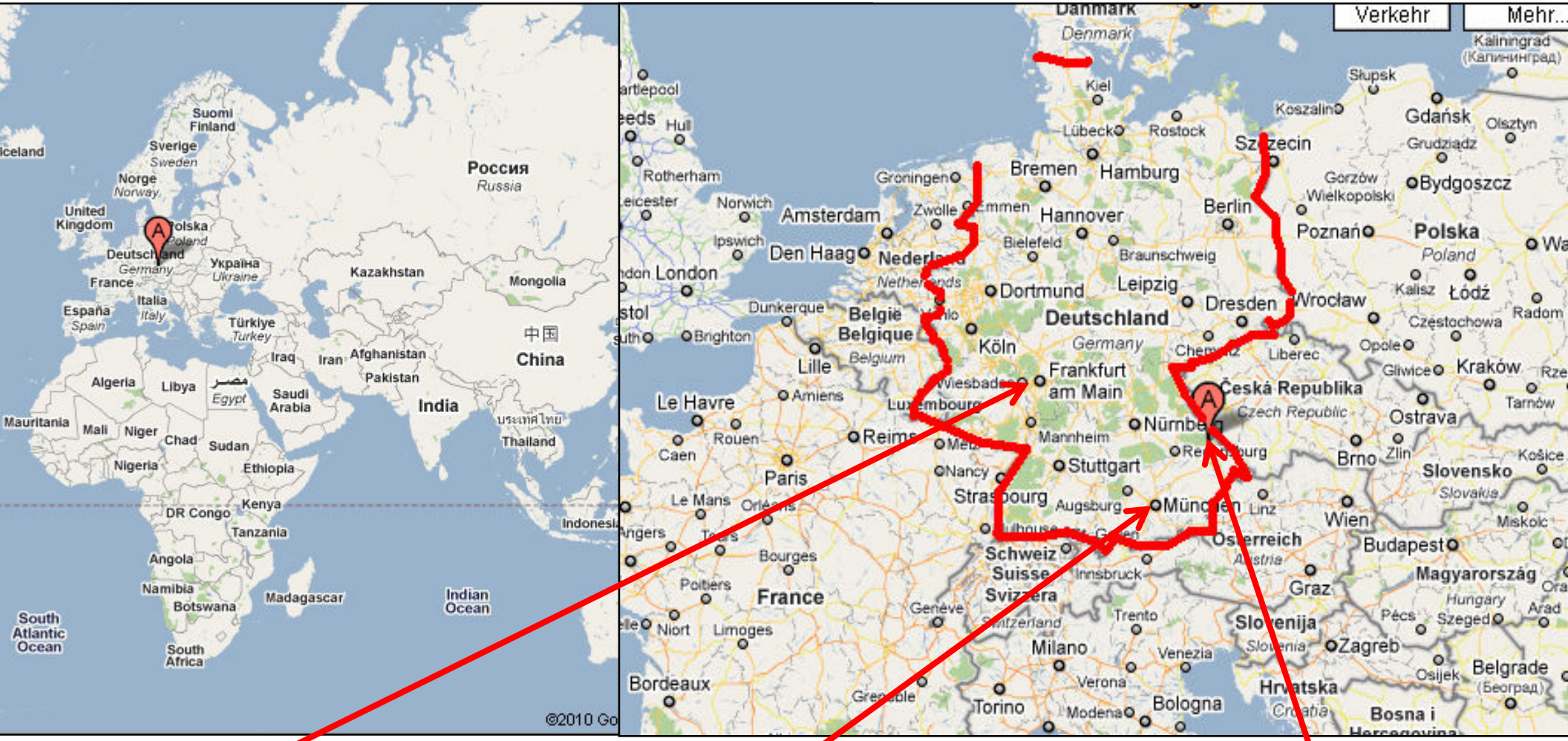
Interacting with radio telescopes in real-time during VLBI sessions using e-control

