

Safe and secure remote control for the twin radio telescope Wettzell

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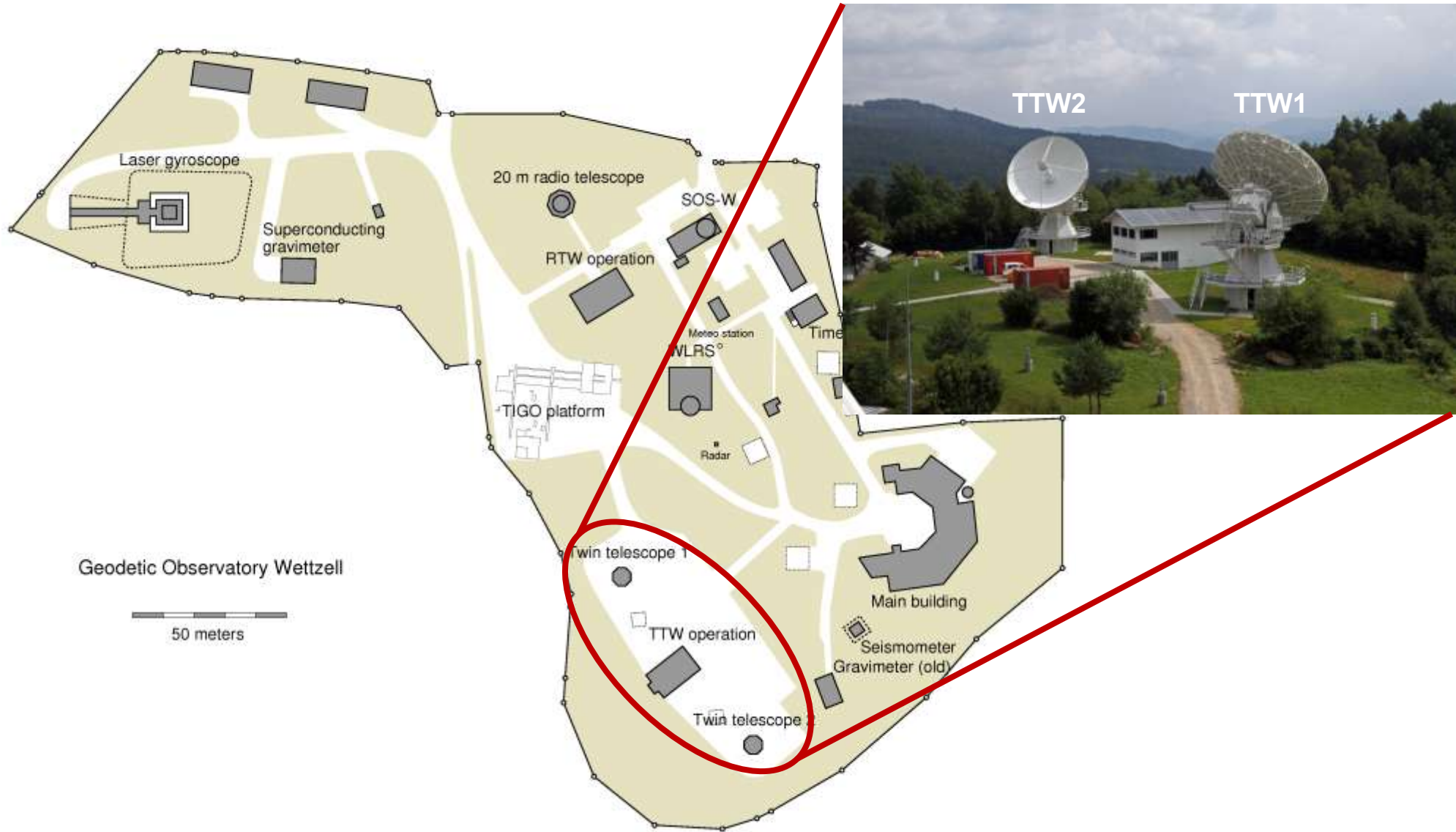
FESG



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Walter Alef (MPIfR), Ed Himwich (NASA/GSFC), Christopher Beaudoin (MIT-Haystack),
Christian Plötz (BKG), Arpad Szomoru (JIVE), Matthias Mühlbauer (BKG),*

The Twin Radio Telescope Wettzell (TTW)

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The Twin Radio Telescope Wettzell (TTW)



Technical details:

- Main reflector: 13.2m
- Ring focal design
- $f/D = 0.29$
- Path Length Error $< 0.3\text{mm}$
- ALMA Mounting with drive velocities of $12^\circ/\text{s}$ in Azimuth and $6^\circ/\text{s}$ in Elevation
- Balanced antenna design
- 27Bit Encoder : 0.0003° resolution
- Adjustable sub-reflector using a Hexapod
- Lifetime min. 20 years



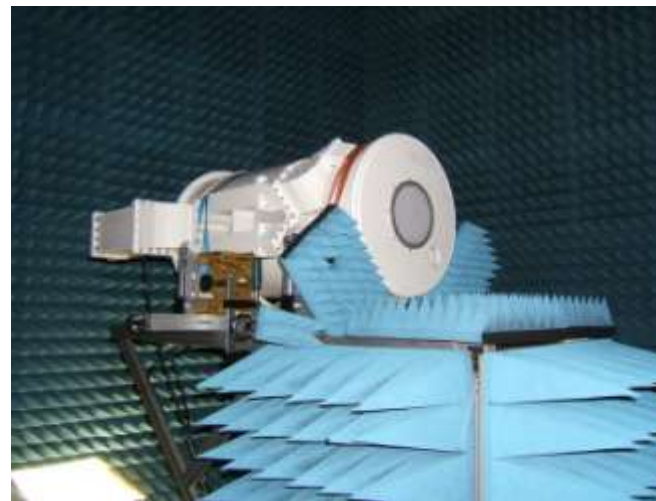
IVS WG 3 – VLBI2010: Current and future requirements
for geodetic VLBI Systems

The Twin Radio Telescope Wettzell (TTW1)

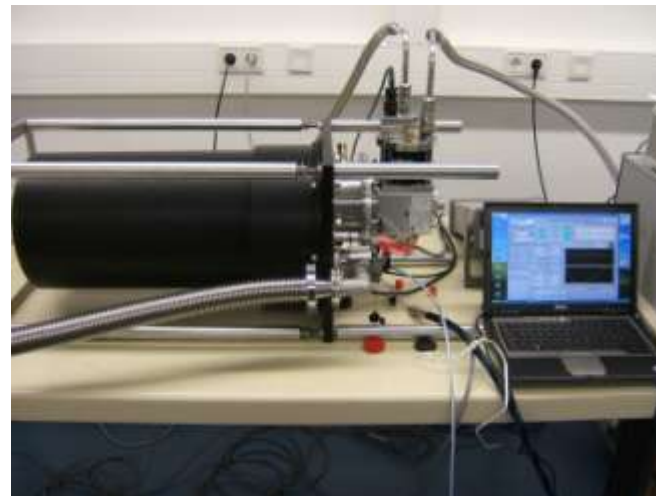
The triband feed



Test in anechoic chamber



Test of the triband-dewar



Performance: feed

Frequency bands:
 S-band: 2.2 – 2.7 GHz
 X-Band: 7.0 – 9.5 GHz
 Ka-band: 28 – 33 GHz

Insertion Loss:
 S-band : < 0.12 dB
 X-Band; < 0.08 dB
 Ka-Band: < 0.5 dB

Return Loss:
 S-band : > 25 dB
 X-Band; > 20 dB
 Ka-Band: > 35dB

Performance: dewar

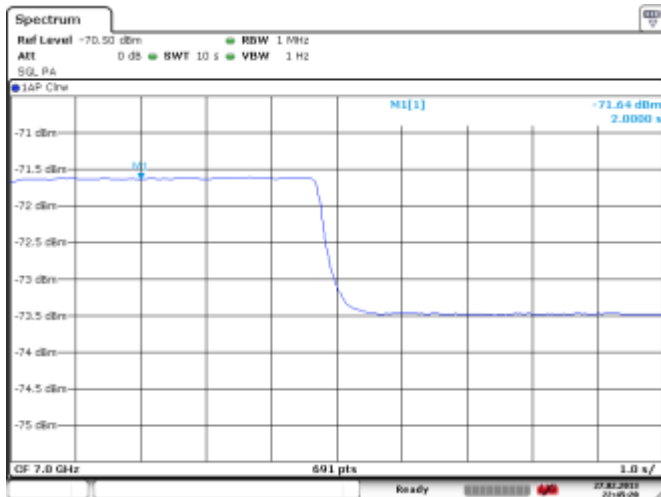
Cold head: T1 = 9 K
 T2 = 25 K

LNA Noise Temperature:
 S-band : < 20 K
 X-Band; < 12 K
 Ka-Band: < 35 K

LNA-Gain:
 S-band : > 40 dB
 X-Band; > 30 dB
 Ka-Band: > 25dB

The Twin Radio Telescope Wettzell (TTW)

