

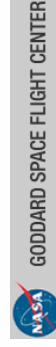
Interacting with radio telescopes in real-time during VLBI sessions using e-control



FESG



Alexander Neidhardt (FESG)
neidhardt@fs.wettzell.de

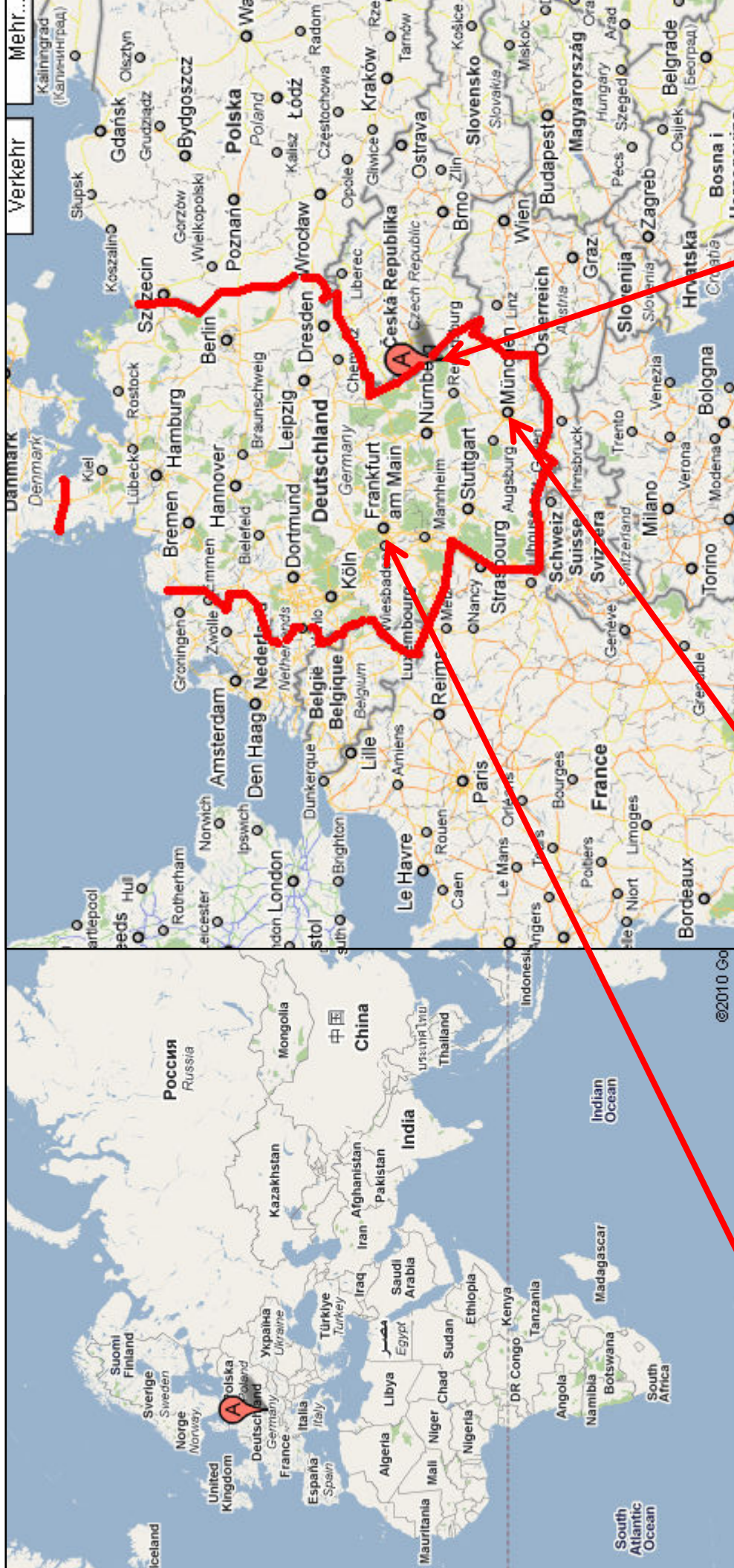


**Max-Planck-Institut
für
Radioastronomie**



**Martin Ettl (FESG), Helge Rottmann (MPIFR), Christian Plötz (BKG),
Matthias Mühlbauer (BKG), Hayo Hase (BKG), Walter Alef (MPIFR),
Sergio Sobarzo (Udec), Cristian Herrera (Udec),
Ed Himwich (NASA/GSFC/NVI)**

The Radio Telescope Wettzell (RTW) and it's location

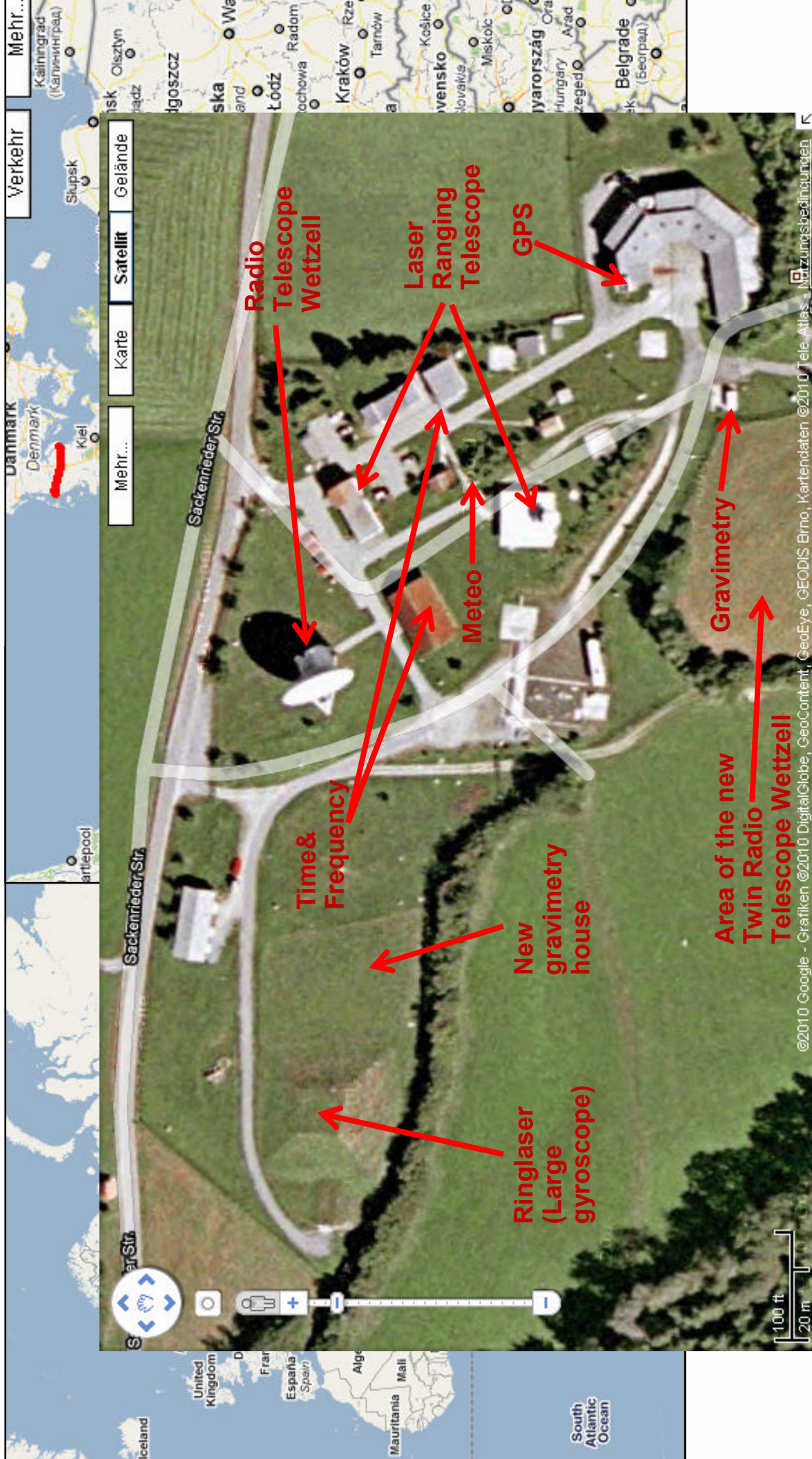


Federal Agency for Cartography and Geodesy, Frankfurt

Technische Universitaet Muenchen Research Group Satellite Geodesy

Geodetic Observatory Wettzell Germany surrounded by the Bavarian Forest

The Radio Telescope Wettzell (RTW) and it's location



The Radio Telescope Wettzell (RTW), it's team and partner sites

RT Wettzell/Germany



The Wettzell VLBI crew (from left to right):
 Ch. Piötz, E. Bauerfeind, G. Kronschabl, R. Schatz,
 W. Schwarz, R. Zeithöfler, A. Neidhardt
 (missing in picture: E. Bielemeier).

