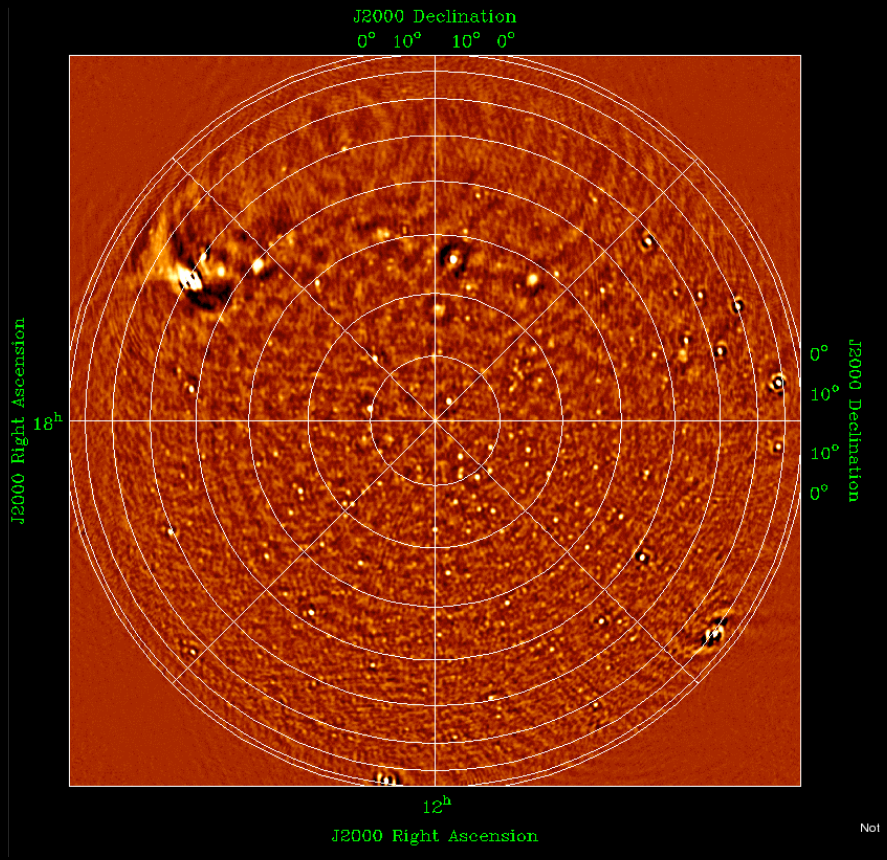
LOFAR
Hardware Status

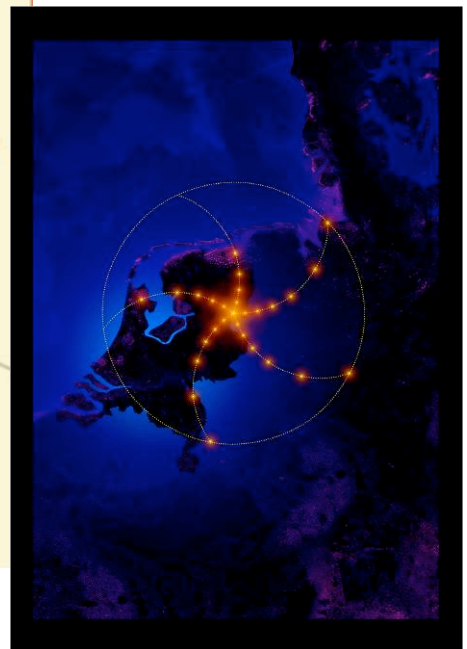
André W. Gunst



Contents

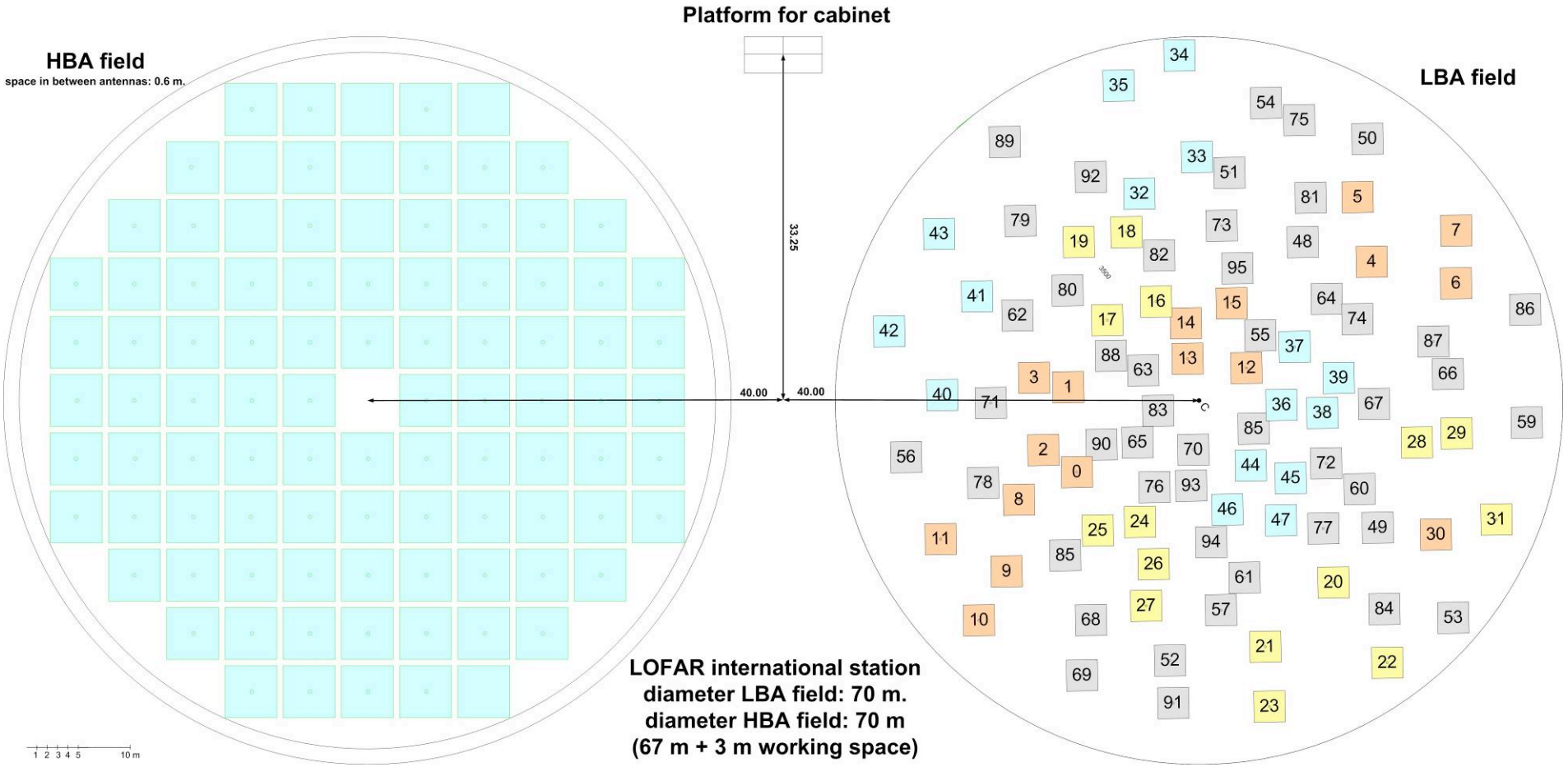
- Stations
- Central Systems
- Control System

The Instrument

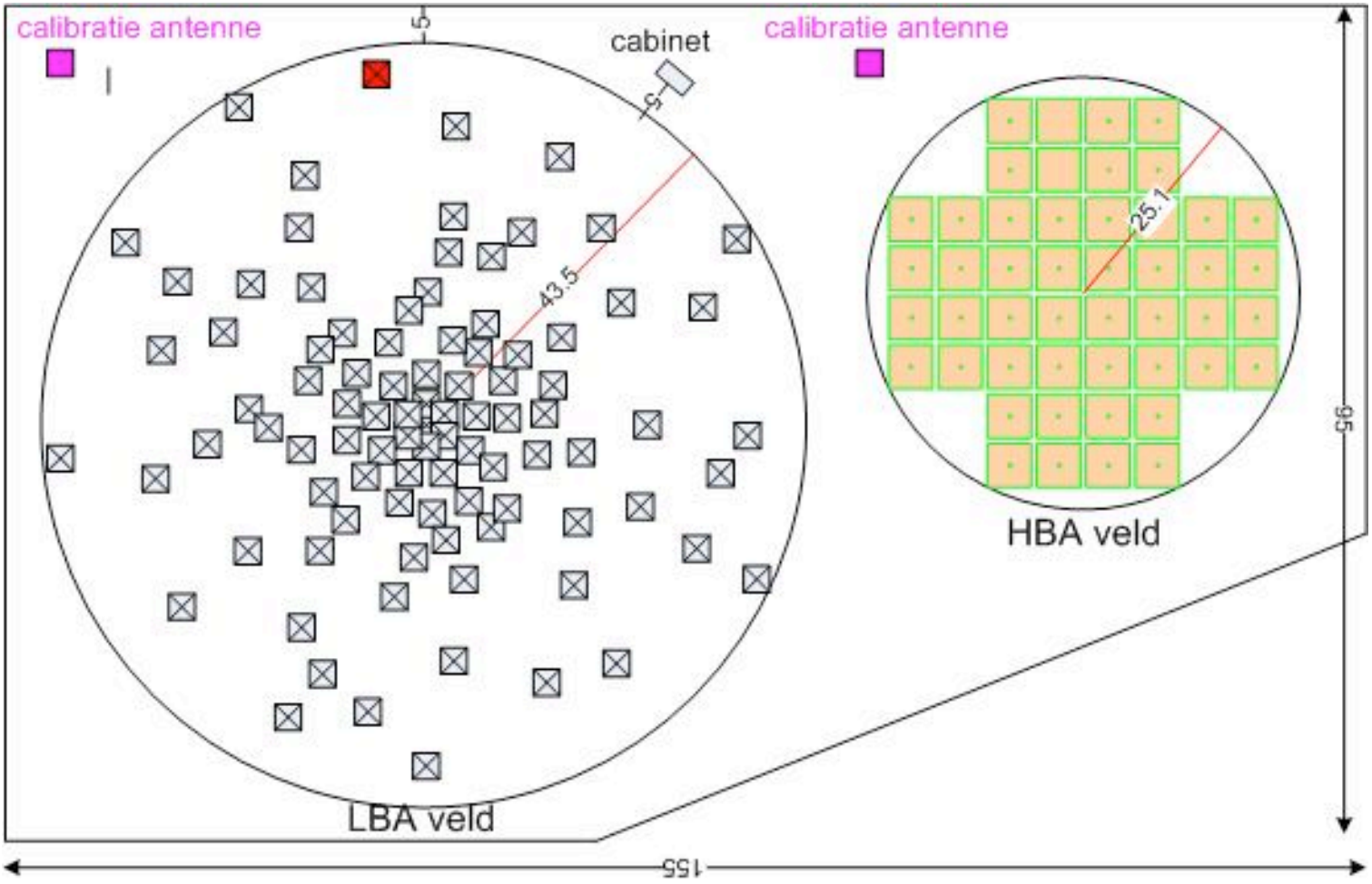


- International stations: 96 High Band Antennas
- Remote stations: 48 HBAs
- Core stations: 2x24 HBAs

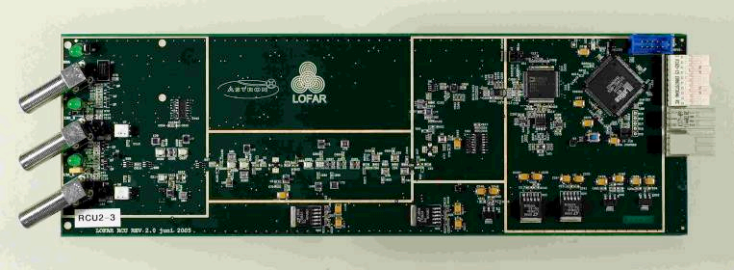
International Stations (≥ 8)



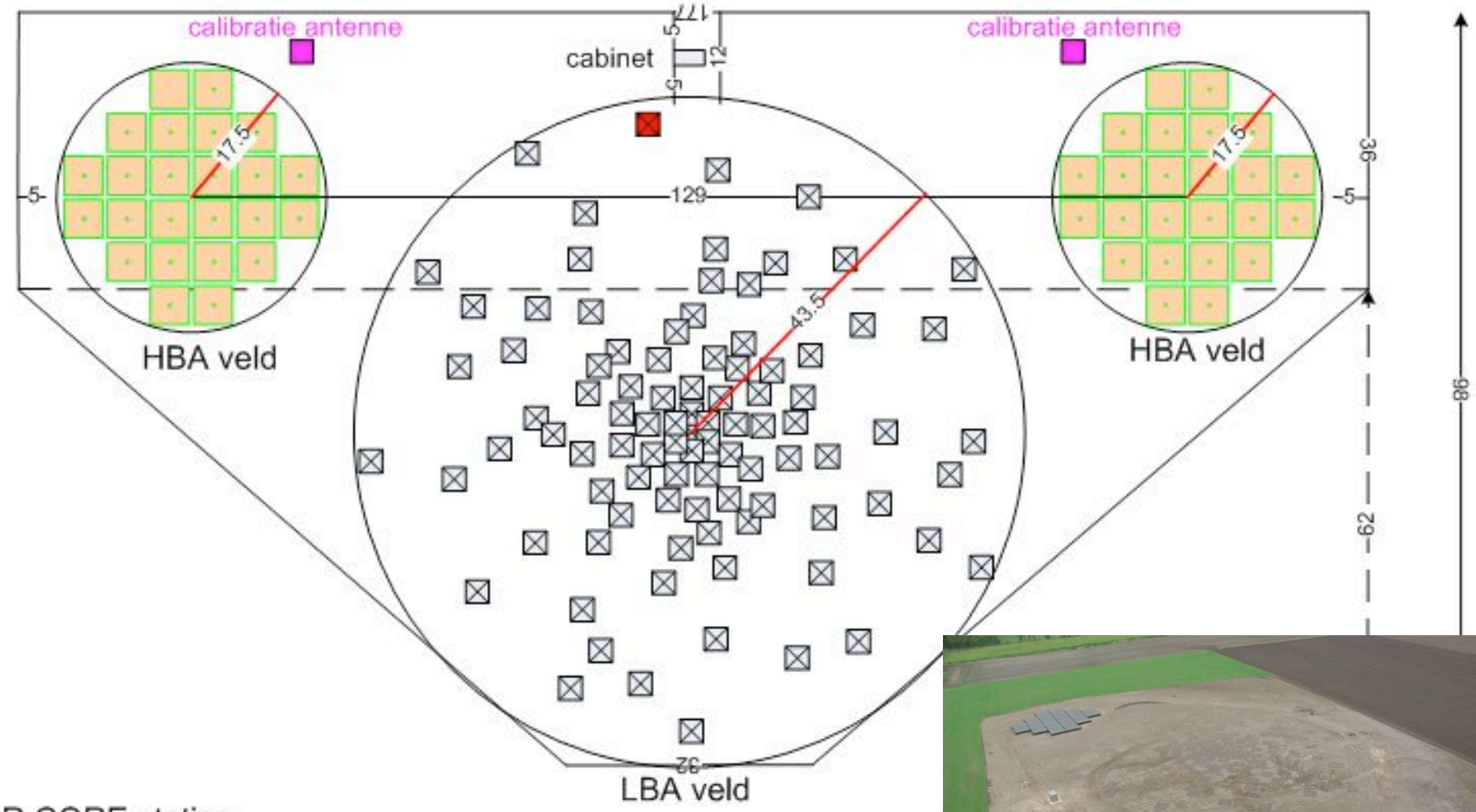
Remote Stations (≥ 18)



LOFAR remote station:
=> LBA veld heeft diameter van 87 meter en bevat 96 antennes
=> HBA veld heeft diameter van 50.2 meter en bevat 48 antennes

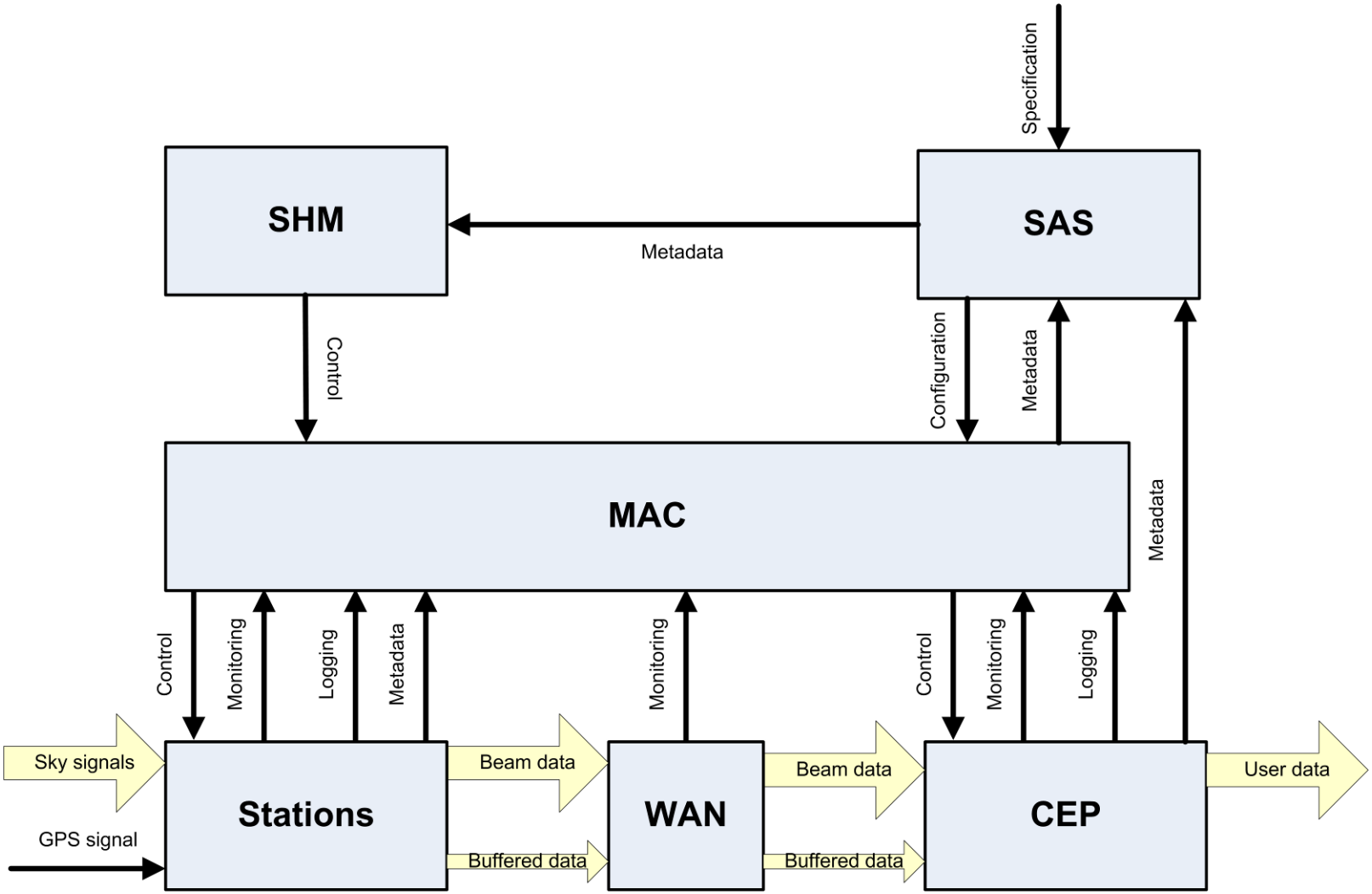


Core Stations (≥ 18)