First Light of TTW1: Cassiopeia A at X-Band

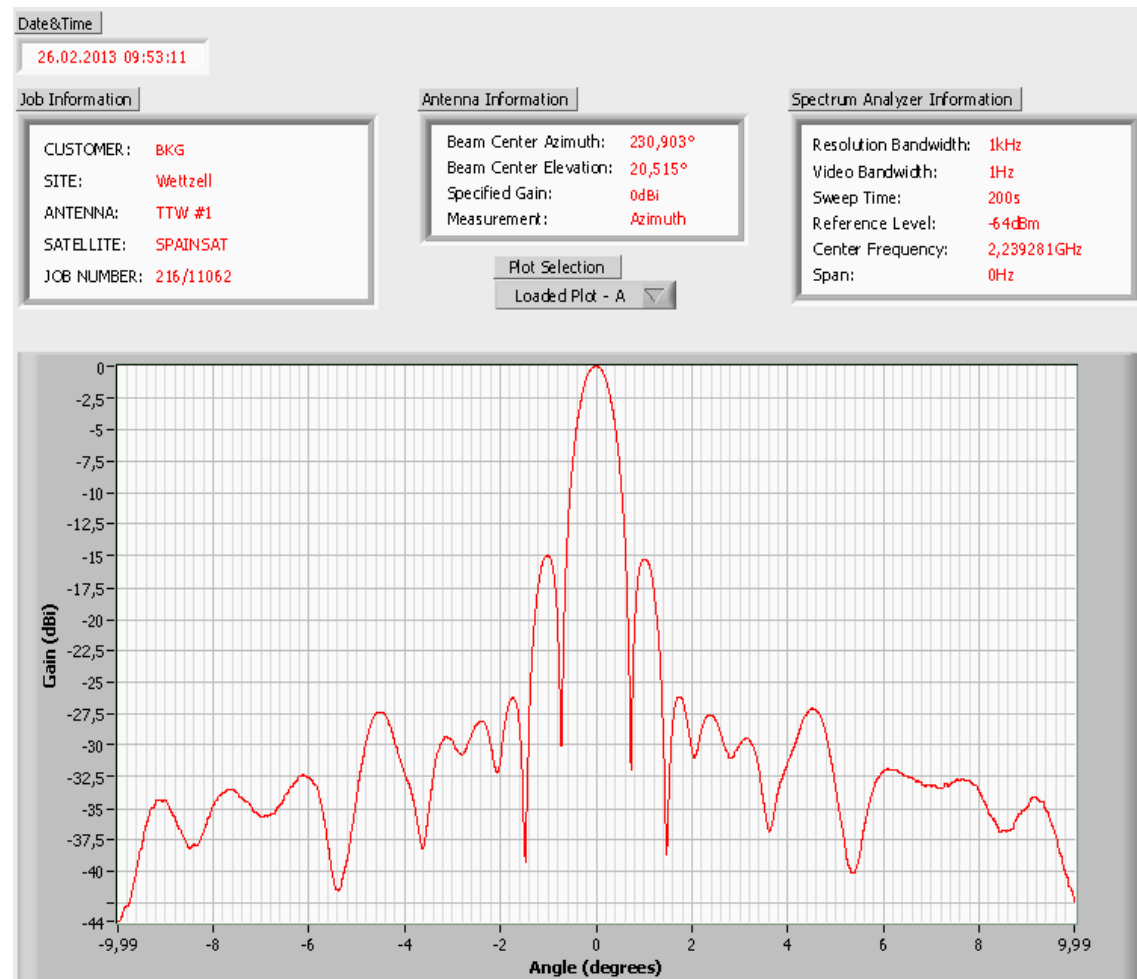


Date: 27. FEB. 2013 22:45:20

Installed Triband-feed



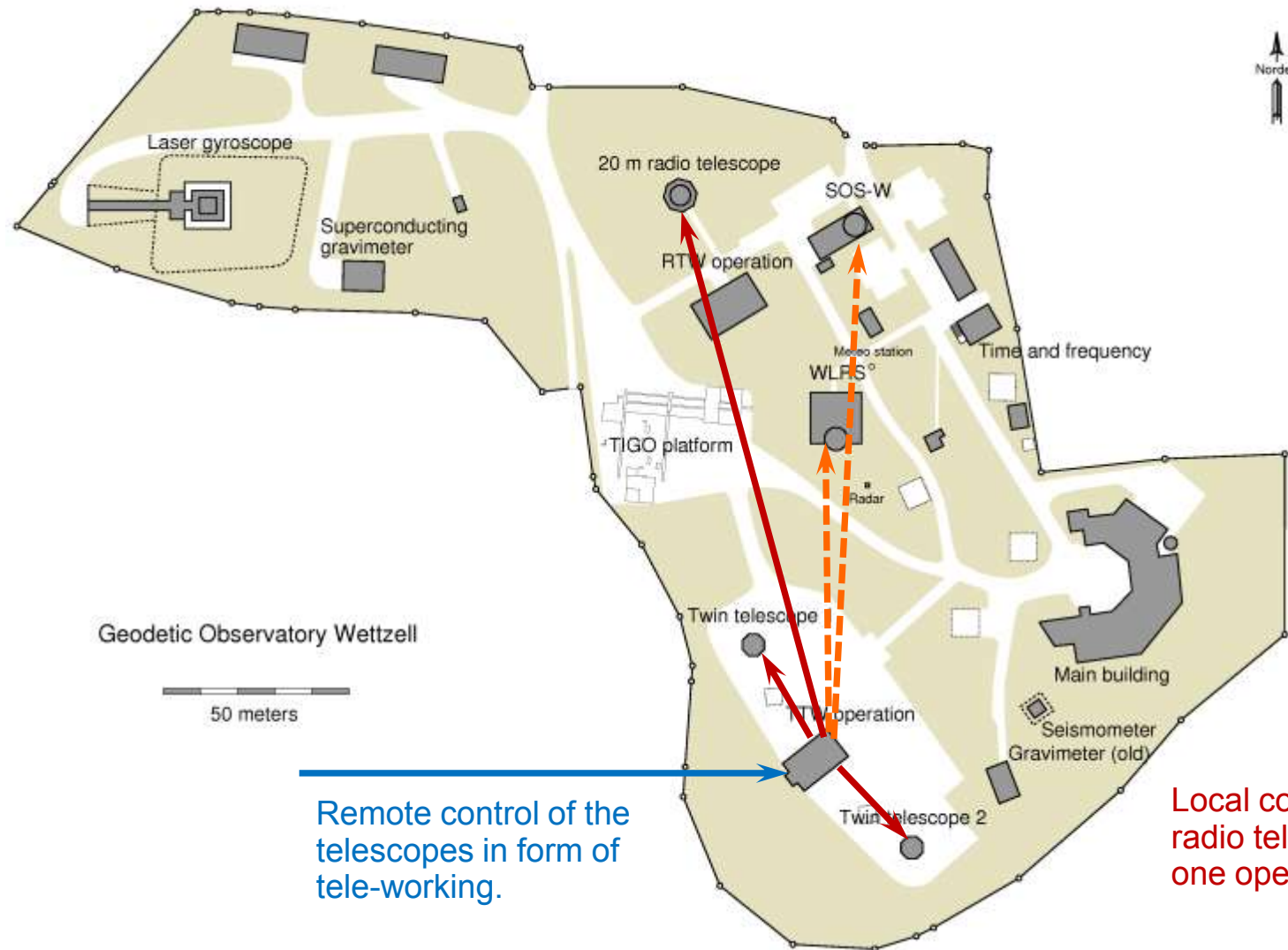
S-Band beam pattern



The Twin Radio Telescope Wettzell (TTW)

The idea behind the new control software

The idea behind the new control software

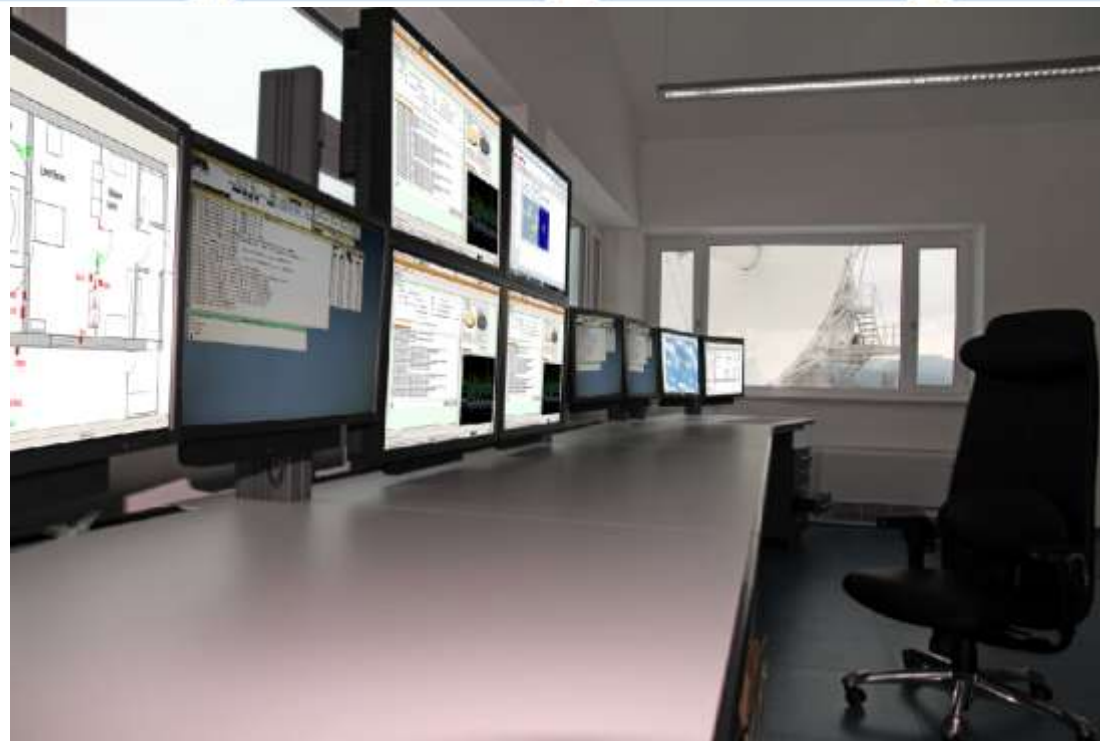
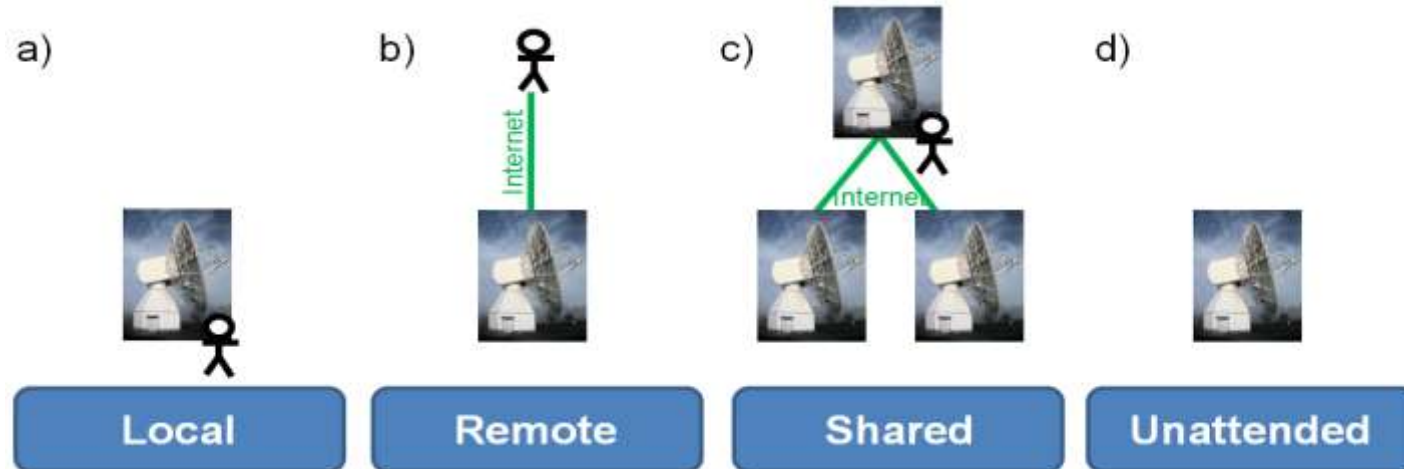


Possible control of two SLR telescopes from the same operator room.