Alexander Neidhardt

Table 2. RTW observations in 2008

program	number of 24h-sessions
IVS R1	49
IVS R4	51
IVS T2	6
IVS R&D	9
RDV/VLBA	6
EUROPE	5
CONTOS	15
total	141
total (in hours)	3384

program	number of 1h-sessions
INT1 (Kokee-RTW)	234
INT2/K (Tsukuba-RTW)	100
INT3/K (Tsukuba-RTW-NyAI)	41
total (in hours)	375

special program	number of experiments
SELENE	19
total (in hours)	92

TIGO Concepción/Chile



**And in the future:
 TTW Wettzell**



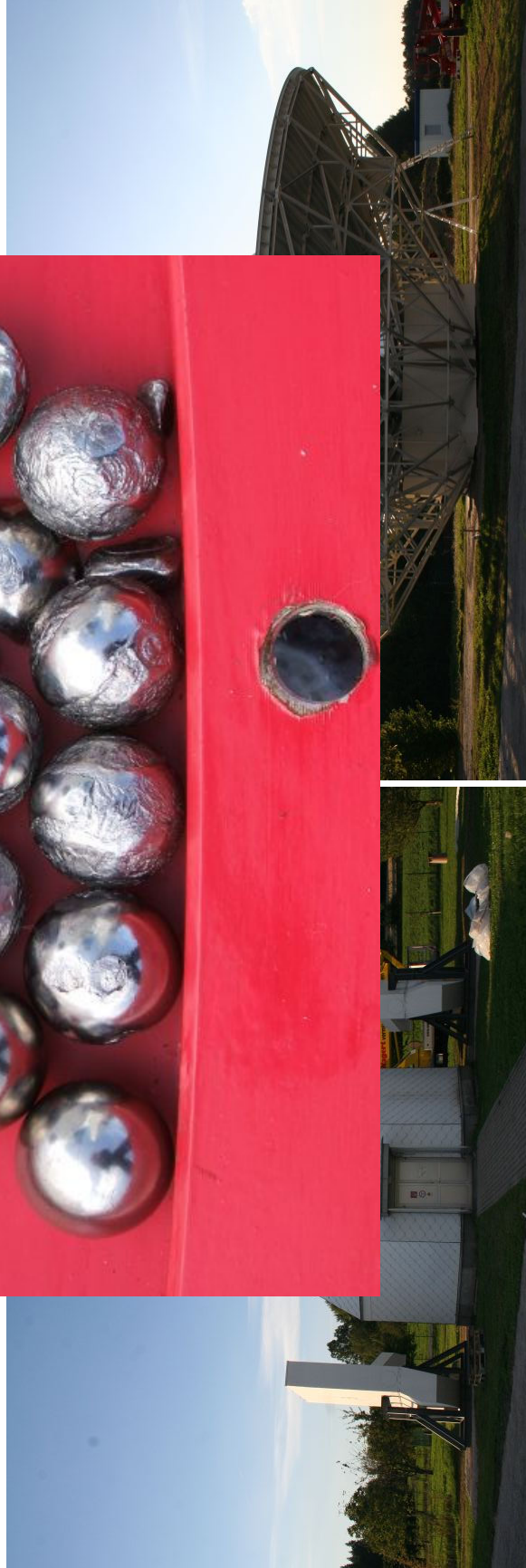
GARS O'Higgins/Antarctica



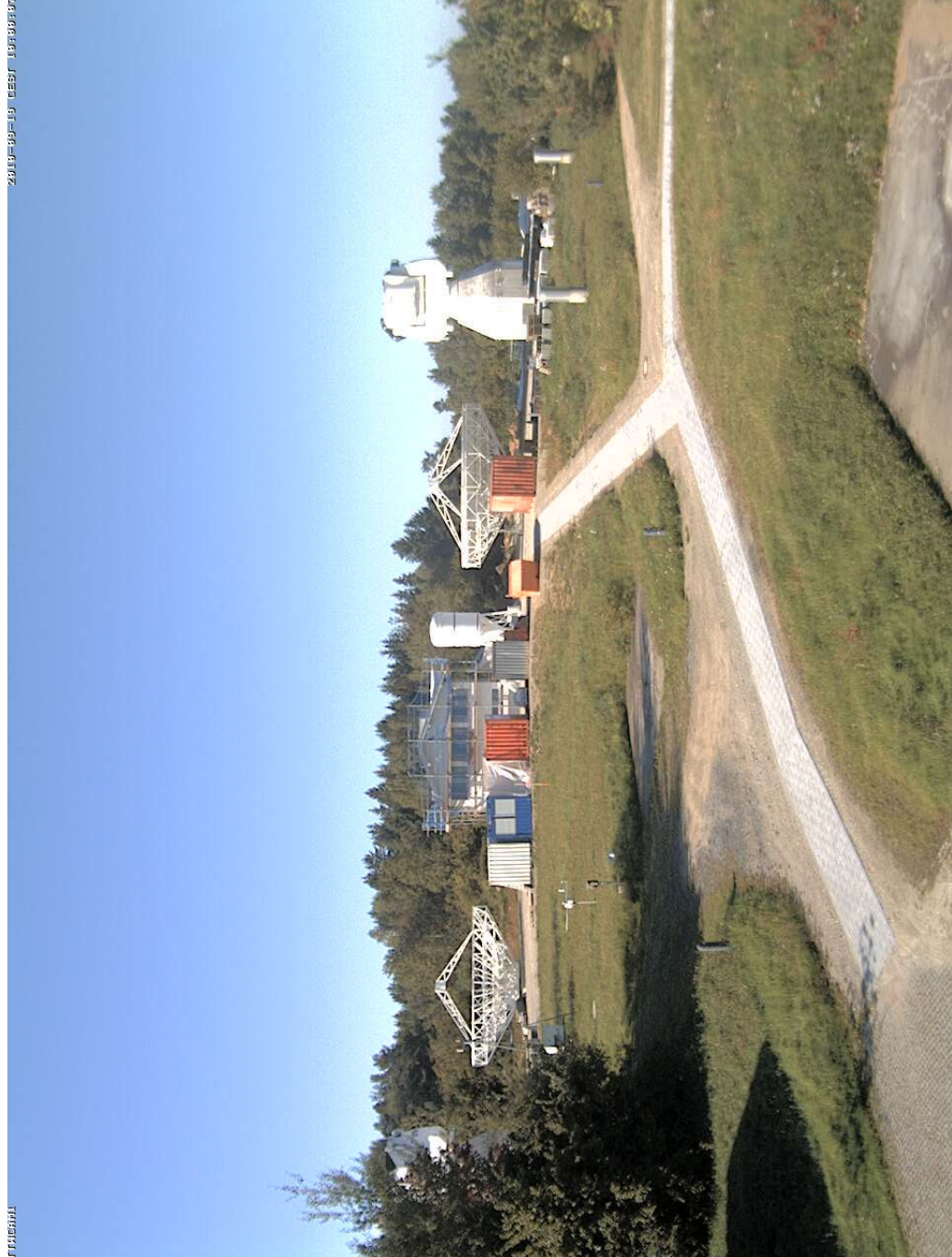
The Radio Telescope Wettzell (RTW): impressions of current activities



The Radio Telescope Wettzell (RTW): impressions of current activities



The TWIN Radio Telescope Wettzell (TTW): impression



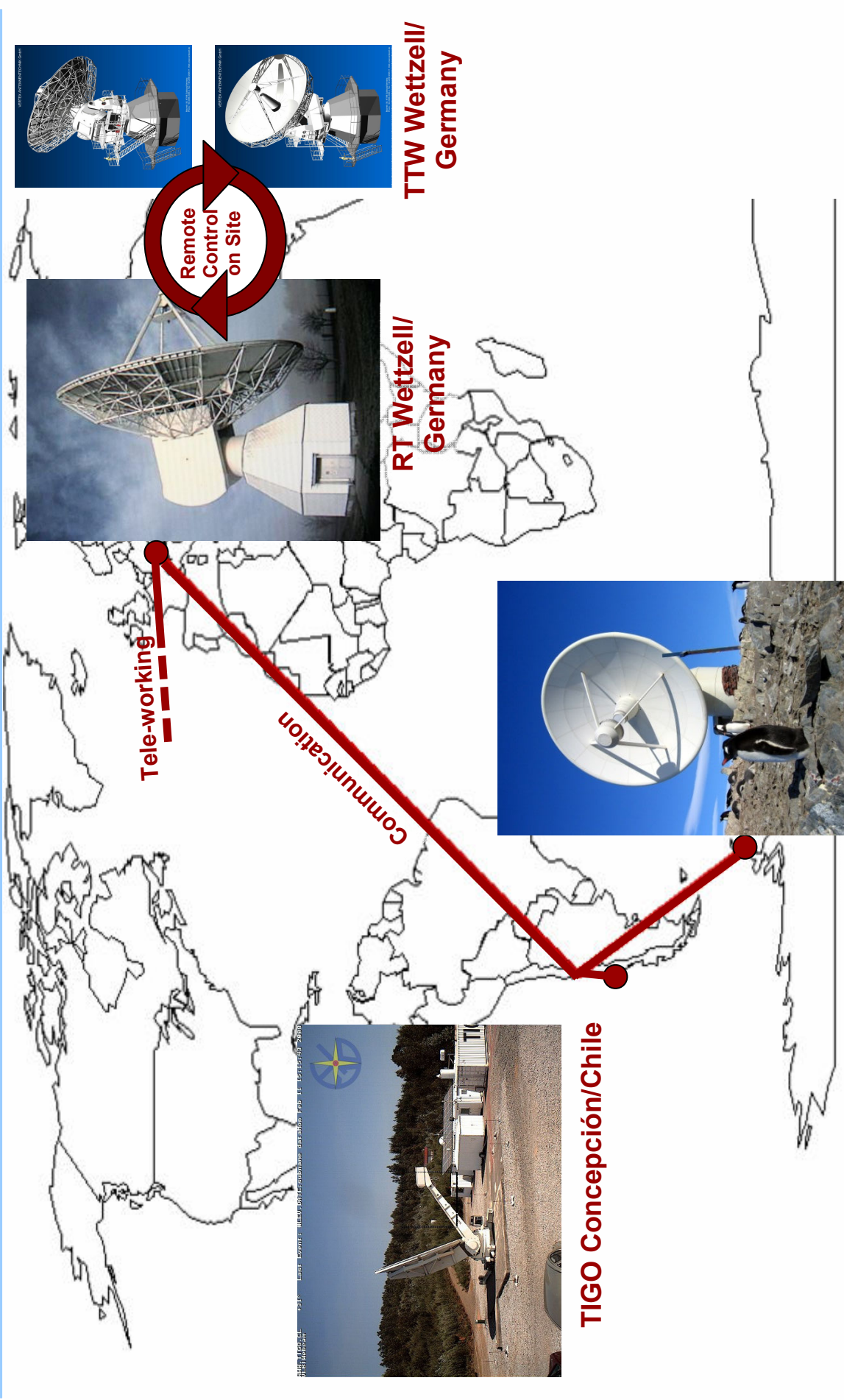
Diameter Main reflector: 13.2m
Diameter sub-reflector: 1.48m
Ring Focus Design with $f/D = 0.29$
Surface quality of the reflectors: < 0.2 mm RMS
Way length error : < 0.3 mm
Surface quality of the panel: < 0.065 mm RMS
ALMA mounting with angular velocities
Angular velocities of $12^\circ/s$ in azimuth and
 $6^\circ/s$ in elevation
Acceleration: Az/EI = $3^\circ/s^2$
Ranges of rotation: Azimuth 540° ,
Elevation $0-115^\circ$
Balanced outrigger
Excellent bearing
27Bit Encoder: 0.0003° resolution
Sub-reflector adjustable via a hexapod



