

e-VLBI over GMPLS

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Decorative blue lines and dots in the bottom-left corner of the slide.

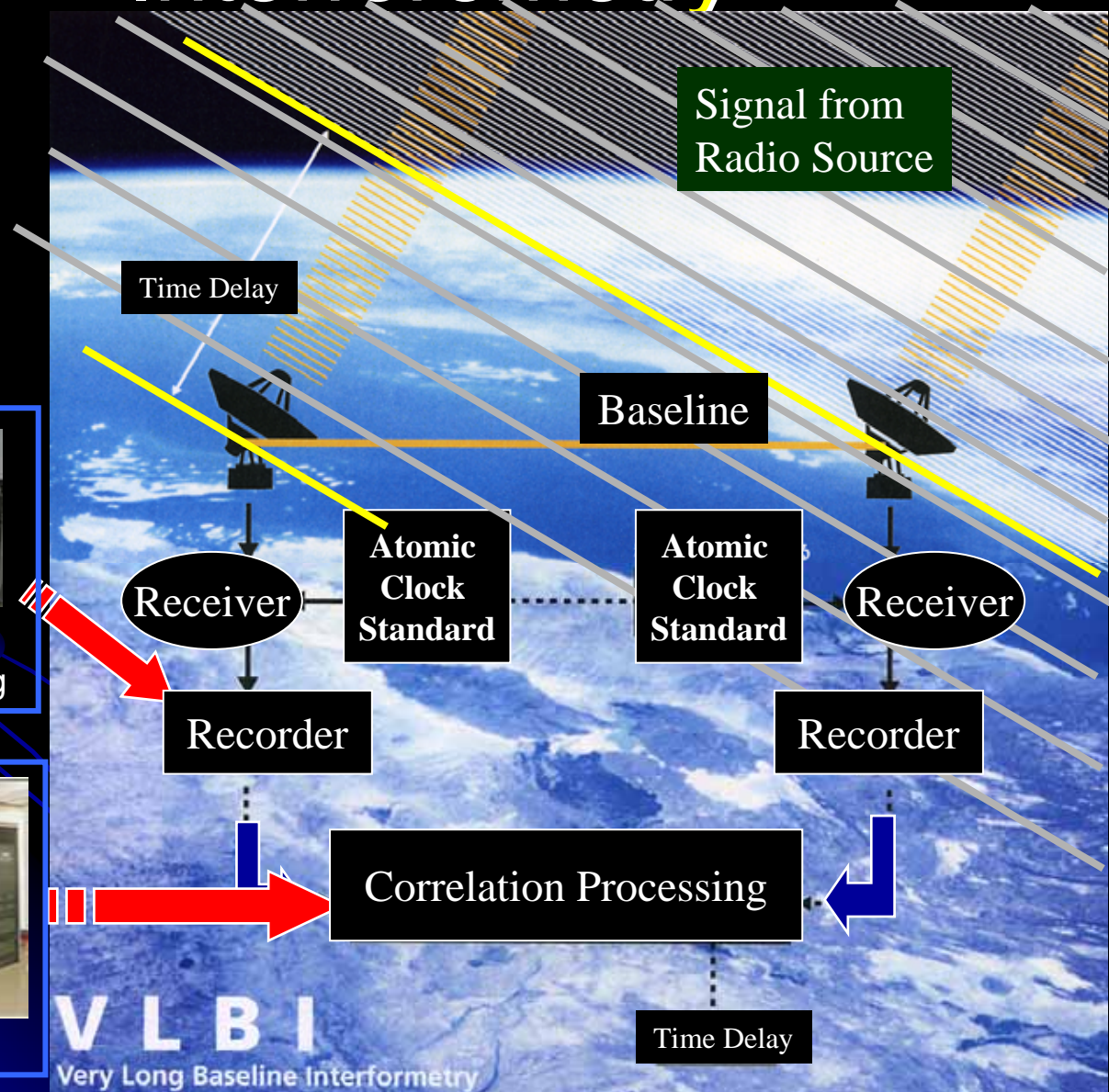
VLBI = Very Long Baseline Interferometry



Radio Telescope



Atomic Time Standard (H-maser)