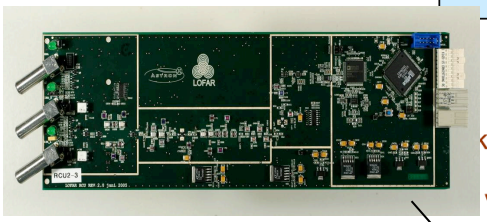


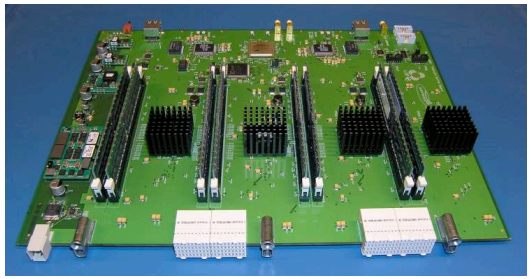
LOFAR CORE station:
=> LBA veld heeft diameter van 87 meter en bevat 96 antennes
=> 2 HBA velden (elk met een diameter van 35 meter) bevatten elk 24

Top Level Architecture



Station Architecture





GPS

MAC

Control

Monitoring

Metadata

Logging

Sync

Local Control

Sync

Time

Sync

Clock

Control

Monitoring

Metadata

Control

Sky Signal

LBL

Antenna Signal

Sky Signal

LBH

Antenna Signal

Sky Signal

HBA

Antenna Signal

Control

Receiver

Antenna Data

Antenna Data

Digital Processing

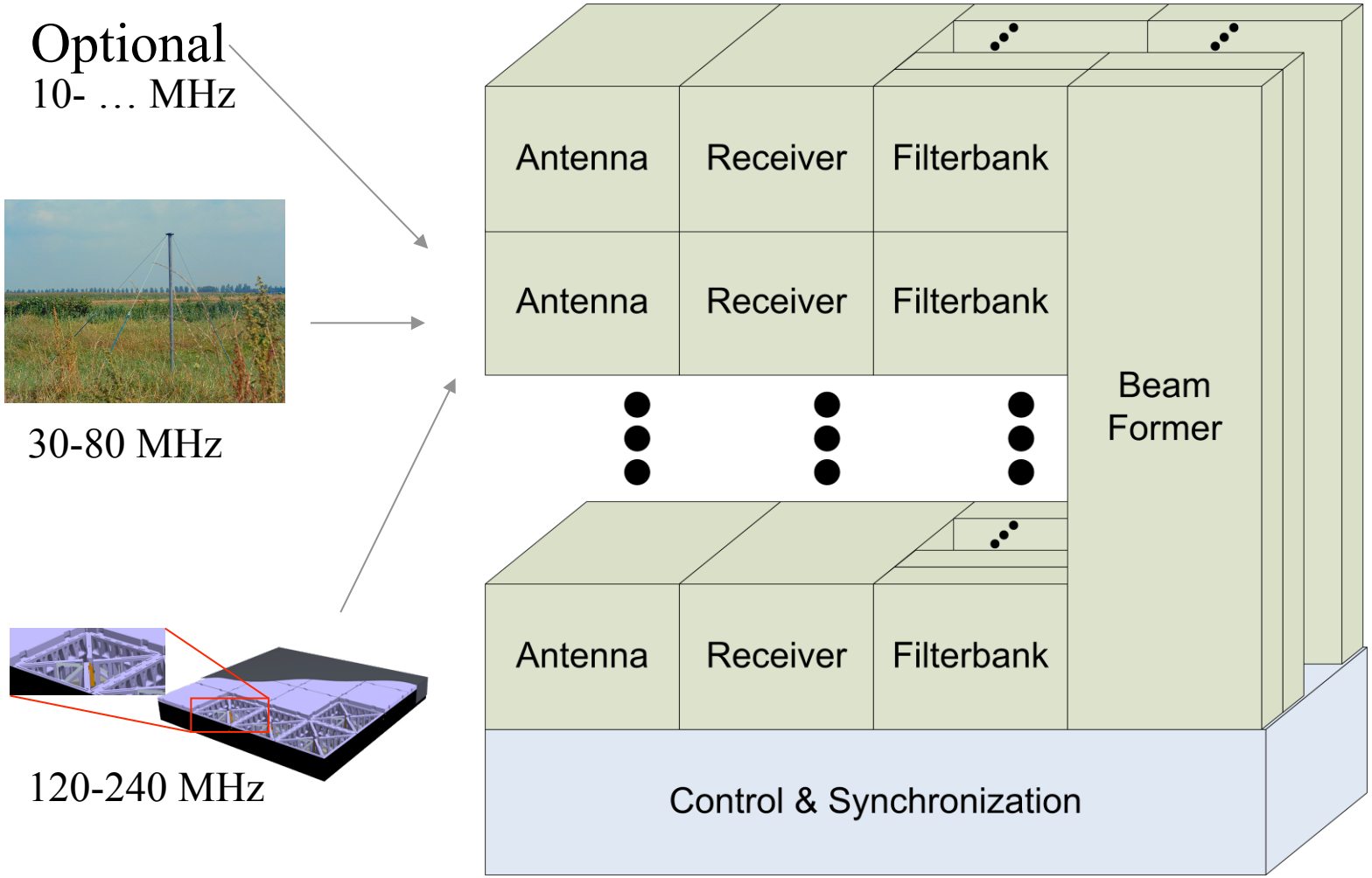
Beam Data

WAN

Buffer Data

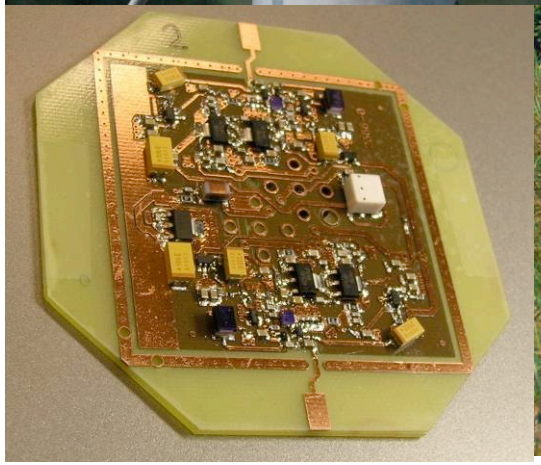
WAN

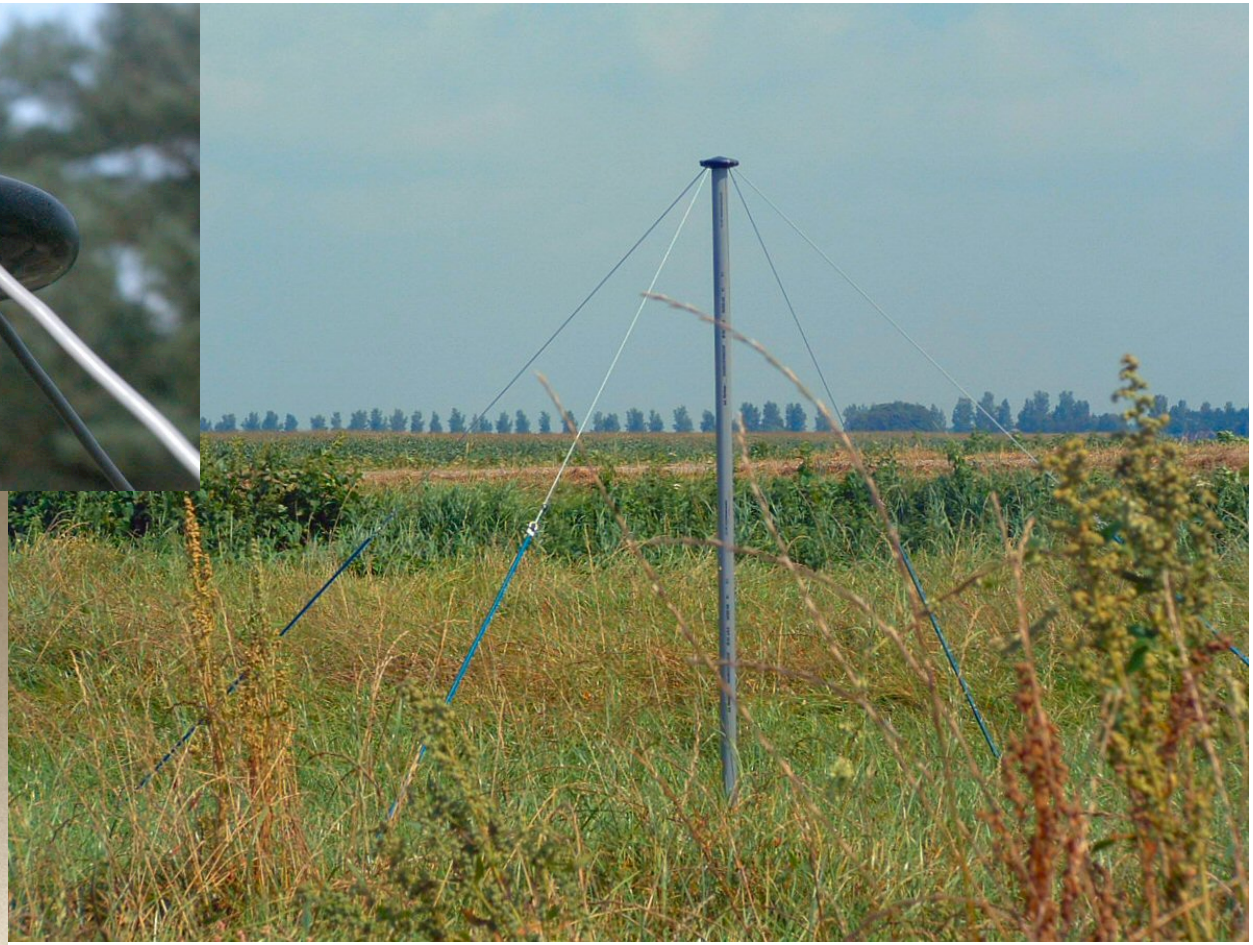
Station Signal Processing



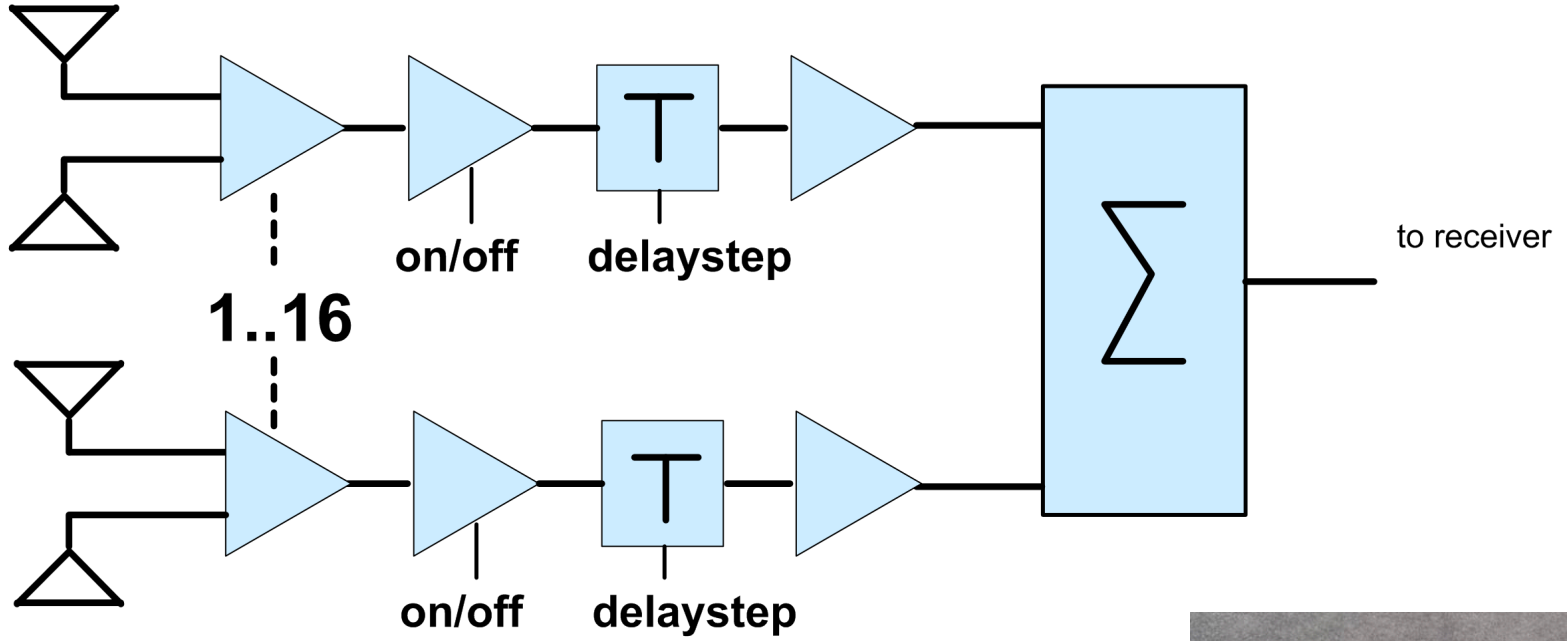
ASTRON

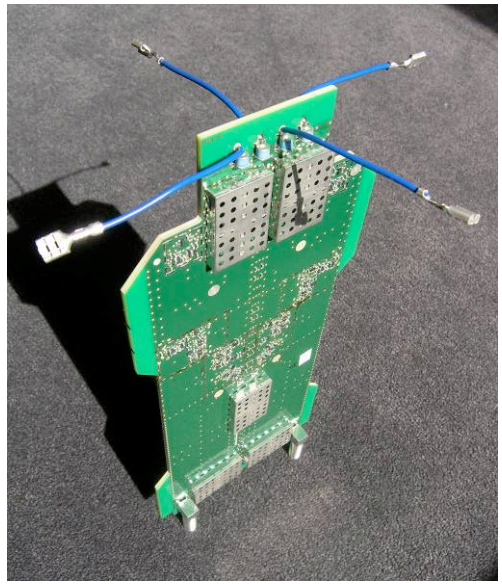
Low Band Antenna (30-80 MHz)