See TWIN poster!

The idea of controlling VLBI telescopes by remote

New observation strategies for VLBI telescopes Wettzell, O'Higgins/Antarctica and TIGO/Concepción



New observation strategies for VLBI telescopes Wettzell, O'Higgins/Antarctica and TIGO/Concepción



Local

- Standard operations
- Local operator

New observation strategies for VLBI telescopes Wettzell, O'Higgins/Antarctica and TIGO/Concepción



Internet



Local

- Standard operations
- Local operator

Remote

- Check system states from everywhere at the observatory
- Tele-working
- Remote assistance and diagnostics
- Control very remote, inaccessible telescopes

New observation strategies for VLBI telescopes Wettzell, O'Higgins/Antarctica and TIGO/Concepción



Local

- Standard operations
- Local operator

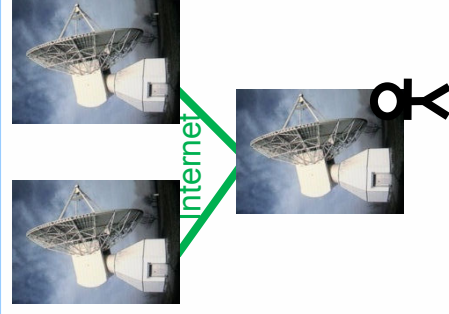
Remote

- Check system states everywhere at the observatory
- Tele-working
- Remote assistance and diagnostics
- Control very remote, inaccessible telescopes

Shared

- Save, passive data live monitoring
- Dedicated control access by responsible person
- Shared access from different observatories
- Shared night shifts

New observation strategies for VLBI telescopes Wettzell, O'Higgins/Antarctica and TIGO/Concepción



Local

- Standard operations
- Local operator

Remote

- Check system states everywhere at the observatory
- Tele-working
- Remote assistance and diagnostics
- Control very remote, inaccessible telescopes

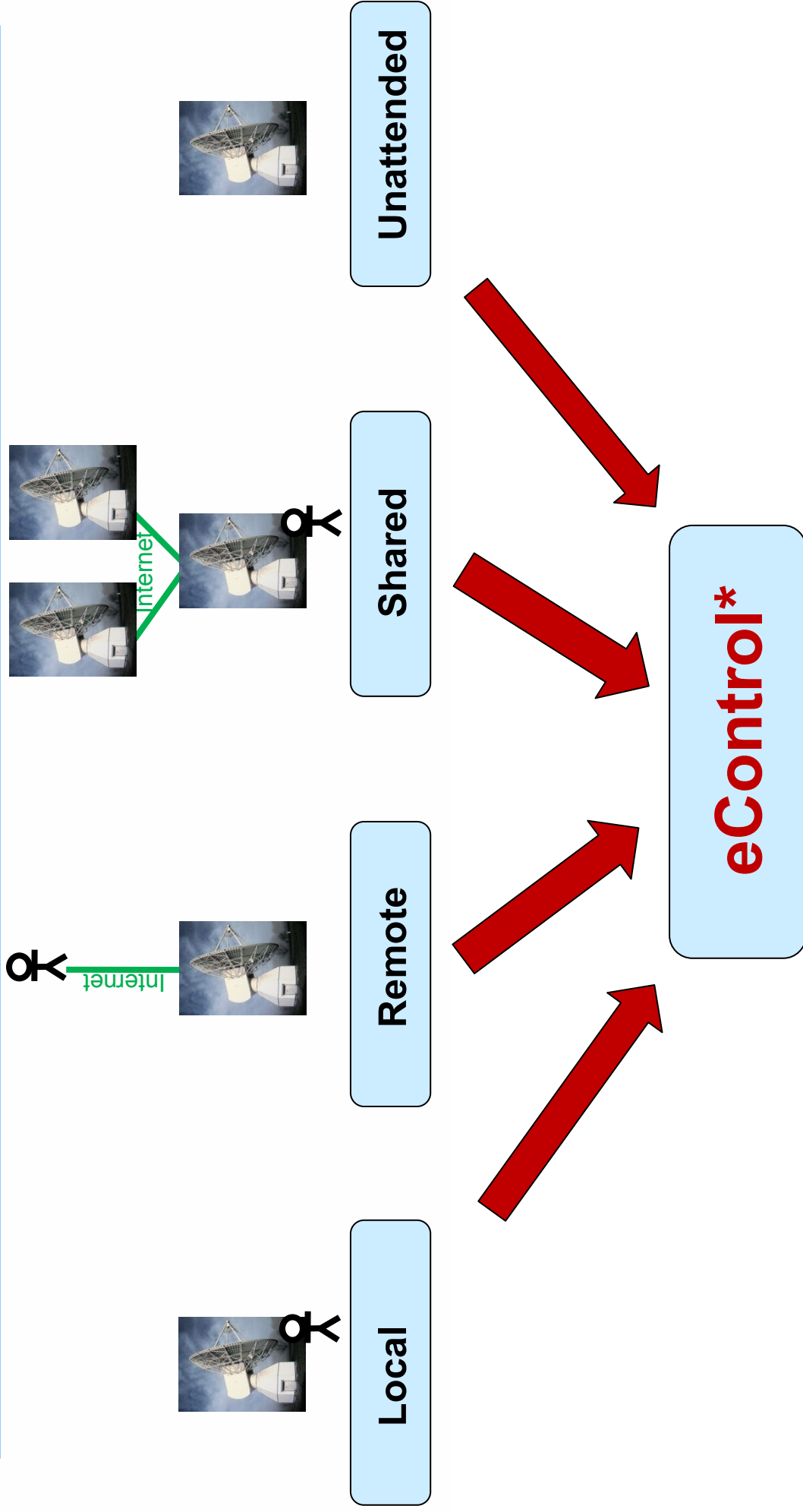
Shared

- Save, passive data live monitoring
- Dedicated control access by responsible person
- Shared access from different observatories
- Shared night shifts

Unattended

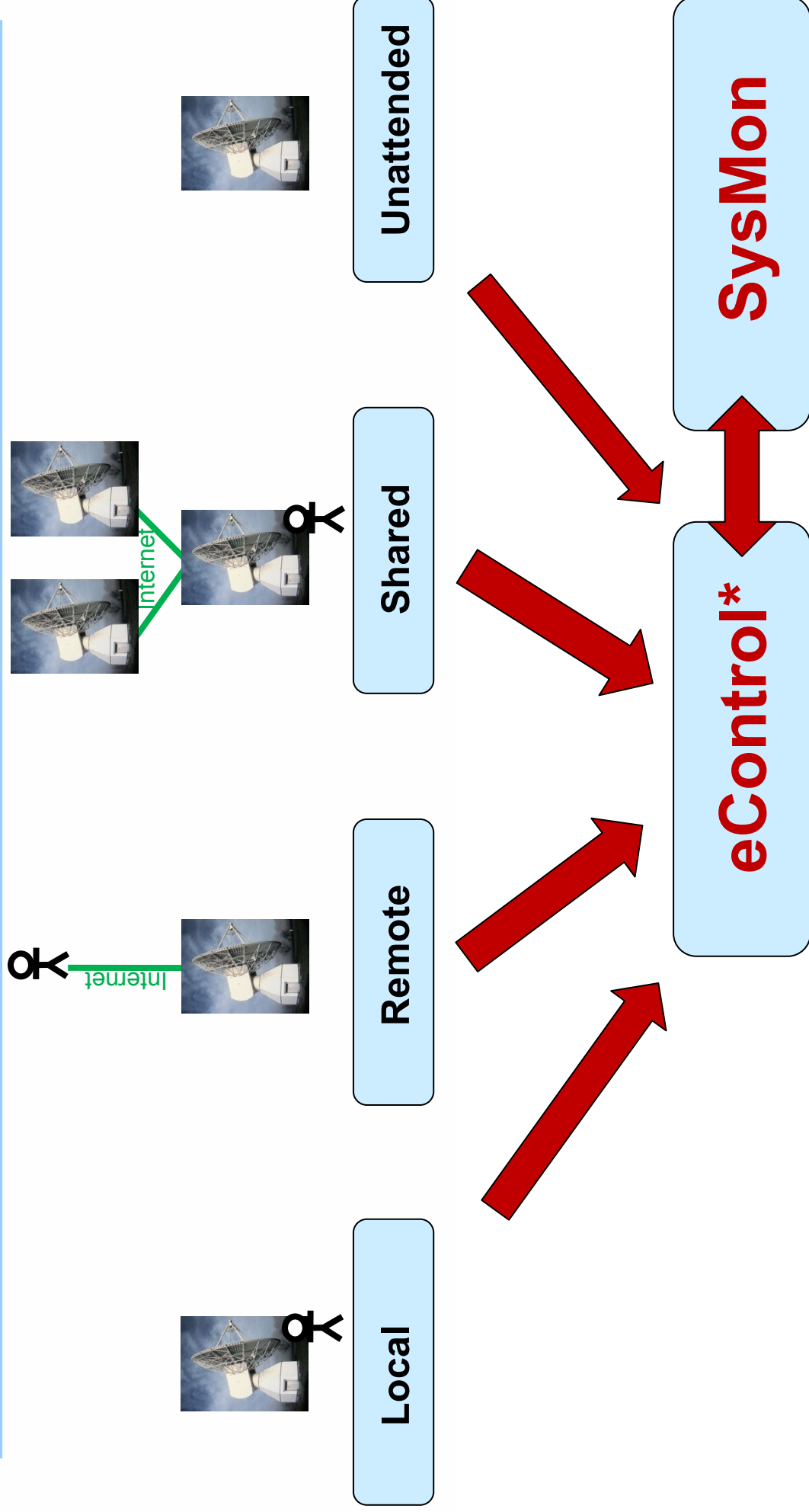
- Observations run autonomous, (semi-) automated and unattended

