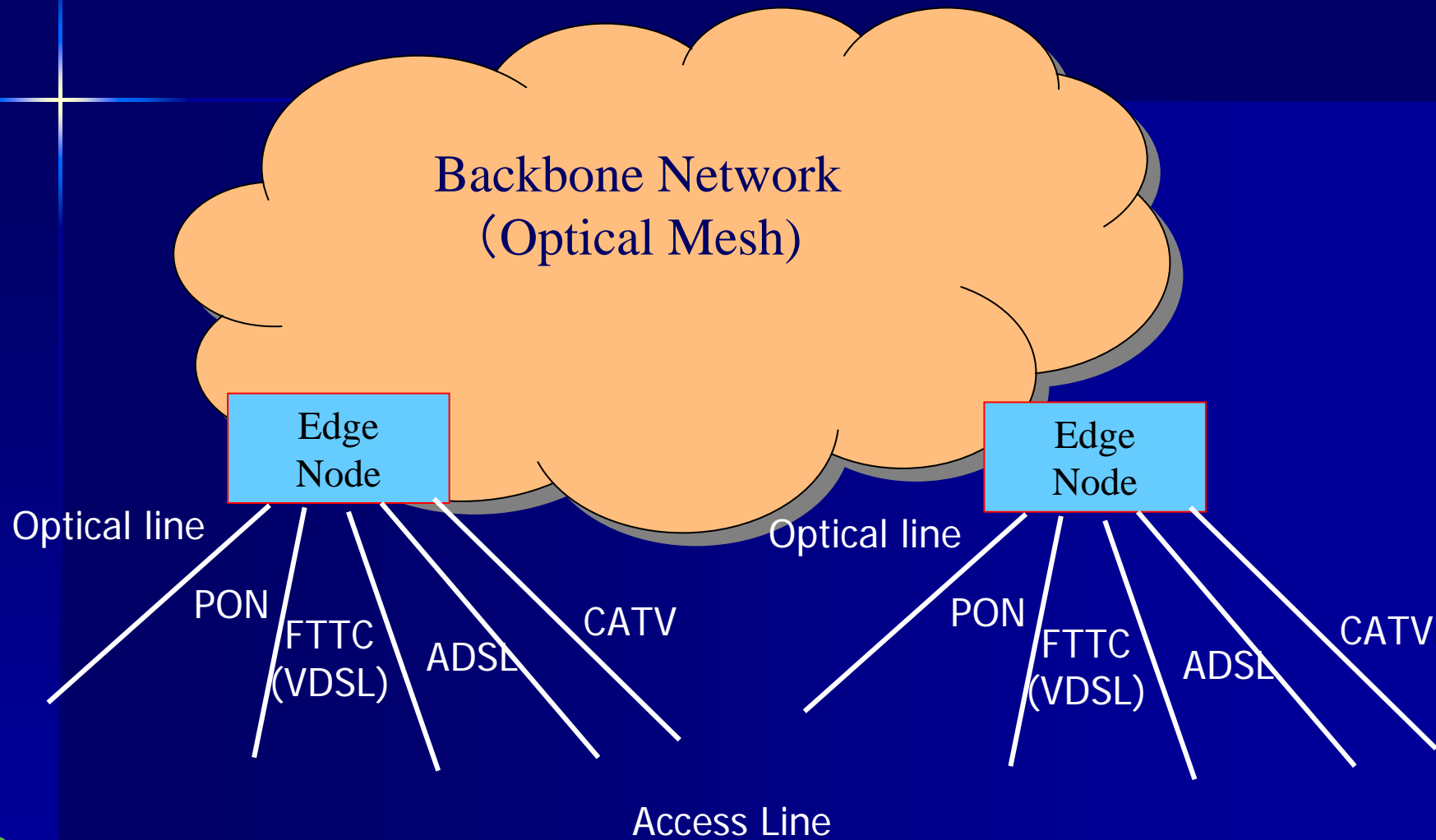
SDH (1988)