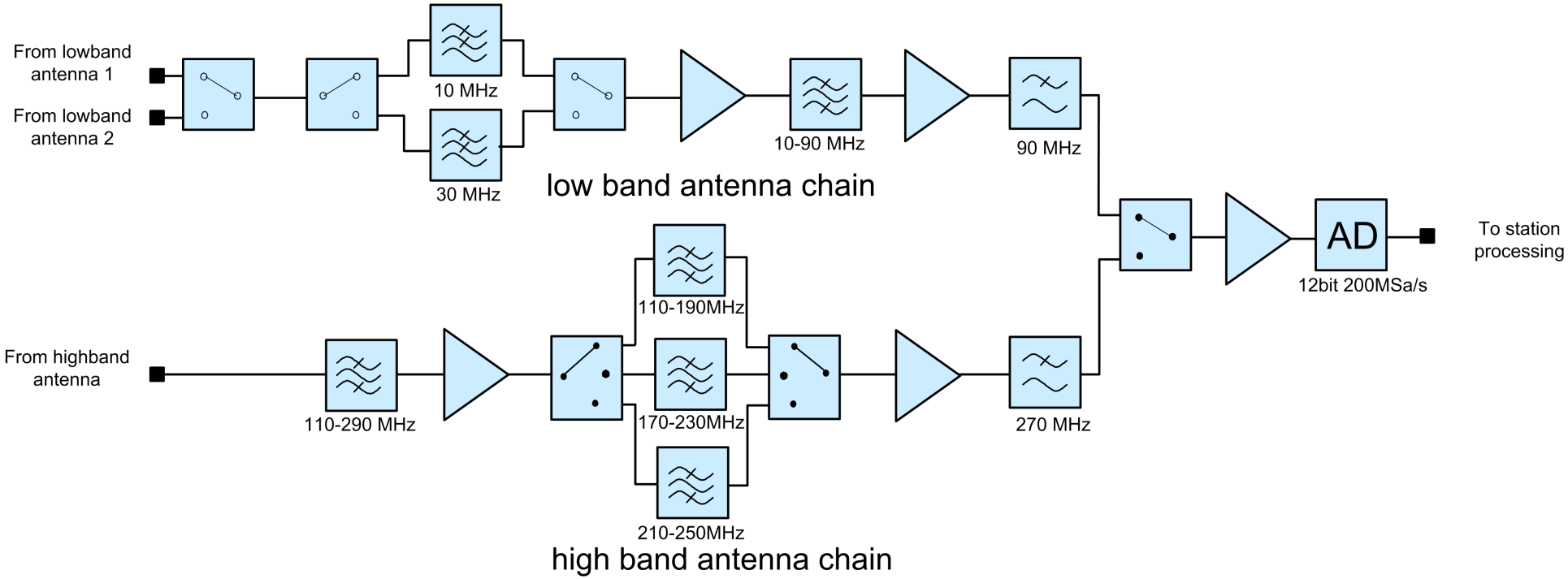


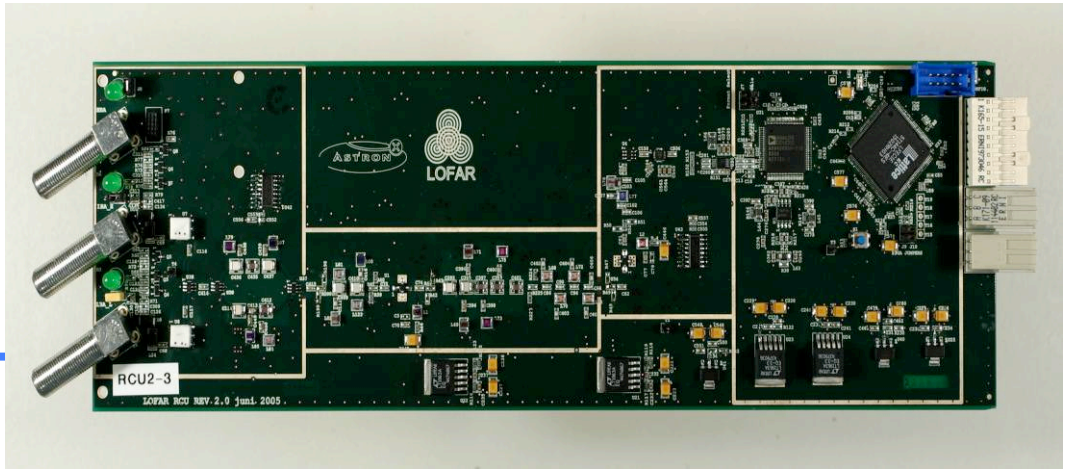
High Band Antenna



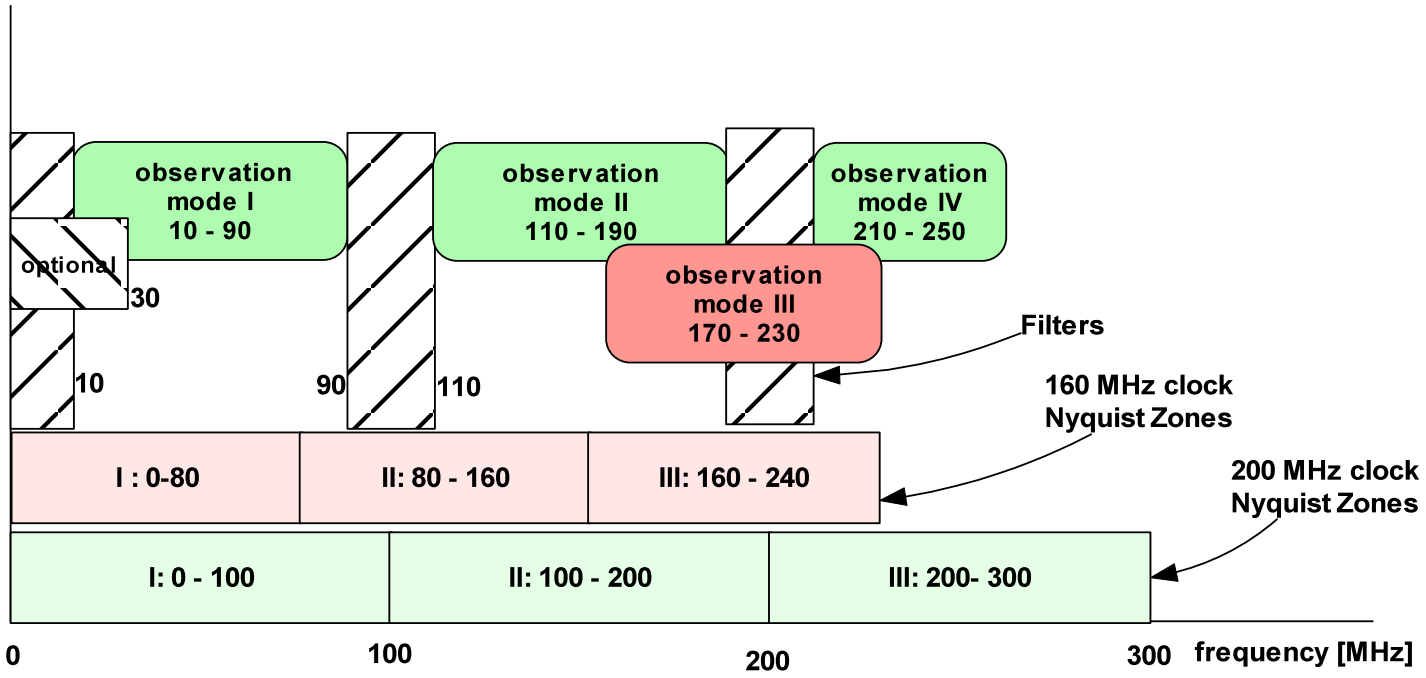


Receiver

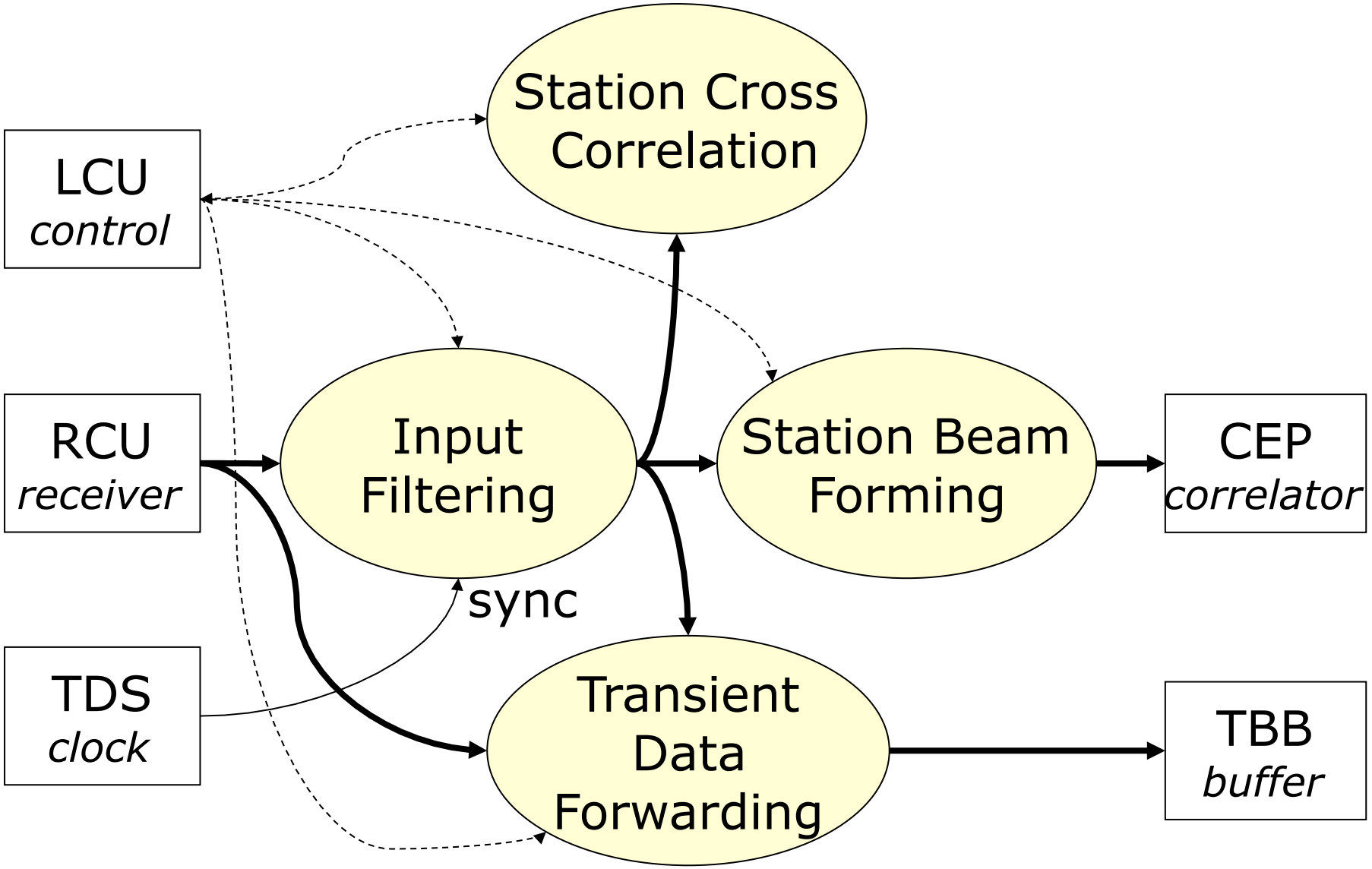

From lowband antenna 1
From lowband antenna 2
10 MHz
30 MHz
10-90 MHz
90 MHz
low band antenna chain
AD
12bit 200MSa/s
To station processing
From highband antenna
110-290 MHz
110-190MHz
170-230MHz
210-250MHz
270 MHz
high band antenna chain


ASTRON
LOFAR
RCU2-3
LOFAR RCU REV.2.0 juni 2005

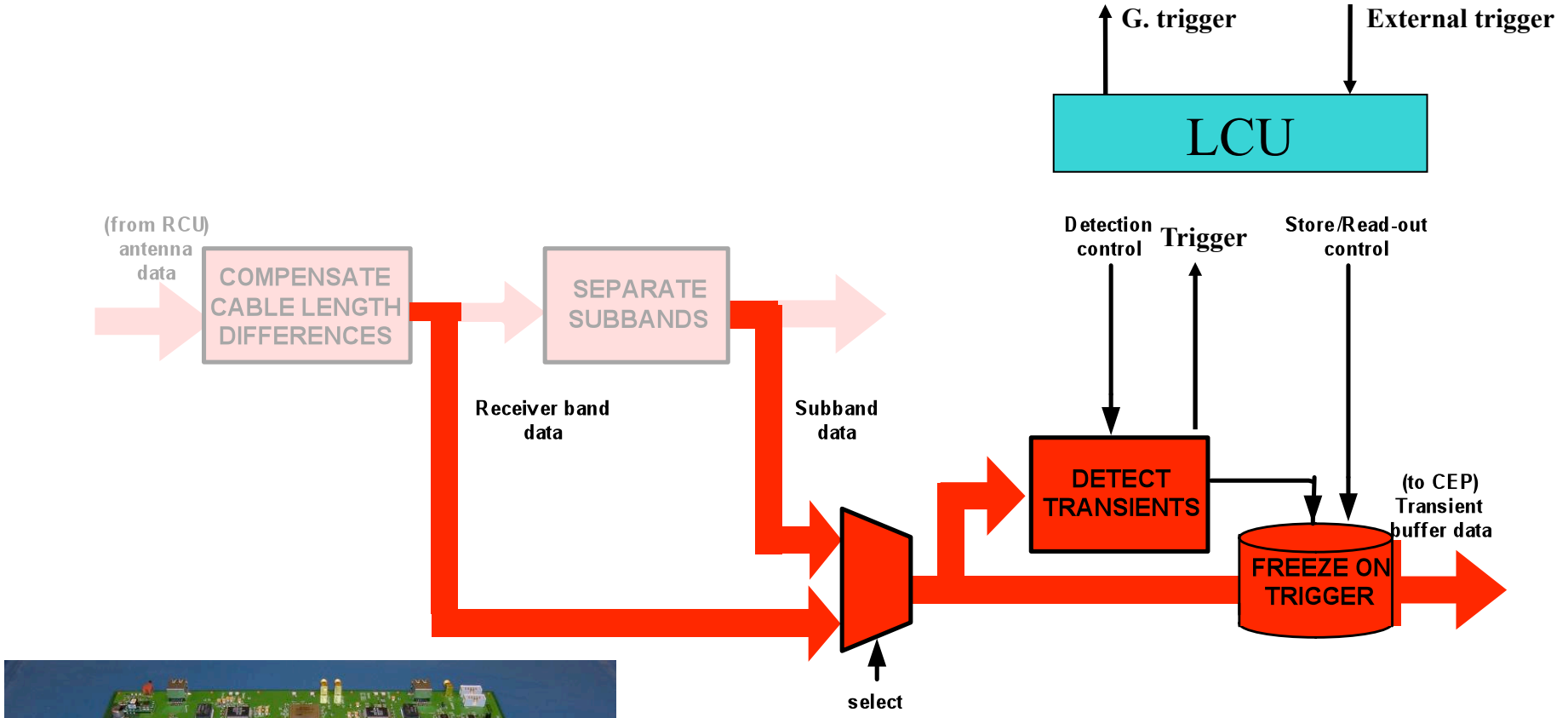
Modes

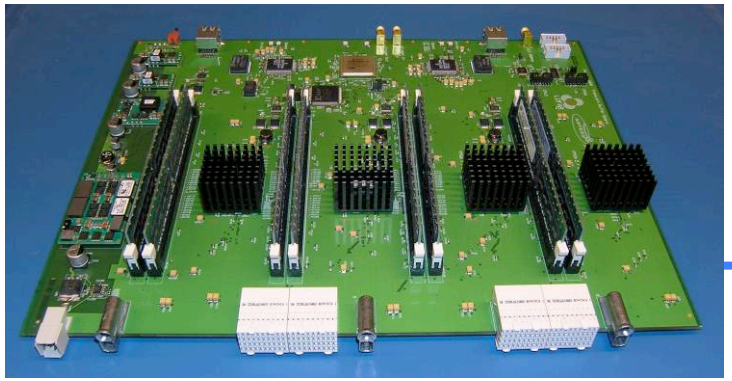


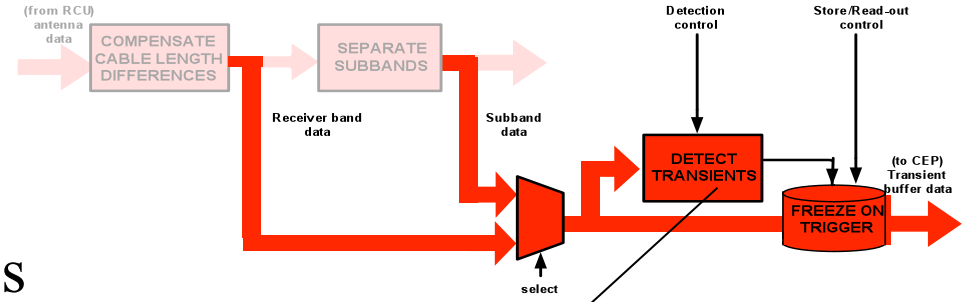
Processing functions



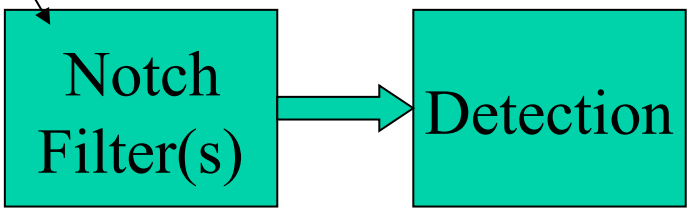
Transient Buffering





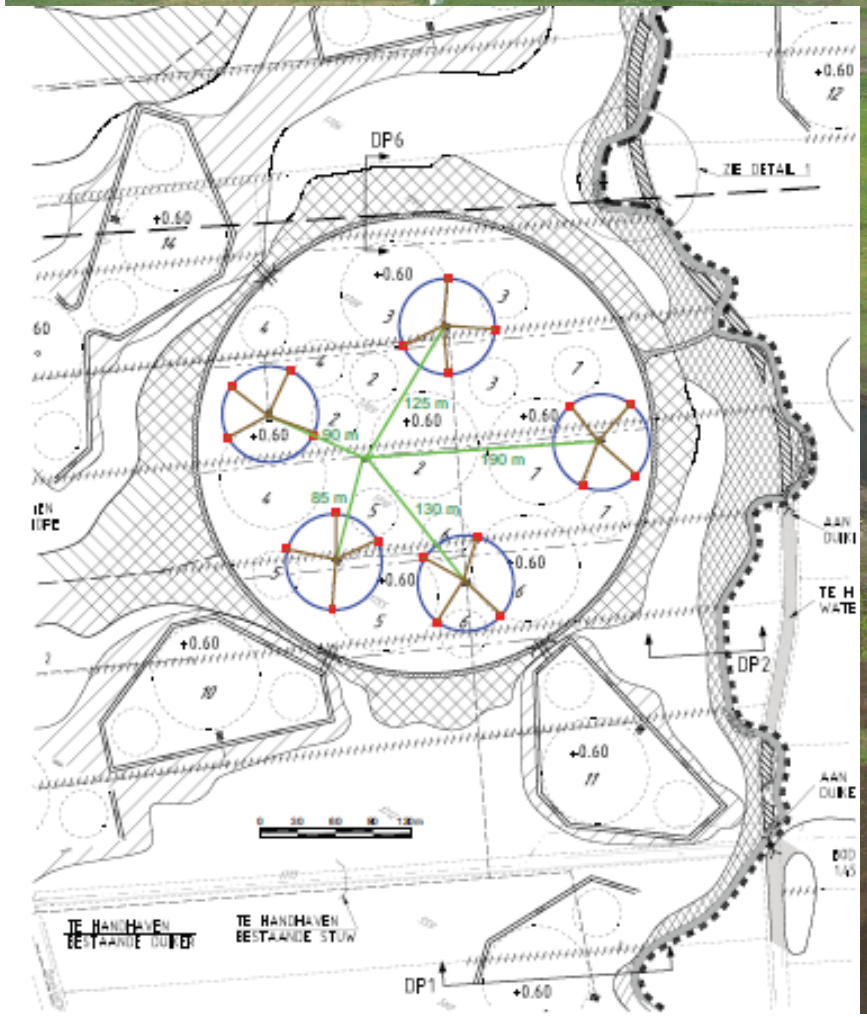


to suppress strong RFI signals
at fixed locations



Detection only possible on the stored signals

Superterp (trigger infrastructure)



- Station Acceptance/Validation Procedure:
  - basic hardware tests
  - checks individual antenna performances
  - checks basic functionalities and interconnections
  - results in a report including the test results
- Formal Station Acceptance by RO:
  - quantifies top level requirements
    - linearity
    - sensitivity (Aeff/Tsys)
    - power consumption

- Central Systems acceptance procedure
  - station remote access
  - station (RSP) – CEP interface
  - station (TBB) – CEP interface
  - Navigator – station interface
  - MAC/SAS – station interface
  - SHM – MAC/SAS – station interface
- Commissioning acceptance procedure
  - checks for fringes
  - … to be discussed tomorrow