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

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



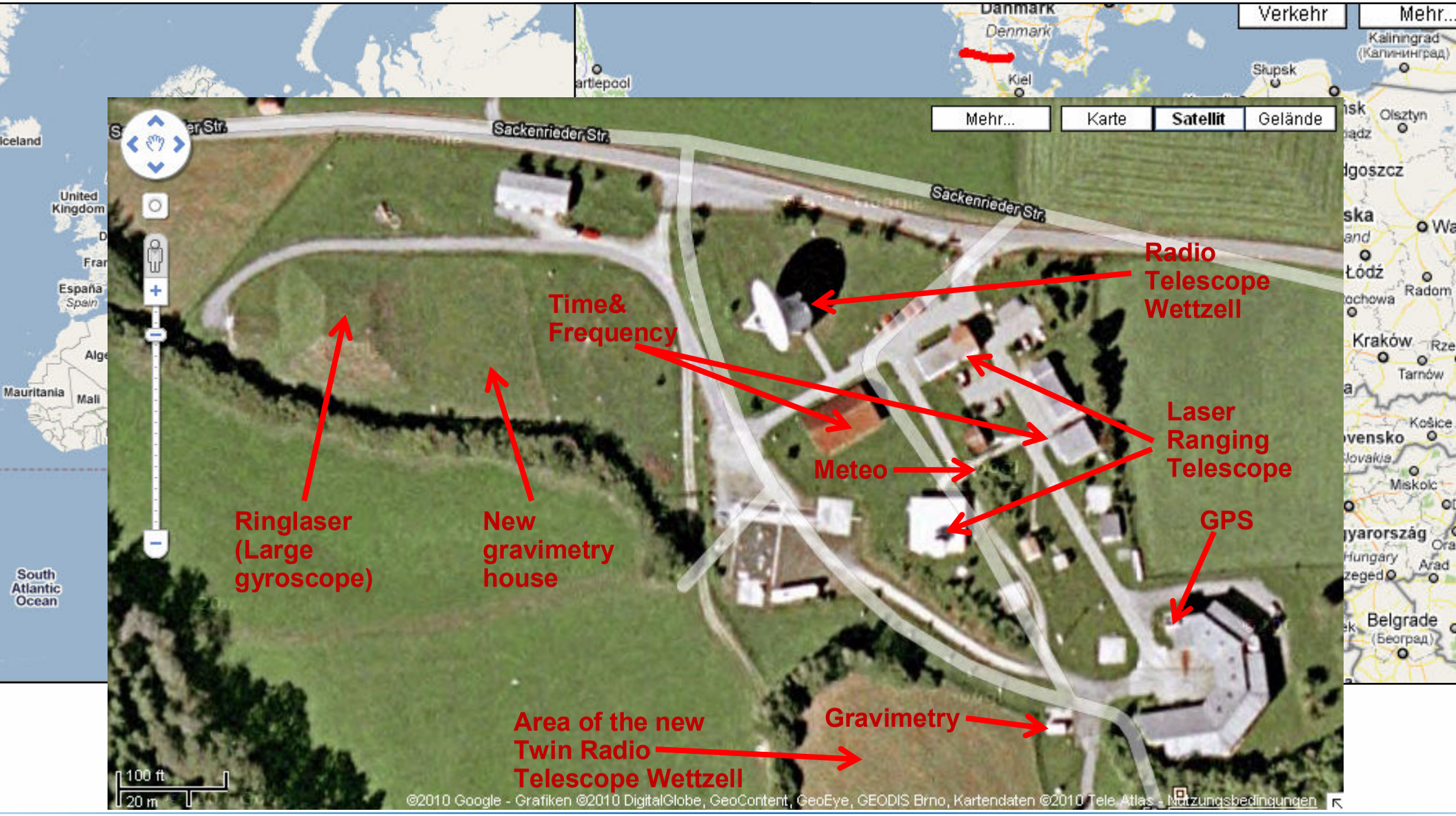
Federal Agency for Cartography and Geodesy, Frankfurt