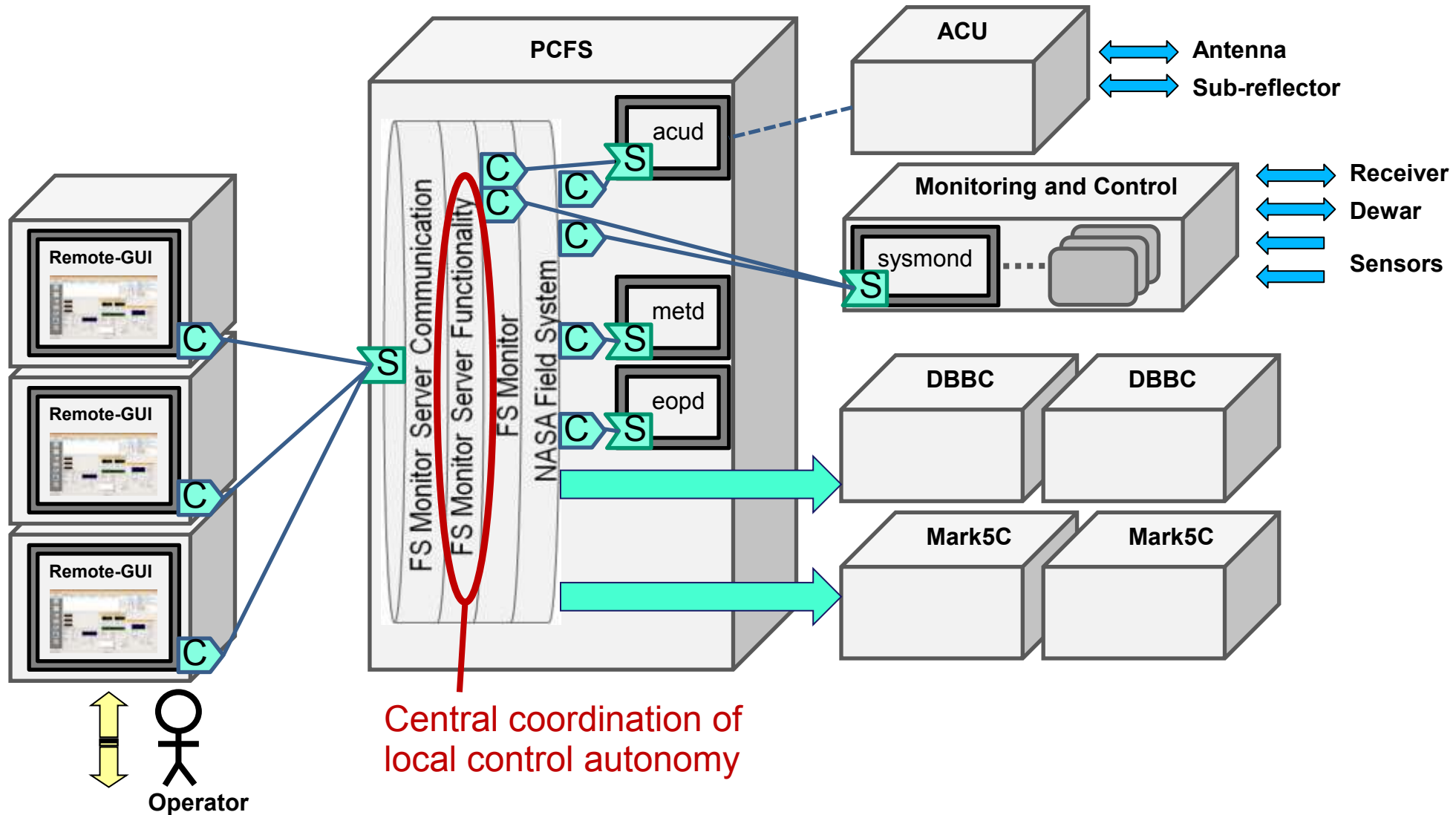
Local control of three radio telescopes from one operator room.

Remote control of the telescopes in form of tele-working.

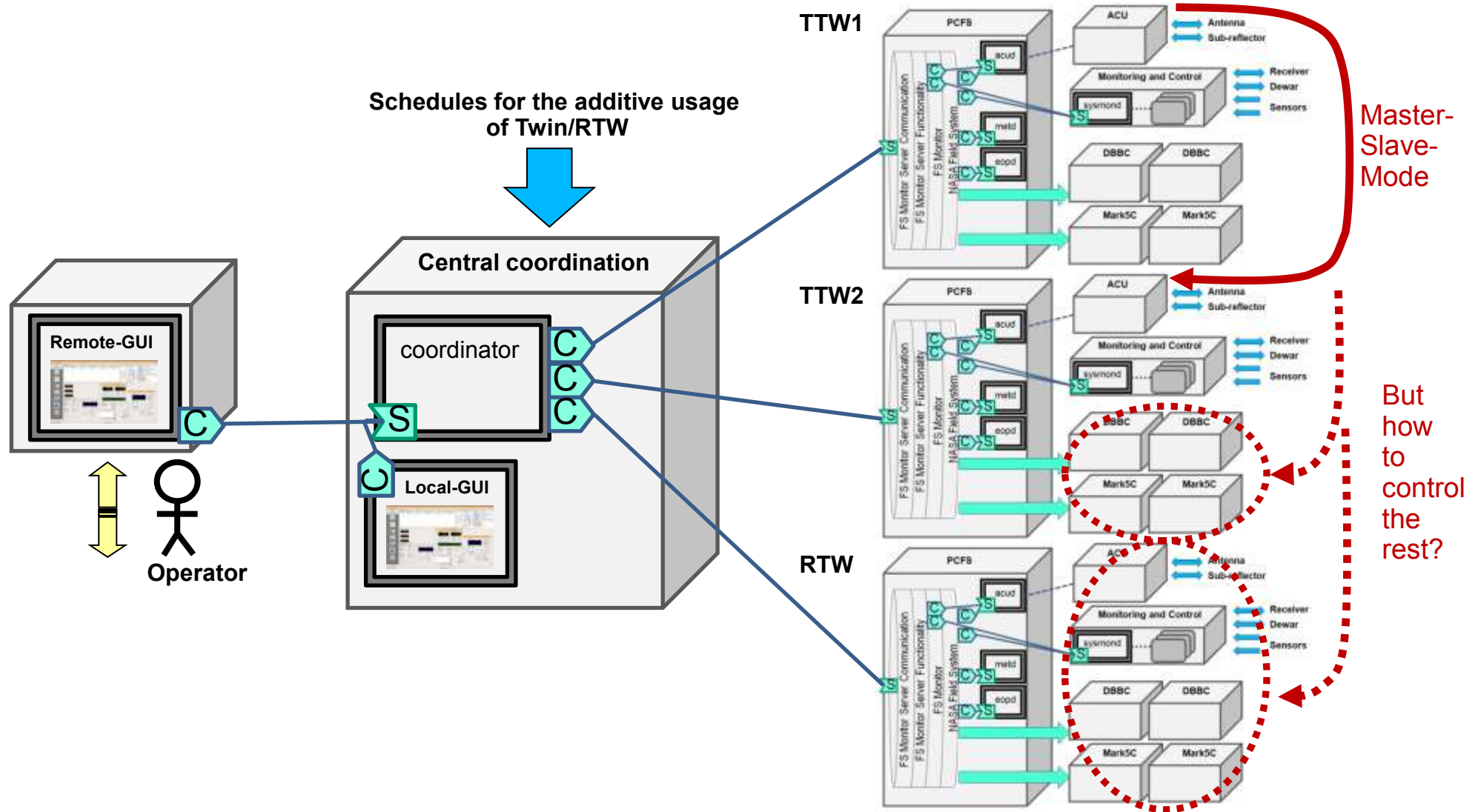
The idea behind the new control software



The idea behind the new control software



The idea behind the new control software

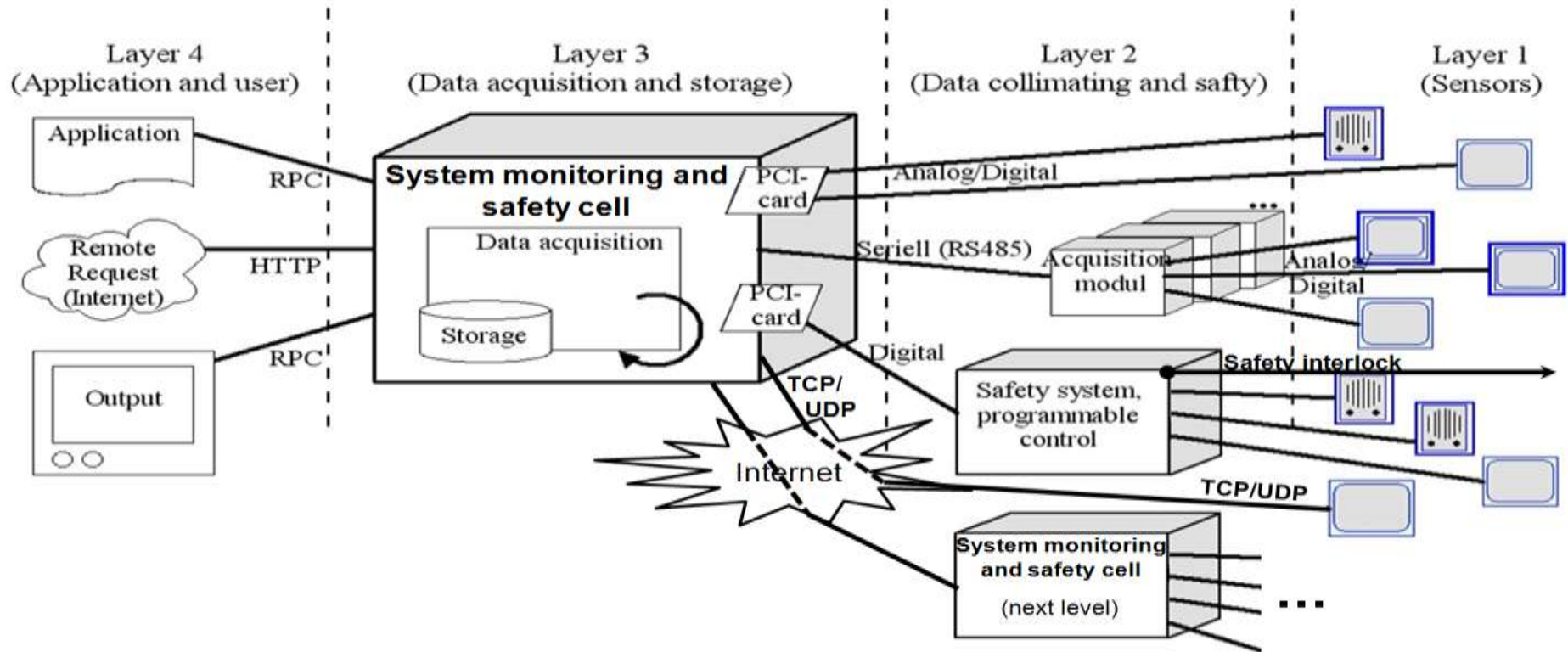


The Twin Radio Telescope Wettzell (TTW)