New observation strategies for VLBI telescopes Wettzell, O'Higgins/Antarctica and TIGO/Concepción



*** per system with individual restrictions and only with reliable, well educated personnel staff on site**

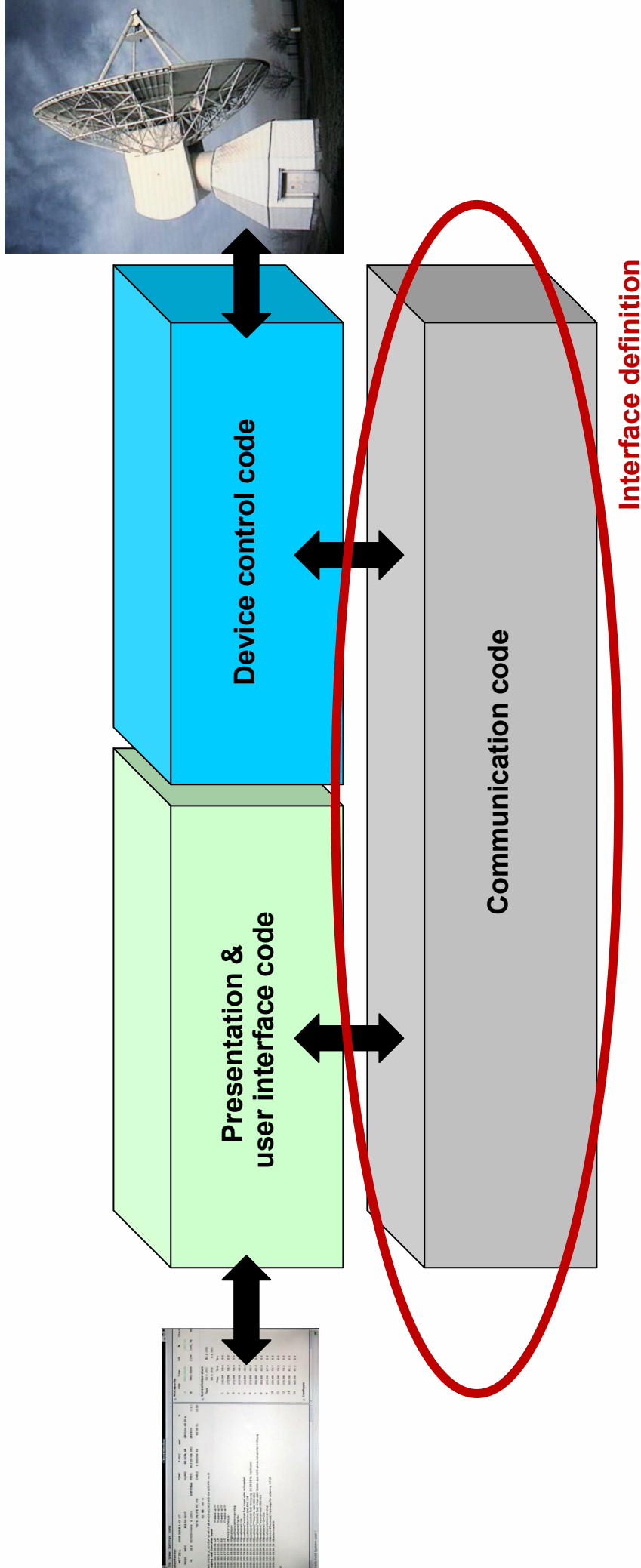
New observation strategies for VLBI telescopes Wettzell, O'Higgins/Antarctica and TIGO/Concepción



*** per system with individual restrictions and only with reliable, well educated personnel staff on site**

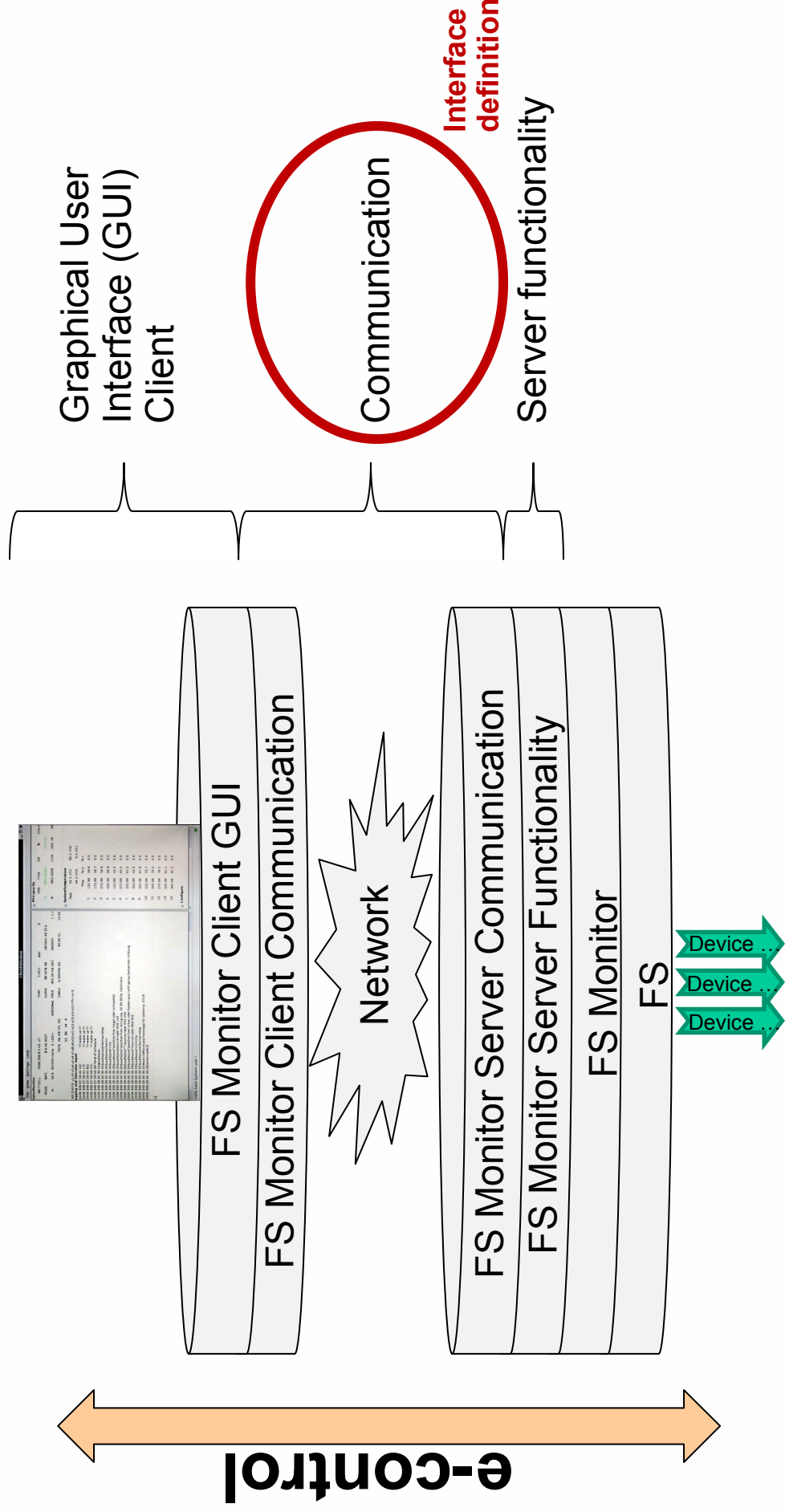
Wettzell's solution for remote control

The idea: remote attendance and control of VLBI telescopes Wettzell, O'Higgins/Antarctica and TIGO/Concepción