The change of the Transmission Line



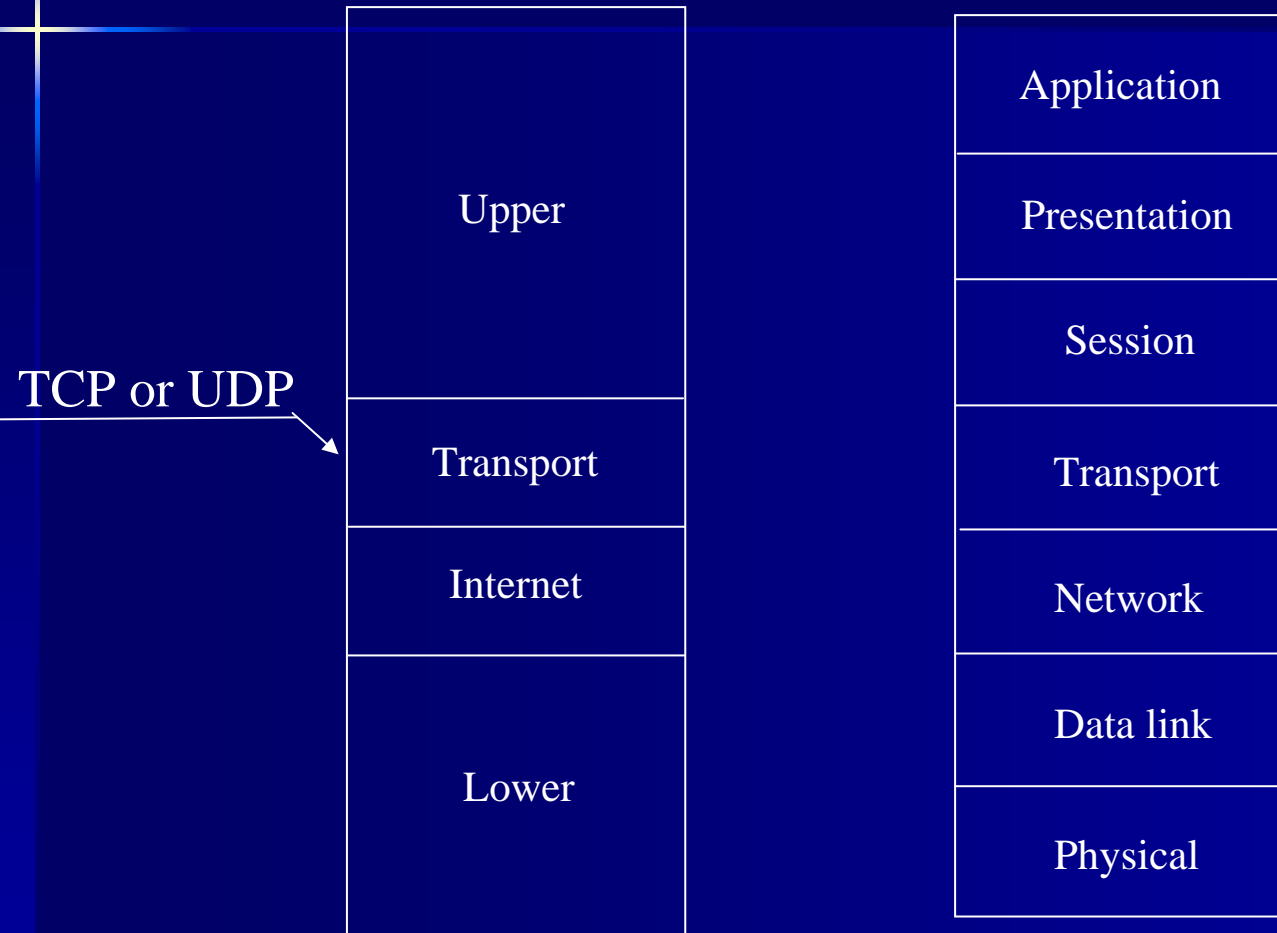
The Transmission Network Configuration



Real-time Data Transmission over IPv4

TCP/IP Internet

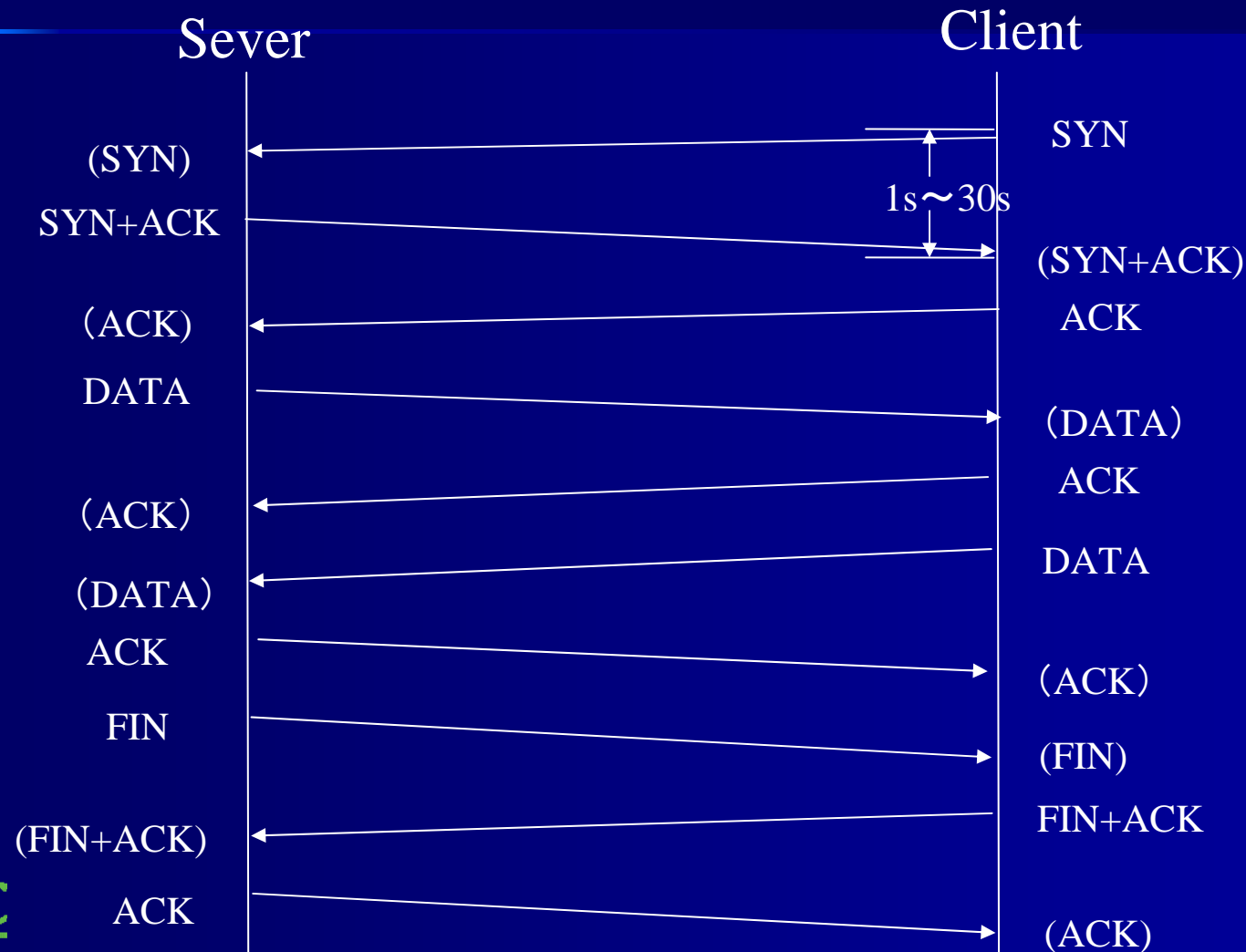
OSI Reference model



Internet protocol architecture

Real-time Data Transmission over TCP/IP

Client-server model is used to transmit the real-time data. TCP connection (full duplex) is established, maintained, and terminated over IP datagram (connectionless).



Leased Line and IP-VPN

Digital Leased Line

High reliability STM (Synchronous Transfer Mode) is used.

- The transmission bandwidth is fixed depending on the digital hierarchy.
- Quality guarantee services are provided,
- the small delay is achieved,
- High cost.

IP-VPN

IP-VPN is originally constructed IP-based virtual private network closed in the telecommunications provider.