The idea behind the new control software

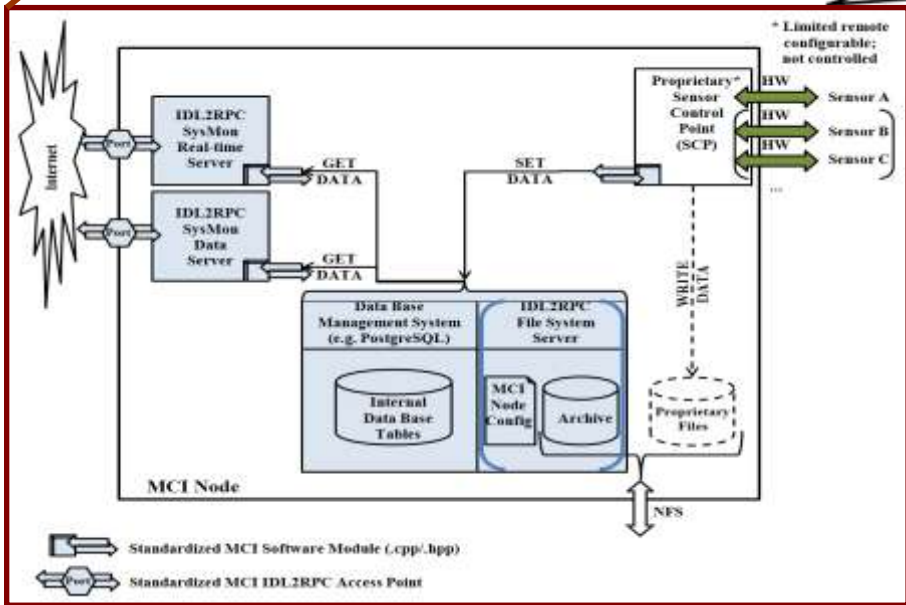
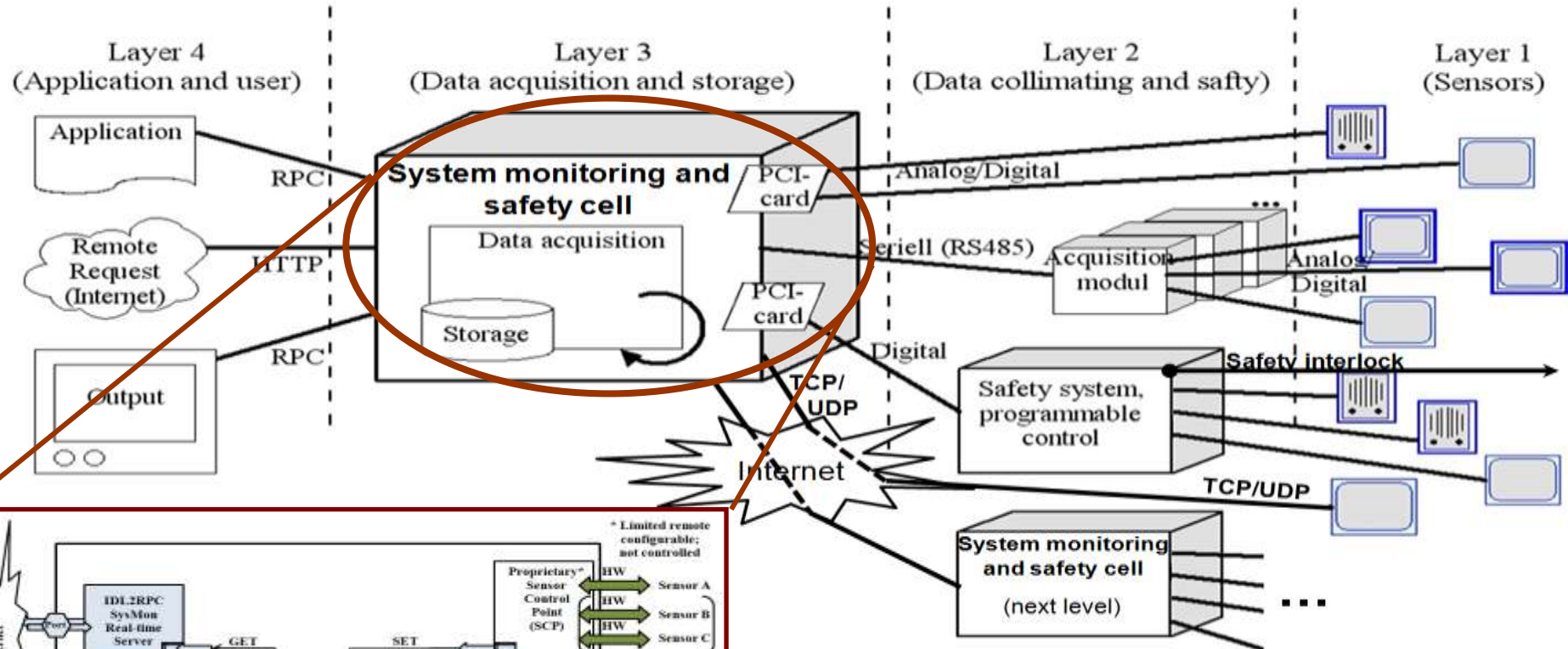
Safety

Safety



Monitoring and Control Infrastructure (MCI)

Safety



- Data for science and analysis
- Data for system operations
- Data for diagnosis

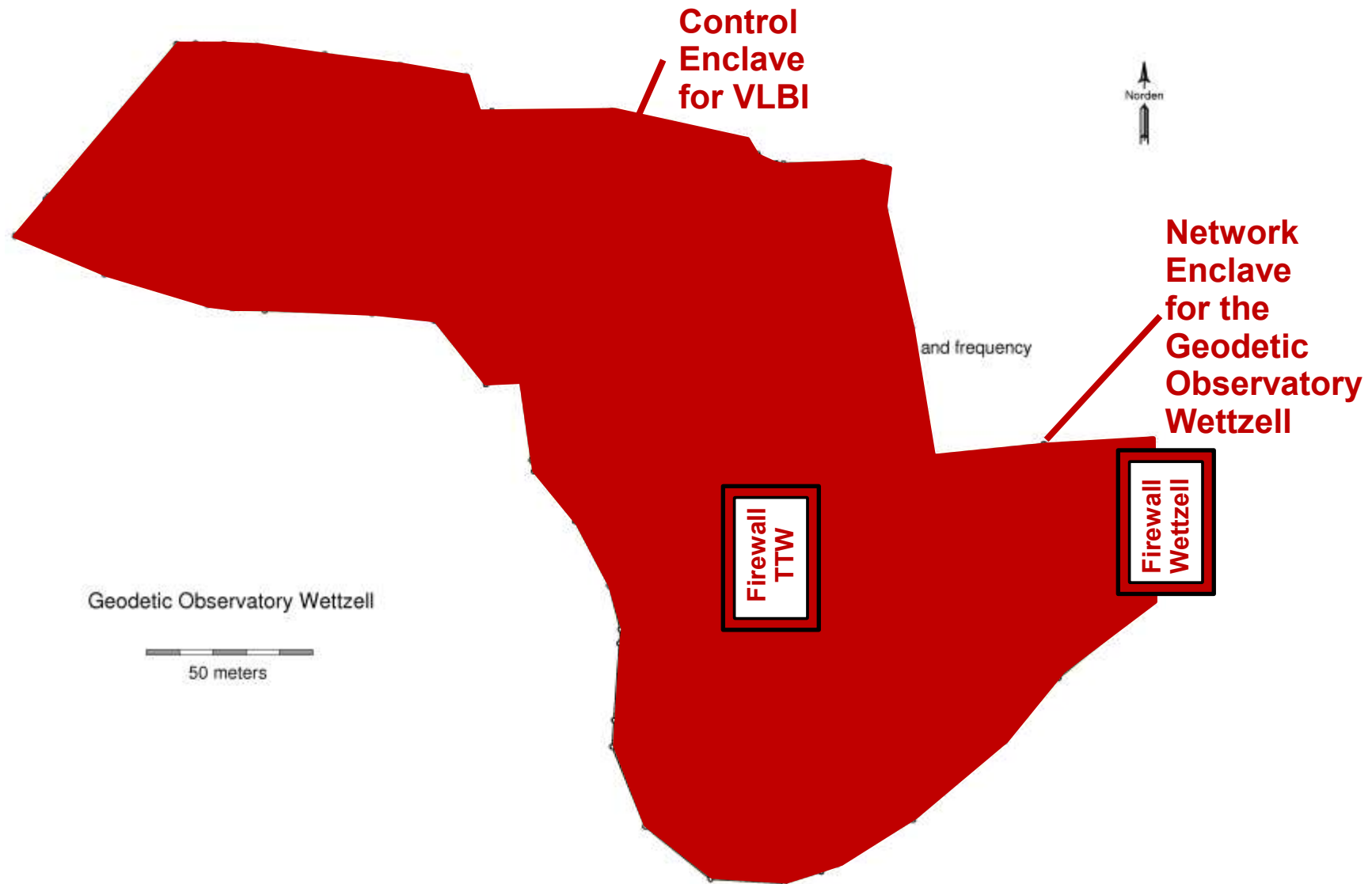
The Twin Radio Telescope Wettzell (TTW)