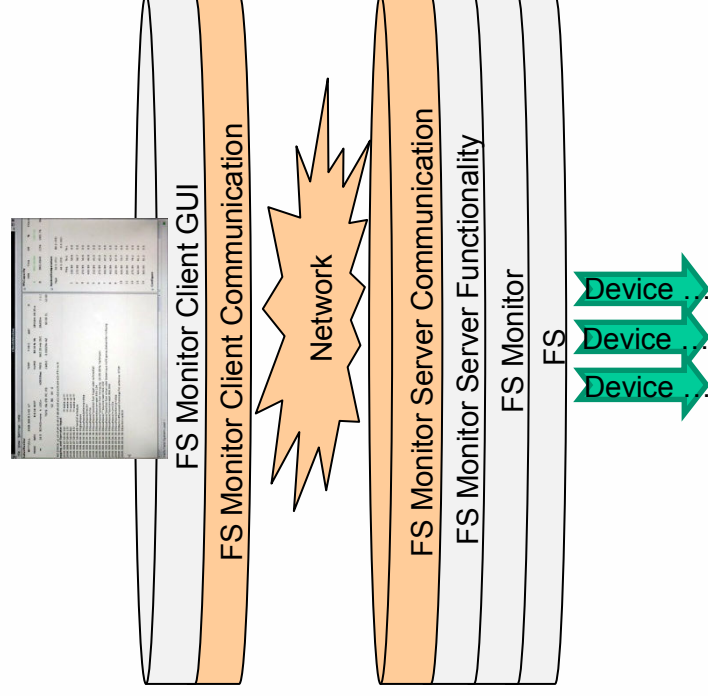


Strict design-separation of these parts

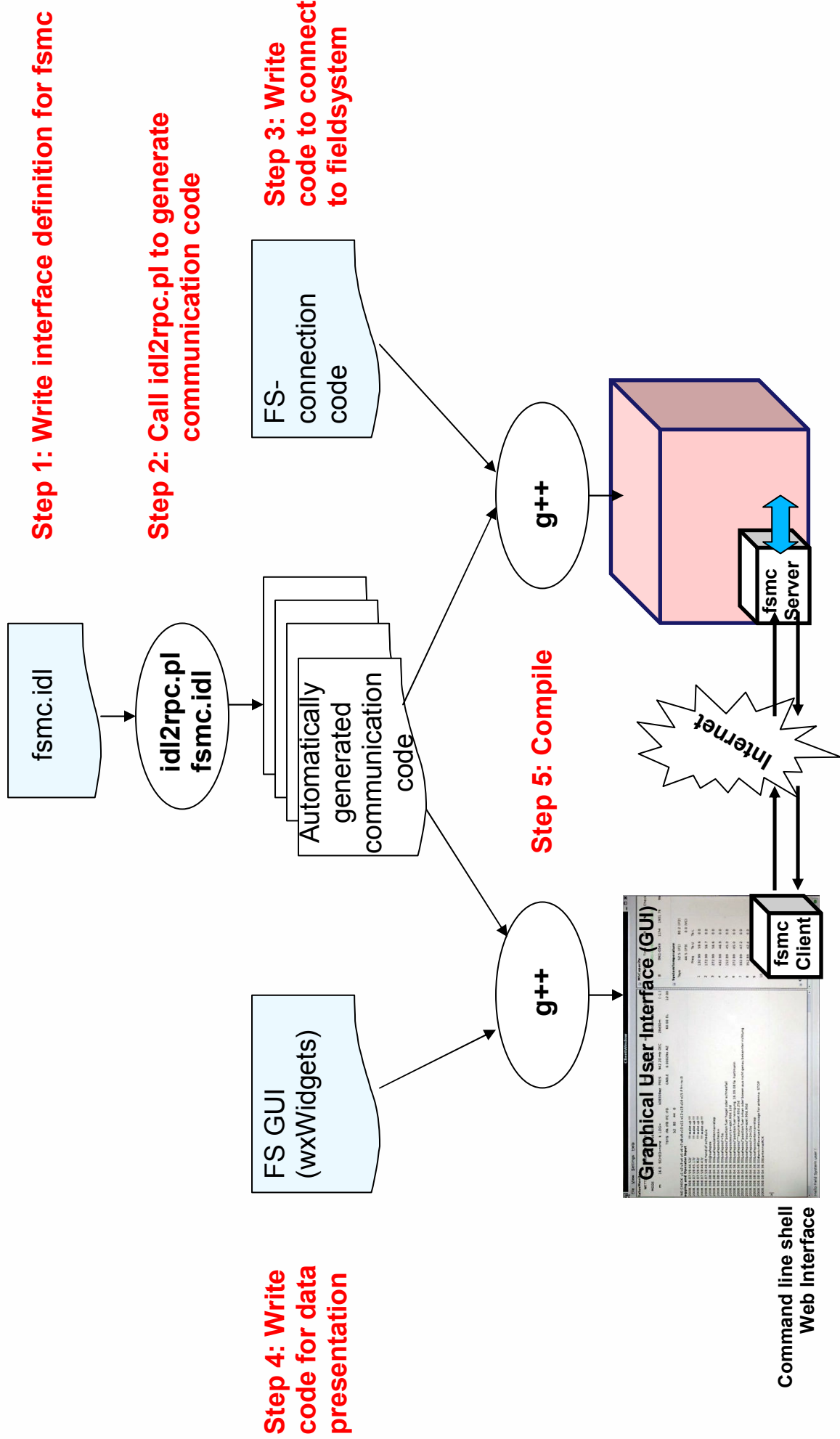
The idea: remote attendance and control of VLBI telescopes Wetzell, O'Higgins/Antarctica and TIGO/Concepción



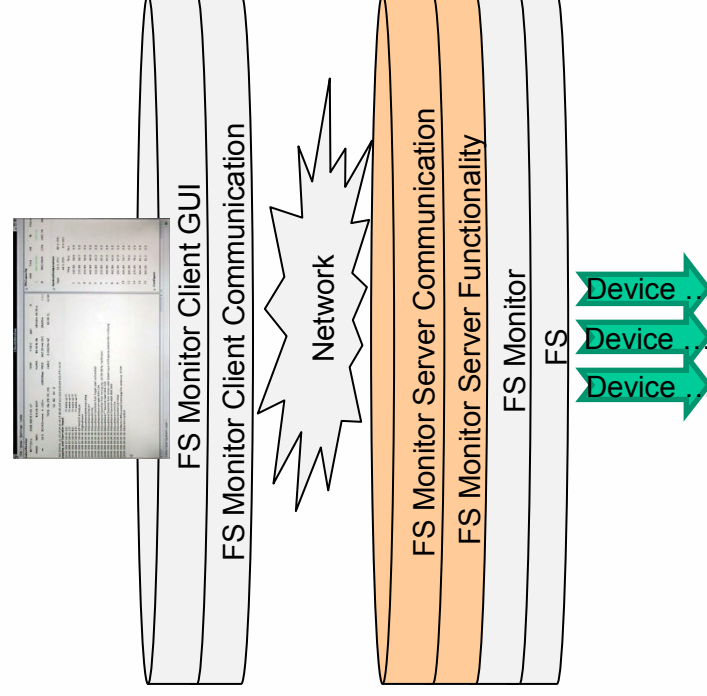
The communication – with a remote procedure call middleware and ssh



The communication – using a middleware generator

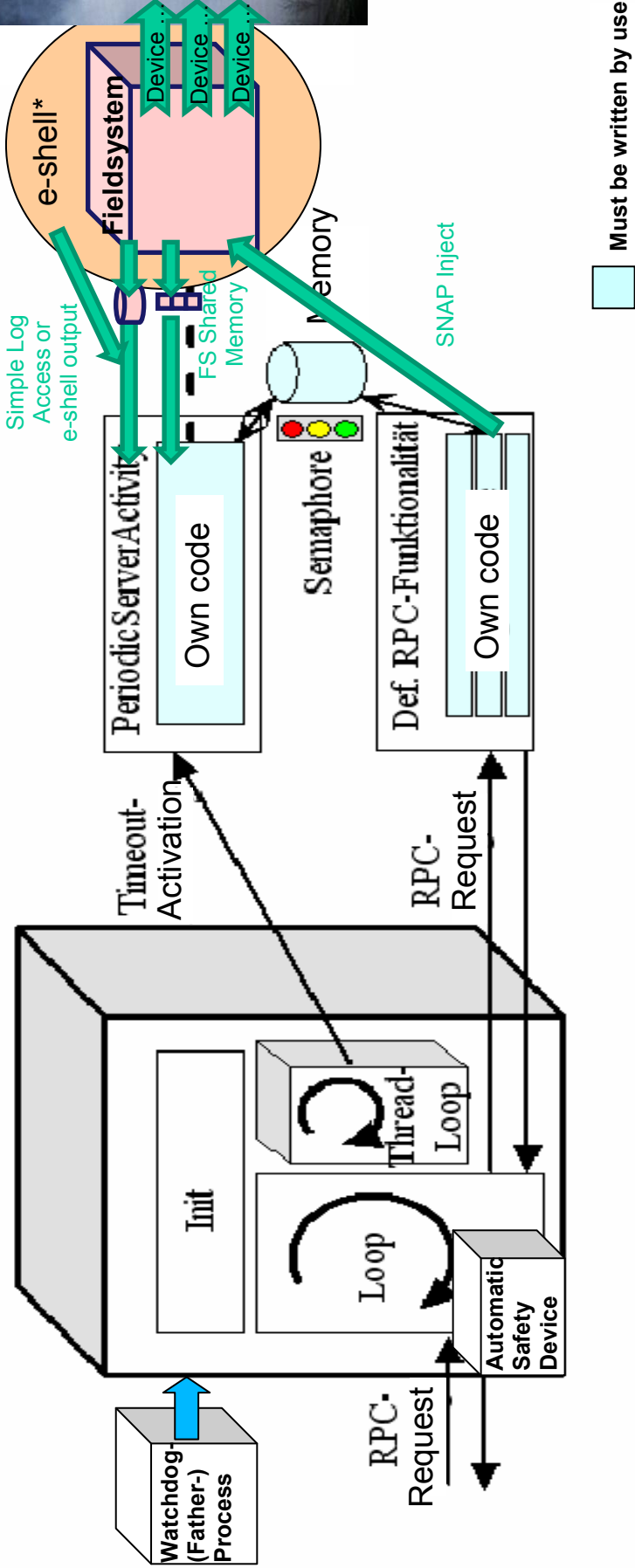


Server extension to existing control software – remote accessible, autonomous process cells