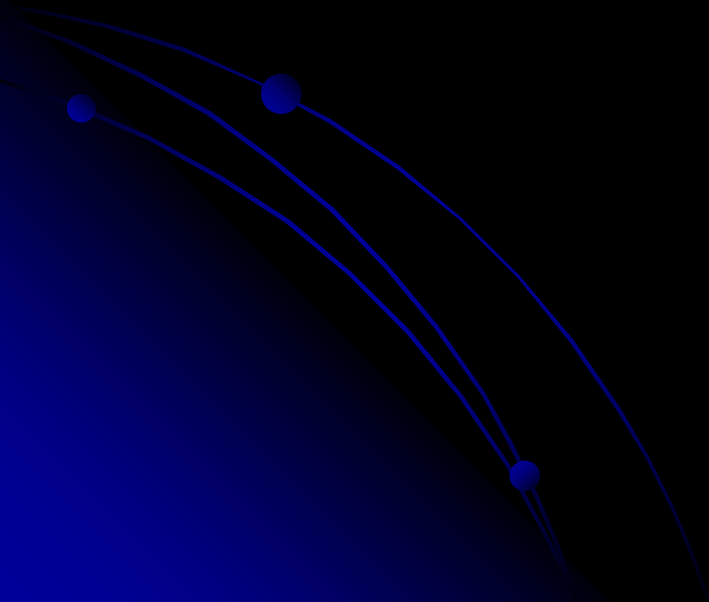
Huge Volume Data Recording



Correlator

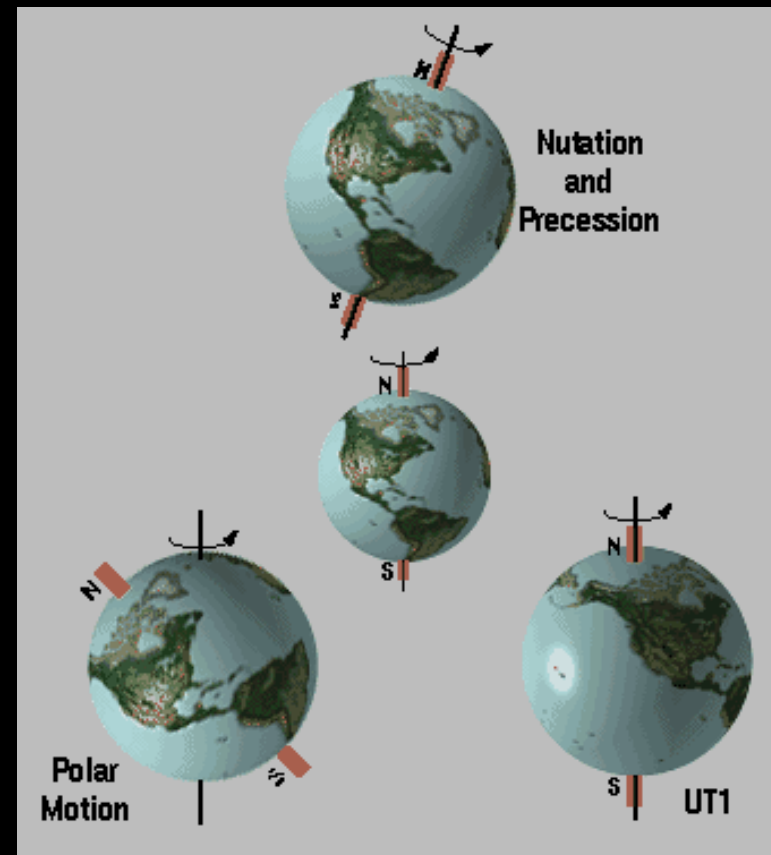
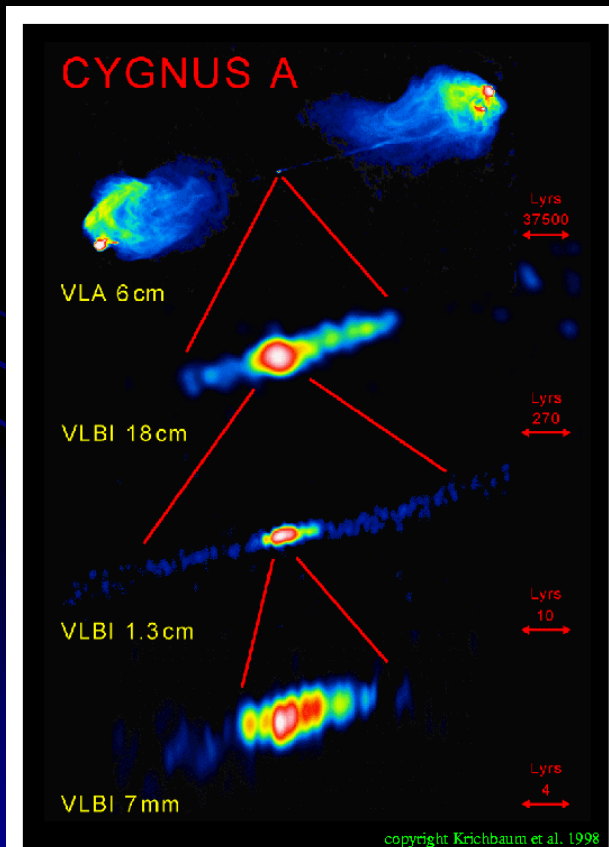
For what VLBI is used for?