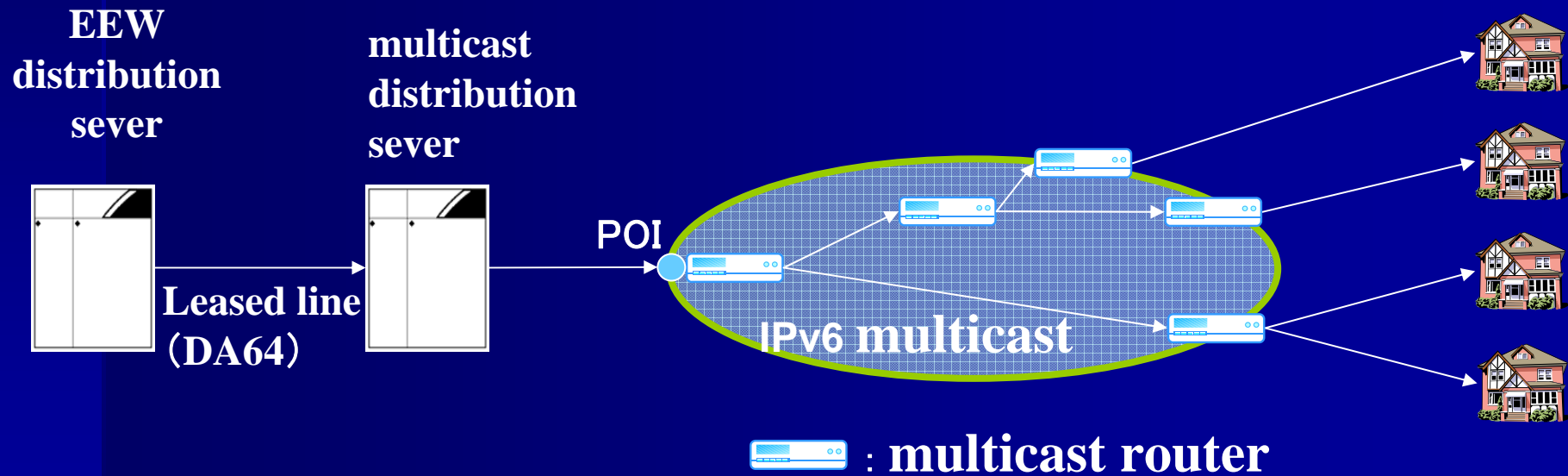
Well known protocol MPLS (Multi-Protocol Label Switching) is usually used for the routing (static routing with the L3 switch).

The bandwidth, and the average delay time etc, are ensured based on the (SLA: Service Level Agreement).

IP V6 Multicast

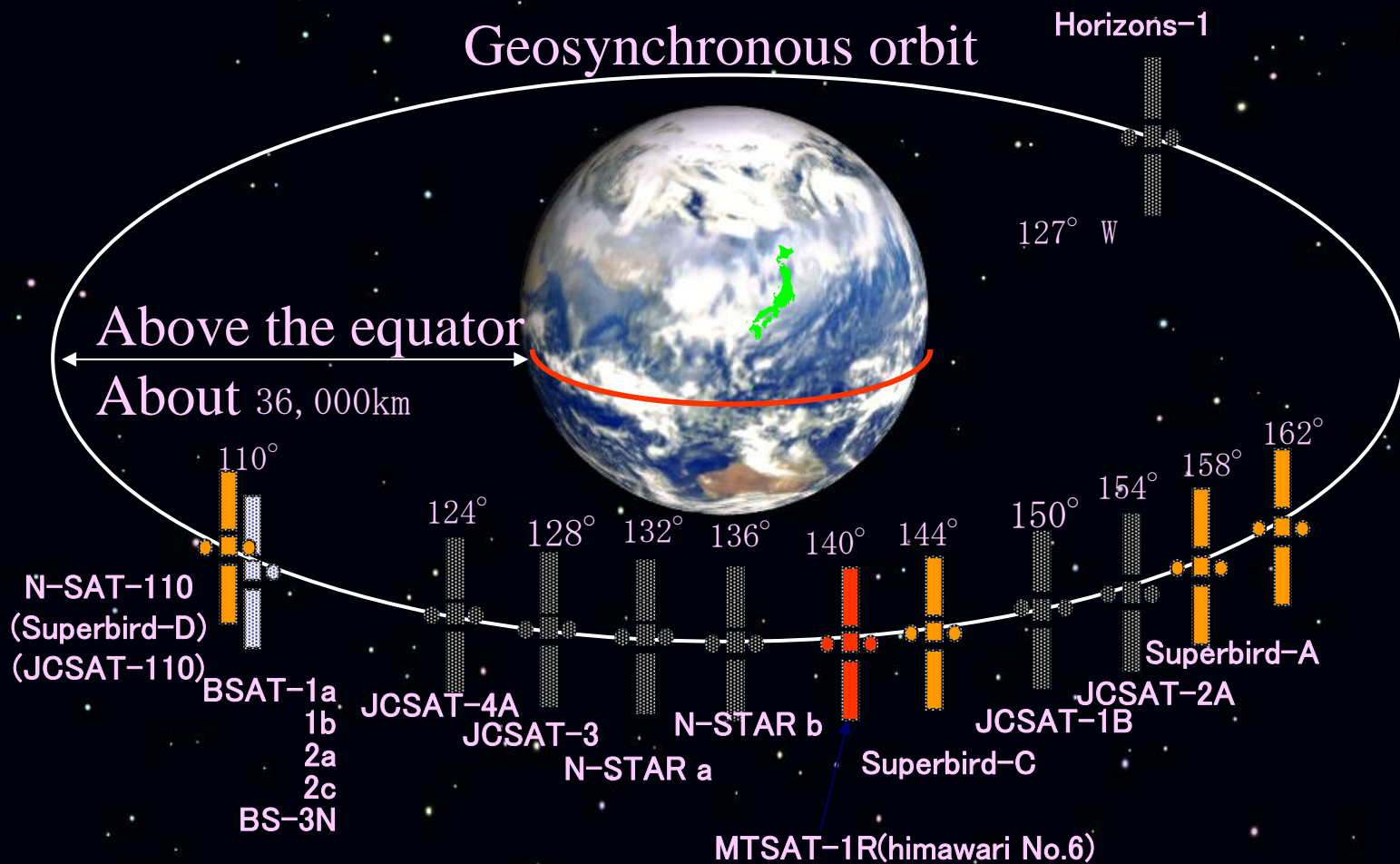
The main functions of the multicast are a data handling function, a group management and multicast security policy providing function.

