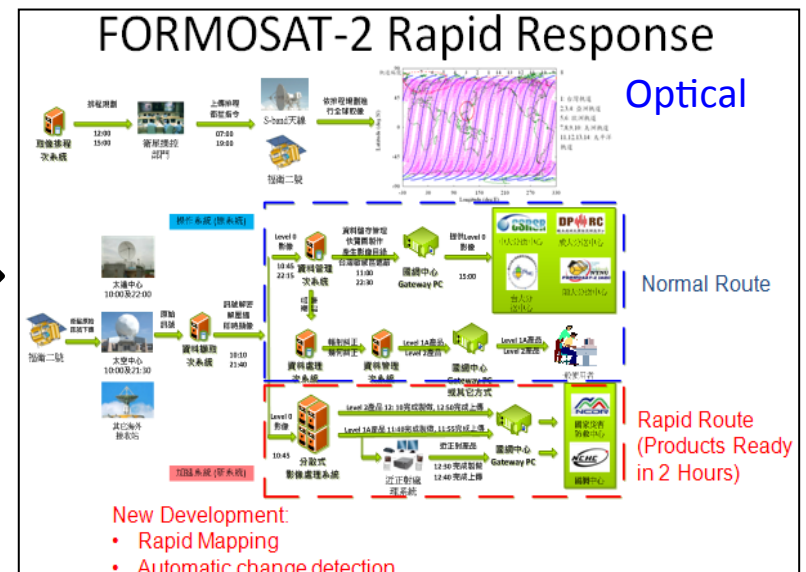
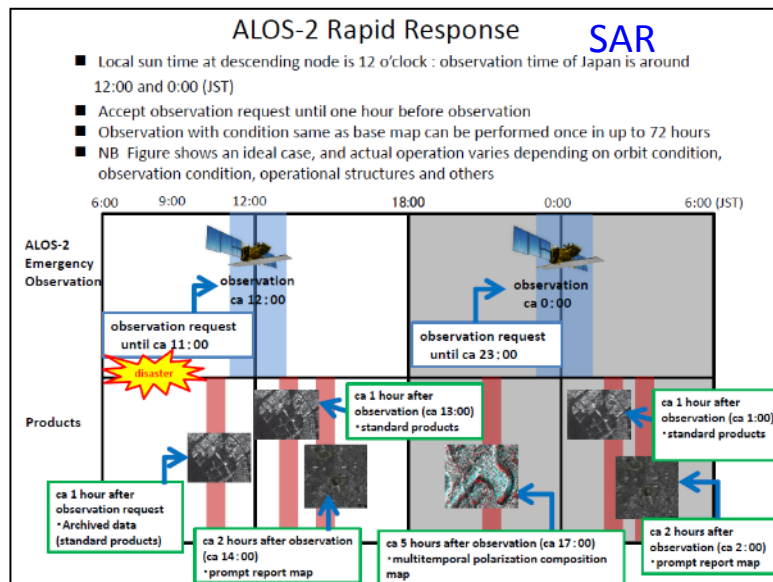


Japan-Taiwan Satellite Image Transmission through PRAGMA Network testbed

Kohei Ichikawa (NAIST),
Shinji Shimojo (Osaka University),
Stoca Chang,
Li-Chi Ku,
Whey-Fone Tsai,
Fang-Pang Lin (NCHC)

Satellite Image Rapid Response to Disaster Event

- Satellite image transmission for rapid response to natural disasters, such as tsunami and earthquake is very critical in Asia Pacific areas. JAXA, Japan and NSPO, Taiwan have planned for possible collaboration of multiple satellites.
- Application case: Emergency Observation and Near real-time satellite image processing are critical for supporting to disaster response between Japan (Tsunami, Earthquake) and Taiwan (Flood, Landslide).
- Complementary utilization of SAR (ALOS-2) (Operated by JAXA, Japan) and Optical (FORMOSAT-2) satellite image. (Operated by NSPO, Taiwan)