Technische Universitaet Muenchen Research Group Satellite Geodesy

Geodetic Observatory Wettzell Germany surrounded by the Bavarian Forest

ee: http://maps.google.com/ Download 2010/0217

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



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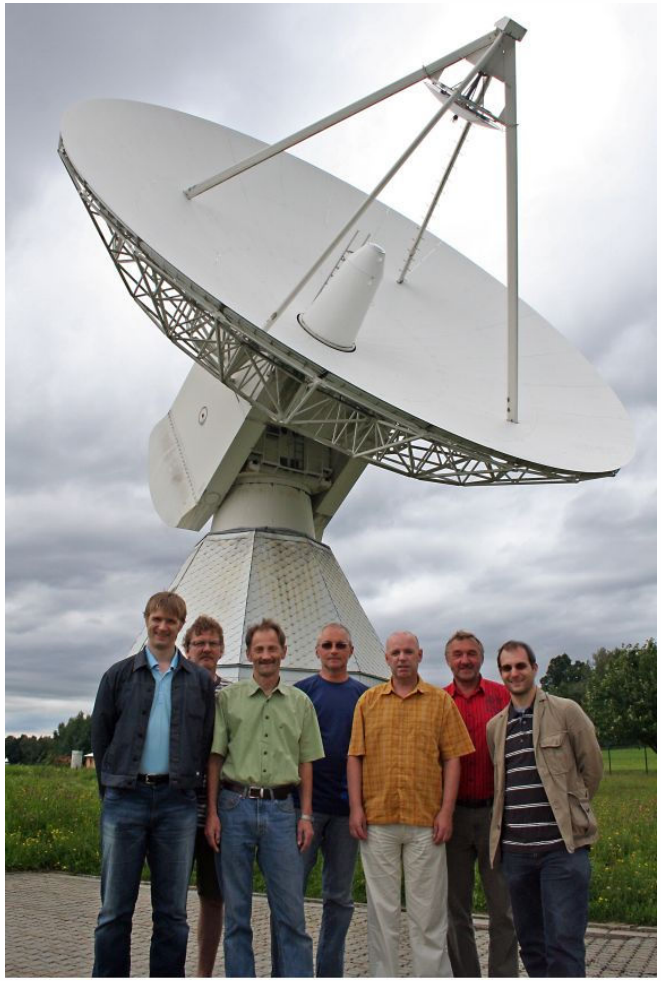
The Radio Telescope Wettzell (RTW), it's team and partner sites

RT Wettzell/Germany



The Wettzell VLBI crew (from left to right):
Ch. Plötz, E. Bauernfeind, G. Kronschnabl, R. Schatz, W. Schwarz, R. Zeitlhöfler, A. Neidhardt
(missing in picture: E. Bielmeier).

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
CONT08	15
total	**141**
total (in hours)	**3384**

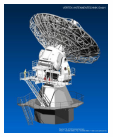
program	number of 1h-sessions
INT1(Kokee-RTW)	234
INT2/K(Tsukuba-RTW)	100
INT3/K(Tsukuba-RTW-NyAl)	41
total (in hours)	**375**

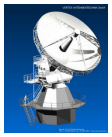
special program	number of experiments
SELENE	19
total (in hours)	**92**