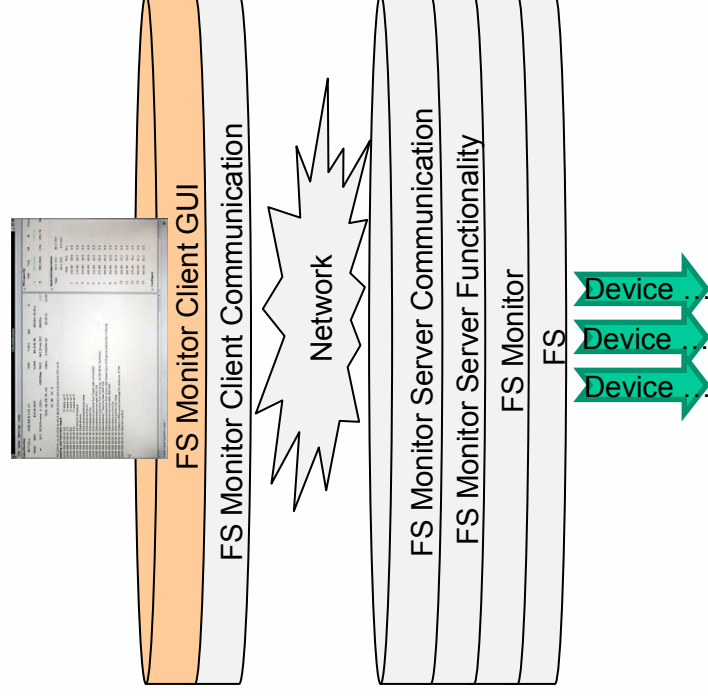


A fieldsystem extension – autonomous process cells

Autonomous process cell offers remote access to the field system
 (at the moment Linux based)



The client – remote (graphical) user interface



The client – graphical, textual or browser based

- Separation of control and presentation logic
- Interchangeability of presentation layer (console shell (ncurses), graphical user interface (wxWidgets), web access via Browser, web service, ...)
- Remote controllable via client-server-architecture on idl2rpc-middle-ware
- Modularity in window units and additionally possible, separately created administration user interfaces for each device

The screenshot shows a web browser window titled 'econtrol' with the following content:

Station Tools

- StatusMonitor

WETTZELL	2010.023.08.46.24	UT	TEMP	-5.8 C	azel	0
MODE	RATE	06:45:50	NEXT	HUMID	90.5 %	RA 00h50m 1.33 s
m	16.0	SCHED=none	LOG=station	PRES	951.6 mb	DEC 28h30m (- 1)
TSYS: IFA		IFB	IFC	IFD	CABLE	0.00042097s
		31	64	24	0	12.0000
- Logging and Operator Input


```

2010.023.08:34:28:00#antcn#Received message for antenna. STOP
2010.023.08:34:28:05#antenna#ACK
2010.023.08:36:48:20#antcn#Received message for antenna. STOP
2010.023.08:36:48:25#antenna#ACK
2010.023.08:37:05:67/F: 375@2010.024.06:45:50.00 sy=/usr2/oper/startevrec.sh kL0024.wz &
2010.023.08:37:05:67/F: 369@2010.024.06:49:50.00 startmka
2010.023.08:37:05:67/Q: 14@2010.024.06:50:50.00 safepos
2010.023.08:37:05:67/Q: 6@2010.024.06:50:50.00 startmka
2010.023.08:37:05:67/F: 375@2010.025.06:15:50.00 sy=/usr2/oper/startevrec.sh kL0025.wz &
2010.023.08:37:05:67/F: 369@2010.025.06:19:50.00 startmka
2010.023.08:37:05:67/Q: 6@2010.025.06:20:50.00 safepos
2010.023.08:37:05:67/Q: 14@2010.025.06:20:50.00 startmka
2010.023.08:38:05:03/H
2010.023.08:38:05:03/F: 375@2010.024.06:45:50.00 sy=/usr2/oper/startevrec.sh kL0024.wz &
2010.023.08:38:05:03/F: 369@2010.024.06:49:50.00 startmka
2010.023.08:38:05:03/Q: 14@2010.024.06:50:50.00 safepos
2010.023.08:38:05:03/F: 375@2010.025.06:15:50.00 sy=/usr2/oper/startevrec.sh kL0025.wz &
2010.023.08:38:05:03/F: 369@2010.025.06:19:50.00 startmka
2010.023.08:38:05:03/Q: 6@2010.025.06:20:50.00 safepos
2010.023.08:38:05:03/Q: 14@2010.025.06:20:50.00 safepos
            
```

M5Capacity

VSN	Time	GB	%	Check UT
A	BKG-0069/ 27h17m	3143.859	98.2	08:28:19
B				08:28:19

Systemtemperature

Tsys	IF1	IF3	IF2	IFC	IFV
31.0068	23.8764	64.3146	0	0	0

Table with 6 columns: Freq, Ts-L, Ts-L

Freq	Ts-L	Ts-L
1	132.99	35.7148
2	172.99	34.3932
3	272.99	32.043
4	432.99	26.0389
5	152.89	24.6385
6	272.89	22.9655
7	332.89	26.0347
8	352.89	24.4271
9	212.99	50.7386
10	220.99	55.176
11	236.99	57.0096
12	292.99	58.4376
13	324.99	65.1272

Bottom status bar: Connected to 127.0.0.1, webcam1 - Mozilla Fire..., [Namenloses Fenster] econtrol [rtwadm@ubuntu:~/S...



Webcam

The client – graphical, textual or browser based

Logging and Operator Input

```

2010.023.08.03:43.49/rx/IE200k, on, a, on, on, off, locked, 17.02
2010.023.08.04:59.49/rx/IE200k, on, a, on, on, off, locked, 17.09
2010.023.08.06:16.49/rx/IE200k, on, a, on, on, off, locked, 17.02
2010.023.08.07:33.49/rx/IE200k, on, a, on, on, off, locked, 16.95
2010.023.08.08:49.49/rx/IE200k, on, a, on, on, off, locked, 17.02
2010.023.08.10:13.49/rx/IE200k, on, a, on, on, off, locked, 17.02
2010.023.08.11:31.49/rx/IE200k, on, a, on, on, off, locked, 16.89
2010.023.08.12:52.49/rx/IE200k, on, a, on, on, off, locked, 17.02
2010.023.08.14:17.49/rx/IE200k, on, a, on, on, off, locked, 17.02
2010.023.08.15:42.49/rx/IE200k, on, a, on, on, off, locked, 16.95
2010.023.08.17:11.49/rx/IE200k, on, a, on, on, off, locked, 17.09
2010.023.08.18:44.48/rx/IE200k, on, a, on, on, off, locked, 17.09
2010.023.08.20:00.49/rx/IE200k, on, a, on, on, off, locked, 17.09
2010.023.08.21:16.48/rx/IE200k, on, a, on, on, off, locked, 17.09
2010.023.08.22:33.49/rx/IE200k, on, a, on, on, off, locked, 17.09
2010.023.08.25:50.46/rx/IE200k, on, a, on, on, off, locked, 17.09
2010.023.08.26:49/rx/IE200k, on, a, on, on, off, locked, 17.02
2010.023.08.28:48.50/rx/IE200k, on, a, on, on, off, locked, 17.02
2010.023.08.27:48.50/rx/IE200k, on, a, on, on, off, locked, 17.02
2010.023.08.25:04.49/rx/IE200k, on, a, on, on, off, locked, 17.02
    
```

Logbook

```

Logging and Operator Input
2010.023.08.34:28.09#Antenna#Received message for antenna. STOP
2010.023.08.36:48.20#Antenna#Received message for antenna. STOP
2010.023.08.37:05.67#Antenna#ACK
2010.023.08.37:05.67#F. 375@2010.024.06.45:50.00. syle=/usr2/oper/steriskb/ncr, sh k1.0024.wz &
2010.023.08.37:05.67#F. 369@2010.024.06.49:50.00. schedule=k1.0024.wz.#1
2010.023.08.37:05.67#Q. 14@2010.024.08.34:27.00. safeops
2010.023.08.37:05.67#Q. 14@2010.024.08.34:27.00. safeops
2010.023.08.37:05.67#F. 375@2010.025.06.15:50.00. syle=/usr2/oper/steriskb/ncr, sh k1.0025.wz &
2010.023.08.37:05.67#F. 369@2010.025.06.19:50.00. schedule=k1.0025.wz.#1
2010.023.08.37:05.67#Q. 14@2010.025.06.20:50.00. startmka
2010.023.08.37:05.67#Q. 14@2010.025.08.03:46.00. safeops
2010.023.08.38:05.03#I. 375@2010.024.06.45:50.00. syle=/usr2/oper/steriskb/ncr, sh k1.0024.wz &
2010.023.08.38:05.03#I. 369@2010.024.06.49:50.00. schedule=k1.0024.wz.#1
2010.023.08.38:05.03#Q. 6@2010.024.06.50:50.00. startmka
2010.023.08.38:05.03#Q. 14@2010.024.08.34:27.00. safeops
2010.023.08.38:05.03#F. 375@2010.025.06.15:50.00. syle=/usr2/oper/steriskb/ncr, sh k1.0025.wz &
2010.023.08.38:05.03#F. 369@2010.025.06.19:50.00. schedule=k1.0025.wz.#1
2010.023.08.38:05.03#Q. 6@2010.025.06.20:50.00. startmka
2010.023.08.38:05.03#Q. 14@2010.025.08.03:46.00. safeops
    
```