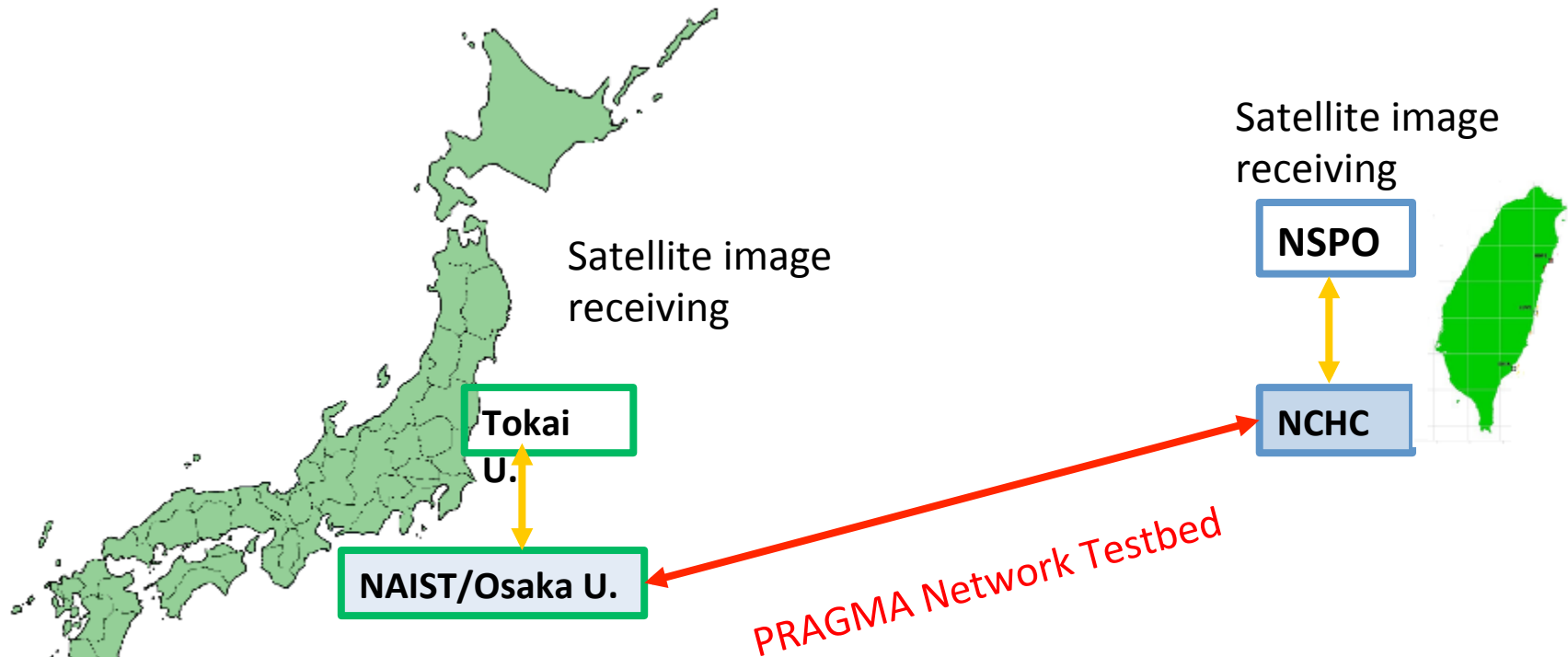


Emergency Observation

- Complementary utilization of SAR (ALOS-2) and Optical (FORMOSAT-2) satellite image
- Rapid Response
 - ALOS-2: accept EO request until one hour before observation, and provide data one hour after observation.
 - FORMOSAT-2: accept EO request until 13:00, and provide data two hours after observation.
 - Satellite Image transmission speed and efficiency in oversea affect the time of response to a natural disaster.

*Synthetic-aperture radar (*SAR*) is a form of radar which is used to create *images* of an object, such as a landscape. SAR can penetrate cloud during observation.

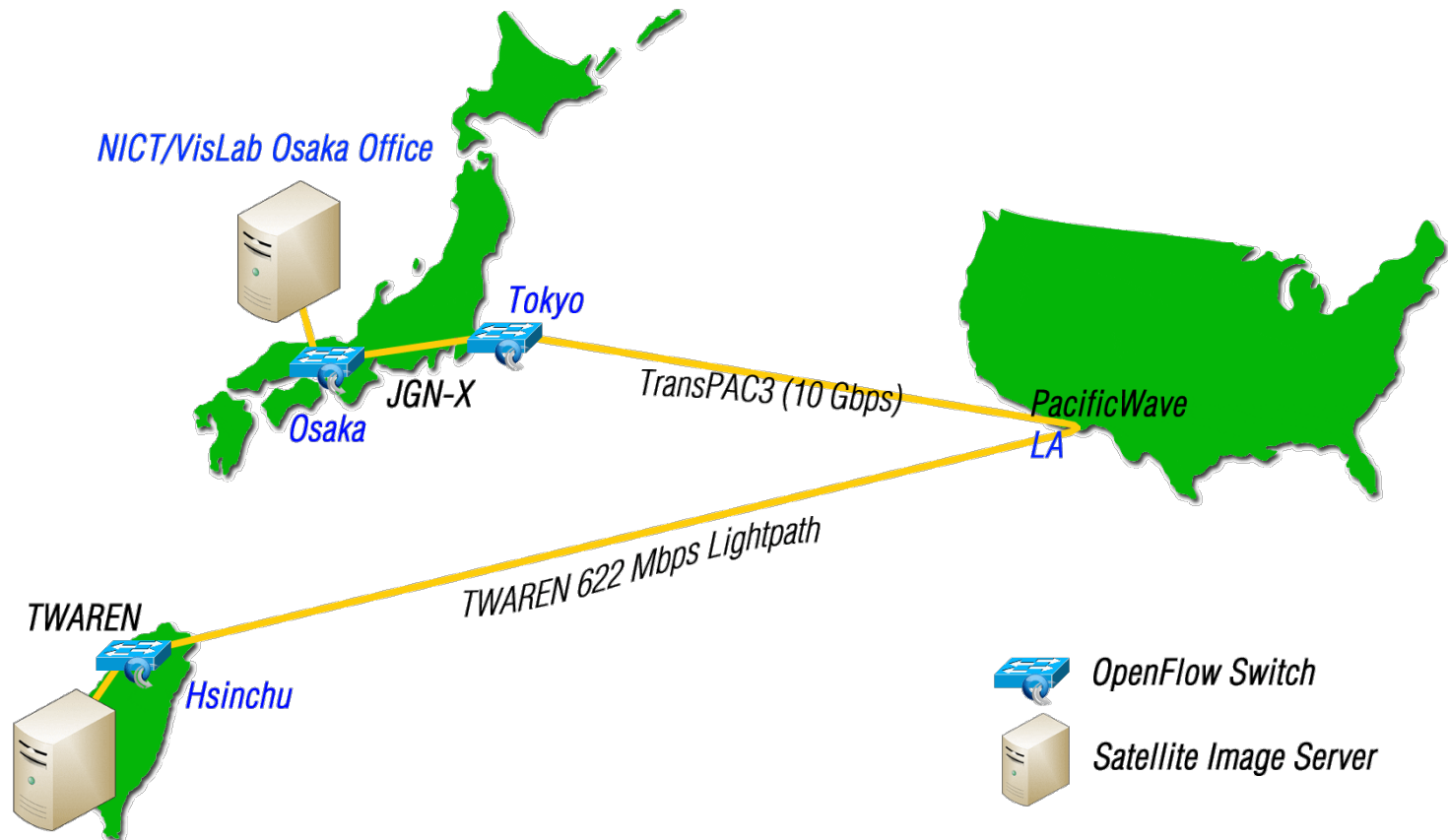
Idea Plan (unofficial) for Satellite Image Receiving & Oversea Transmission for data sharing between two satellites.