TIGO Concepción/Chile

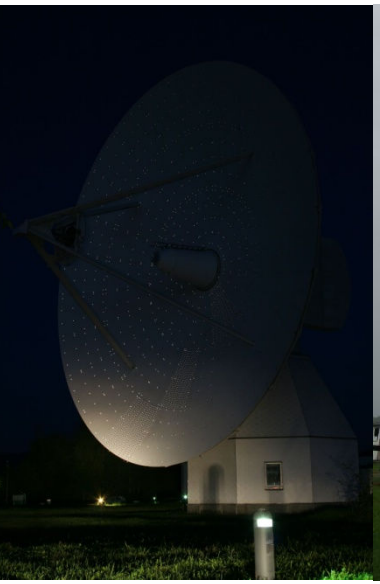
GARS O'Higgins/Antarctica

And in the future: TTW Wettzell

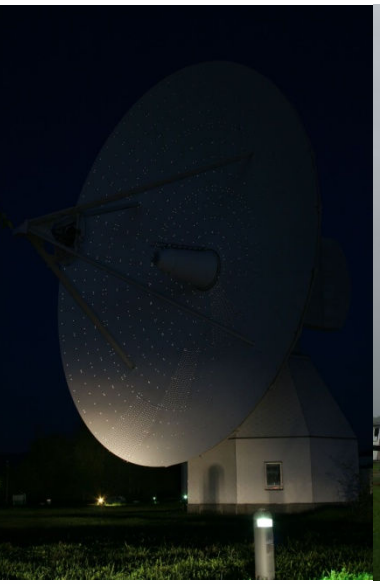




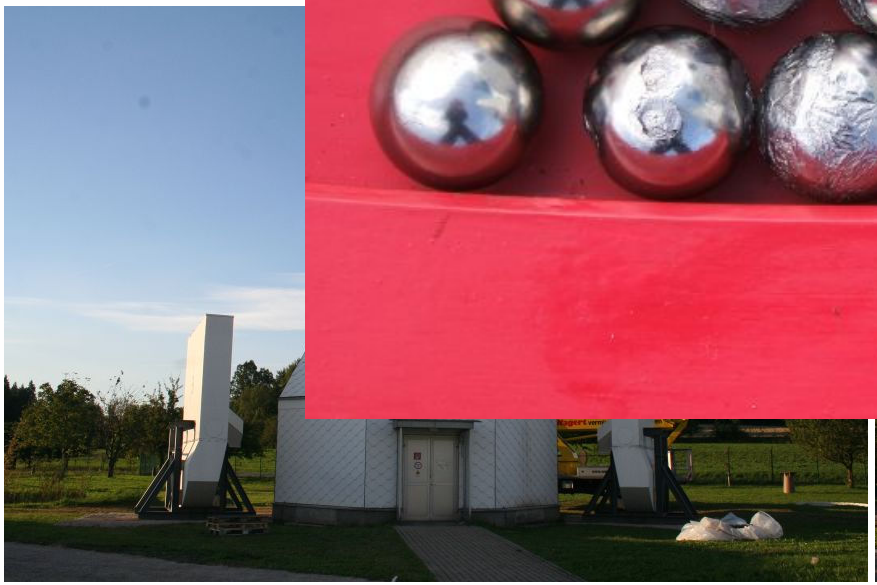
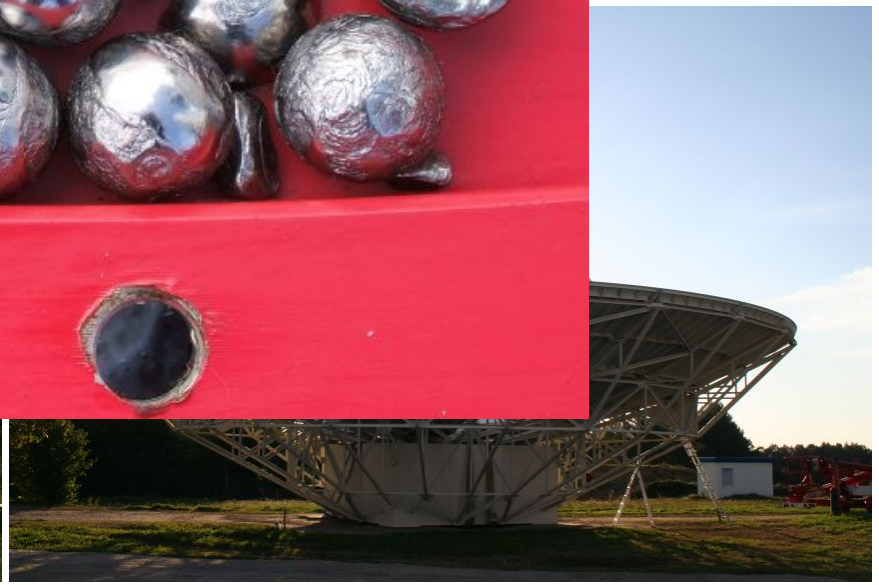
The Radio Telescope Wettzell (RTW): impressions of current activities