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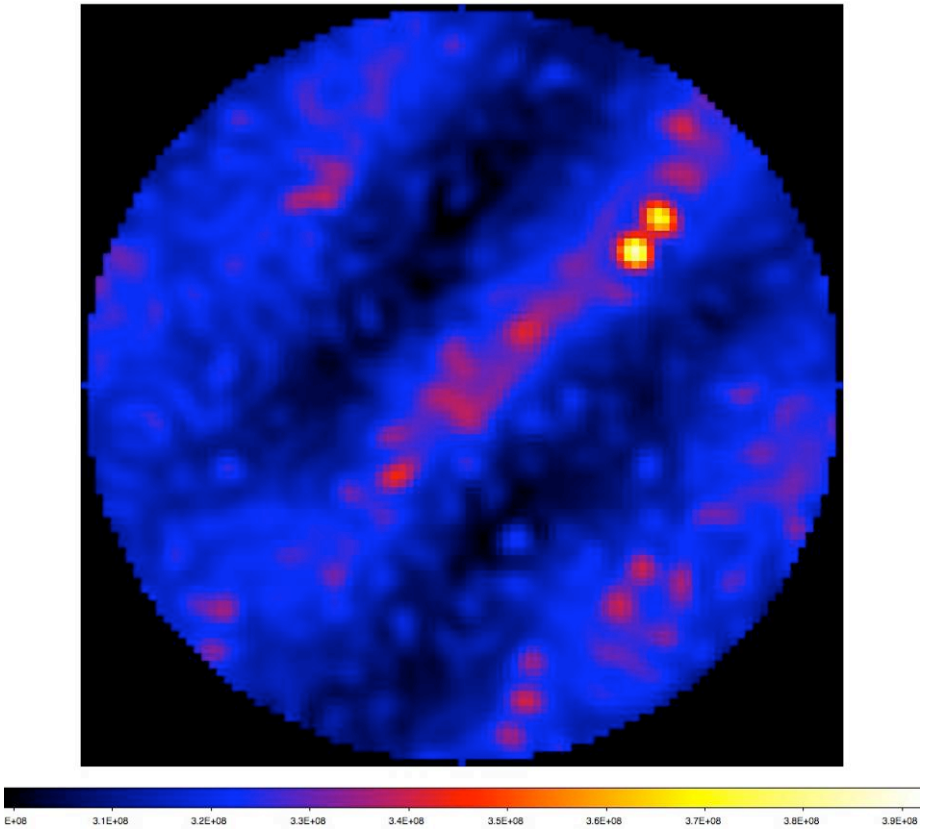
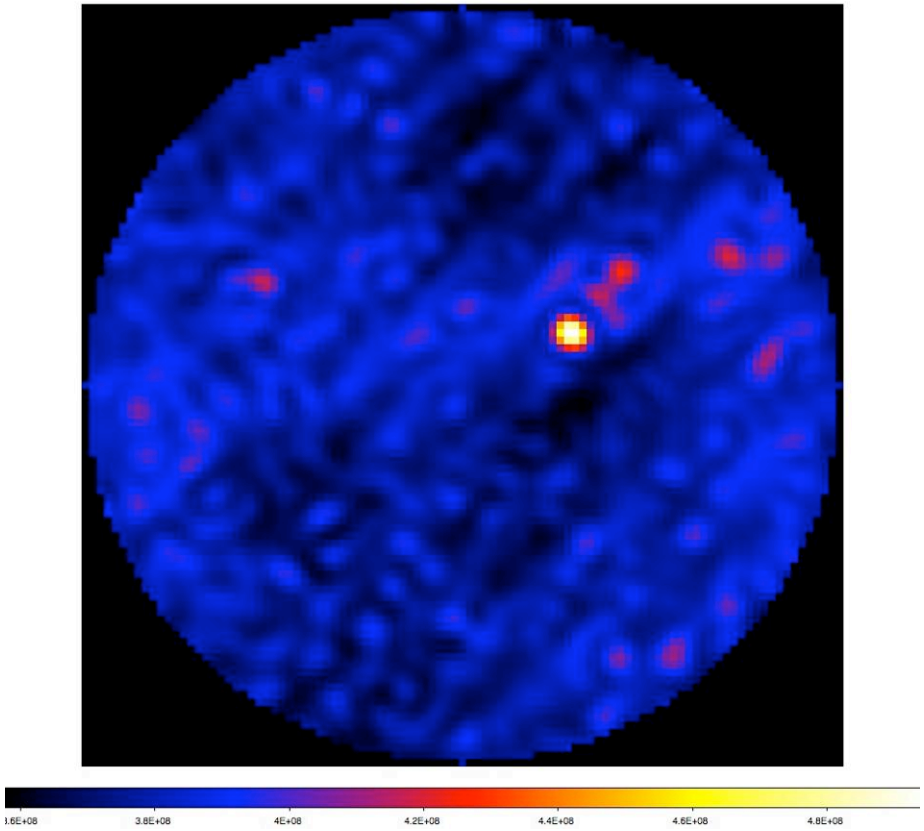
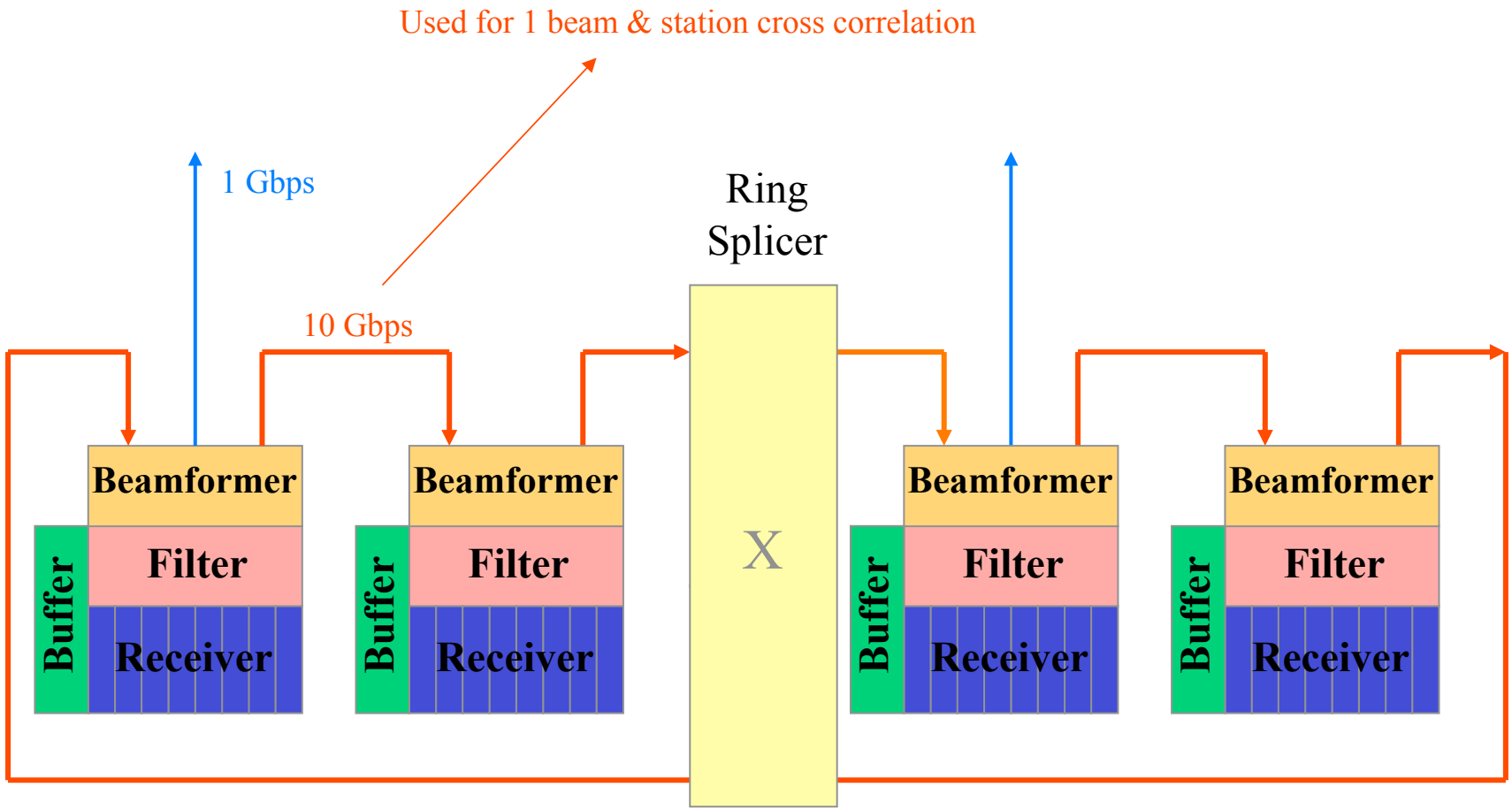
Different cable lengths