- Astronomy
- Geodesy
- Spacecraft Navigation



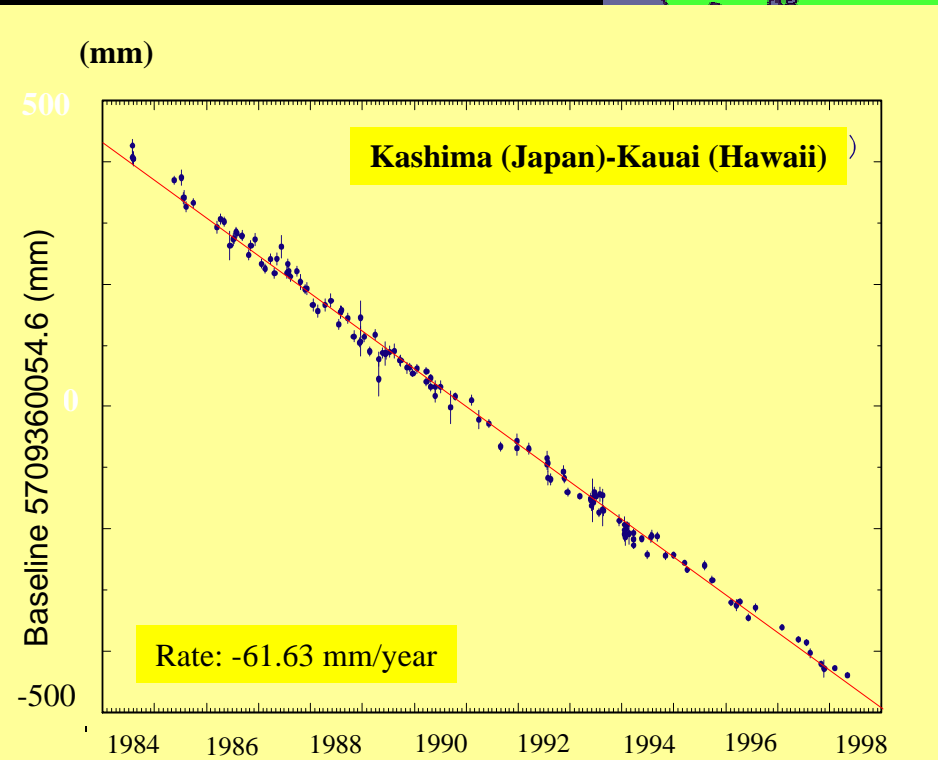
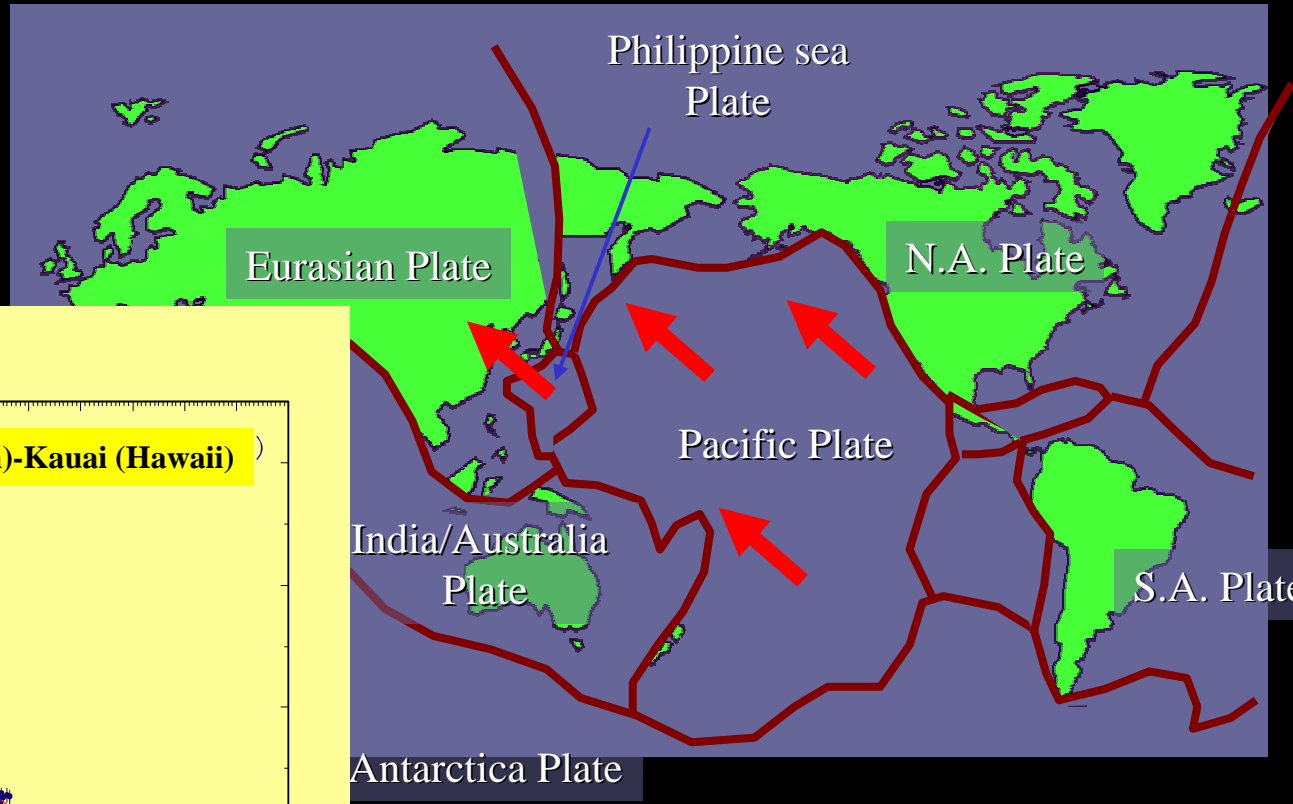
High Resolution Radio Astronomy