First stage to test the performance of Network for image transmission between NAIST/Osaka U. and NCHC>

Network Topology

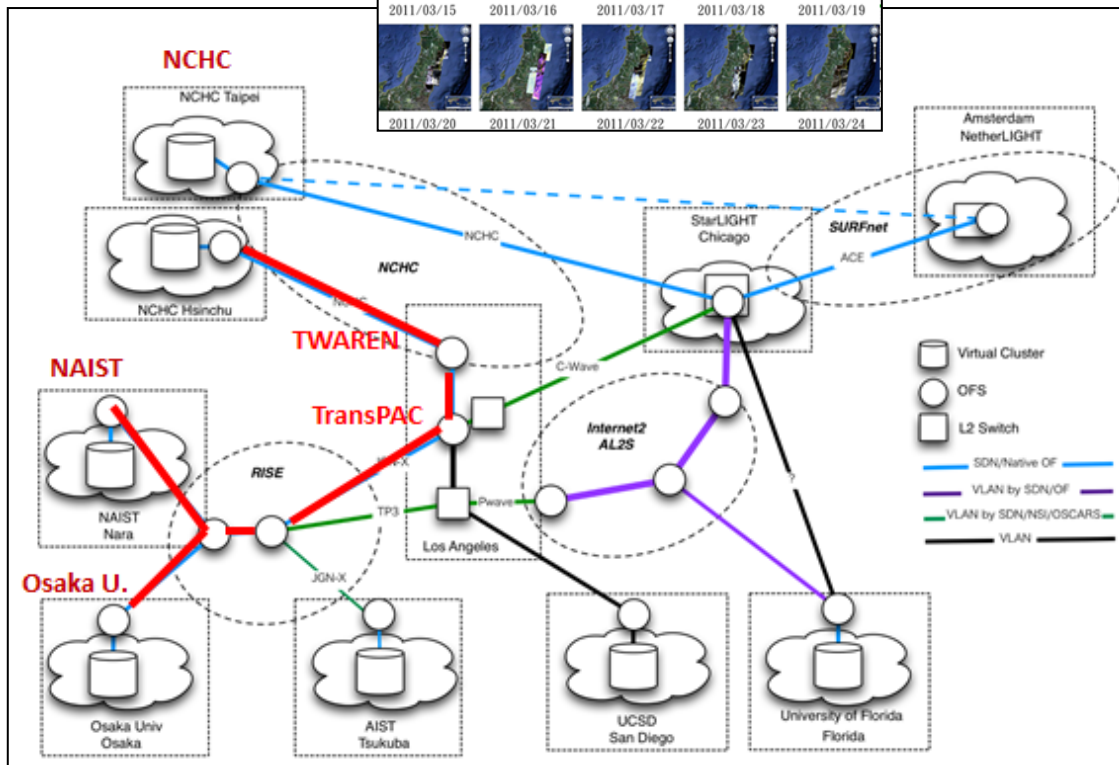
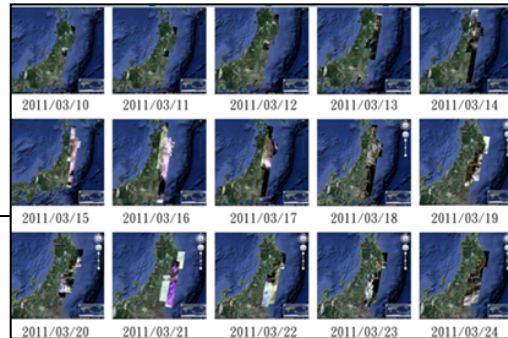
- Through PRAGMA-ENT testbed (end to end SDN)
- TWAREN and JGN-X direct peering in Los Angeles
- Using a dedicated 622 Mbps lightpath



Satellite Image Transmission through PRAGMA Network Testbed

Collaborators: Kohei Ichikawa (NAIST), Shinji Shimojo (Osaka U.), Stoca Chang (NCHC), Li-Chi Ku(NCHC),

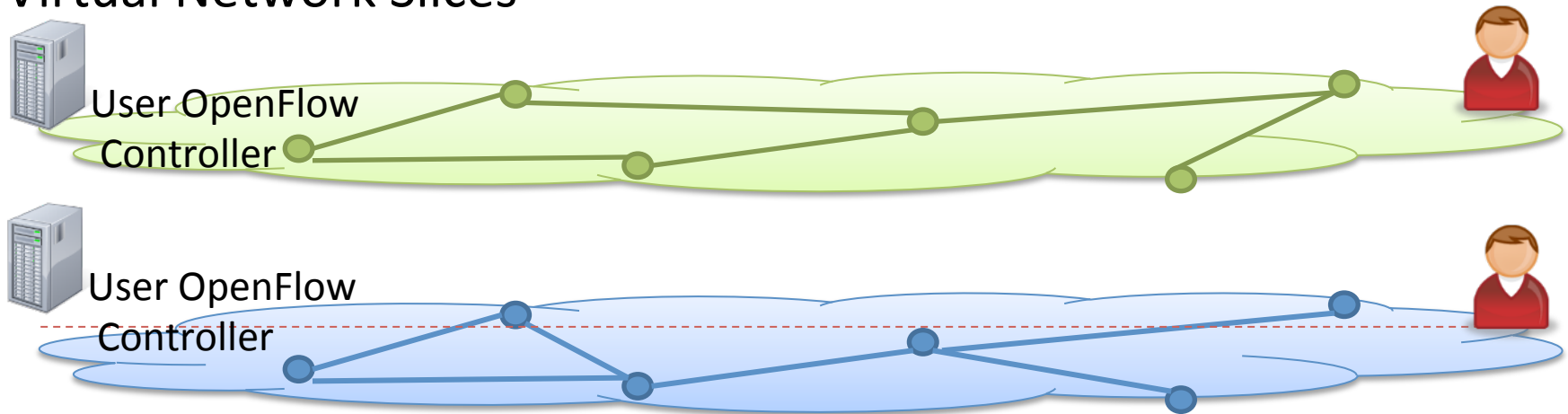
Whey-Fone Tsai (NCHC), Bo Chen (NSPO), Fang-Pang Lin (NCHC)



- ◆ This DEMO connecting network between NAIST & Osaka U-Umeda and NCHC through access of the PRAGMA network testbed via TWAREN and TransPAC networks in oversea.
- ◆ Formosat-2 Satellite images associated with 2011 Tohoku earthquake are used as the demo case for performance study of the network testbed.