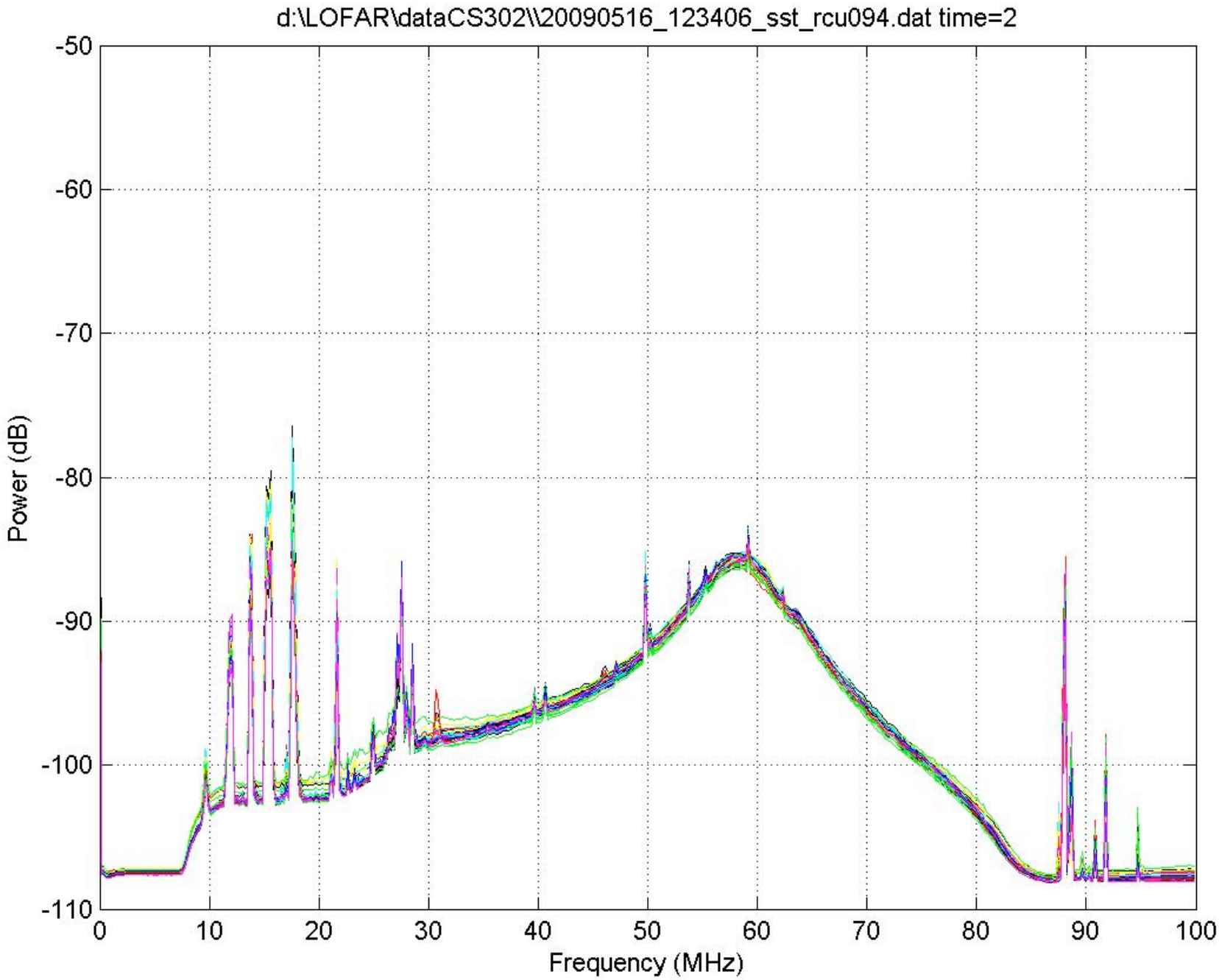


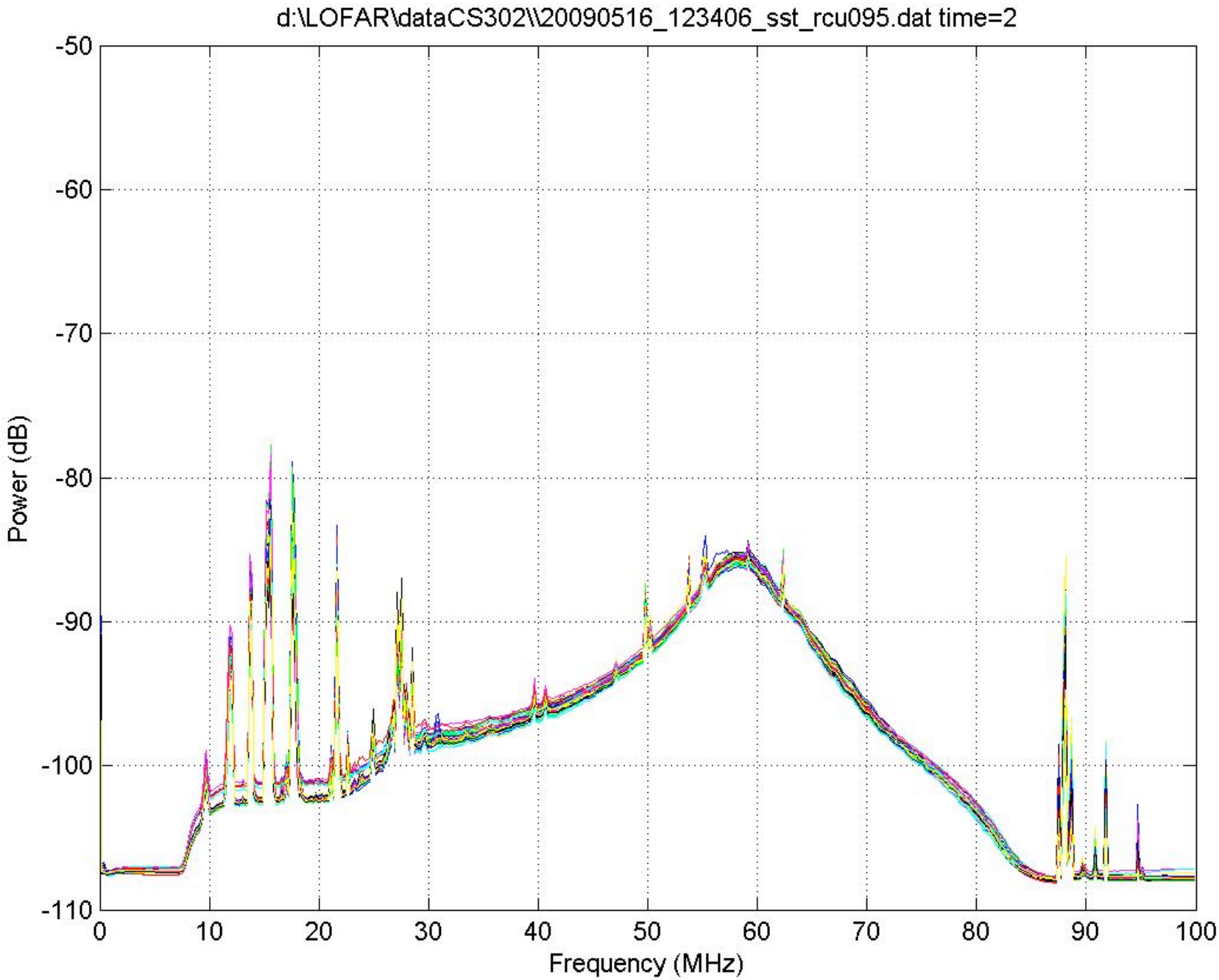


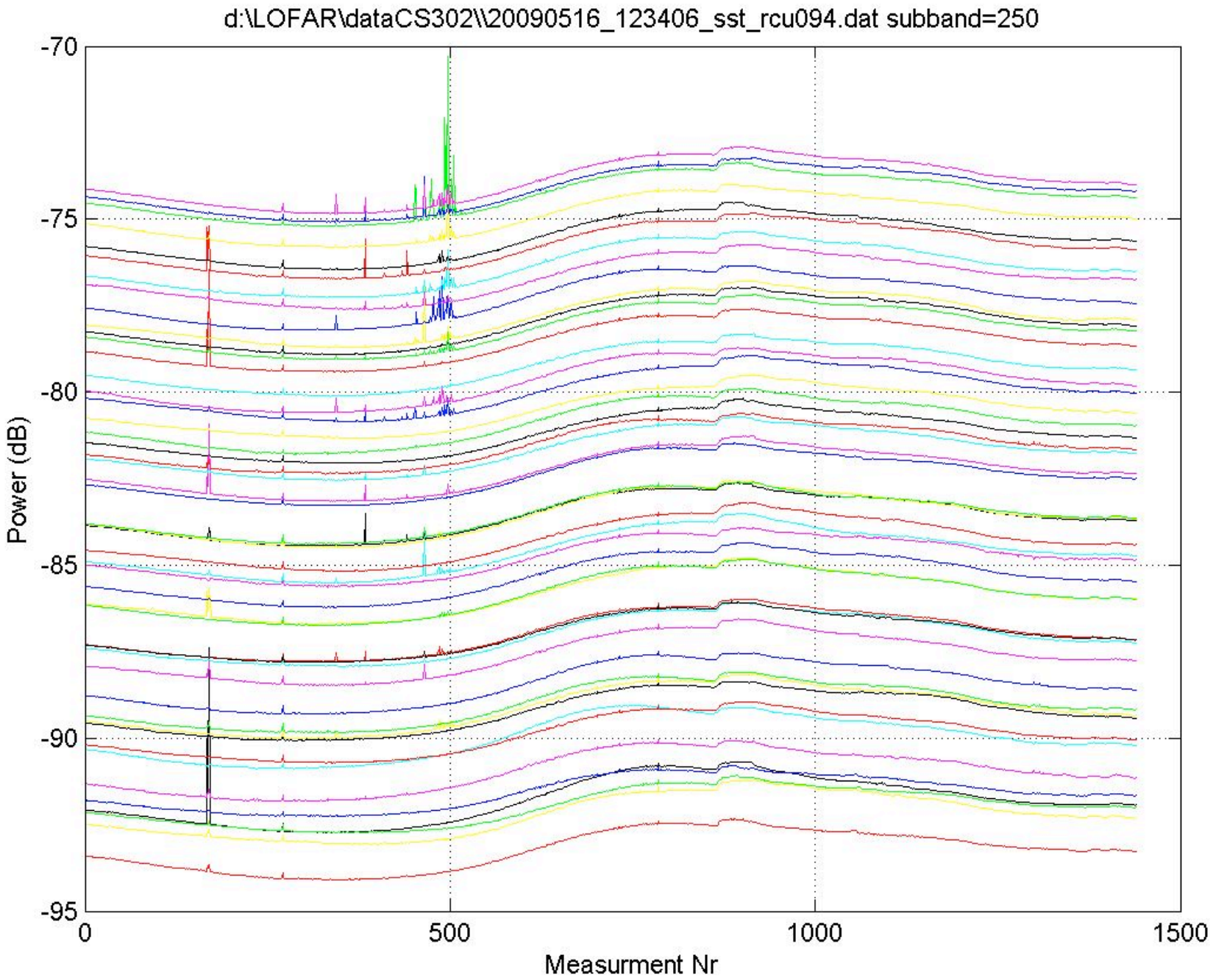
Ring Splitter In Core Stations

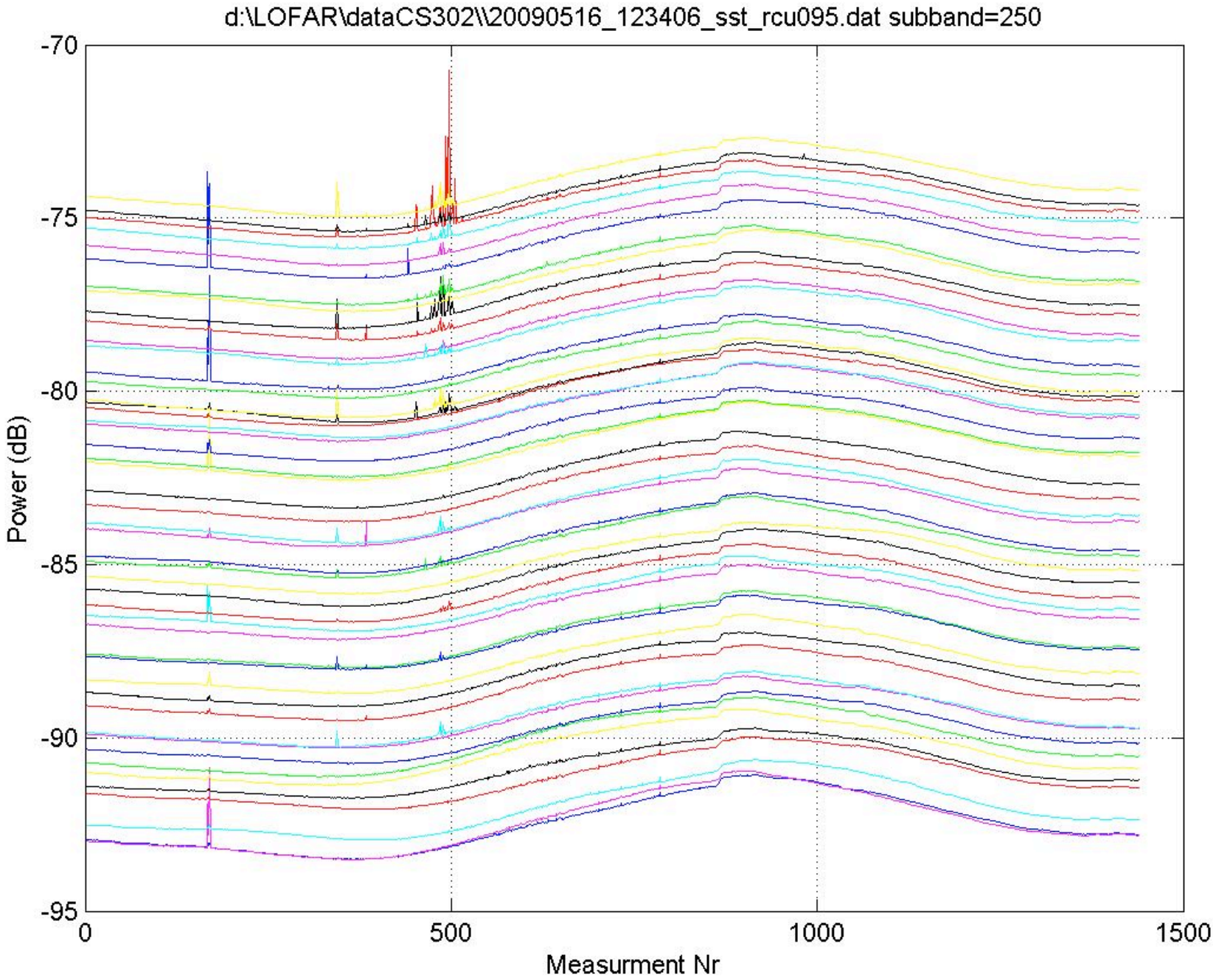


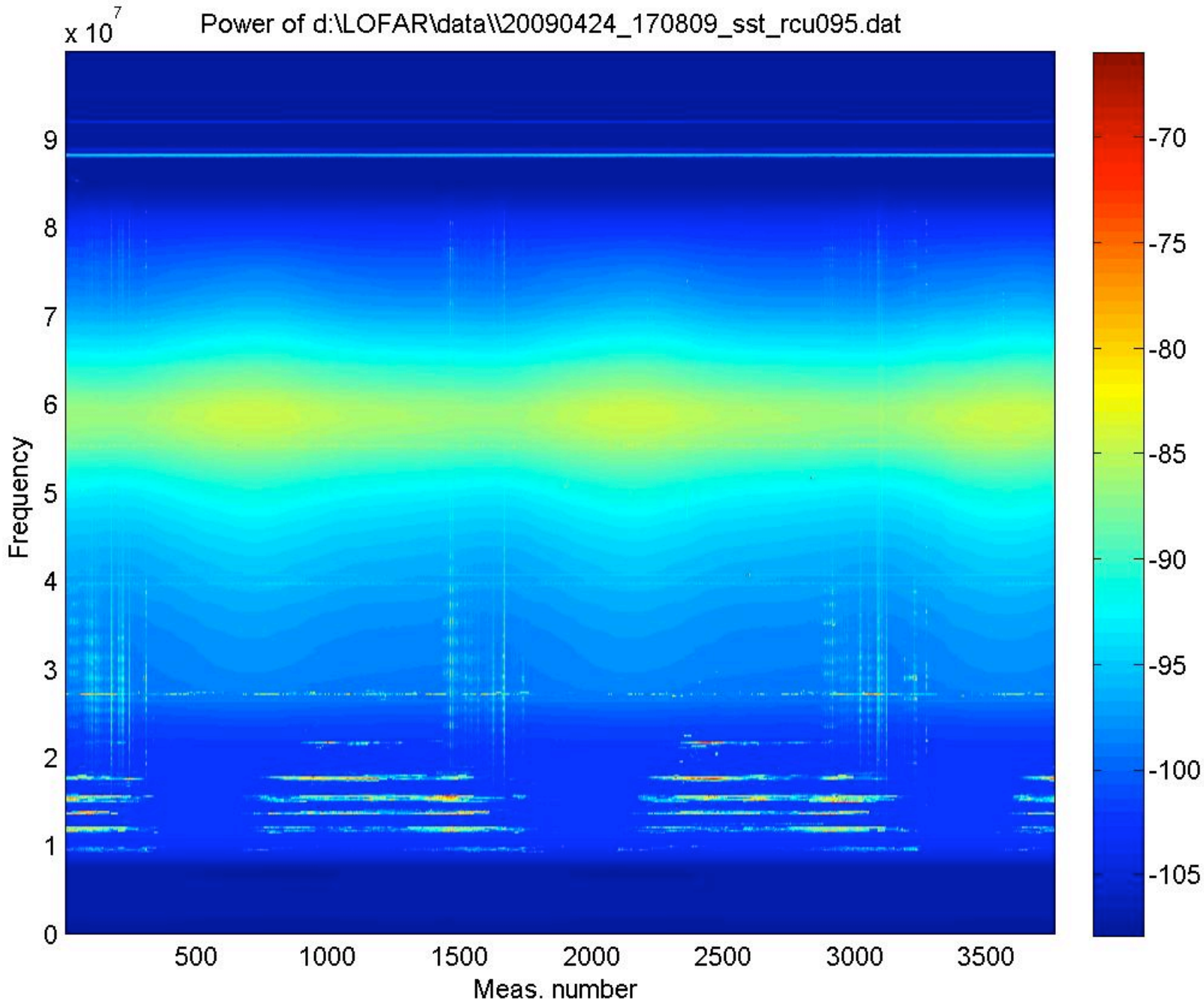
Expected availability: August 2009

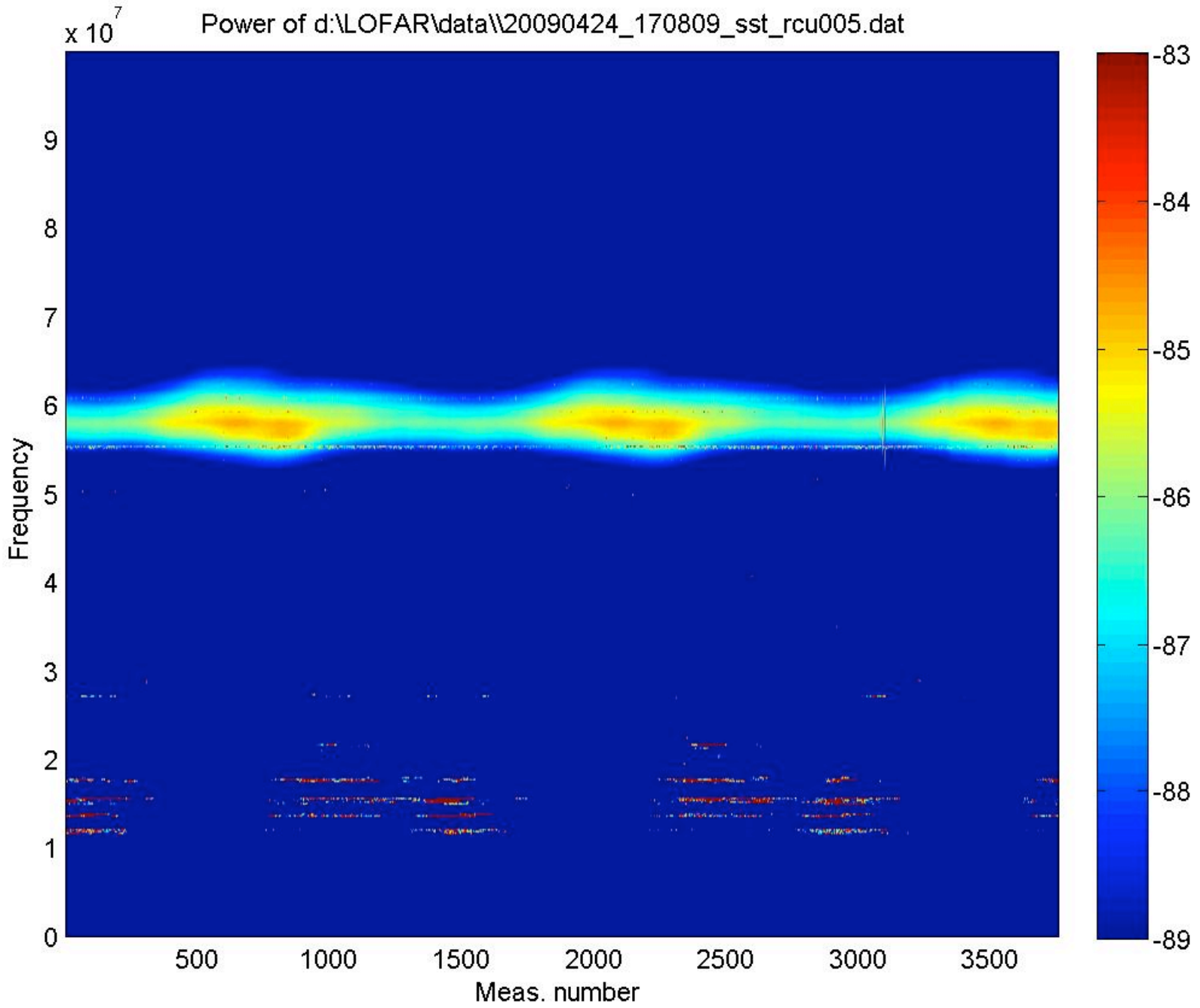

d:\LOFAR\dataCS302\\20090516_123406_sst_rcu094.dat time=2
-50
-60
-70
-80
-90
-100
-110
Power (dB)
0
10
20
30
40
50
60
70
80
90
100
Frequency (MHz)


d:\LOFAR\dataCS302\\20090516_123406_sst_rcu095.dat time=2
-50
-60
-70
-80
-90
-100
-110
Power (dB)
0
10
20
30
40
50
60
70
80
90
100
Frequency (MHz)


d:\LOFAR\dataCS302\\20090516_123406_sst_rcu094.dat subband=250
-70
-75
-80
-85
-90
-95
Power (dB)
0
500
1000
1500
Measurment Nr


d:\LOFAR\dataCS302\\20090516_123406_sst_rcu095.dat subband=250
-70
-75
-80
-85
-90
-95
Power (dB)
0
500
1000
1500
Measurment Nr


Power of d:\LOFAR\data\\20090424_170809_sst_rcu095.dat
x 10^7
Frequency
0
1
2
3
4
5
6
7
8
9
500
1000
1500
2000
2500
3000
3500
Meas. number
-70
-75
-80
-85
-90
-95
-100
-105


Power of d:\LOFAR\data\\20090424_170809_sst_rcu005.dat
x 10^7
Frequency
Meas. number
0
1
2
3
4
5
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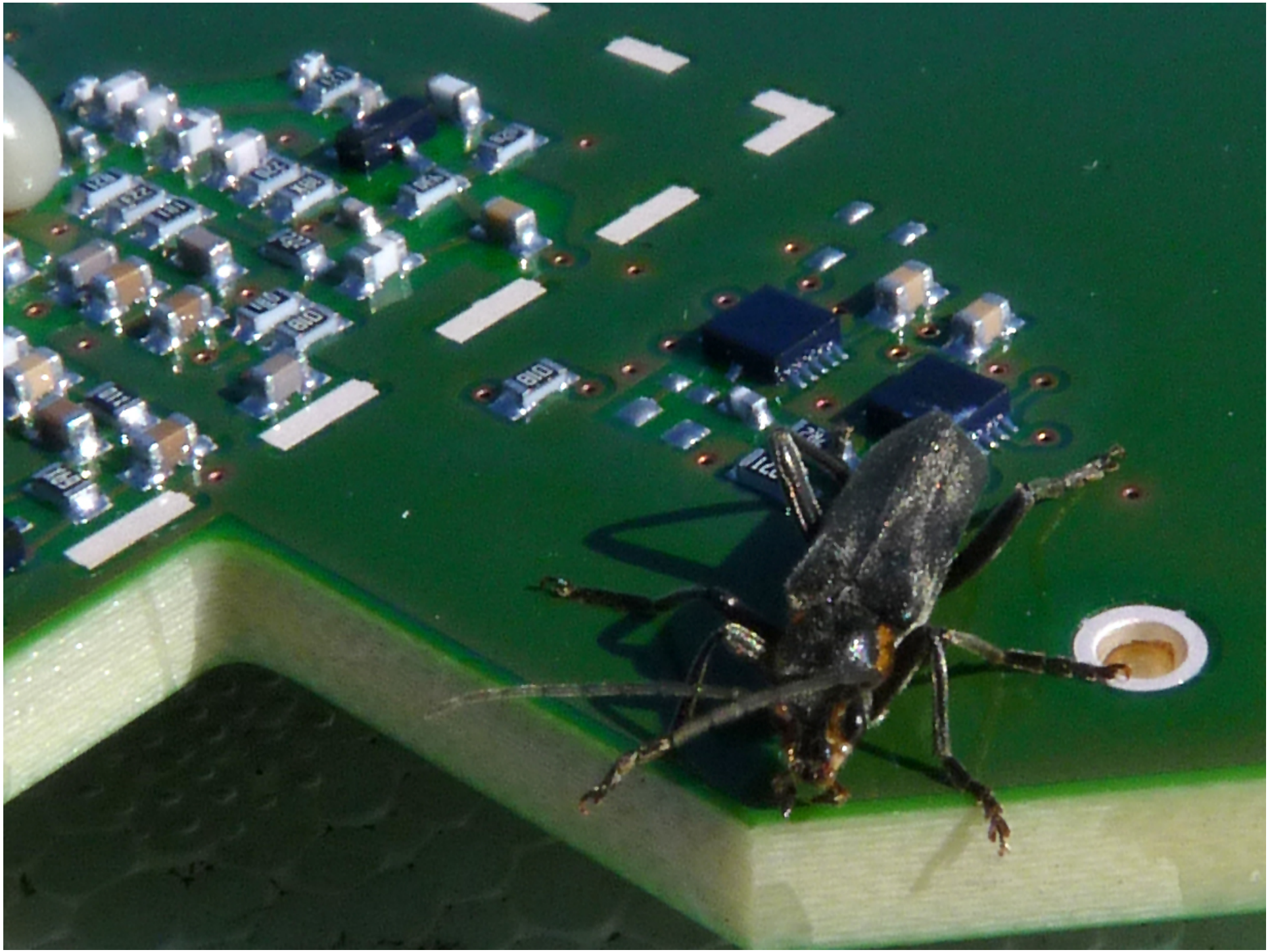
-83
-84
-85
-86
-87
-88
-89