1. 100-1000 Times higher than Hubble Telescope (0.1 arc sec)
2. Definition of the Celestial Reference Frame (20 μ -arc sec)



Precise Space Geodesy

mm-precision of baseline measurement



Spacecraft Navigation



**Spacecraft
NOZOMI for
Japanese first
Mars exploration
mission**



HAYABUSA

Cassini-Huygens mission

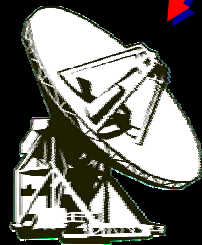


Saturn Exploration
Cassini-Huygens by ESA

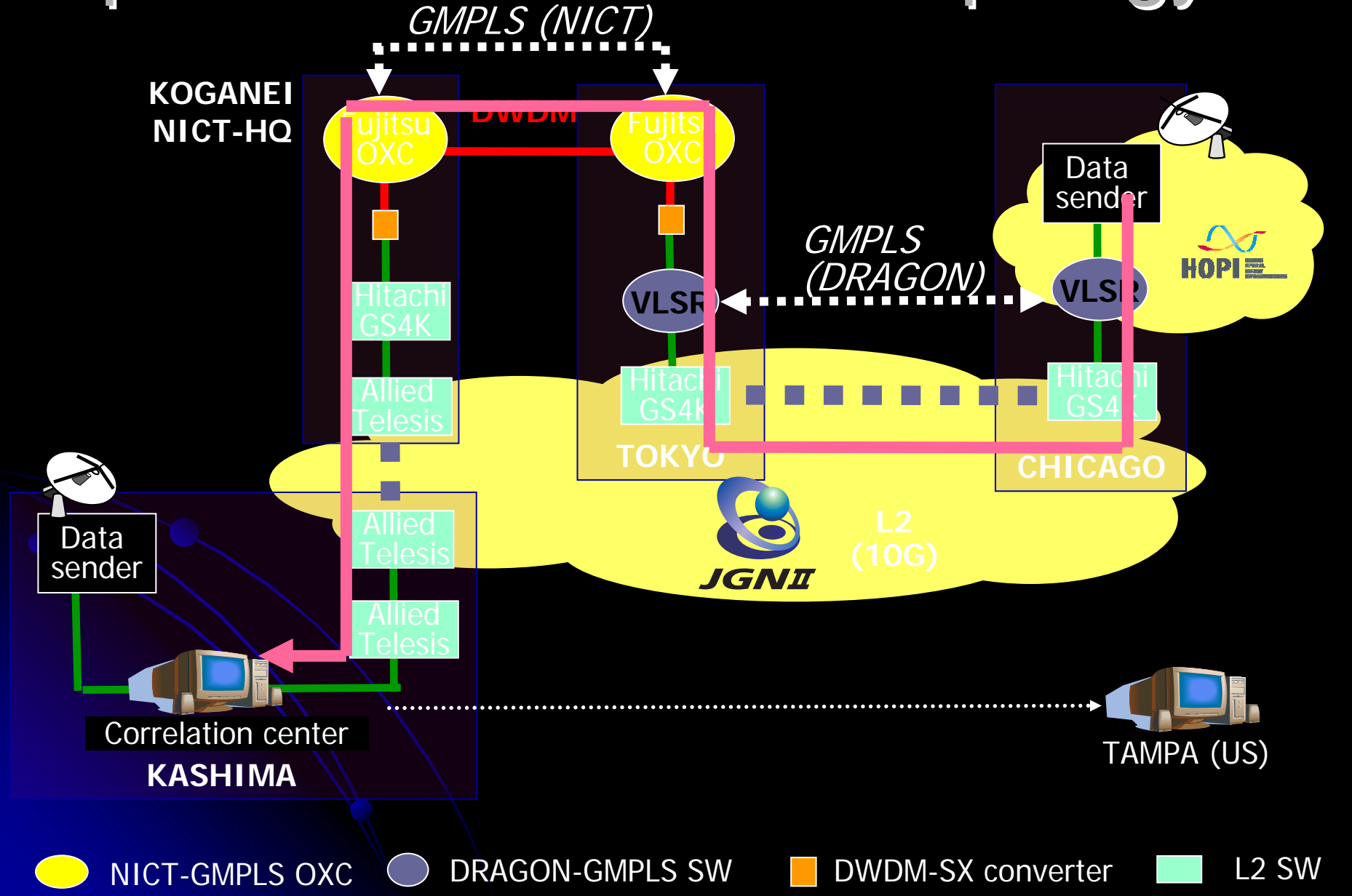
Huygens VLBI-Observation : Wind of Titan
was measured by VLBI tracking of
Huygens



Ground station for Huygens observation