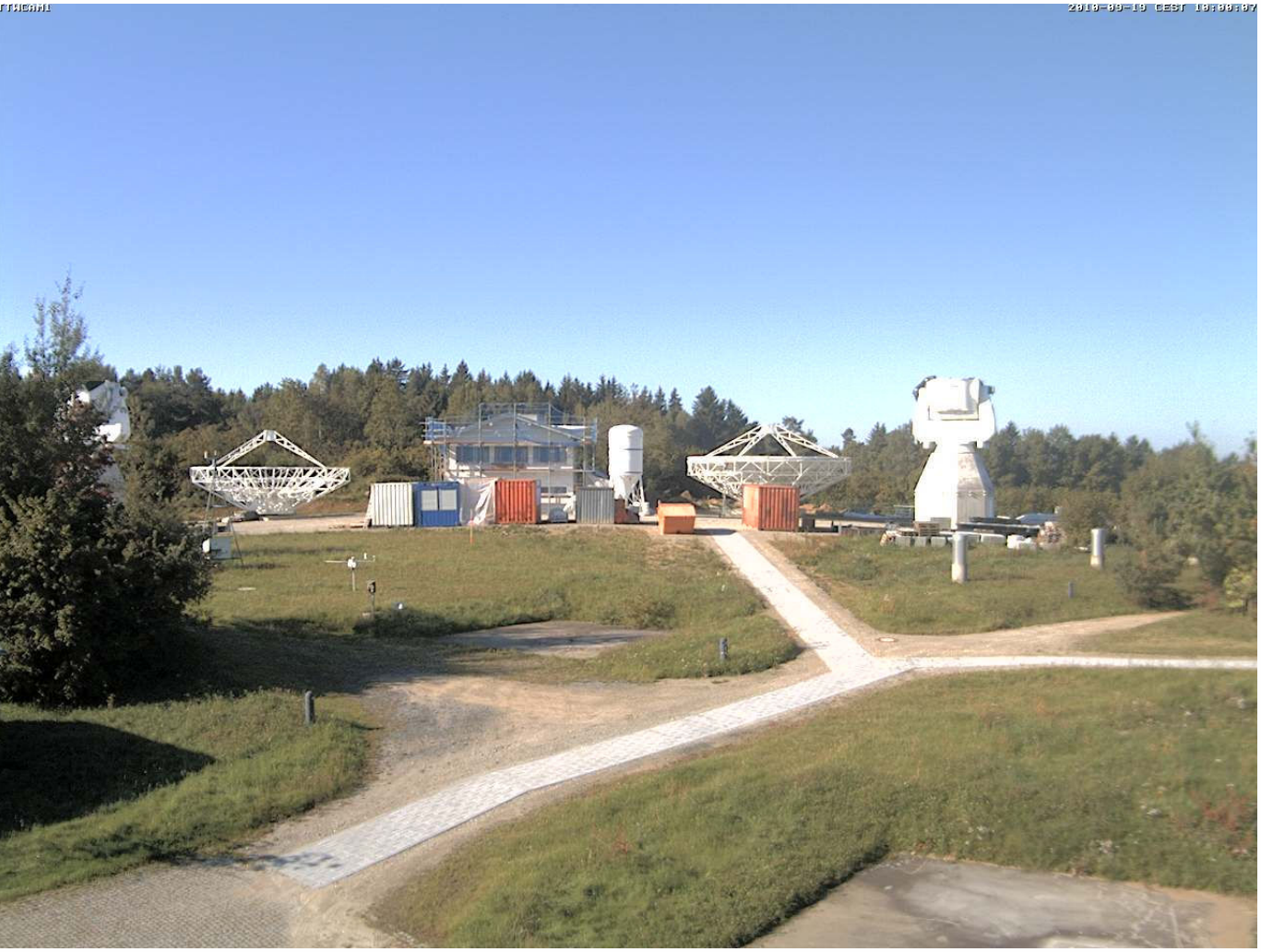
The Radio Telescope Wettzell (RTW): impressions of current activities