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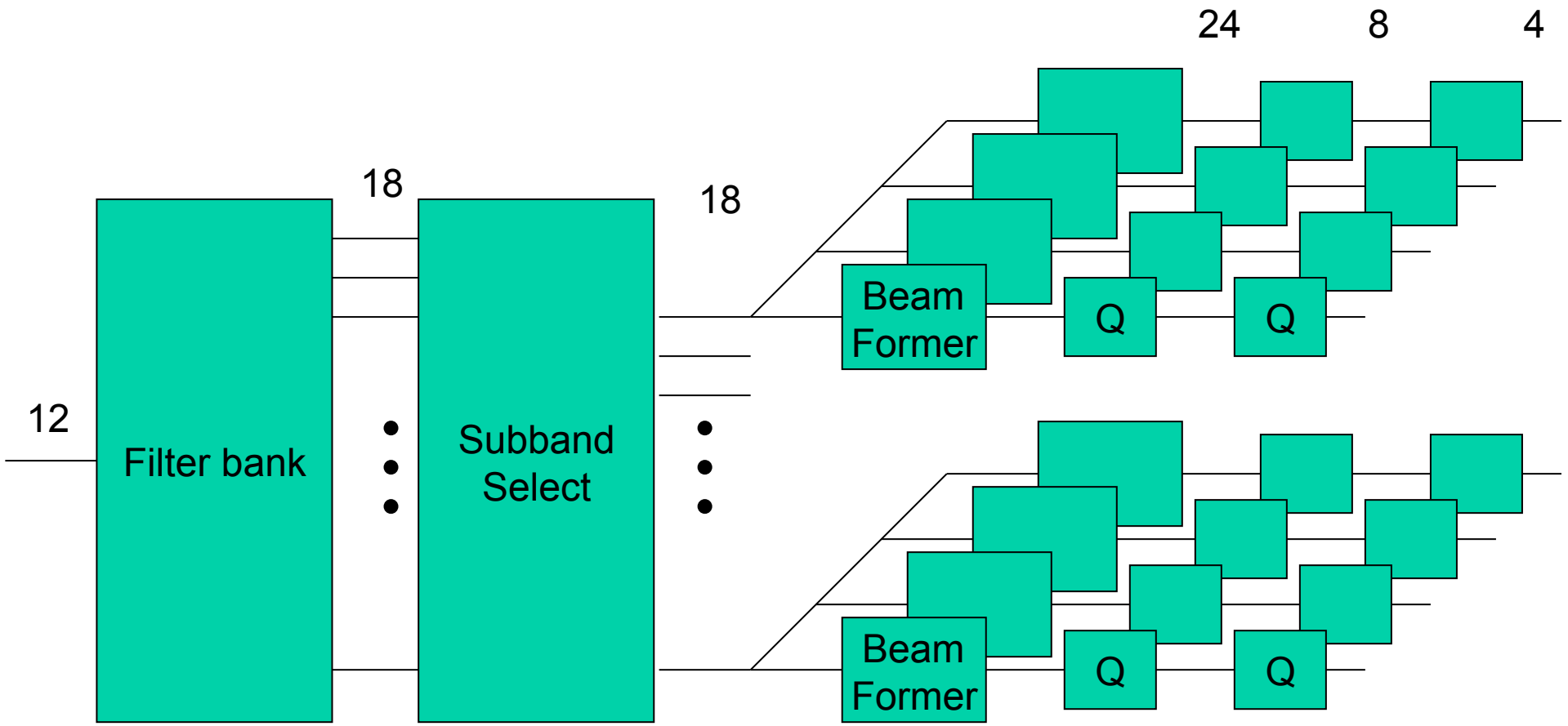
4 Bit Mode

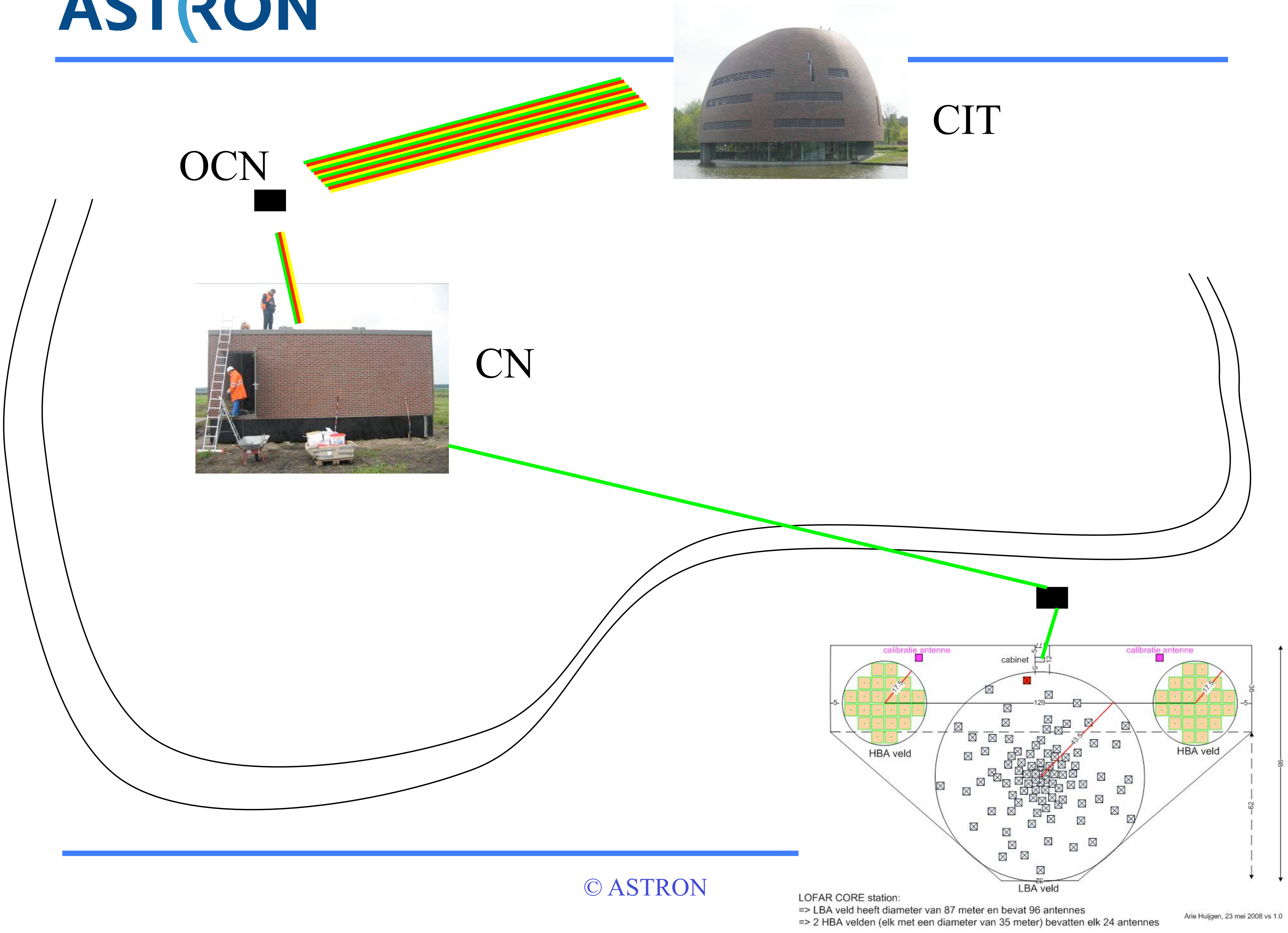


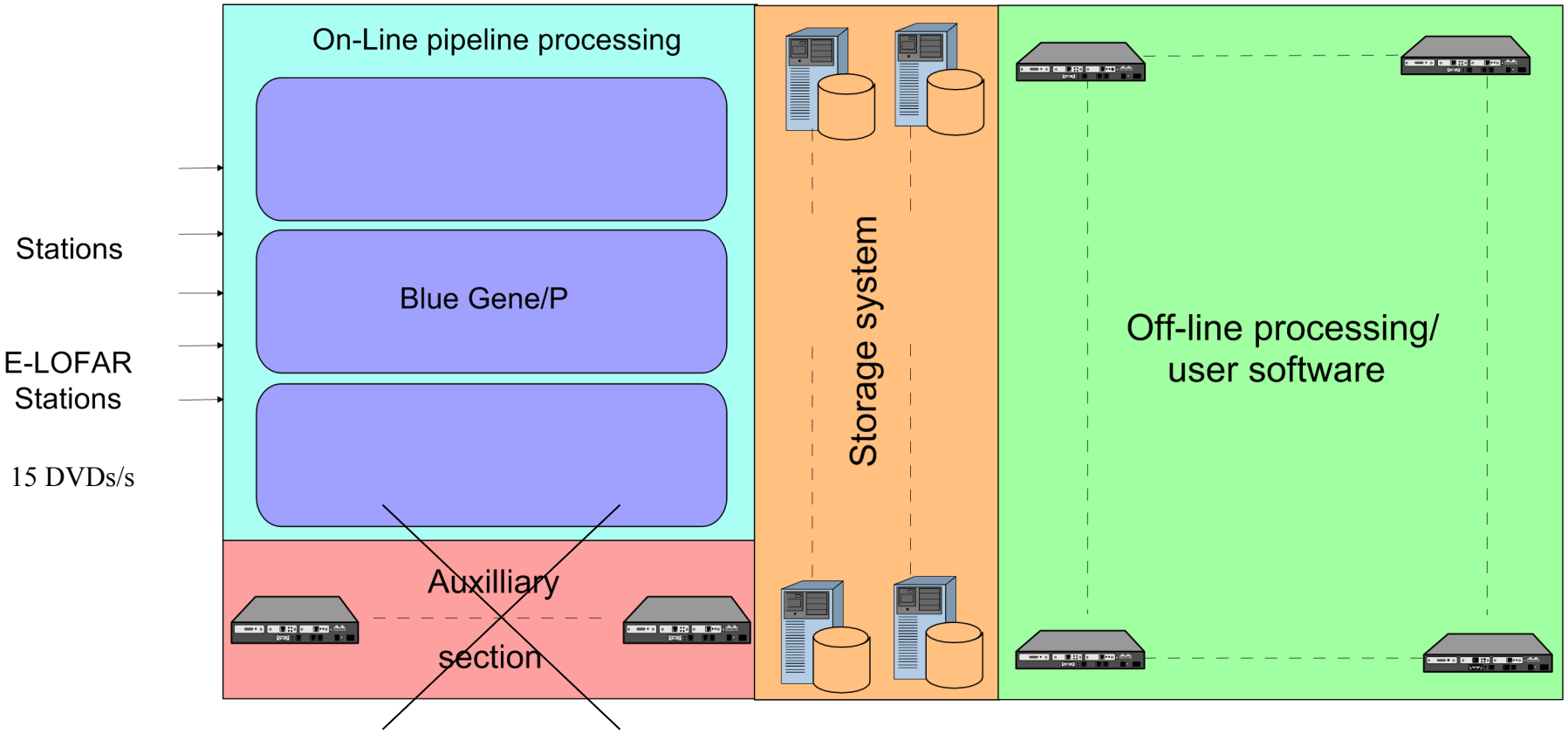
Expected availability:
late 2009/early 2010

Bandwidth Improvement

Clock frequency	160	200	MHz
Sub-band width	156.25	195.3	kHz
# sub-bands / RSP	62	62	
Total # sub-bands	248	248	
Bandwidth	38.75	48.44	MHz
Data rate / RSP	620	775	Mb/s
Total data rate	2.48	3.1	Gb/s

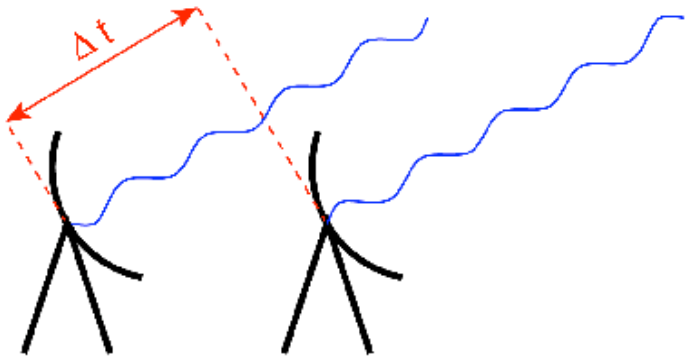
Expected availability: June 2009


CIT
OCN
CN
calibratie antenne
cabinet
calibratie antenne
17.5
129
17.5
43.5
HBA veld
HBA veld
LBA veld
LOFAR CORE station:
=> LBA veld heeft diameter van 87 meter en bevat 96 antennes
=> 2 HBA velden (elk met een diameter van 35 meter) bevatten elk 24 antennes
Arie Huijgen, 23 mei 2008 vs 1.0


On-Line pipeline processing
Blue Gene/P
Auxilliary
section
Storage system
Off-line processing/
user software
Stations
E-LOFAR
Stations
15 DVDs/s
40 TFlops
1-2 PByte
10 TFlops

BG/P responsibilities

- Receive data streams from each station
- Buffer the data stream
- Synchronise input streams
- Apply delay compensation (over complete sample periods)
- Route data to correct compute node
- High volume processing
- Data reduction

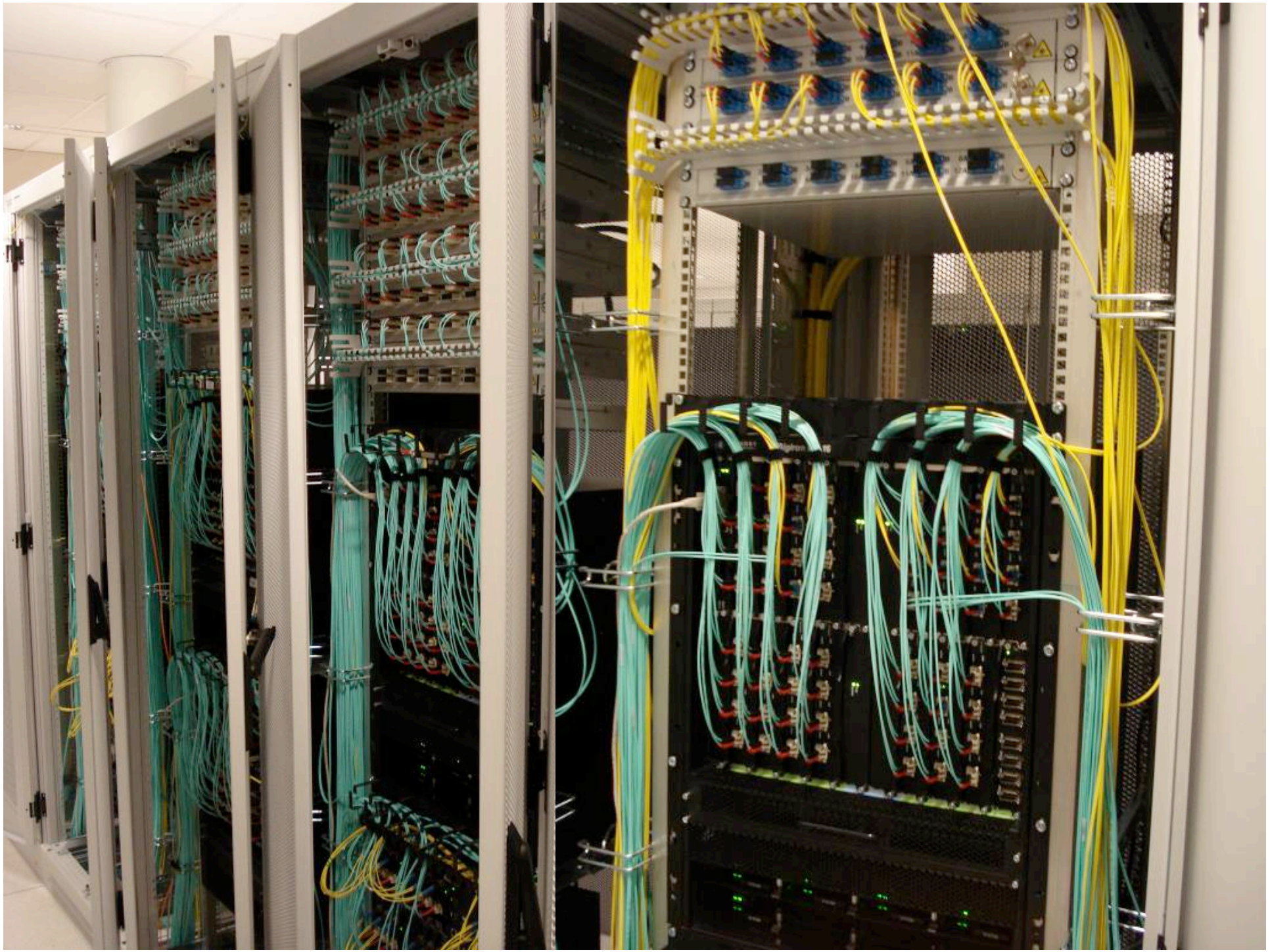


Storage section responsibilities

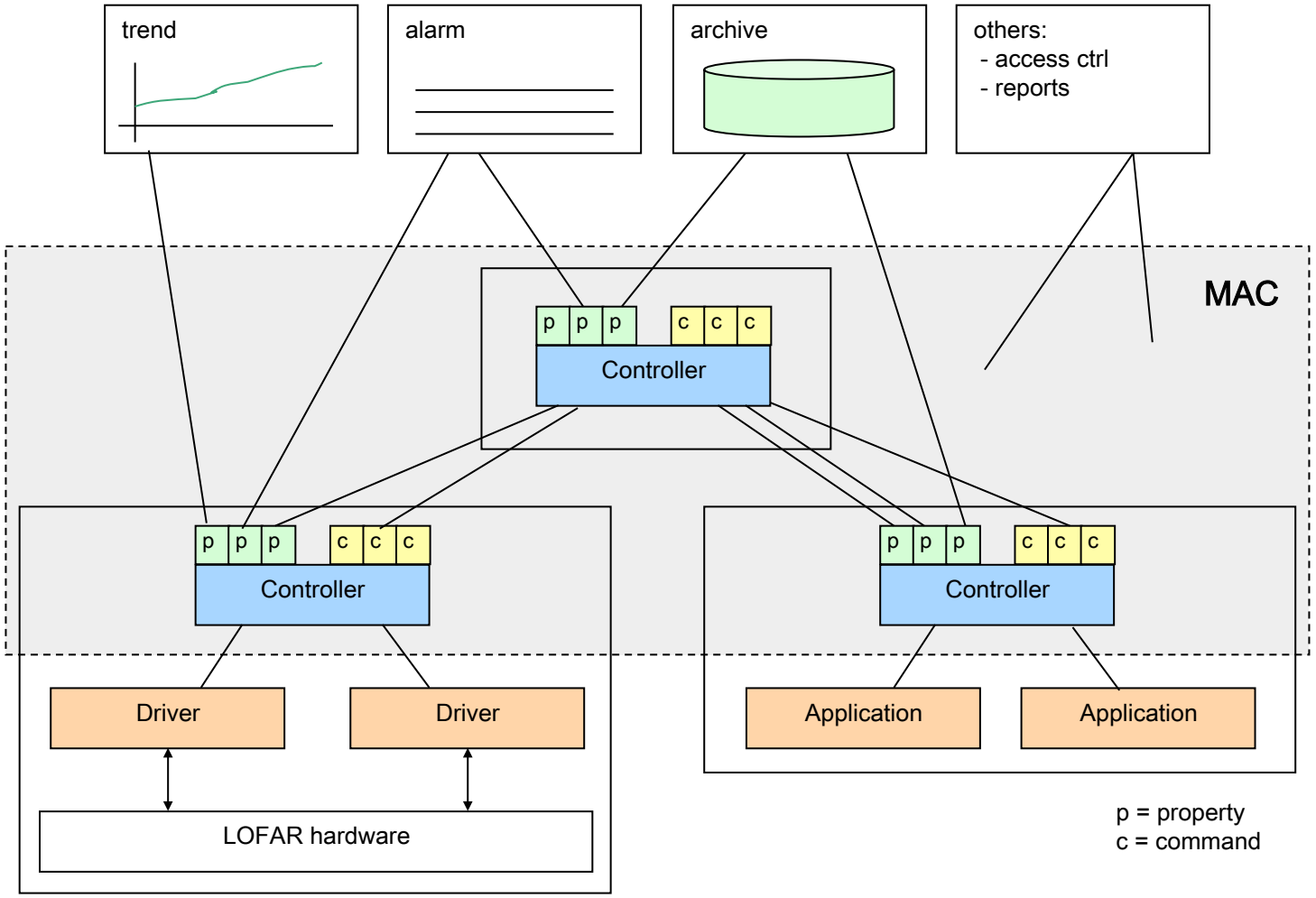
- Short term storage (~5 days)
- Store results of on-line processing
- Creates observation files from the BG/P output
- Provide data for off-line processing
- Store intermediate results for off-line processing