The idea behind the new control software

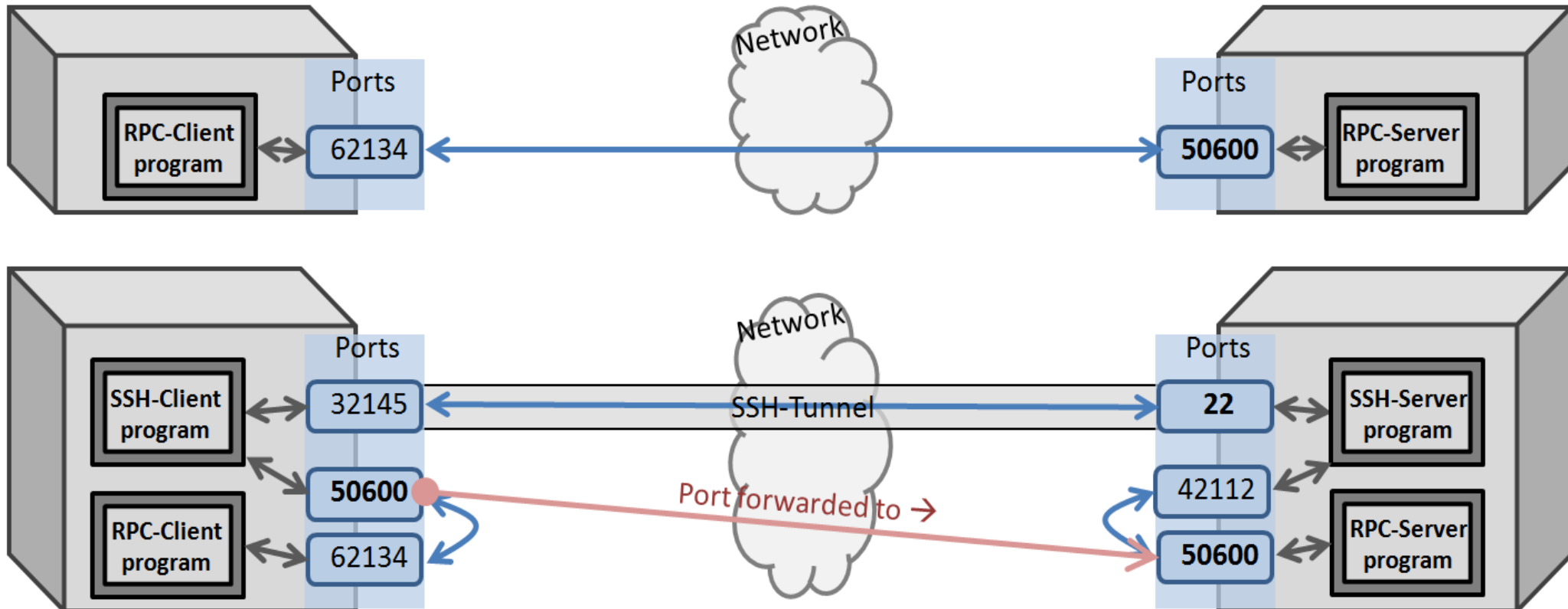
Safety

Security

Security



Security



sshbroker

rbash

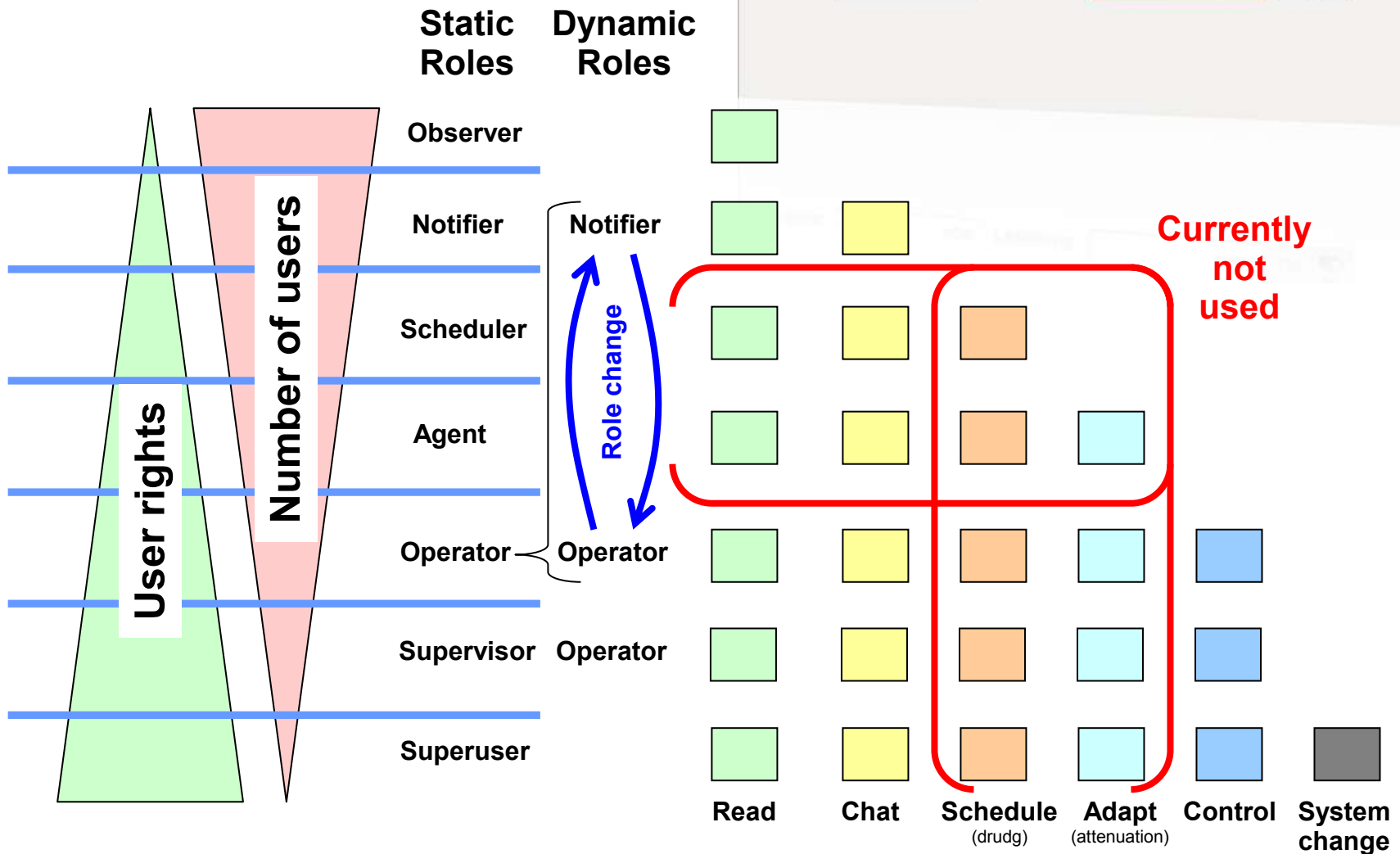
Tunneled e-RemoteCtrl



Wetzell Software Toolbox
(well tested modules & components)

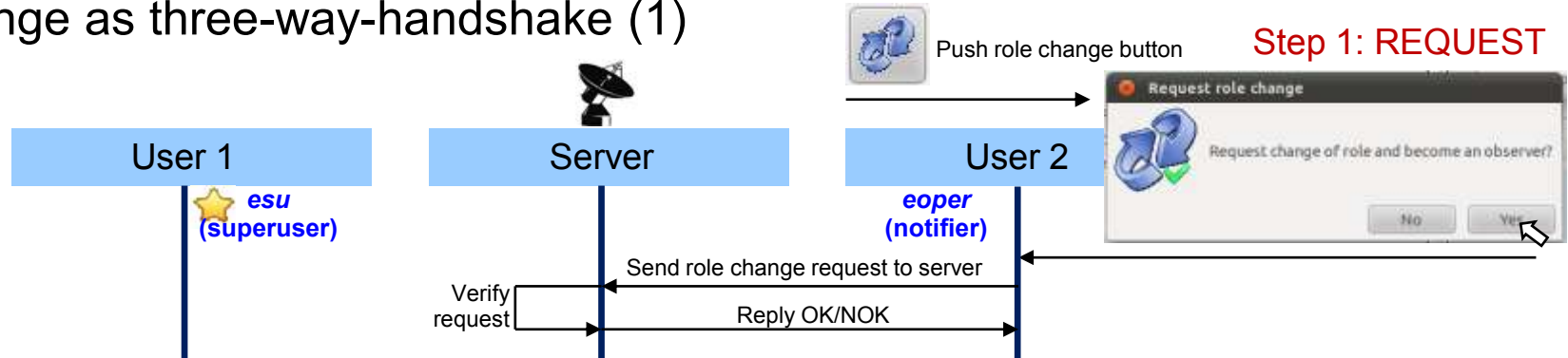
Security NEXPRes

User role management with authentication and authorization



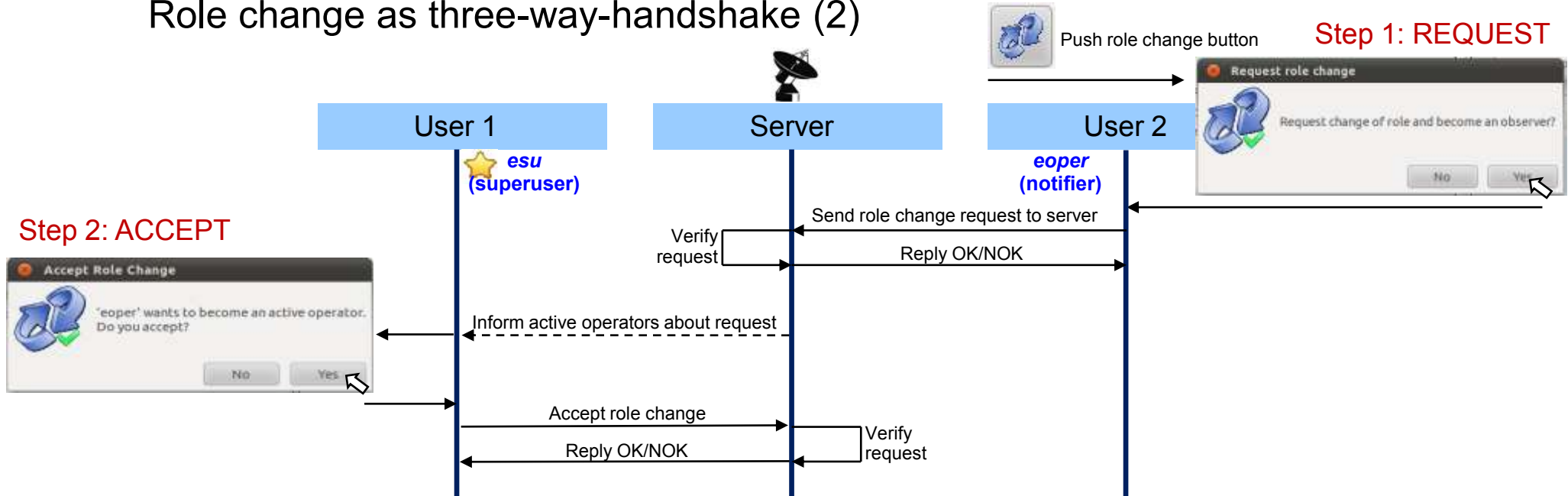
Security

Role change as three-way-handshake (1)