Single IP packet is sent to multicast router in which the packet is copied of the required number to send to the down stream.



(Communication Satellite) : Communication using space satellite

Main communication and broadcast satellites in Japan



Communication Satellite

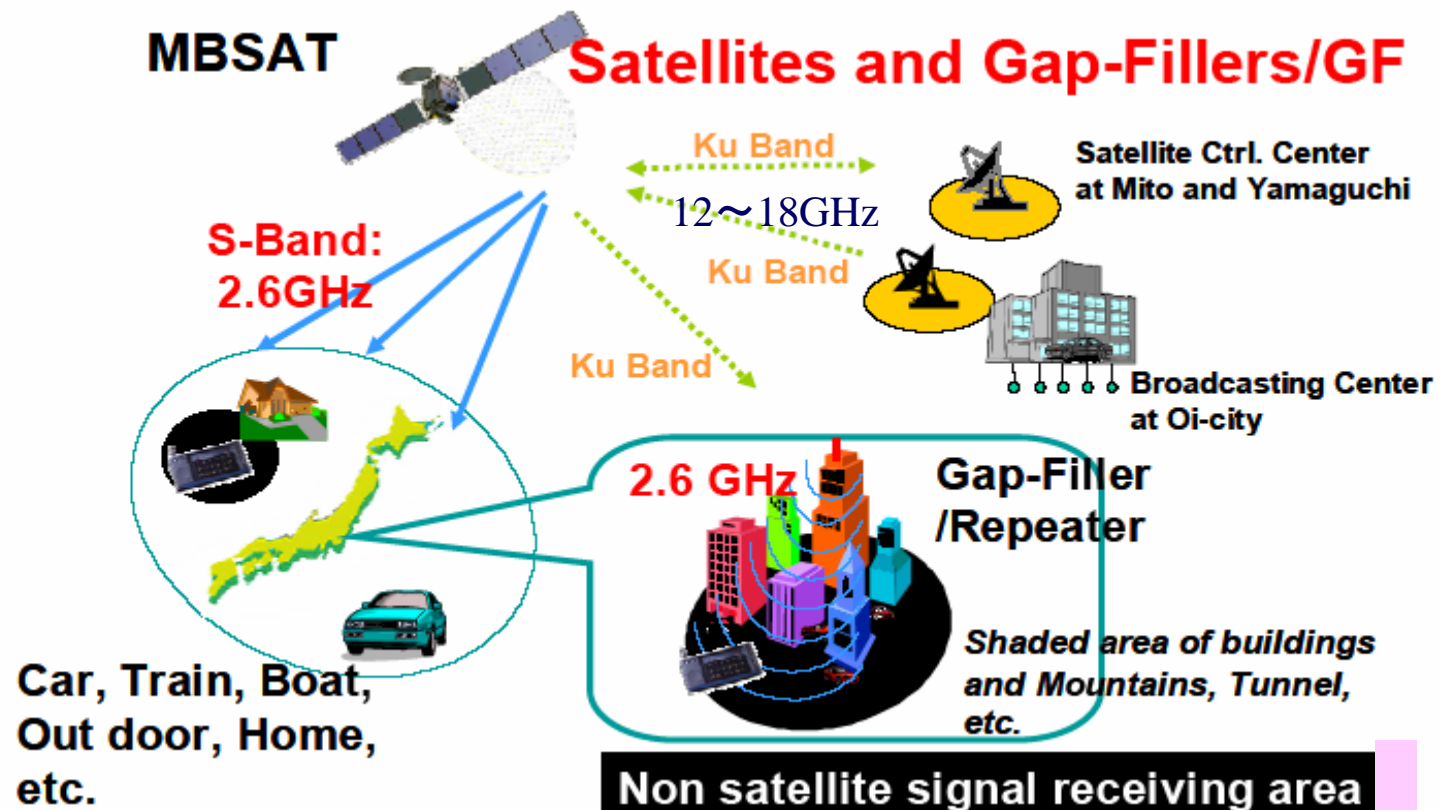
Merits

- Coverage: The whole Japan and foreign countries,
- To broadcast simultaneously throughout the country,
- To provide redundant configuration (Duplicated the center),
- High security is provided,
- Bandwidth flexibly is provided from Several kbps to Several 10Mbps.

Demerits

A fixed propagation delay of about 250 milliseconds is produced.
The line utilization rates of 99.98% or more by heavy rain
(The antenna of 60cm ϕ is used in Tokyo).
To set up the parabolic antenna at the proper position.