Demo environment

Virtual Network Slices



AutoVFlow

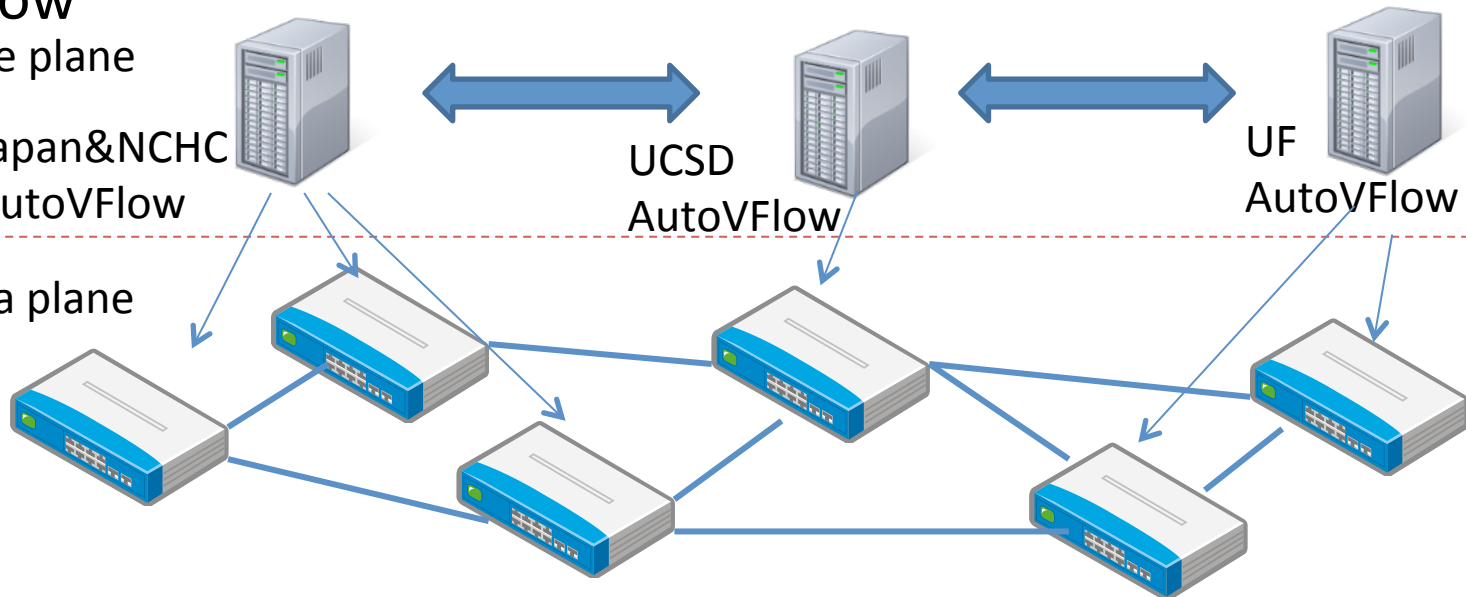
Slice plane

Japan&NCHC
AutoVFlow

UCSD
AutoVFlow

UF
AutoVFlow

Data plane



FS-2 IMAGE for Japan Earthquake

- Method:
 - rsync
- Data set:
 - Total size: 10.7 GB, 59 files.
- Dataset details:
 - 1. Aomori(青森市): 5 files, 422 MB.
 - 2. GOI (五井,市原市): 1 file, 10.2 MB
 - 3. Japan Enhancement: 8 files, 6.18 GB.
 - 4. Iwate(岩手縣) : 39 files, 3.18 GB.
 - 5. Sendai(仙台市) : 6 files, 922 MB.

Network speed test: CASE 1 (Internet)