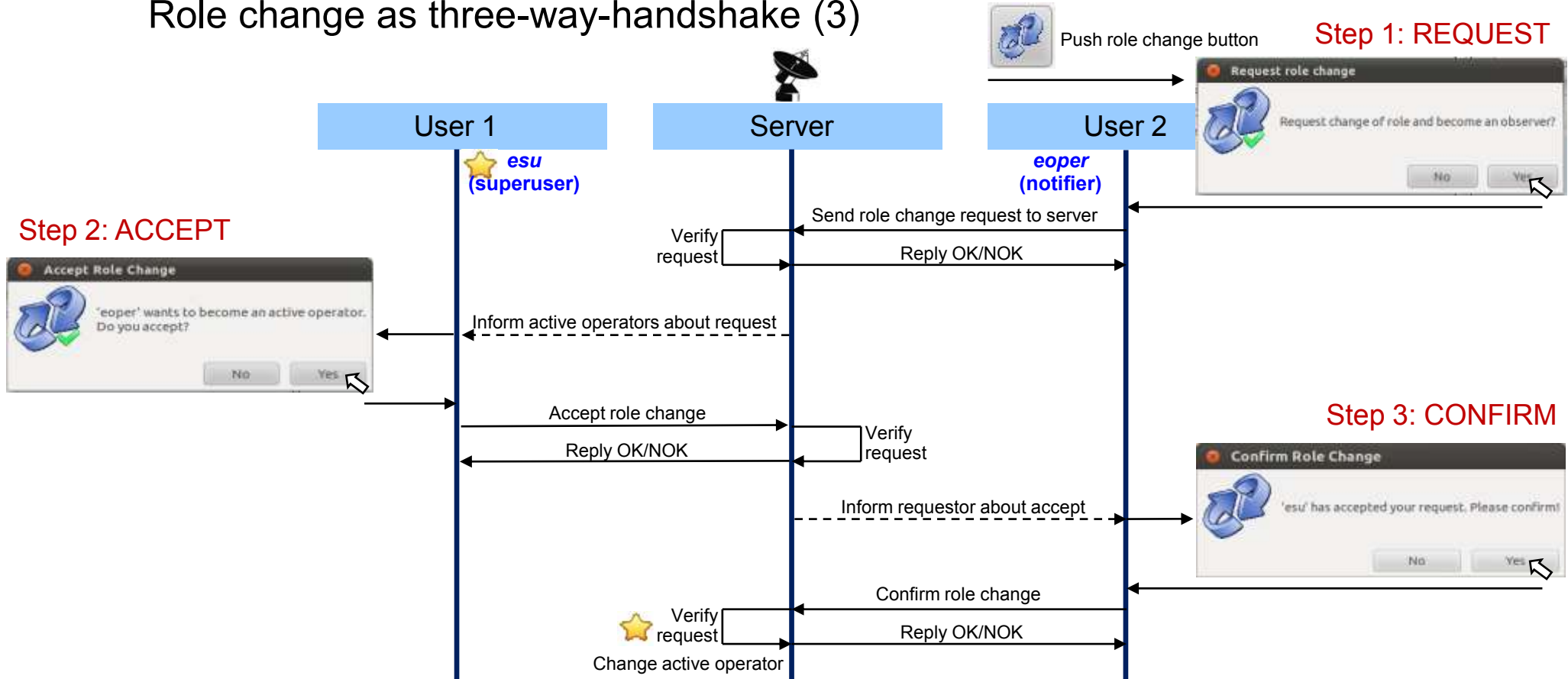
Security

Role change as three-way-handshake (2)



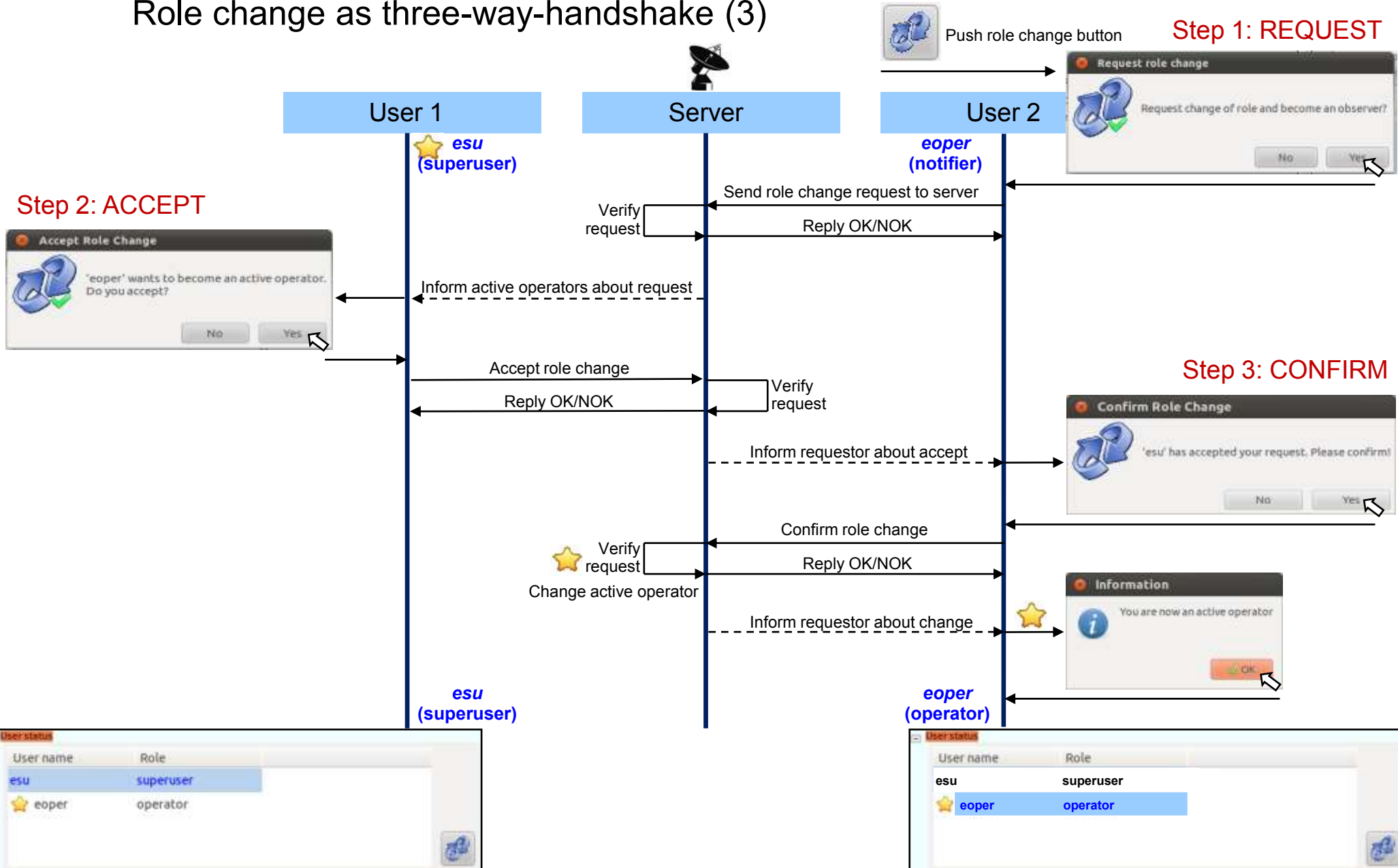
Security

Role change as three-way-handshake (3)



Security

Role change as three-way-handshake (3)



The Twin Radio Telescope Wettzell (TTW)

The idea behind the new control software

Safety

Security

Features

Features

Main window

User status

Status monitor

Logging & Command input

The screenshot shows a web-based monitoring interface. At the top, a menu bar includes 'Stations' with sub-items 'Yarragadee', 'rtwextern', 'Kathrine', and 'Hobart', which are circled in red. The main content area is divided into several sections:

- User status:** A table showing user information.

User name	Role
oper	superuser
eoper	notifier
- Status Monitor:** A table displaying system metrics for 'HOBART12'.

MODE	RATE	SCHED=none	LOG=station	TEMP	HUMID	PRES	TSYS: IFA	IFB	IFC	IFD	CABLE	AZ	EL
				16.8 C	57.1 %	1007.8 mib	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
- Logging and Operator Input:** A log window showing remote access events.


```
2012.292.13.39:47.91: Remote access: user 'eoper' (alias 'eoper') logged in
2012.292.13.49:46.84: Remote access: user 'eoper' (alias 'eoper(1)') logged in
2012.292.13.50:44.04: Remote access: user with alias 'eoper' logged out bye system
2012.292.13.52:07.55: Remote access: user 'eoper' (alias 'eoper') logged in
```
- Chat:** A chat window showing a conversation.


```
[alexander*] hallo
[oper] hello
[alexander*] how are you
[oper] fine, how can i help you?
[alexander*] the schedule has changed
[alexander*] please drudg it again
[oper] ok, thanks!
[alexander*] thank you
```
- MSCapacity:** Two pie charts showing disk usage for 'A' and 'B' drives.

Drive	Free	Used
A	99% free	2% used
B	0% free	0% used
- System Temperature:** A line graph showing temperature trends over time.
- Chat:** A chat window showing a conversation.
- SysMon Data:** A table showing sensor data.