Chat

```

[alexander*] hello
[opert] hello
[alexander*] how are you
[opert] fine, how can i help you?
[alexander*] the schedule has changed
[alexander*] please drugg it again
[opert] ok, thanks!
[alexander*] thank you
    
```

Configure

RPC-Clients RPC-Server SSH Hot-Key Table

Command	Hot Key
/usr2/ifs/bin/monpcal	CONTROL + SHIFT + V
/usr/bin/xterm -e /usr2/ifs/bin/pfmed	CONTROL + SHIFT + P
/usr/bin/xterm	control + shift + x
/usr2/prog/econtrol/bin/econtrol	control+shift+e
/usr/bin/ncit	control+shift+h

/home/rtwadm/econtrol/config-econtrol-extern/RPCClient.conf

Remote program startu

SSH

Configure

RPC-Clients RPC-Server SSH Hot-Key Table

Station Network Access Settings

Enable

Site: Wetzell

Port: 22000

User Name: vlbi

Port Binding: 22222:193.174.1.66.80:22

Additional Cmd: -2

Station IP: gate1-w.wetzell.tifag.de

DSA File: /home/rtwadm/econtrol/RT...

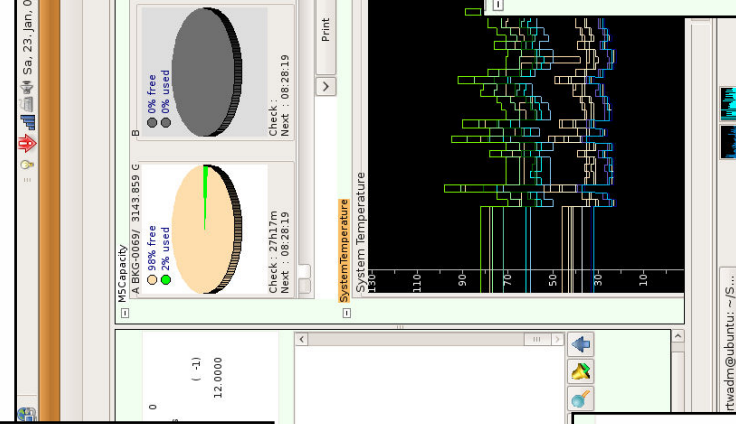
Pass Phrase:

Pass Phrase:

Timeout-Settings: 20 [s]

/home/rtwadm/econtrol/config-econtrol-extern/RPCClient.conf

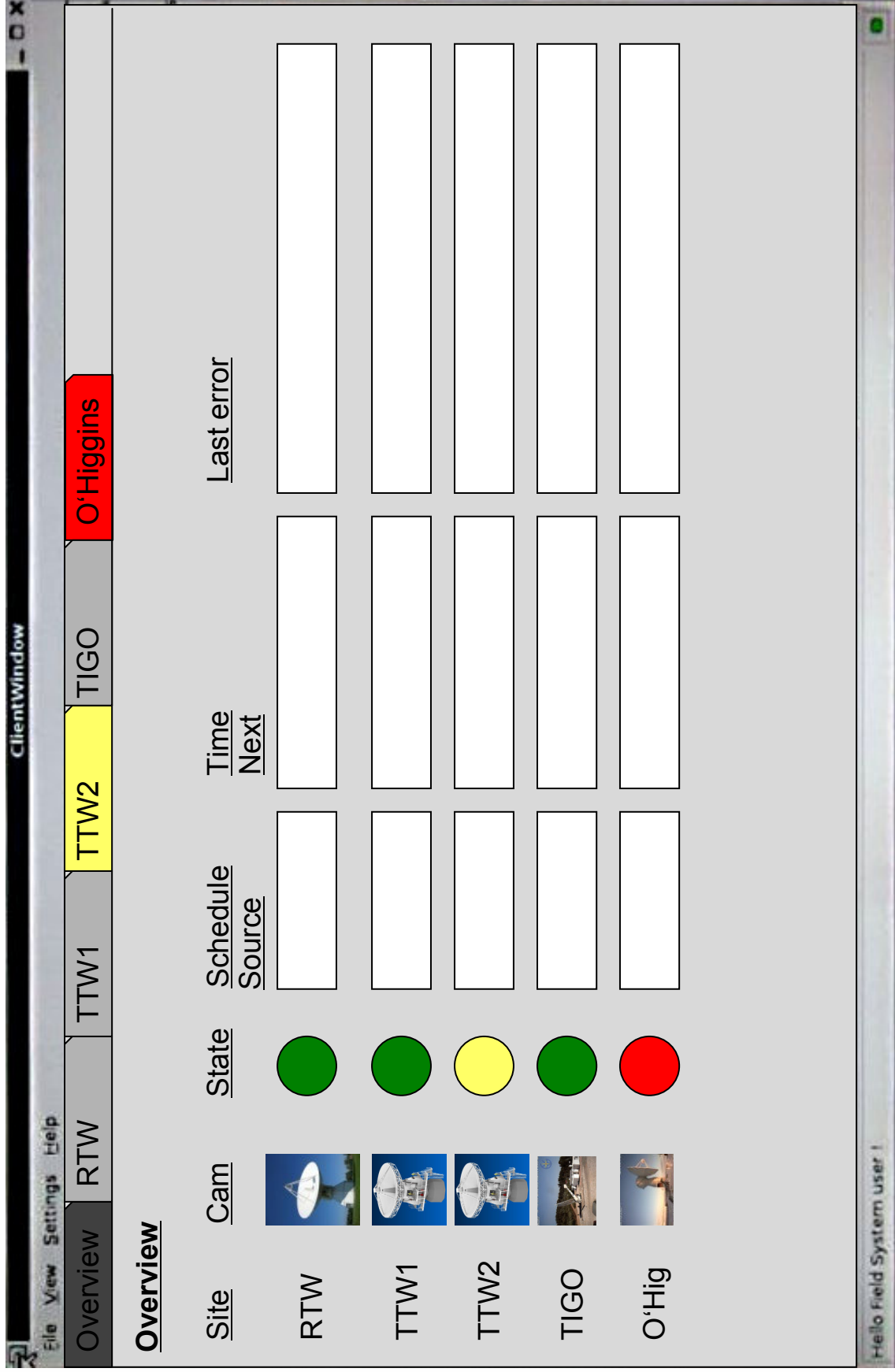
Graphic and Classic main interface



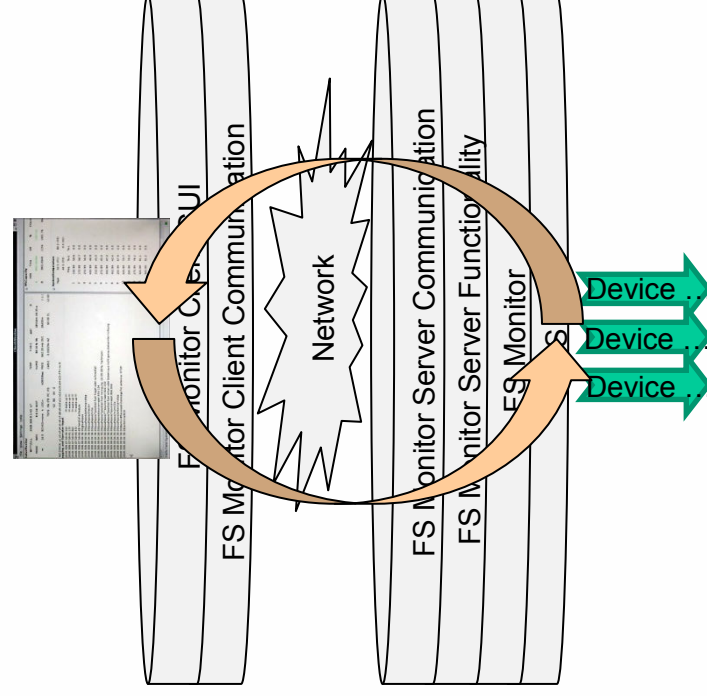
The interface displays system health metrics. On the left, there are two circular gauges: 'MSCapacity' showing 96% free and 2% used, and 'BKG-00697' showing 0% free and 0% used. In the center, a 'System Temperature' gauge shows 136 degrees. On the right, a line graph shows network activity over time, with a peak around 110 units.