Experimental Network Topology



Why Dedicated-Bandwidth Path by GMPLS?

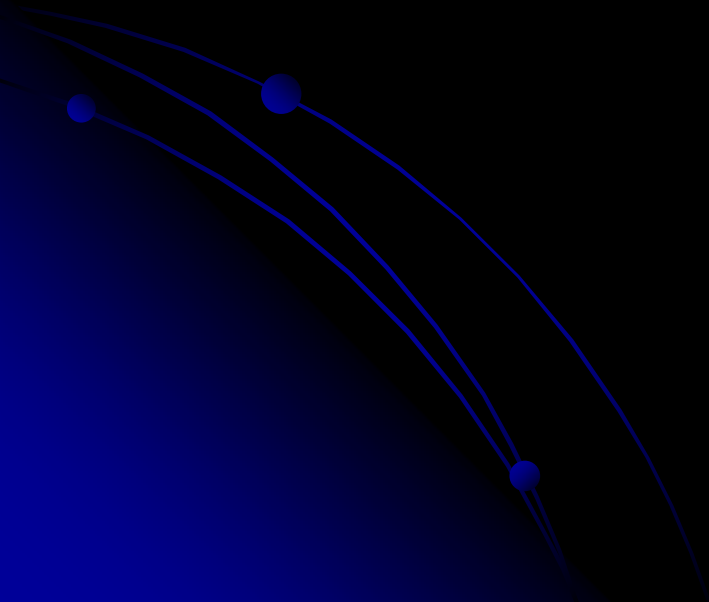
- Three essential requirements in e-VLBI
 - Long Baseline for high angular resolution
 - Large Bandwidth for high sensitivity
 - Real-time data transfer for fast/rapid turnaround
- Light/Electro-Paths are a promising solution for long-distance, high-speed, and real-time e-VLBI with guaranteed bandwidth.
- RSVP-TE of GMPLS establishes dedicated communication paths **automatically** and **speedily**.
 - Chicago → Kashima in case of this demonstration.