Sensor	Value	Unit
Rel. height	-0.454	mm
Temp1	15.13	deg. C
Temp2	19.73	deg. C
Temp3	20.86	deg. C
Temp4	15.97	deg. C

Mark 5 capacity

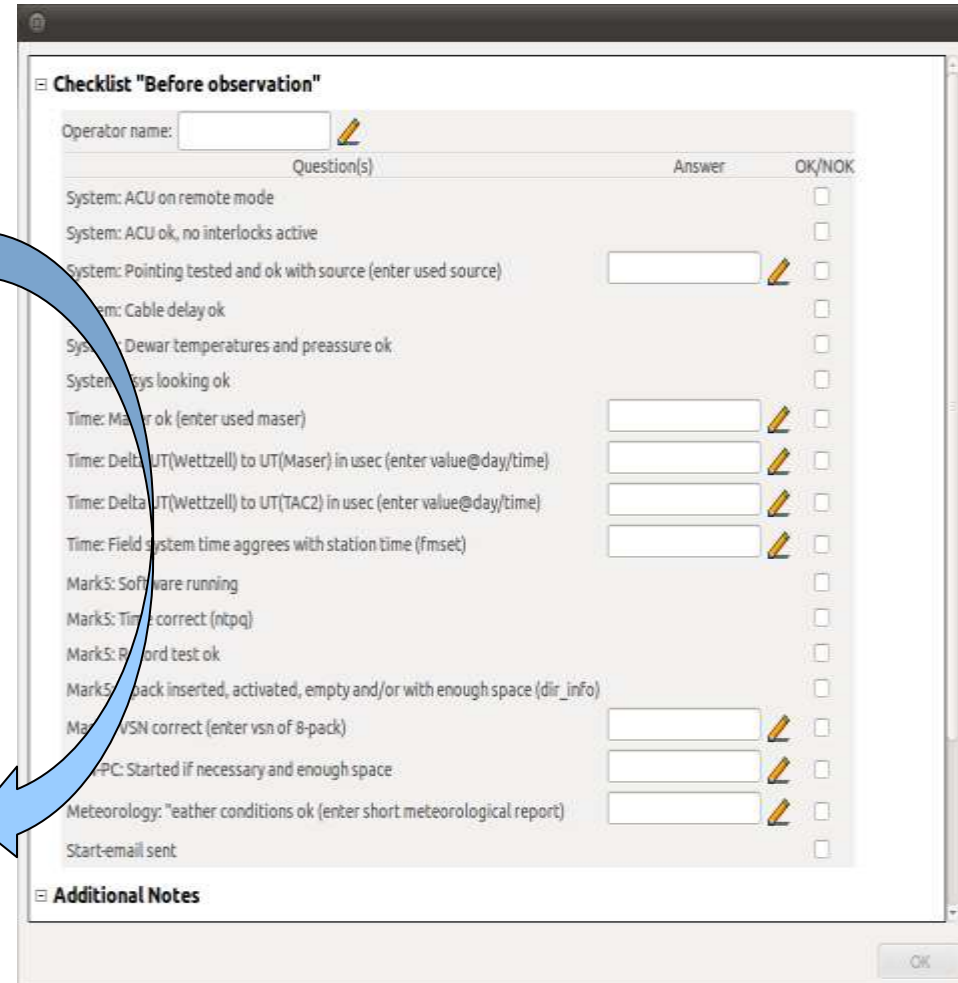
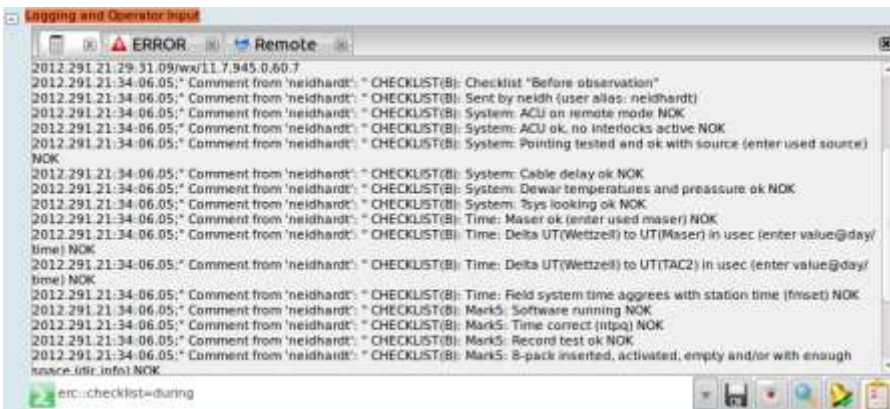
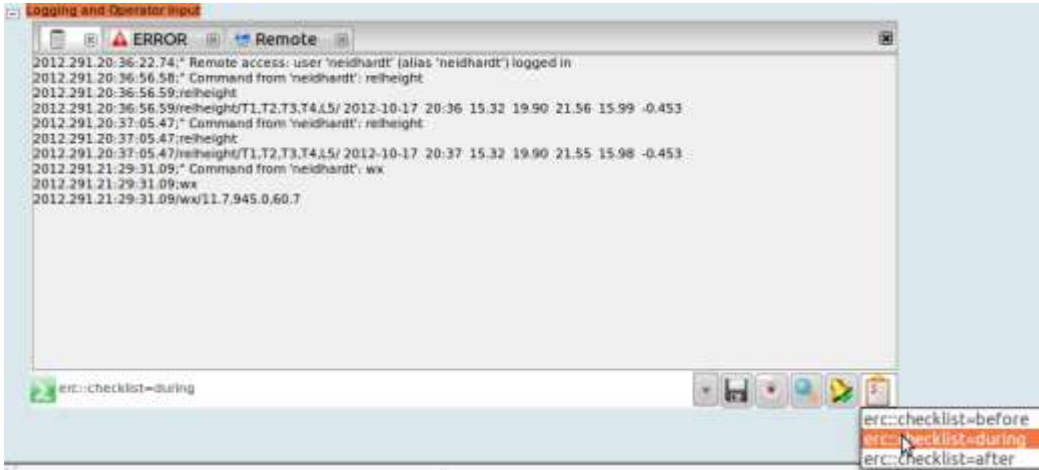
System temperatures

Chat

Connection status

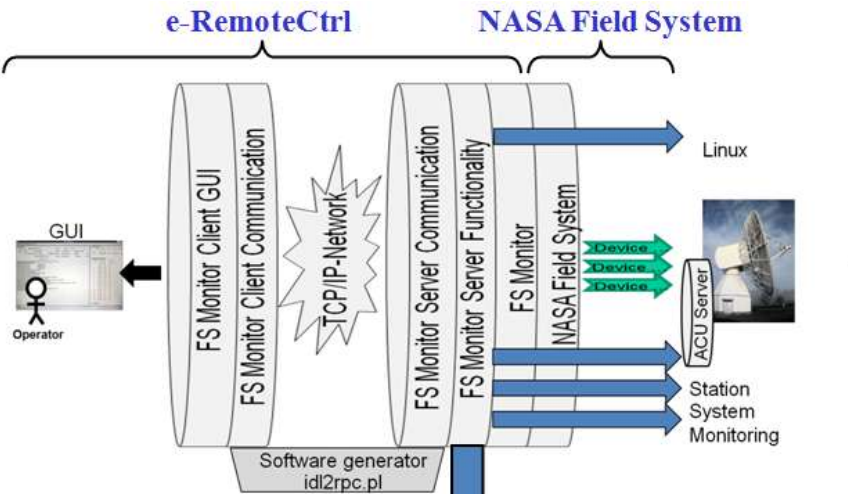
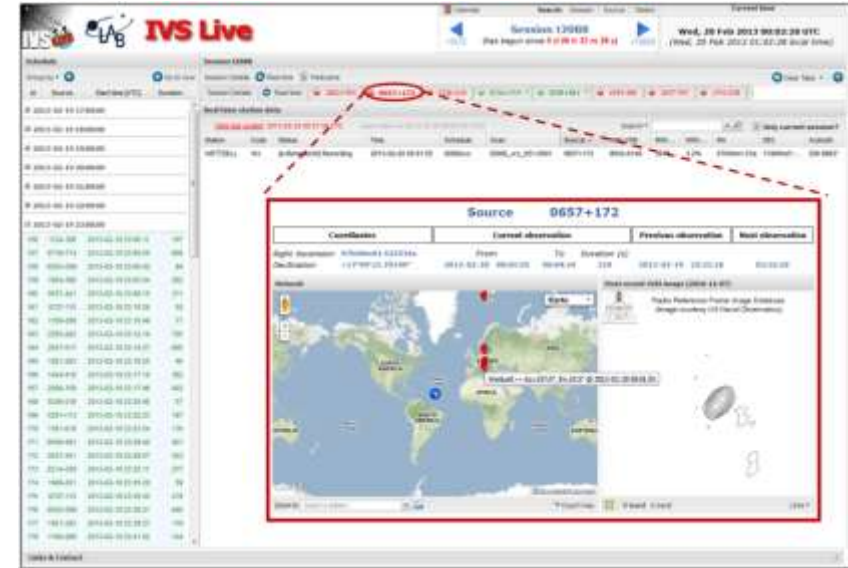
Features

Checklists



Features

e-QuickStatus
(see also the poster)

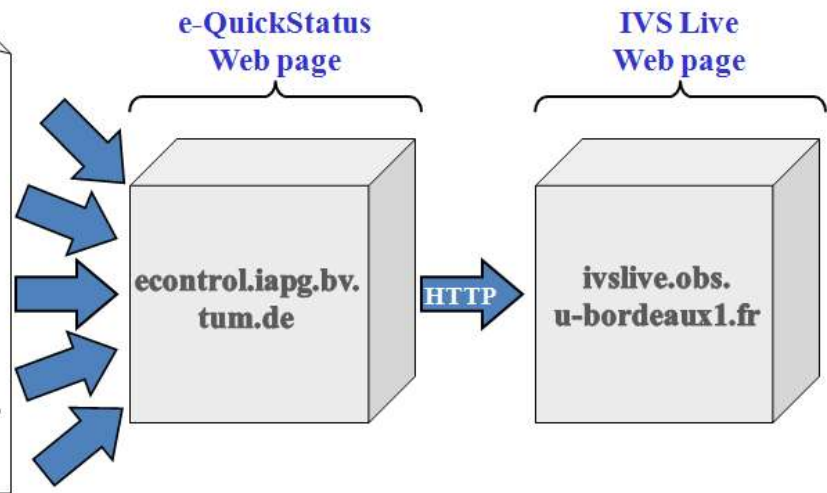


Status file:

```

<eQuickStatusInfo>
  Service = IVS
  Stationname = Wettzell
  StationIVSCode = Wz
  Schedule = t2088wz
  Status = Recording
  Time = 2013.05.14:13:31
  Source = 3c418
  Scan = t2088wz_051-1413b
  Mark5VSN = BKG+0141
  Mark5Volume = 2814.575
  Mark5Used = 70.4
  Rightascension = 20h38m37.00s
  Declination = 51d19m12.3s
  Azimuth = 299.6721°
  Elevation = 48.5204°
  CableDelay = 0.00036
  SystemTemperatureIFA = 34
  SystemTemperatureIFB = 68
  SystemTemperatureIFC = 27
  SystemTemperatureIFD = 0
  MeteorologyTemperature = -2.8°
  MeteorologyHumidity = 77.6%
  MeteorologyPressure = 945.2hP
</eQuickStatusInfo>
    
```

- Field system startup
- Field system terminated
- Starting schedule
- Schedule finished
- Pointing
- Recording
- Halt
- Continue



The Twin Radio Telescope Wettzell (TTW)

The idea behind the new control software

Safety

Security

Features

Testbed and e-RemoteCtrl network

Test bed and e-RemoteCtrl network



Many thanks to all stations, using the e-RemoteCtrl software!!!