- NCHC -> NAIST
- Data: 260 MB
- Speed (Internet):
 - 2.06 MB/s
- Time: 2min/10sec

```
140.110.27.193:4322 -
系统管理员: 命令提示字元
[InchEsd-lemon rsyncNCHC]$ pwd
/home/nchc/rsyncNCHC/rsyncNCHC
[InchEsd-lemon rsyncNCHC]$ ls -l
total 215888
-rwx----- 1 nchc nchc 283470 Feb 12 03:30 cgsqpe72log.txt
-rwx----- 1 nchc nchc 220496321 Dec 17 12:13 imgclip_geo.tif
drwx----- 2 nchc nchc 4096 Mar 18 16:36 Nantou_slope
-rwx----- 1 nchc nchc 276781 Feb 12 04:20 qpelog.txt
[InchEsd-lemon rsyncNCHC]$ ls
cgsqpe72log.txt imgclip_geo.tif Nantou_slope qpelog.txt
[InchEsd-lemon rsyncNCHC]$ cd..
-bash: cd..: command not found
[InchEsd-lemon rsyncNCHC]$ cd ..
[InchEsd-lemon rsyncNCHC]$ ls
rsyncNCHC
[InchEsd-lemon rsyncNCHC]$ rm -rf rsyncNCHC/
rm: cannot remove 'rsyncNCHC/': Is a directory
[InchEsd-lemon rsyncNCHC]$ rm -rf rsyncNCHC/
[InchEsd-lemon rsyncNCHC]$ ks
-bash: ks: command not found
[InchEsd-lemon rsyncNCHC]$ ls
[InchEsd-lemon rsyncNCHC]$ cd ..
[InchEsd-lemon ~]$ ls
rsyncNAIST rsyncNCHC
[InchEsd-lemon ~]$ rm -rf *
[InchEsd-lemon ~]$ ls
[InchEsd-lemon ~]$ exit
logout
Connection to sd-lemon.naist.jp closed.

C:\Users\Administrator>rsync -avrtzu /cygdrive/c/rsyncNCHC/1.txt nchc@sd-lemon.naist.jp:
sending incremental file list
rsync: link_stat "/cygdrive/c/rsyncNCHC/1.txt" failed: No such file or directory (2)

sent 18 bytes received 11 bytes 19.33 bytes/sec
total size is 0 speedup is 0.00
rsync error: some files/attrs were not transferred (see previous errors) (code 2) at main.c(1165) [sender=3.1.1]

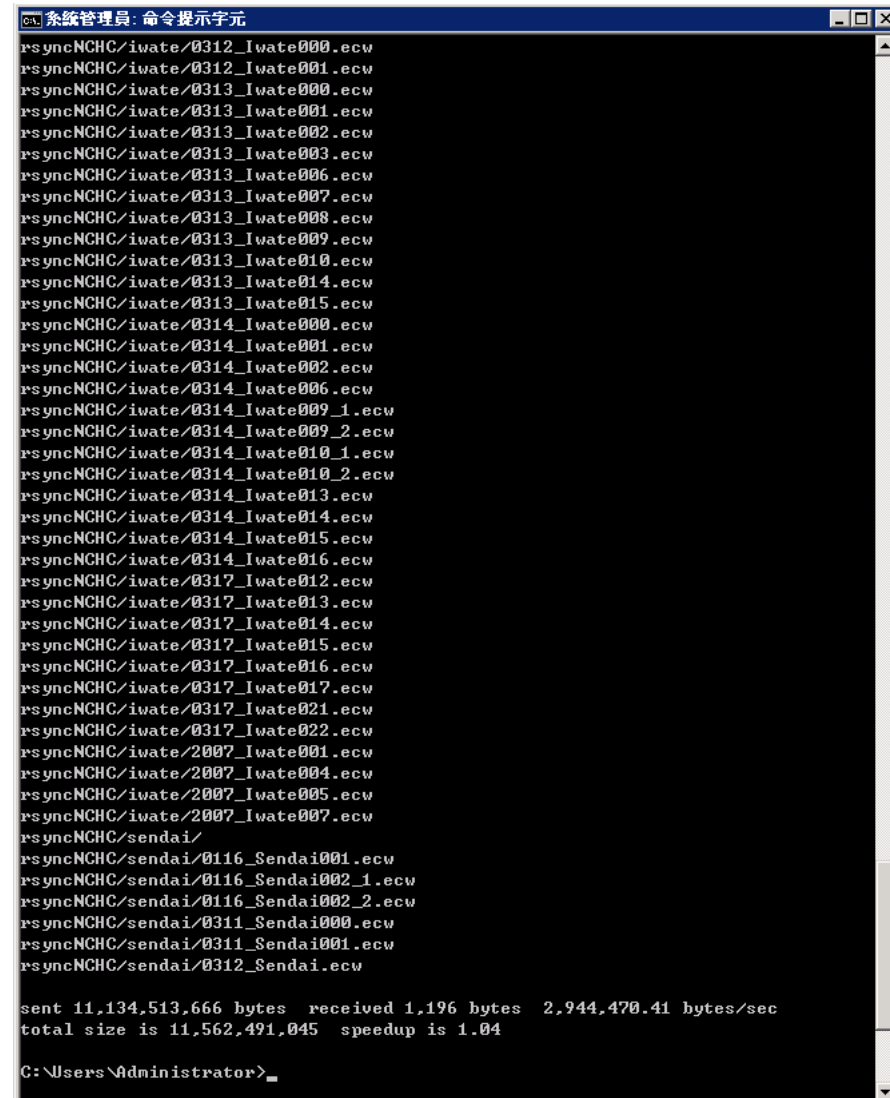
C:\Users\Administrator>rsync -avrtzu /cygdrive/c/rsyncNCHC nchc@sd-lemon.naist.jp:
sending incremental file list
rsyncNCHC/
rsyncNCHC/cgsqpe72log.txt
rsyncNCHC/imgclip_geo.tif
rsyncNCHC/qpelog.txt
rsyncNCHC/Nantou_slope/
rsyncNCHC/Nantou_slope/Nantou_slope.dbf
rsyncNCHC/Nantou_slope/Nantou_slope.prj
rsyncNCHC/Nantou_slope/Nantou_slope.shp
rsyncNCHC/Nantou_slope/Nantou_slope.shx

sent 129,099,538 bytes received 168 bytes 2,776,337.76 bytes/sec
total size is 265,675,018 speedup is 2.06

C:\Users\Administrator>rsync -avrtzu /cygdrive/c/rsyncNCHC nchc@sd-lemon.naist.jp:
```

Network speed test: CASE 1 (Internet)

- NCHC -> NAIST
- Data: 10.7 GB
- Speed (Internet):
 - 2.94 MB/s
- Time: 1hour/3min/2sec