Mobile broadcasting Services

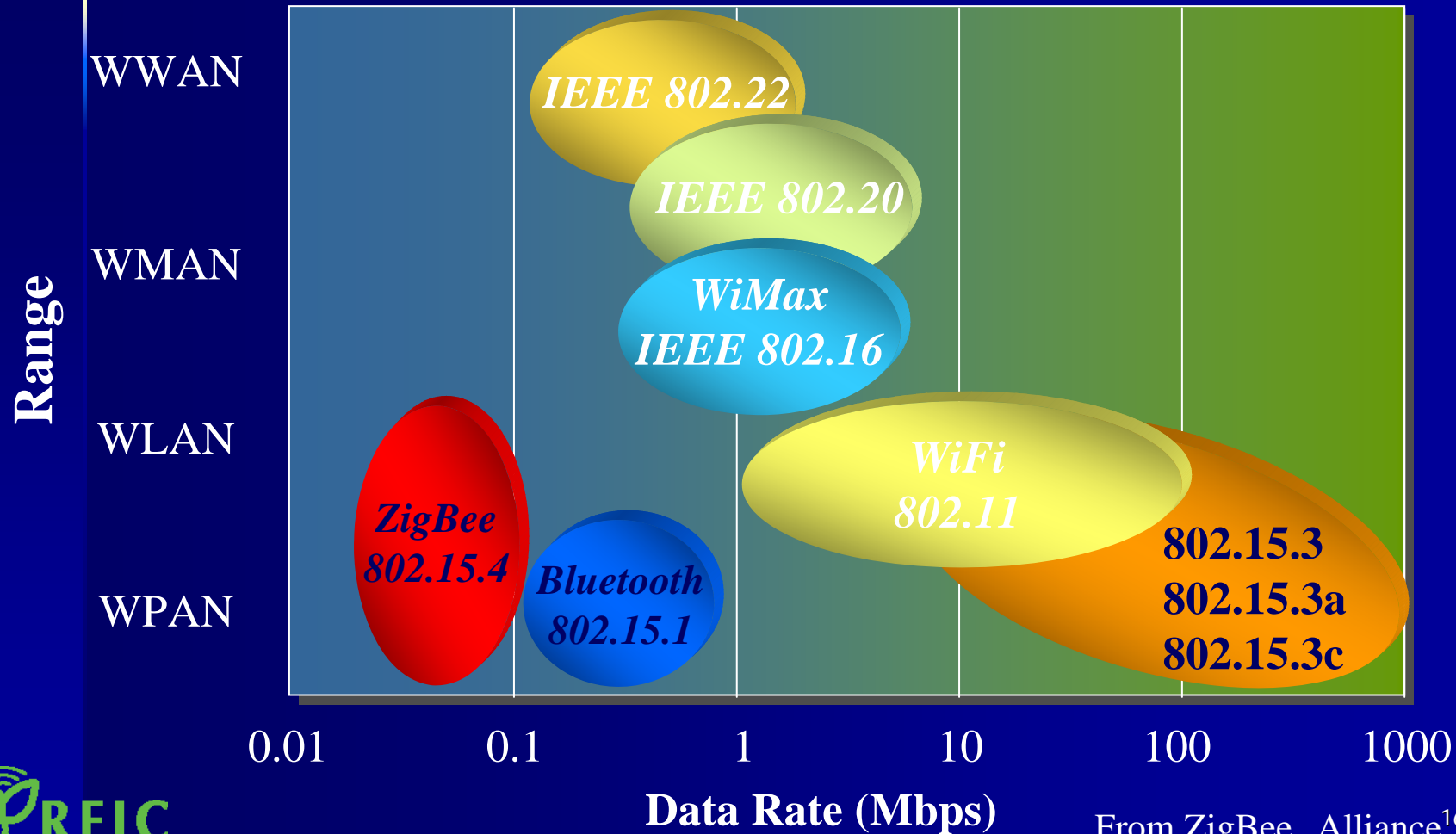


From : <http://www.mobilemonday.jp/presentations/mcbo.pdf>

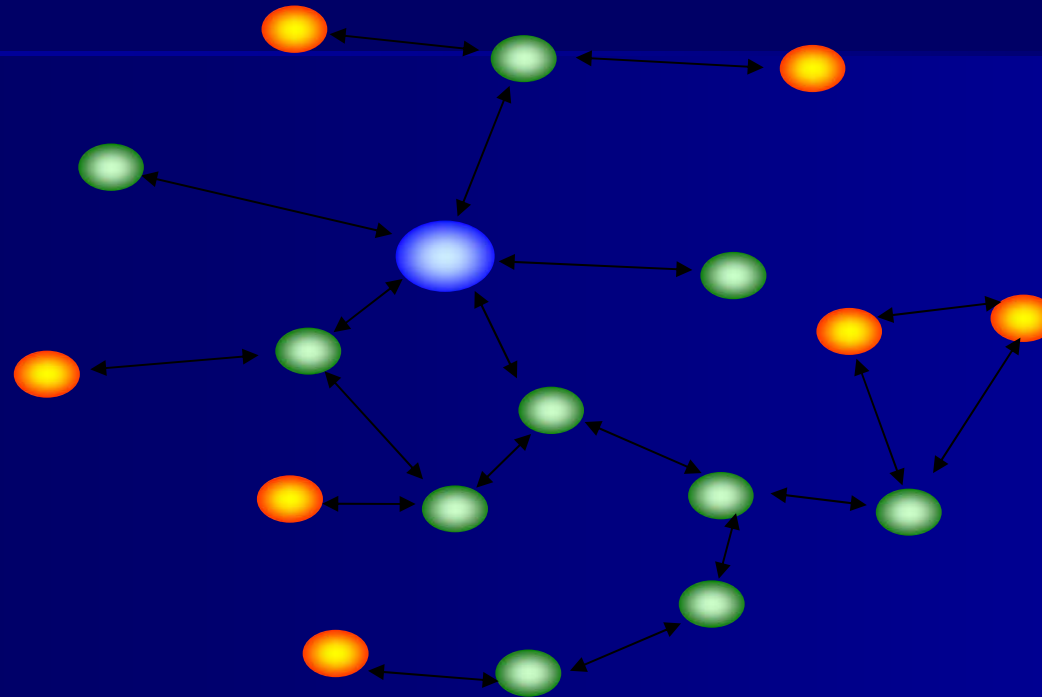
Home Wireless Transmission: ZigBee

Transmission speed: Maximum 250kbps

Transmission Distance: 30m or less



ZigBee Network



- Interconnection among the sensors and the controllers.
- Topologically 64k terminals.
- Zigbee is used among the wireless LANs utilized the 2.4GHz band in Japan.

Summary of the Data Transmission

	Leased Line	The internet (TCP)	IPv6 multicast	CS
Transmission delay	Smallest	Large (fluctuate)	Small	Large (stationary)
multicast	none	none	practicable	practicable
reliability	High	Low	Relatively safe	High
Cost	High	Lowest	Low	Highest

Public Announcement

Media: Television, radio, and disaster prevention wireless.

Broadcast area: limited.

Content: Certain information is only once sent for the each EEW.

EEW sending criteria: Seismic intensity; 5- or more,
Detection points; 2 or more.

Television