The client – graphical, textual or browser based

Planned overview and all-in-one control for several sites

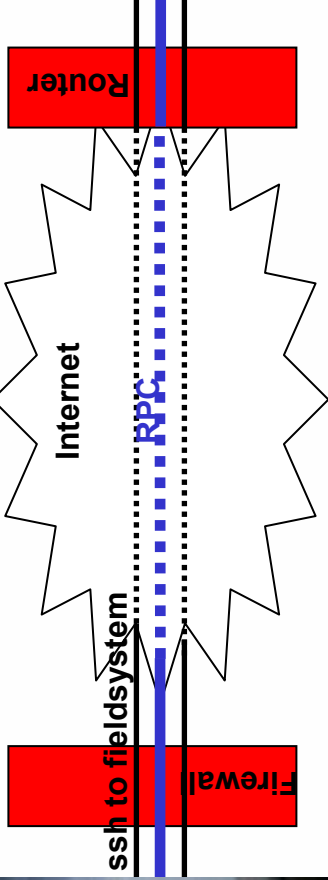


The first complete shared observation tests – Wetzell and TIGO

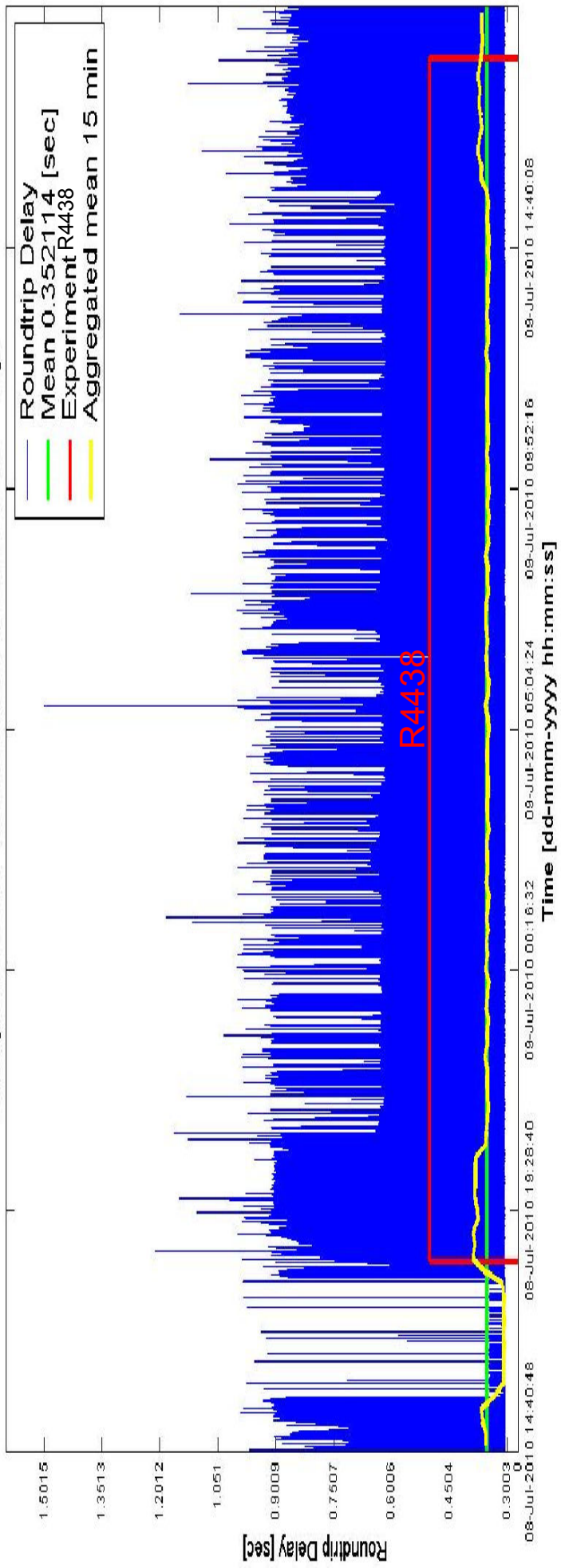


The first complete shared observation tests (IVS-session R4438)

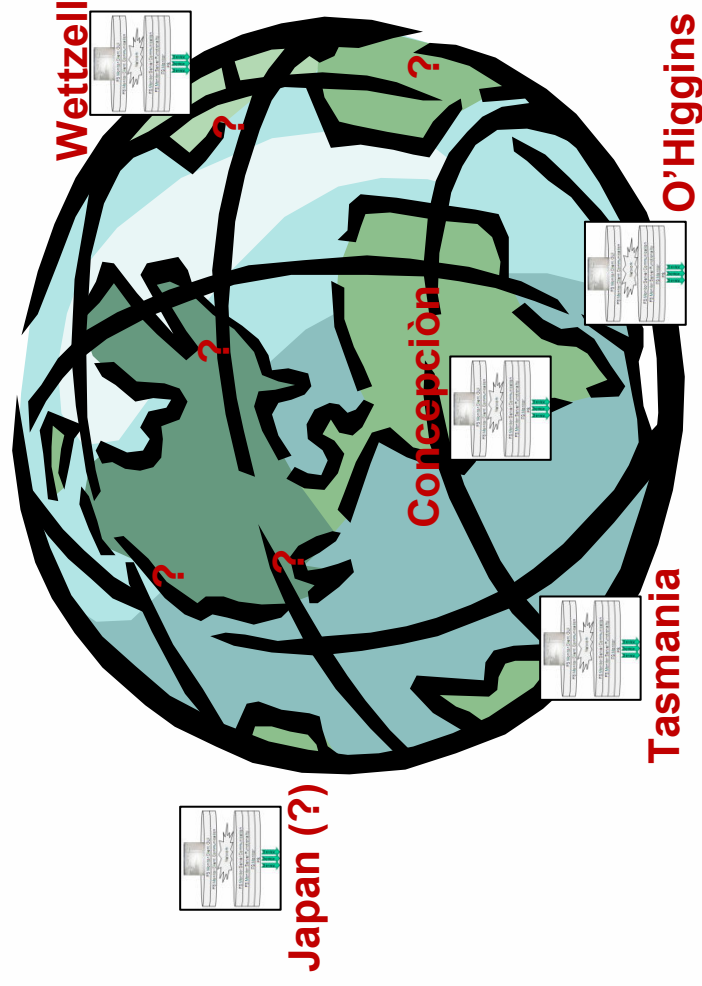
GO Wettzell/
Germany



Fieldsystem remote control and attendance Wettzell -> Tigo



**First release is available now for testing!
Feel free to try and to adapt it for your system!!
And the future ...**





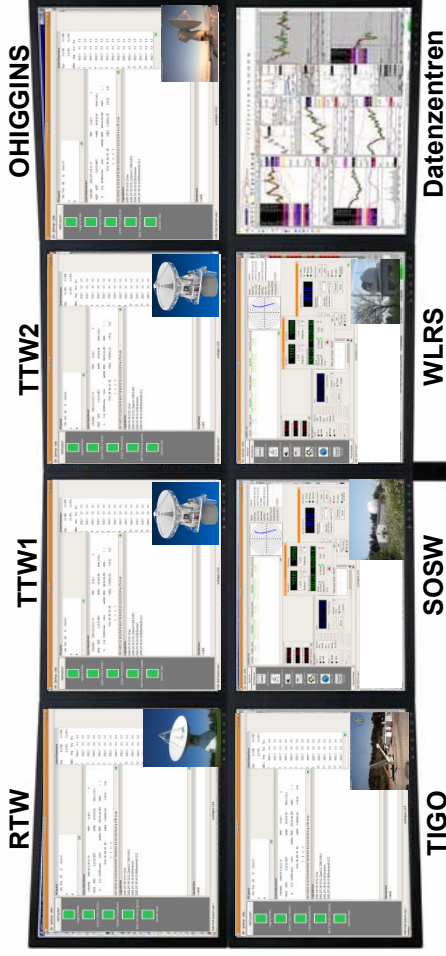
And the future ...

- 1) Participation at the **NEXPRES-project proposal** (EVN) including the development of an operator based security system (authentication and authorization, read and write control, control handover etc.) together with the MPIfR Bonn
- 2) Main focus lies also on finalizing (and maybe offering) a complete **control system for SLR** in same style
- 3) Development of an **additional monitoring systems** to realize a stable system overview
- 4) Realization of **hardware-level devices** with same interface technique within the field system (similar to SLR-control system)
- 5) Improve the technology => **Technical GGOS or SKA realizations**

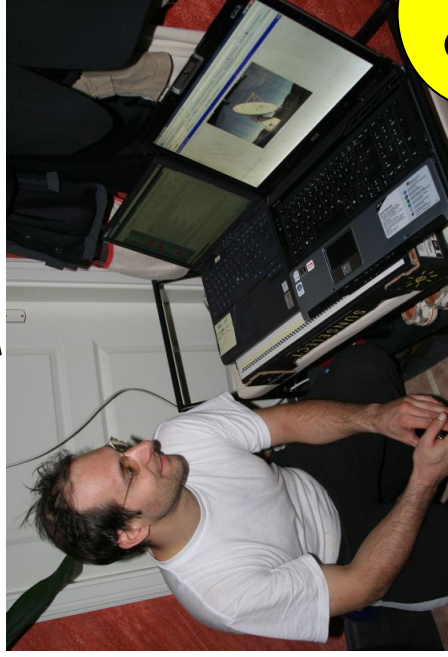
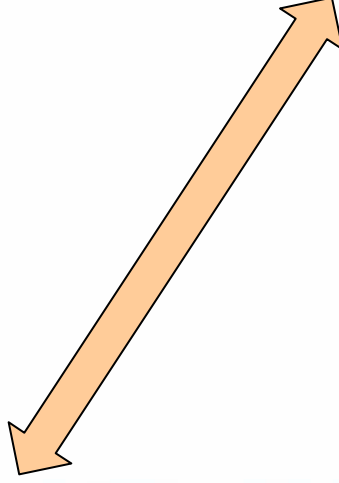
How to get the software?

Email to neidhardt@fs.wettzell.de

Thank you!



Similar to: Hase, Hayo; et. al.: Twin Telescope Wettzell (TTW) – a VLBI2010 Radio Telescope Project. IVS General Meeting 2008



And this is a lucky remote observer in his private “home observatory” controlling the radio telescope in Wettzell immediately after waking up!