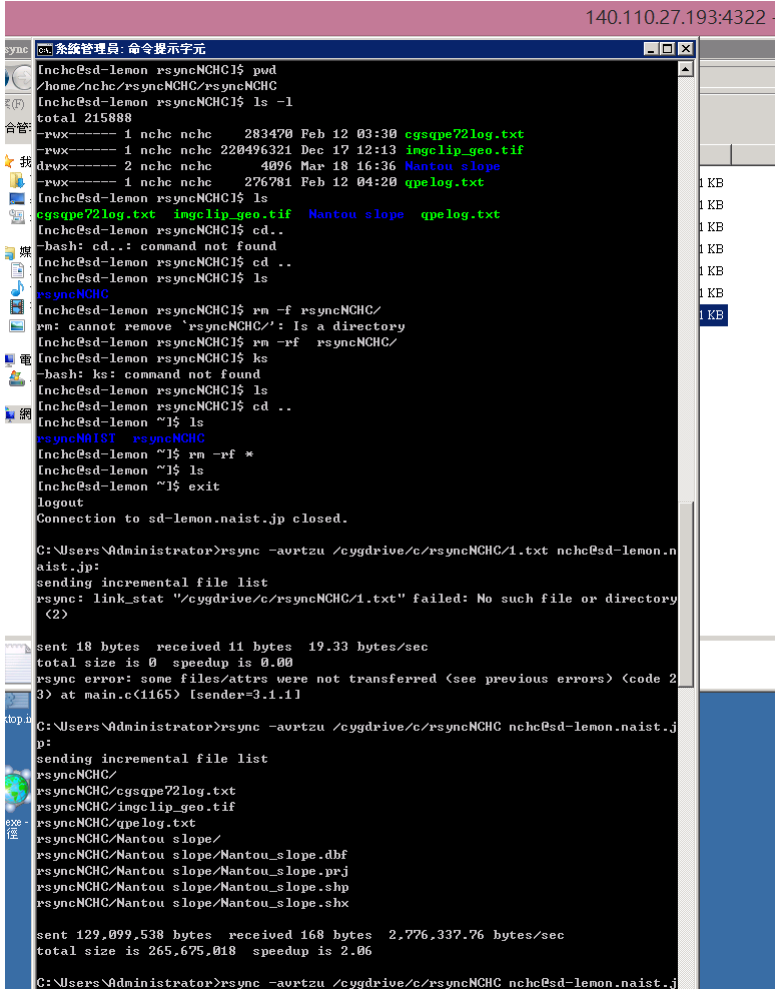
```
系統管理員: 命令提示字元
rsyncNCHC/iwate/0312_Iwate000.ecw
rsyncNCHC/iwate/0312_Iwate001.ecw
rsyncNCHC/iwate/0313_Iwate000.ecw
rsyncNCHC/iwate/0313_Iwate001.ecw
rsyncNCHC/iwate/0313_Iwate002.ecw
rsyncNCHC/iwate/0313_Iwate003.ecw
rsyncNCHC/iwate/0313_Iwate006.ecw
rsyncNCHC/iwate/0313_Iwate007.ecw
rsyncNCHC/iwate/0313_Iwate008.ecw
rsyncNCHC/iwate/0313_Iwate009.ecw
rsyncNCHC/iwate/0313_Iwate010.ecw
rsyncNCHC/iwate/0313_Iwate014.ecw
rsyncNCHC/iwate/0313_Iwate015.ecw
rsyncNCHC/iwate/0314_Iwate000.ecw
rsyncNCHC/iwate/0314_Iwate001.ecw
rsyncNCHC/iwate/0314_Iwate002.ecw
rsyncNCHC/iwate/0314_Iwate006.ecw
rsyncNCHC/iwate/0314_Iwate009_1.ecw
rsyncNCHC/iwate/0314_Iwate009_2.ecw
rsyncNCHC/iwate/0314_Iwate010_1.ecw
rsyncNCHC/iwate/0314_Iwate010_2.ecw
rsyncNCHC/iwate/0314_Iwate013.ecw
rsyncNCHC/iwate/0314_Iwate014.ecw
rsyncNCHC/iwate/0314_Iwate015.ecw
rsyncNCHC/iwate/0314_Iwate016.ecw
rsyncNCHC/iwate/0317_Iwate012.ecw
rsyncNCHC/iwate/0317_Iwate013.ecw
rsyncNCHC/iwate/0317_Iwate014.ecw
rsyncNCHC/iwate/0317_Iwate015.ecw
rsyncNCHC/iwate/0317_Iwate016.ecw
rsyncNCHC/iwate/0317_Iwate017.ecw
rsyncNCHC/iwate/0317_Iwate021.ecw
rsyncNCHC/iwate/0317_Iwate022.ecw
rsyncNCHC/iwate/2007_Iwate001.ecw
rsyncNCHC/iwate/2007_Iwate004.ecw
rsyncNCHC/iwate/2007_Iwate005.ecw
rsyncNCHC/iwate/2007_Iwate007.ecw
rsyncNCHC/sendai/
rsyncNCHC/sendai/0116_Sendai001.ecw
rsyncNCHC/sendai/0116_Sendai002_1.ecw
rsyncNCHC/sendai/0116_Sendai002_2.ecw
rsyncNCHC/sendai/0311_Sendai000.ecw
rsyncNCHC/sendai/0311_Sendai001.ecw
rsyncNCHC/sendai/0312_Sendai.ecw

sent 11,134,513,666 bytes  received 1,196 bytes  2,944.470.41 bytes/sec
total size is 11,562,491,045  speedup is 1.04

C:\Users\Administrator>
```

Network speed test: CASE 2 (PRAGMA NETWORK TESTBED)