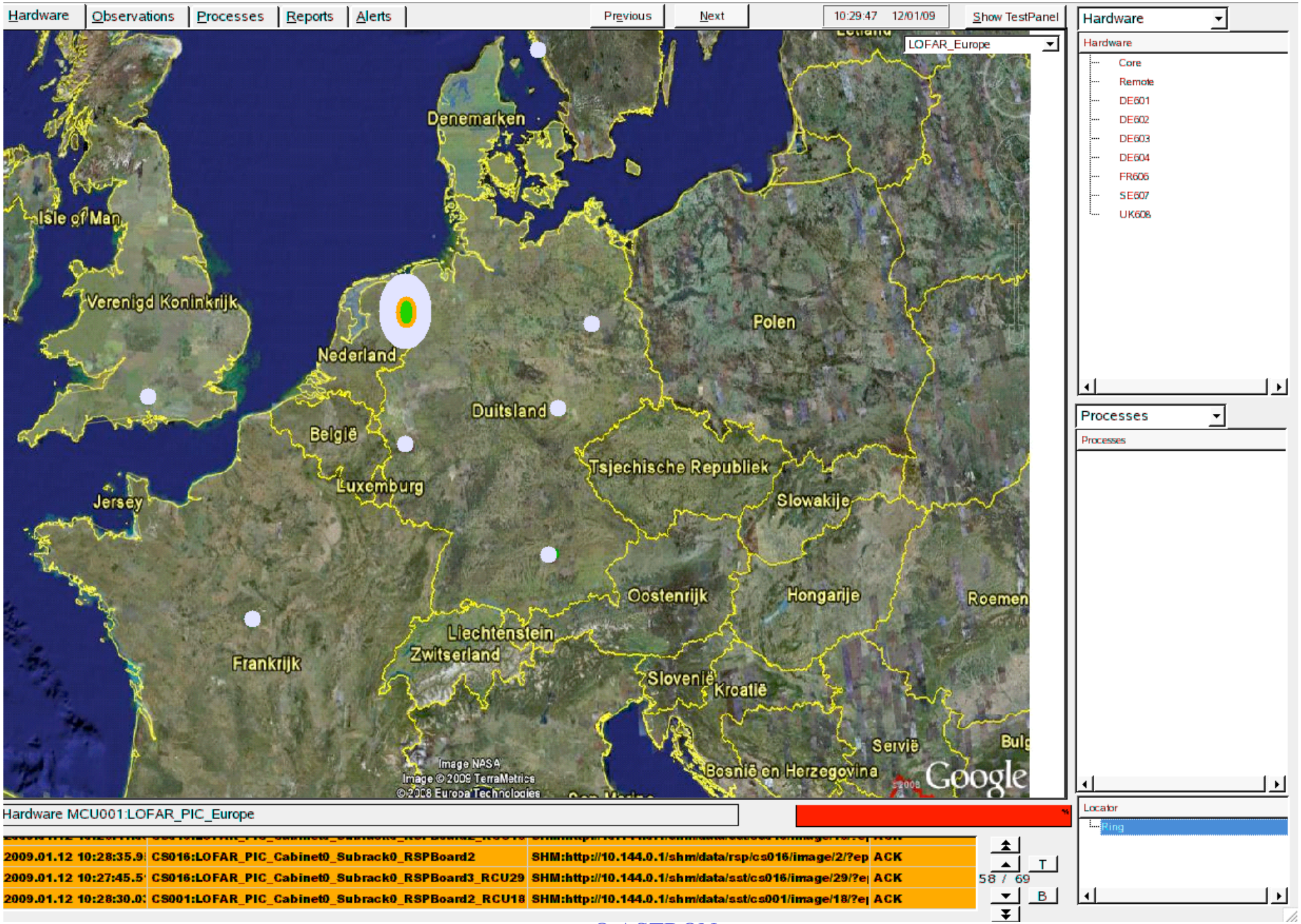
Off-line section responsibilities

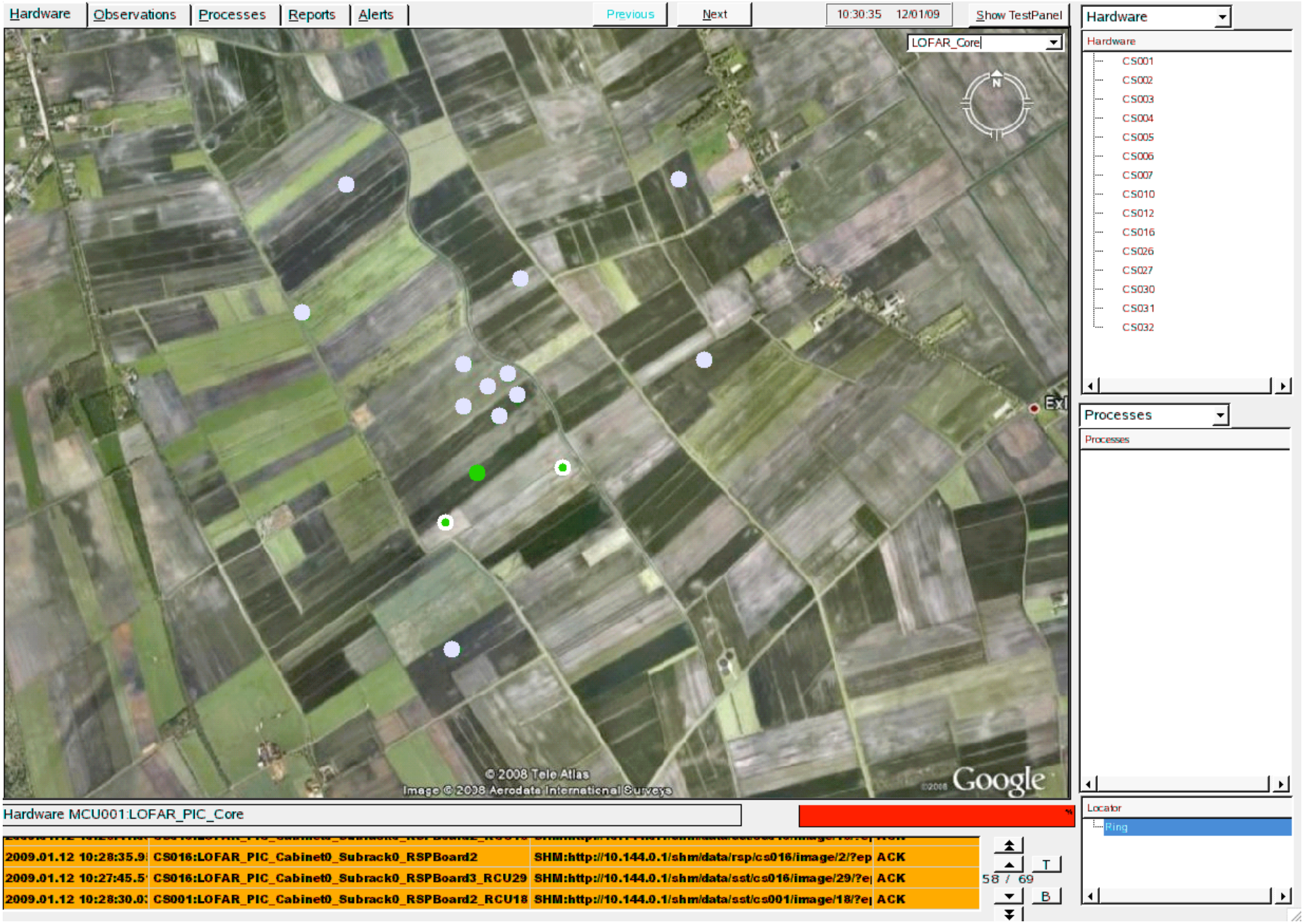
- Create end products
- Dependent on the observation mode
- Data reduction
- Prepare data for export out of LOFAR