The TWIN Radio Telescope Wettzell (TTW): impression

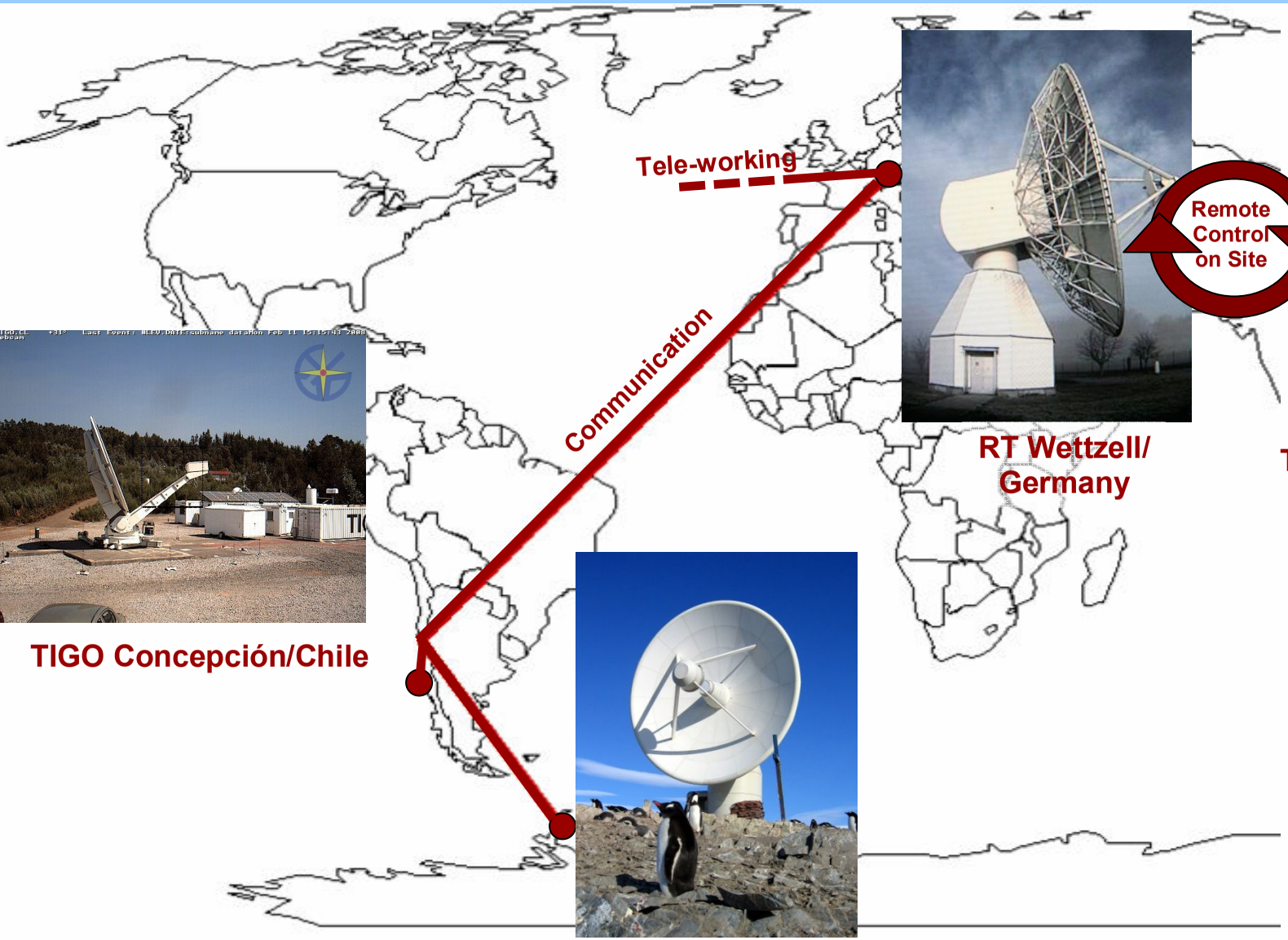


Diameter Main reflector: 13.2m
Diameter sub-reflector: 1.48m
Ring Focus Design with f/D = 0.29
Surface quality of the reflectors: < 0.2 mm RMS
Way length error : < 0.3 mm
Surface quality of the panel: < 0.065 mm RMS
ALMA mounting with angular velocities
Angular velocities of 12°/s in azimuth and
6°/s in elevation
Acceleration: Az/El = 3°/ s2
Ranges of rotation: Azimuth 540°,
Elevation 0-115°
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