Network Overview



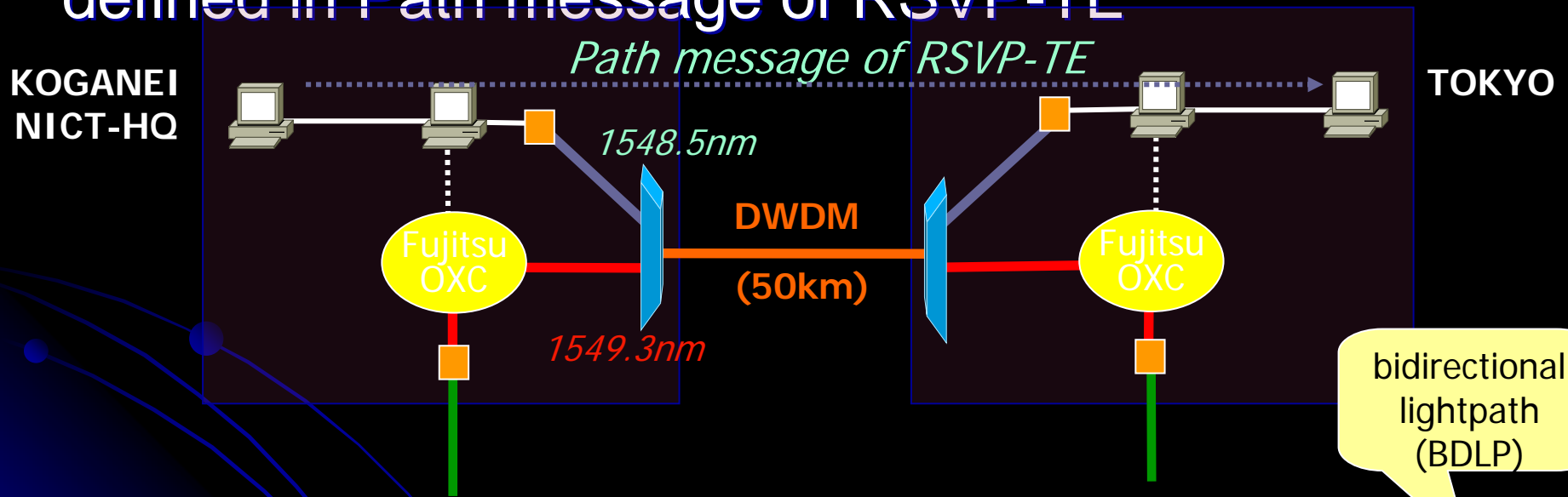
- Network
 - L1: JGN2 (Tokyo metro)
 - L2: JGN2, HOPI (Transpacific, Tokyo-Kashima)
 - L3: APAN, TransPAC, Abilene
- GMPLS
 - DRAGON's GMPLS provisions Chicago-Tokyo Path
 - NICT's GMPLS provisions Tokyo-Koganei Wavelength path
 - Use the same wavelength in both directions
- Contributions
 - Chris Tracy and Jerry Sobieski of MAX/DRAGON
 - Moritaka Kimura, Yasuhiro Koyama (e-VLBI), Sugang Xu, Takatoshi Ikeda, Masaki Hirabaru, and, Hideki Otsuki (Network) of NICT
- Many thanks to
 - JGN2 Osaka RC, Osaka University, and NBCR/UCSD

Thank you for your
attention



Bidirectional Wavelength Paths *NICT*

- Using different wavelengths in up/downstream makes OXC configuration complex
- Need to use the same wavelength in both directions
- An 8-octet “Bidirectional Lightpath Flag Object” is defined in Path message of RSVP-TE



```
usoft(config-rsvp)#  
usoft(config-rsvp)# show rsvp path  
Index      TnlID  LSP-ID  IngressAddress  EgressAddress  role    state  ownLabel  srcLabel  dstLabel  Bdlp  
-----  
1101005704  4      4       10.10.10.1     10.10.10.4    INGRESS ESTA    1000     2000     1  
1101016896  5      5       10.10.10.1     10.10.10.2    INGRESS ESTA    1001     2001     0  
usoft(config-rsvp)#
```