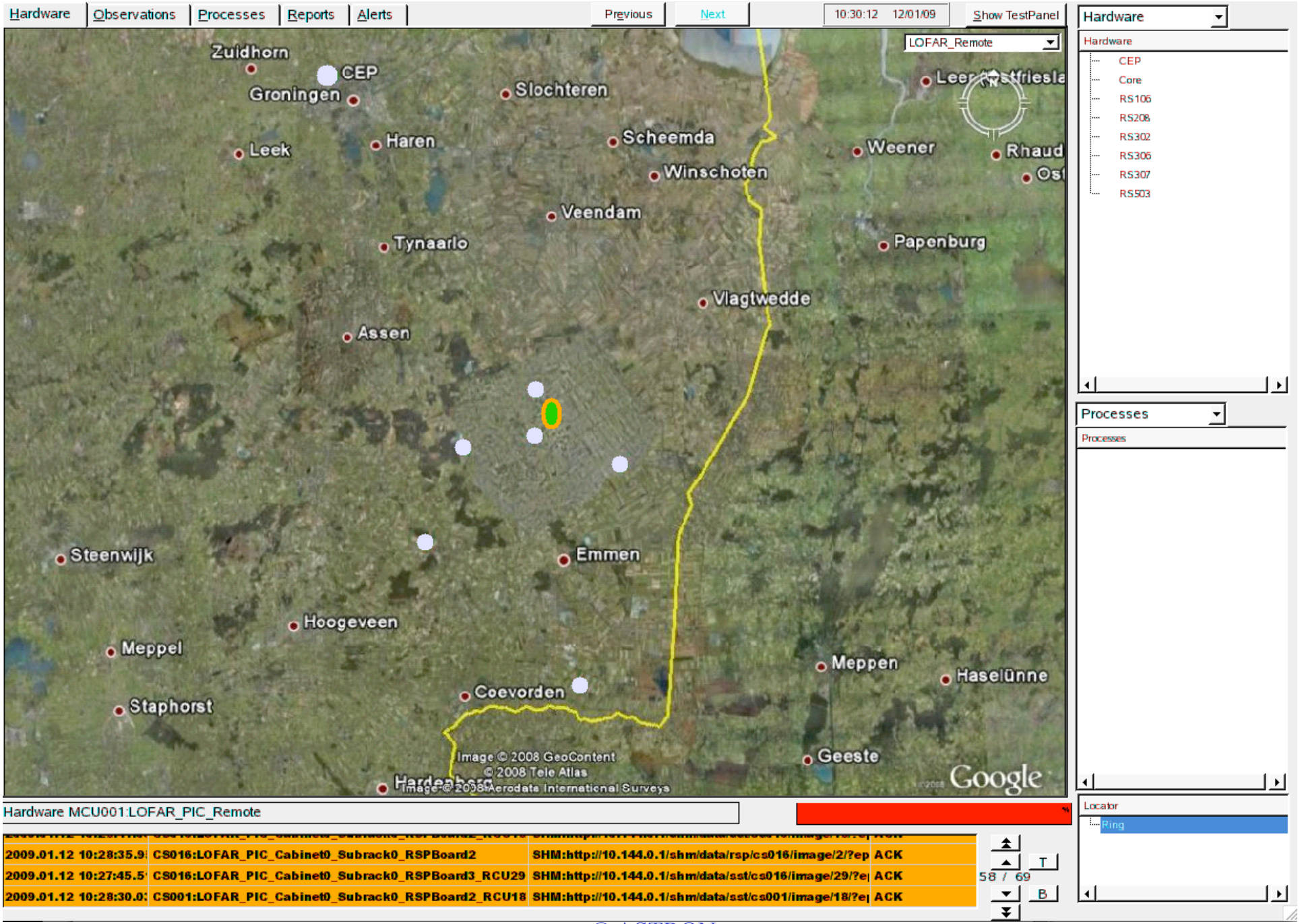


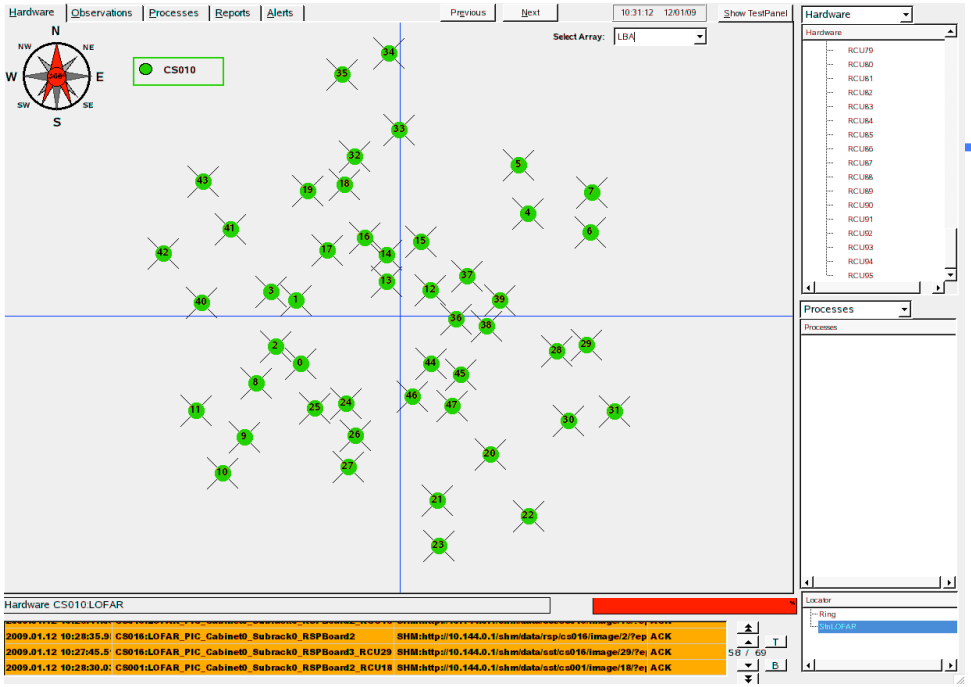
MAC in a birds eye view

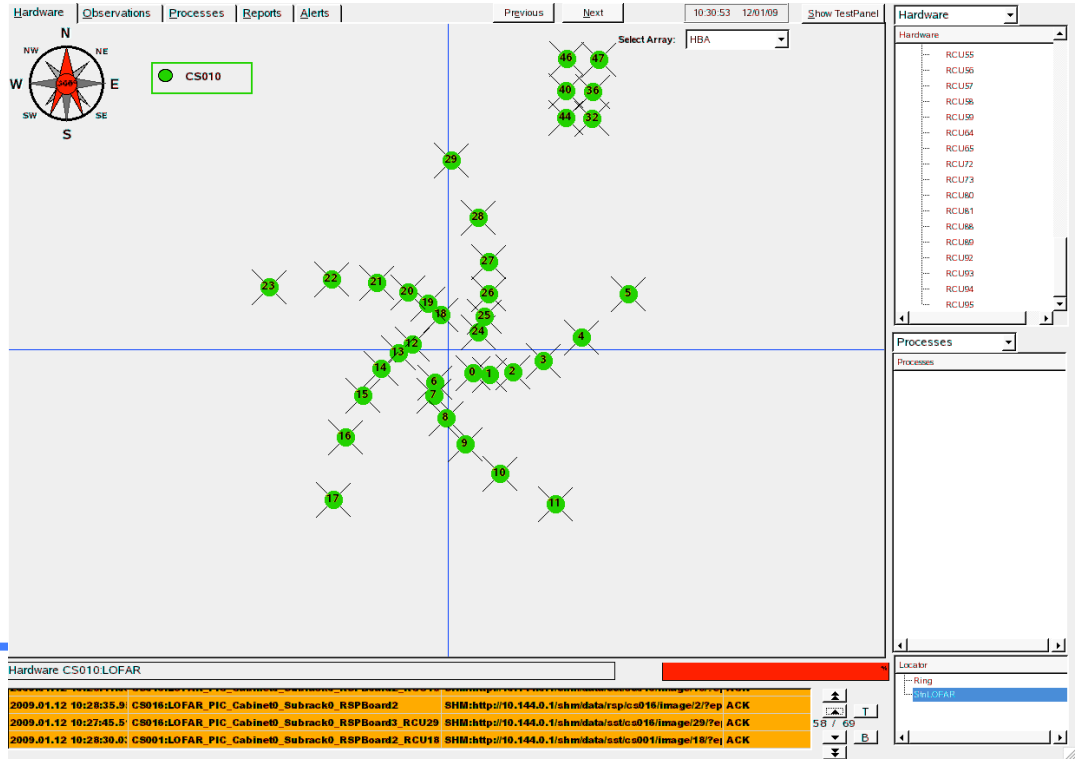


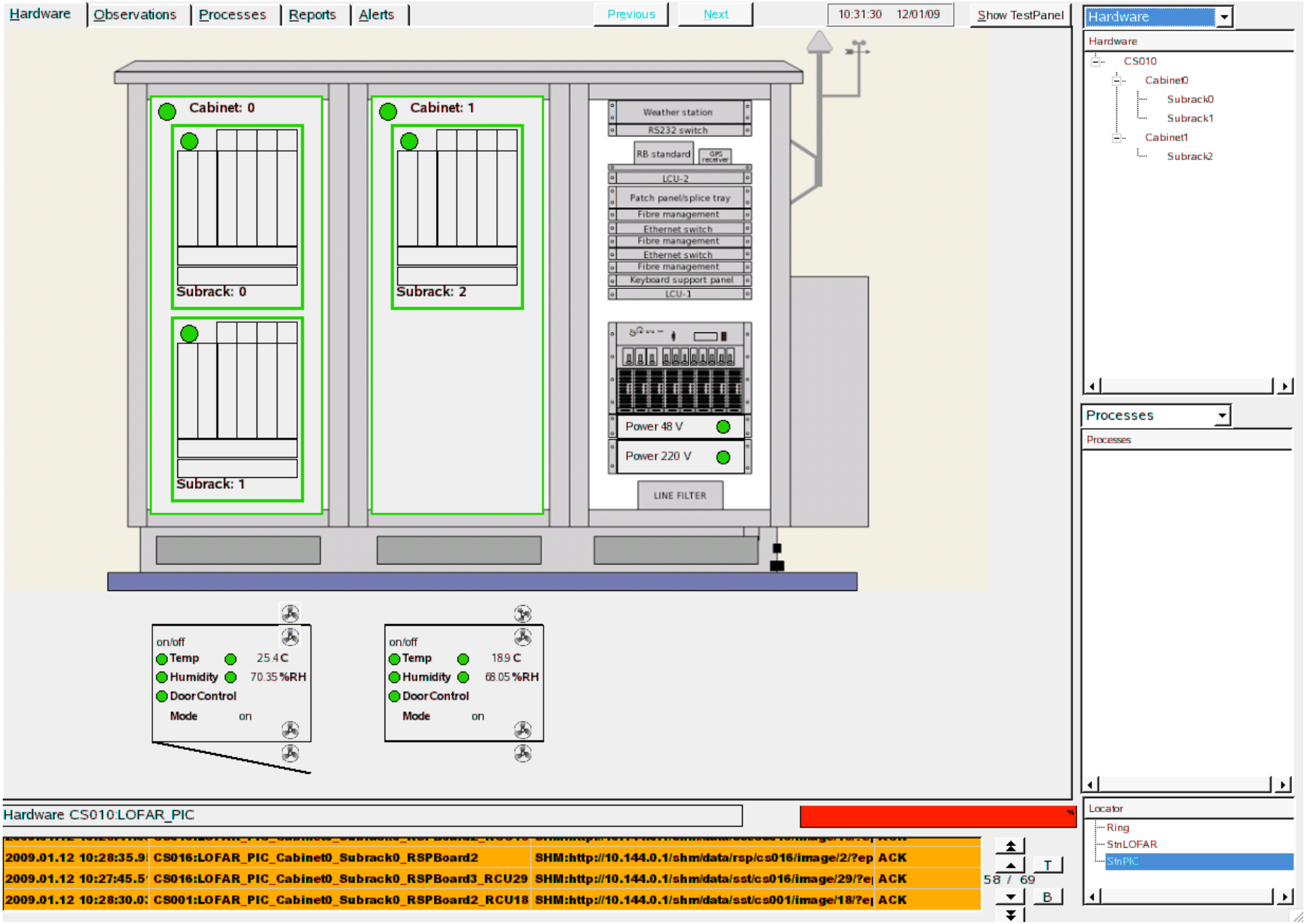

Hardware
Observations
Processes
Reports
Alerts
Previous
Next
10:29:47 12/01/09
Show TestPanel
LOFAR_Europe
Hardware
Core
Remote
DE601
DE602
DE603
DE604
FR606
SE607
UK608
Processes
Locator
Ring
Denemarken
Isle of Man
Verenigd Koninkrijk
Nederland
Polen
Duitsland
België
Luxemburg
Tsjechische Republiek
Slowakije
Jersey
Oostenrijk
Hongarije
Roemen
Liechtenstein
Zwitserland
Frankrijk
Slovenië
Kroatië
Servië
Bosnië en Herzegovina
Image NASA
Image © 2009 TerraMetrics
© 2008 Europa Technologies
Google
Hardware MCU001:LOFAR_PIC_Europe
2009.01.12 10:28:35.9 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2 SHM:http://10.144.0.1/shm/data/rsp/cs016/image/2/?ep ACK
2009.01.12 10:27:45.5 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard3_RCU29 SHM:http://10.144.0.1/shm/data/sst/cs016/image/29/?e ACK
2009.01.12 10:28:30.0 CS001:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2_RCU18 SHM:http://10.144.0.1/shm/data/sst/cs001/image/18/?e ACK
T
58 / 69
B

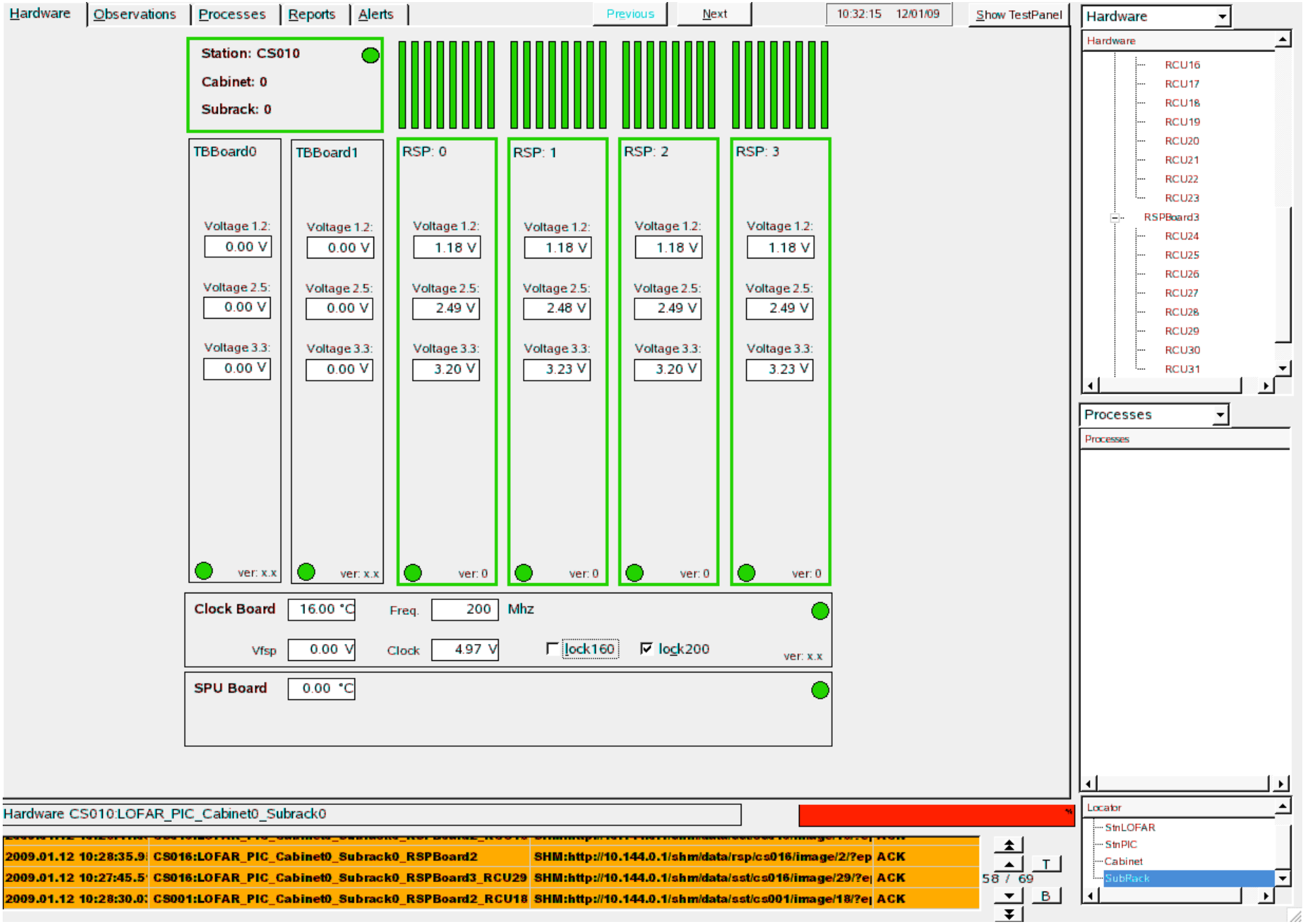

Hardware
Observations
Processes
Reports
Alerts
Previous
Next
10:30:35 12/01/09
Show TestPanel
LOFAR_Core
Hardware
Hardware
CS001
CS002
CS003
CS004
CS005
CS006
CS007
CS010
CS012
CS016
CS026
CS027
CS030
CS031
CS032
Processes
Processes
Locator
Ring
© 2008 Tele Atlas
Image © 2008 Aerodata International Surveys
Google
Hardware MCU001:LOFAR_PIC_Core
2009.01.12 10:28:35.9 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2 SHM:http://10.144.0.1/shm/data/rsp/cs016/image/2/?ep ACK
2009.01.12 10:27:45.5 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard3_RCU29 SHM:http://10.144.0.1/shm/data/sst/cs016/image/29/?e ACK
2009.01.12 10:28:30.0 CS001:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2_RCU18 SHM:http://10.144.0.1/shm/data/sst/cs001/image/18/?e ACK
T
58 / 69
B

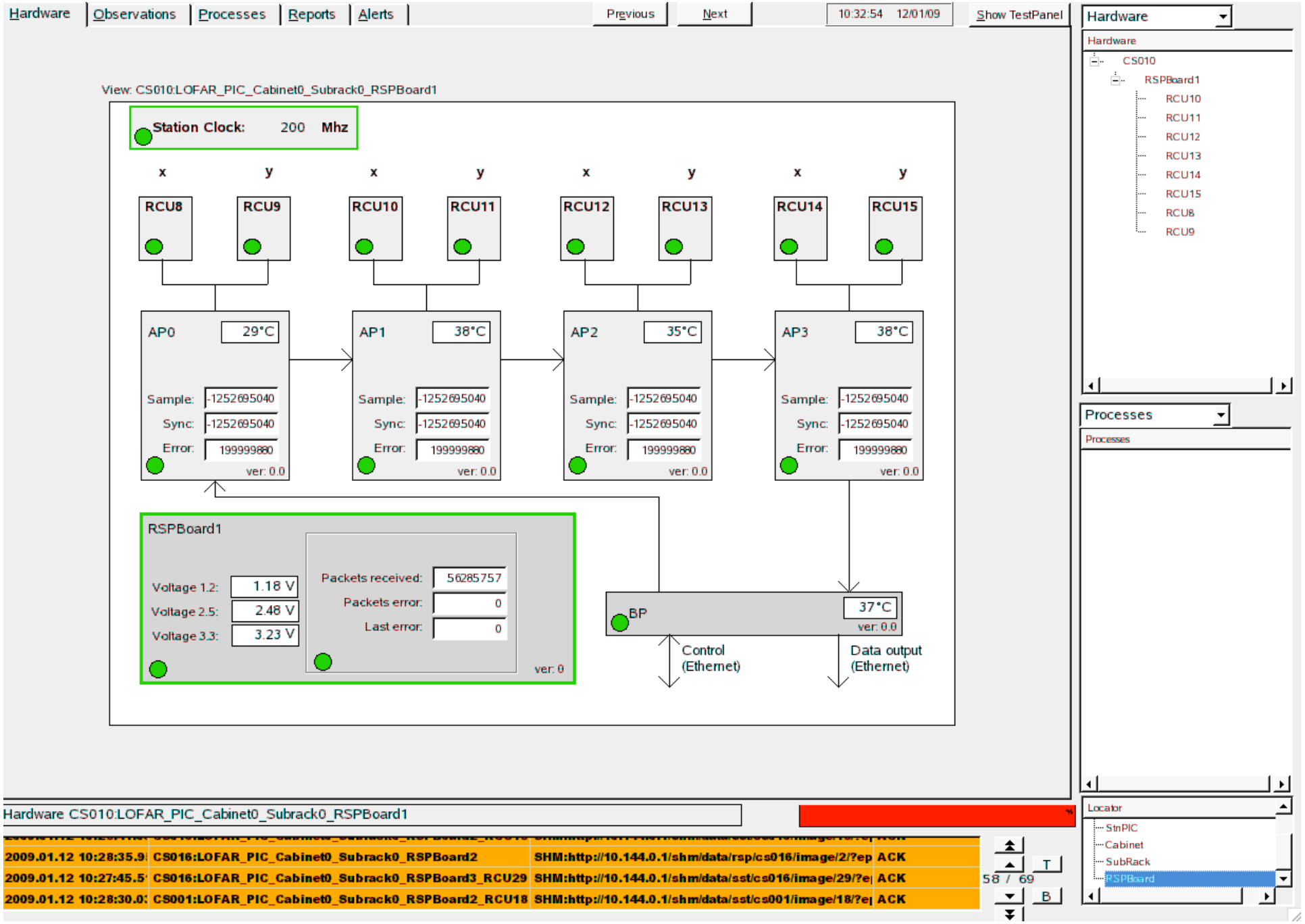

Hardware
Observations
Processes
Reports
Alerts
Previous
Next
10:30:12 12/01/09
Show TestPanel
LOFAR_Remote
Zuidhorn
CEP
Groningen
Slochteren
Leek
Haren
Scheemda
Weener
Winschoten
Veendam
Tynaarlo
Papenburg
Vlagtwedde
Assen
Steenwijk
Emmen
Hoogeveen
Meppel
Meppen
Haselünne
Coevorden
Staphorst
Geeste
Image © 2008 GeoContent
© 2008 Tele Atlas
Image © 2008 Aerodata International Surveys
Google
Hardware
CEP
Core
RS106
RS208
RS302
RS306
RS307
RS503
Processes
Locator
Ring
Hardware MCU001:LOFAR_PIC_Remote
2009.01.12 10:28:35.9 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2 SHM:http://10.144.0.1/shm/data/rsp/cs016/image/2/?ep ACK
2009.01.12 10:27:45.5 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard3_RCU29 SHM:http://10.144.0.1/shm/data/sst/cs016/image/29/?e ACK
2009.01.12 10:28:30.0 CS001:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2_RCU18 SHM:http://10.144.0.1/shm/data/sst/cs001/image/18/?e ACK
T
58 / 69
B


Hardware
Observations
Processes
Reports
Alerts
Previous
Next
10:31:12 12/01/09
Show TestPanel
Select Array: LBA
CS010
Hardware
Processes
Hardware CS010:LOFAR
2009.01.12 10:28:35.9 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2 SHM:http://10.144.0.1/shm/data/rsp/cs016/image/2/?ep ACK
2009.01.12 10:27:45.5 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard3_RCU29 SHM:http://10.144.0.1/shm/data/sst/cs016/image/29/?e ACK
2009.01.12 10:28:30.0 CS001:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2_RCU18 SHM:http://10.144.0.1/shm/data/sst/cs001/image/18/?e ACK
58 / 69


Hardware
Observations
Processes
Reports
Alerts
Previous
Next
10:30:53 12/01/09
Show TestPanel
Select Array: HBA
CS010
Hardware
Processes
Hardware CS010:LOFAR
2009.01.12 10:28:35.9 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2 SHM:http://10.144.0.1/shm/data/rsp/cs016/image/2/?ep ACK
2009.01.12 10:27:45.5 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard3_RCU29 SHM:http://10.144.0.1/shm/data/sst/cs016/image/29/?e ACK
2009.01.12 10:28:30.0 CS001:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2_RCU18 SHM:http://10.144.0.1/shm/data/sst/cs001/image/18/?e ACK
58 / 69


Hardware
Observations
Processes
Reports
Alerts
Previous
Next
10:31:30 12/01/09
Show TestPanel
Cabinet: 0
Subrack: 0
Subrack: 1
Cabinet: 1
Subrack: 2
Weather station
RS232 switch
RB standard
GPS receiver
LCU-2
Patch panel/splice tray
Fibre management
Ethernet switch
Fibre management
Ethernet switch
Fibre management
Keyboard support panel
LCU-1
Power 48 V
Power 220 V
LINE FILTER
on/off
Temp 25.4 C
Humidity 70.35 %RH
Door Control
Mode on
on/off
Temp 18.9 C
Humidity 68.05 %RH
Door Control
Mode on
Hardware
Hardware
CS010
Cabinet0
Subrack0
Subrack1
Cabinet1
Subrack2
Processes
Processes
Hardware CS010:LOFAR_PIC
Locator
Ring
StnLOFAR
StnPIC
2009.01.12 10:28:35.9 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2 SHM:http://10.144.0.1/shm/data/rsp/cs016/image/2/?ep ACK
2009.01.12 10:27:45.5 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard3_RCU29 SHM:http://10.144.0.1/shm/data/sst/cs016/image/29/?e ACK
2009.01.12 10:28:30.0 CS001:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2_RCU18 SHM:http://10.144.0.1/shm/data/sst/cs001/image/18/?e ACK
58 / 69
T
B


Hardware
Observations
Processes
Reports
Alerts
Previous
Next
10:32:15 12/01/09
Show TestPanel
Station: CS010
Cabinet: 0
Subrack: 0
TBBoard0
TBBoard1
RSP: 0
RSP: 1
RSP: 2
RSP: 3
Voltage 1.2:
Voltage 2.5:
Voltage 3.3:
0.00 V
1.18 V
2.49 V
2.48 V
3.20 V
3.23 V
ver: x.x
ver: 0
Clock Board
16.00 °C
Freq.
200
Mhz
Vfsp
0.00 V
Clock
4.97 V
lock160
lock200
SPU Board
0.00 °C
Hardware
RCU16
RCU17
RCU18
RCU19
RCU20
RCU21
RCU22
RCU23
RSPBoard3
RCU24
RCU25
RCU26
RCU27
RCU28
RCU29
RCU30
RCU31
Processes
Locator
StnLOFAR
StnPIC
Cabinet
SubRack
Hardware CS010:LOFAR_PIC_Cabinet0_Subrack0
2009.01.12 10:28:35.9 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2 SHM:http://10.144.0.1/shm/data/rsp/cs016/image/2/?ep ACK
2009.01.12 10:27:45.5 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard3_RCU29 SHM:http://10.144.0.1/shm/data/sst/cs016/image/29/?e ACK
2009.01.12 10:28:30.0 CS001:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2_RCU18 SHM:http://10.144.0.1/shm/data/sst/cs001/image/18/?e ACK
58 / 69
T
B


Hardware
Observations
Processes
Reports
Alerts
Previous
Next
10:32:54 12/01/09
Show TestPanel
View: CS010:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard1
Station Clock: 200 Mhz
RCU8
RCU9
RCU10
RCU11
RCU12
RCU13
RCU14
RCU15
AP0 29°C
AP1 38°C
AP2 35°C
AP3 38°C
Sample: -1252695040
Sync: -1252695040
Error: 199999880
ver: 0.0
RSPBoard1
Voltage 1.2: 1.18 V
Voltage 2.5: 2.48 V
Voltage 3.3: 3.23 V
Packets received: 56285757
Packets error: 0
Last error: 0
ver: 0
BP 37°C
Control (Ethernet)
Data output (Ethernet)
Hardware
CS010
RSPBoard1
Processes
Locator
StnPIC
Cabinet
SubRack
RSPBoard
Hardware CS010:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard1
2009.01.12 10:28:35.9 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2 SHM:http://10.144.0.1/shm/data/rsp/cs016/image/2/?ep ACK
2009.01.12 10:27:45.5 CS016:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard3_RCU29 SHM:http://10.144.0.1/shm/data/sst/cs016/image/29/?e ACK
2009.01.12 10:28:30.0 CS001:LOFAR_PIC_Cabinet0_Subrack0_RSPBoard2_RCU18 SHM:http://10.144.0.1/shm/data/sst/cs001/image/18/?e ACK
58 / 69
T
B


The End