- NCHC -> NAIST
- Data: 3.54GB
- Speed (PRAGMA):
 - 5.43 MB/s
- Time
 - 10min/51.5sec



```
140.110.27.193:4322 -
rsync 系统管理员: 命令提示字元
InchEdsd-lemon rsyncNCHC1$ pwd
/home/nchc/rsyncNCHC/rsyncNCHC
InchEdsd-lemon rsyncNCHC1$ ls -l
total 215888
-rwx----- 1 nchc nchc 283470 Feb 12 03:30 cgsqpe72log.txt
-rwx----- 1 nchc nchc 220496321 Dec 17 12:13 ingclip_geo.tif
drwx----- 2 nchc nchc 4096 Mar 18 16:36 Nantou slope
-rwx----- 1 nchc nchc 276781 Feb 12 04:20 qpelog.txt
InchEdsd-lemon rsyncNCHC1$ ls
cgsqpe72log.txt ingclip_geo.tif Nantou slope qpelog.txt
InchEdsd-lemon rsyncNCHC1$ cd..
-bash: cd..: command not found
InchEdsd-lemon rsyncNCHC1$ cd ..
InchEdsd-lemon rsyncNCHC1$ ls
rsyncNCHC
InchEdsd-lemon rsyncNCHC1$ rm -f rsyncNCHC/
rm: cannot remove 'rsyncNCHC/': Is a directory
InchEdsd-lemon rsyncNCHC1$ rm -rf rsyncNCHC/
InchEdsd-lemon rsyncNCHC1$ ks
-bash: ks: command not found
InchEdsd-lemon rsyncNCHC1$ ls
InchEdsd-lemon rsyncNCHC1$ cd ..
InchEdsd-lemon ~1$ ls
rsyncNAIST rsyncNCHC
InchEdsd-lemon ~1$ rm -rf *
InchEdsd-lemon ~1$ ls
InchEdsd-lemon ~1$ exit
logout
Connection to sd-lemon.naist.jp closed.

C:\Users\Administrator>rsync -avrtzu /cygdrive/c/rsyncNCHC/1.txt nchcEdsd-lemon.naist.jp:
sending incremental file list
rsync: link_stat "/cygdrive/c/rsyncNCHC/1.txt" failed: No such file or directory
(2)

sent 18 bytes received 11 bytes 19.33 bytes/sec
total size is 0 speedup is 0.00
rsync error: some files/attrs were not transferred (see previous errors) (code 2
3) at main.c(1165) [sender=3.1.1]

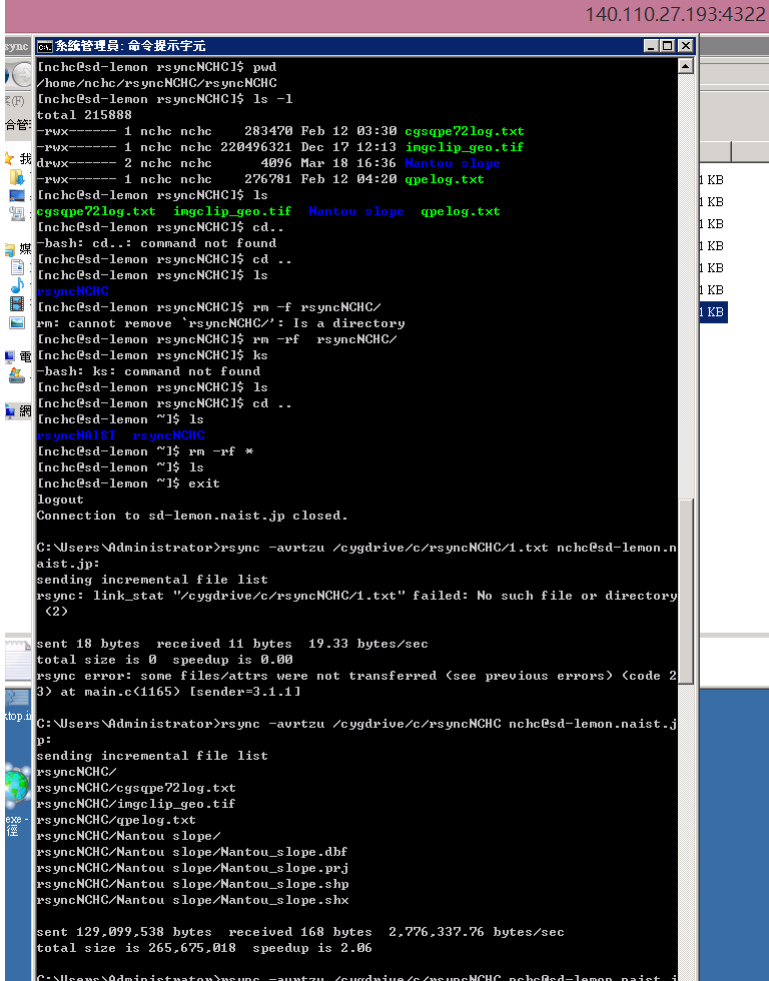
C:\Users\Administrator>rsync -avrtzu /cygdrive/c/rsyncNCHC nchcEdsd-lemon.naist.jp:
sending incremental file list
rsyncNCHC/
rsyncNCHC/cgsqpe72log.txt
rsyncNCHC/ingclip_geo.tif
rsyncNCHC/qpelog.txt
rsyncNCHC/Nantou slope/
rsyncNCHC/Nantou slope/Nantou_slope.dbf
rsyncNCHC/Nantou slope/Nantou_slope.prj
rsyncNCHC/Nantou slope/Nantou_slope.shp
rsyncNCHC/Nantou slope/Nantou_slope.shx

sent 129,099,538 bytes received 168 bytes 2,776,337.76 bytes/sec
total size is 265,675,018 speedup is 2.06

C:\Users\Administrator>rsync -avrtzu /cygdrive/c/rsyncNCHC nchcEdsd-lemon.naist.jp:
```

Network speed test: CASE 2 (PRAGMA NETWORK TESTBED)