Thank you

The software is available on the Web page <http://www.econtrol-software.de>

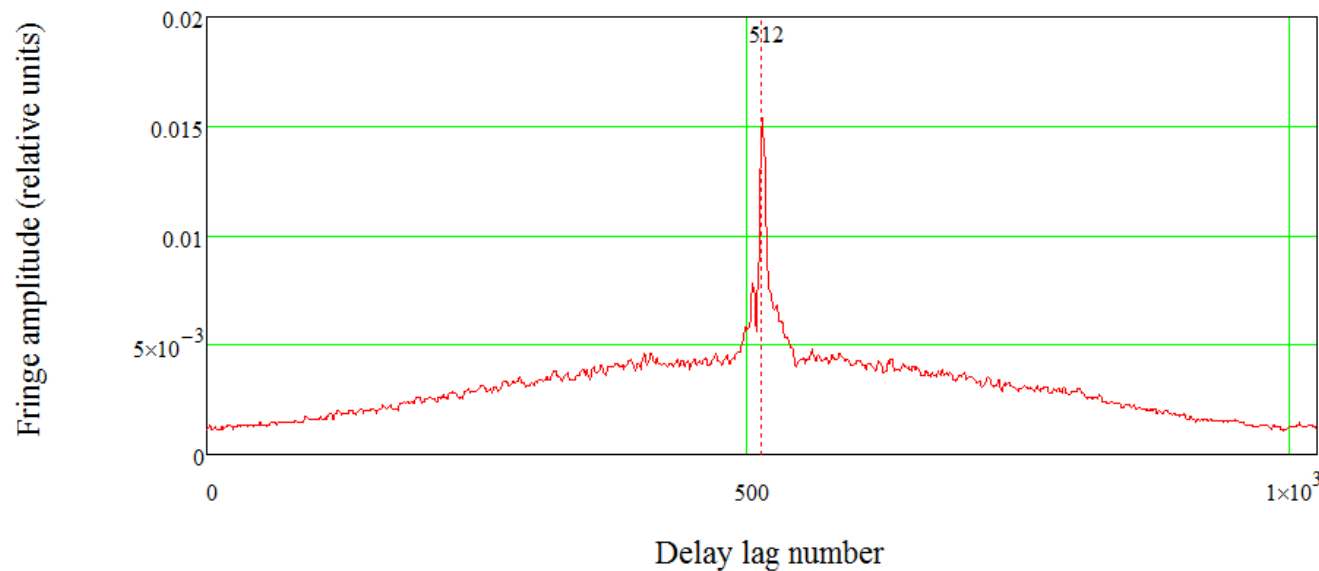
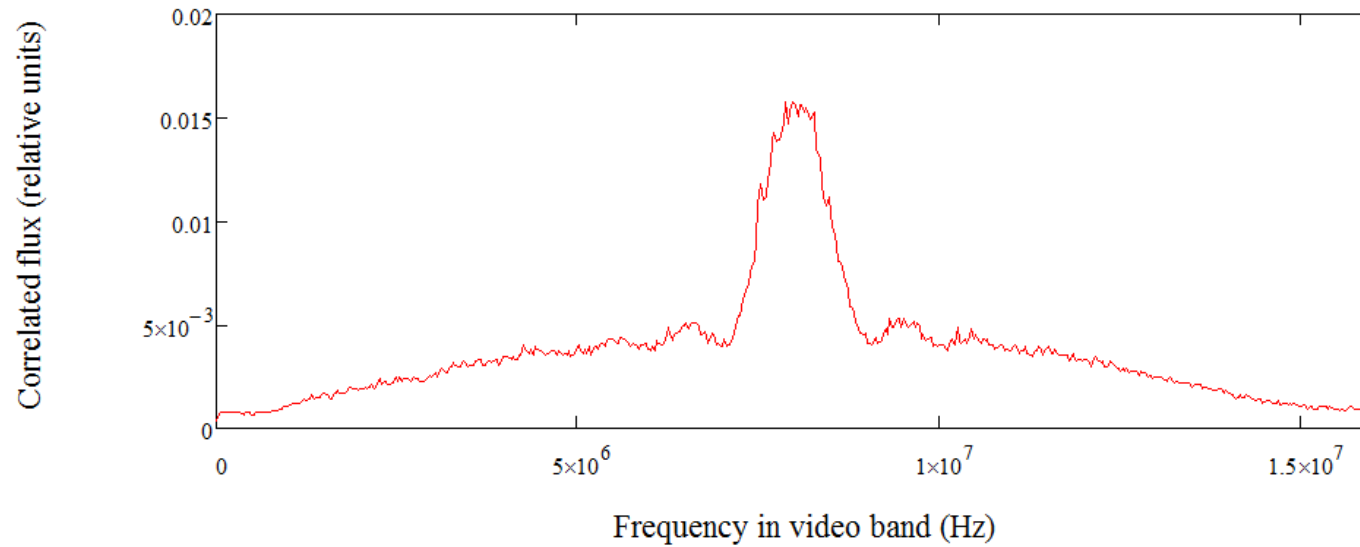




Correlated spectrum and correlation function in lag domain, scan1
Satellite tracking of Glonass with Onsala and 20m-RTW



(see also the poster)



Date&Time

26.02.2013 12:13:58

Job Information

CUSTOMER: BKG
 SITE: Wettzell
 ANTENNA: TTW #1
 SATELLITE: SPAINSAT
 JOB NUMBER: 216/11062

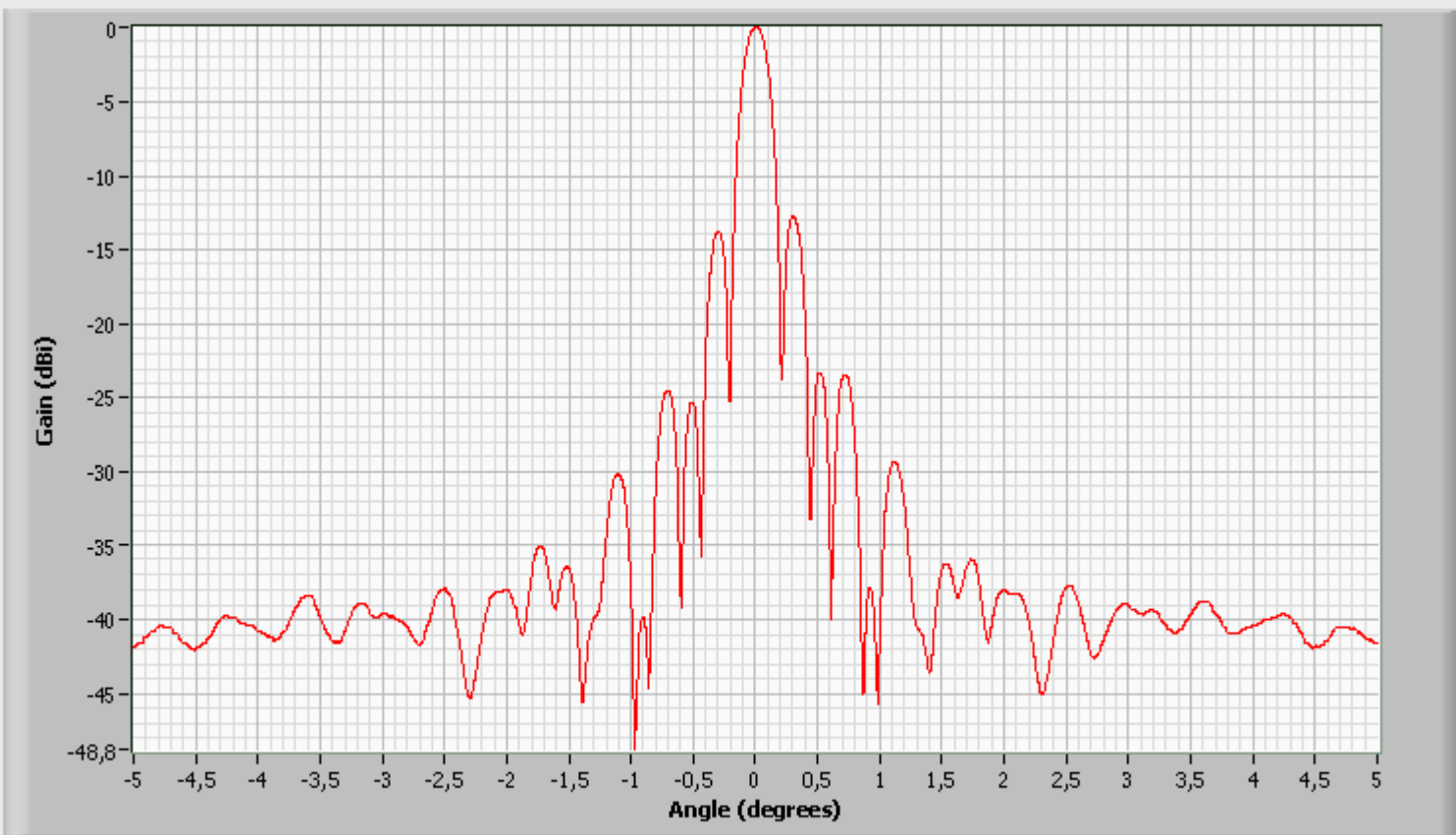
Antenna Information

Beam Center Azimuth: 230,903°
 Beam Center Elevation: 20,548°
 Specified Gain: 0dBi
 Measurement: Elevation

Plot Selection
 Loaded Plot - A

Spectrum Analyzer Information

Resolution Bandwidth: 1kHz
 Video Bandwidth: 1Hz
 Sweep Time: 200s
 Reference Level: -40dBm
 Center Frequency: 7,250515GHz
 Span: 0Hz



X-Band beam pattern