- NAIST -> NCHC
- Data: 442MB
- Speed (PRAGMA):
 - 6.11 MB/s
- Time
 - 72.49sec



The screenshot shows a terminal window titled "系统管理员: 命令提示字元" (System Administrator: Command Prompt) with a window ID of 140.110.27.193:4322. The terminal displays the following commands and output:

```
Inchc@sd-lemon rsyncNCHC1$ pwd
/home/nchc/rsyncNCHC/rsyncNCHC
Inchc@sd-lemon rsyncNCHC1$ ls -l
total 215888
-rwx----- 1 nchc nchc 283470 Feb 12 03:30 cgsqpe72log.txt
-rwx----- 1 nchc nchc 220496321 Dec 17 12:13 ingclip_geo.tif
drwx----- 2 nchc nchc 4096 Mar 18 16:36 Nantou slope
-rwx----- 1 nchc nchc 276781 Feb 12 04:20 qpelog.txt
Inchc@sd-lemon rsyncNCHC1$ ls
cgsqpe72log.txt ingclip_geo.tif Nantou slope qpelog.txt
Inchc@sd-lemon rsyncNCHC1$ cd..
-bash: cd..: command not found
Inchc@sd-lemon rsyncNCHC1$ cd ..
Inchc@sd-lemon rsyncNCHC1$ ls
rsyncNCHC
Inchc@sd-lemon rsyncNCHC1$ rm -f rsyncNCHC/
rm: cannot remove 'rsyncNCHC/': Is a directory
Inchc@sd-lemon rsyncNCHC1$ rm -rf rsyncNCHC/
Inchc@sd-lemon rsyncNCHC1$ ks
-bash: ks: command not found
Inchc@sd-lemon rsyncNCHC1$ ls
Inchc@sd-lemon rsyncNCHC1$ cd ..
Inchc@sd-lemon ~1$ ls
rsyncNAIST rsyncNCHC
Inchc@sd-lemon ~1$ rm -rf *
Inchc@sd-lemon ~1$ ls
Inchc@sd-lemon ~1$ exit
logout
Connection to sd-lemon.naist.jp closed.

C:\Users\Administrator>rsync -avrtzu /cygdrive/c/rsyncNCHC/1.txt nchc@sd-lemon.naist.jp:
sending incremental file list
rsync: link_stat "/cygdrive/c/rsyncNCHC/1.txt" failed: No such file or directory
(2)

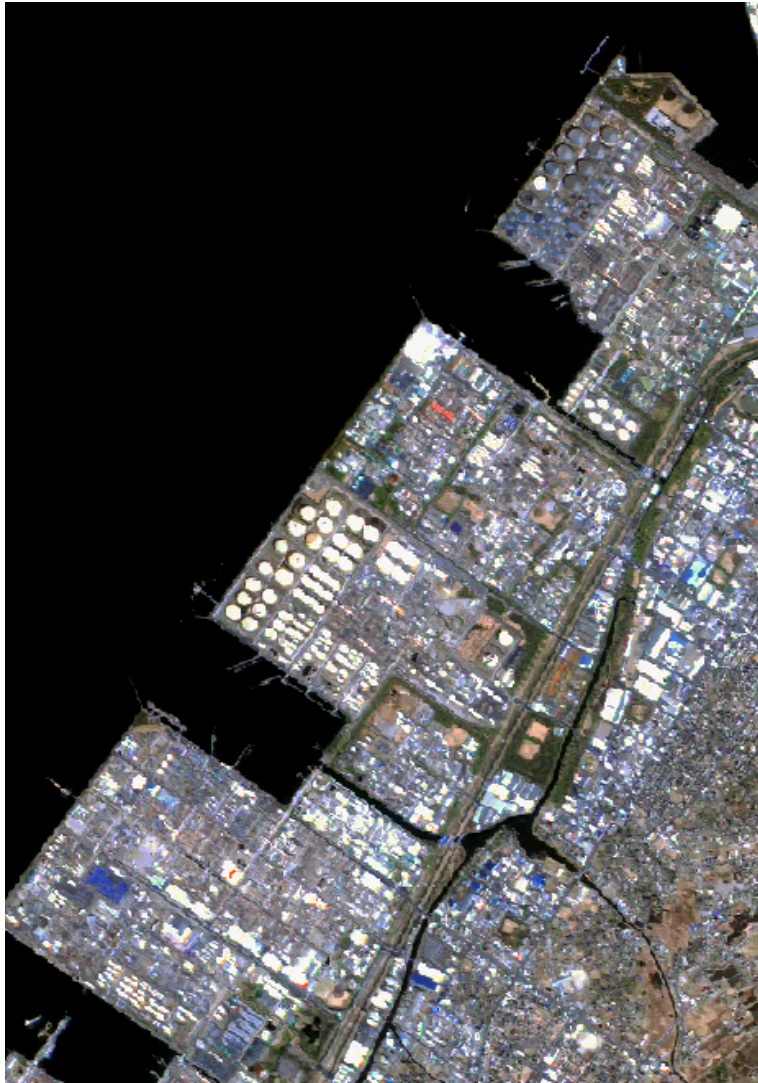
sent 18 bytes received 11 bytes 19.33 bytes/sec
total size is 0 speedup is 0.00
rsync error: some files/attrs were not transferred (see previous errors) (code 2
3) at main.c(1165) [sender=3.1.1]

C:\Users\Administrator>rsync -avrtzu /cygdrive/c/rsyncNCHC nchc@sd-lemon.naist.jp:
sending incremental file list
rsyncNCHC/
rsyncNCHC/cgsqpe72log.txt
rsyncNCHC/ingclip_geo.tif
rsyncNCHC/qpelog.txt
rsyncNCHC/Nantou slope/
rsyncNCHC/Nantou slope/Nantou_slope.dbf
rsyncNCHC/Nantou slope/Nantou_slope.prj
rsyncNCHC/Nantou slope/Nantou_slope.shp
rsyncNCHC/Nantou slope/Nantou_slope.shx

sent 129,099,538 bytes received 168 bytes 2,776,337.76 bytes/sec
total size is 265,675,018 speedup is 2.06

C:\Users\Administrator>rsync -avrtzu /cygdrive/c/rsyncNCHC nchc@sd-lemon.naist.jp:
```

GOI (五井,市原市)



Japan enhancement
(Tsunami area)



Sendai