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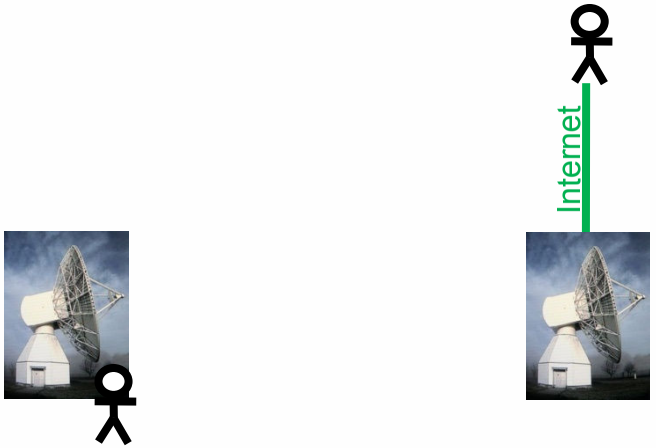

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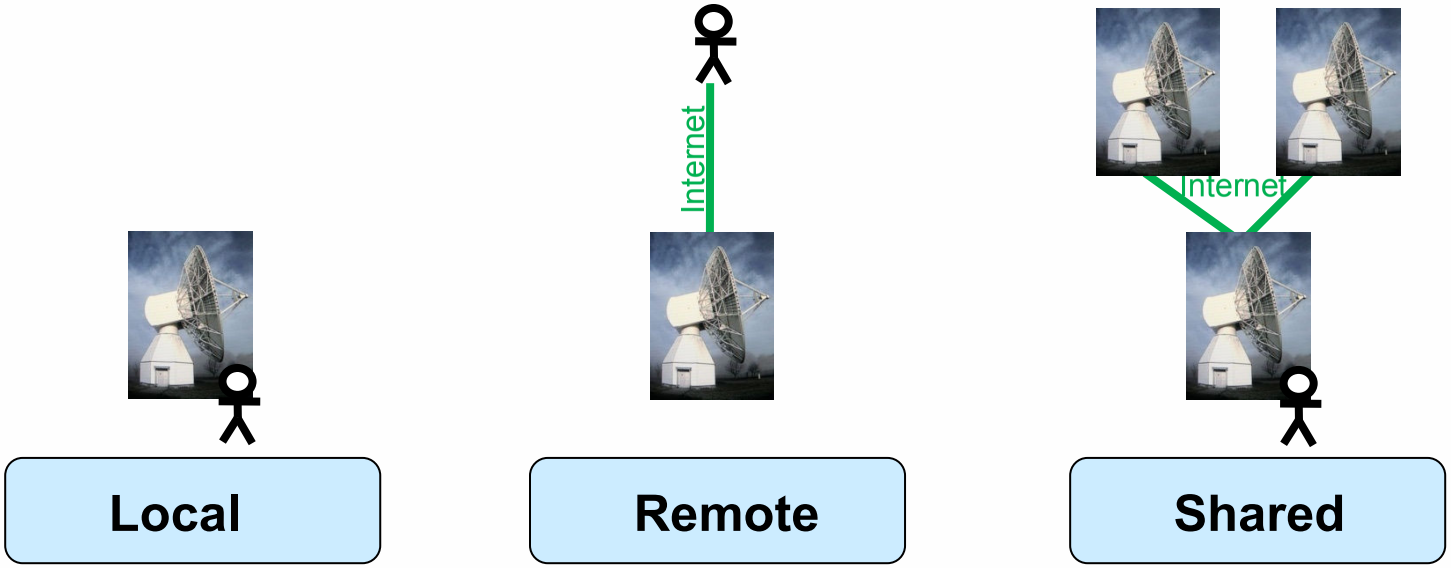
Remote

- 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



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

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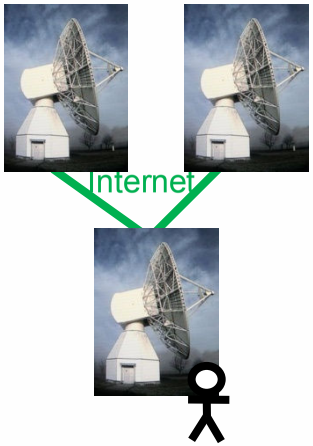


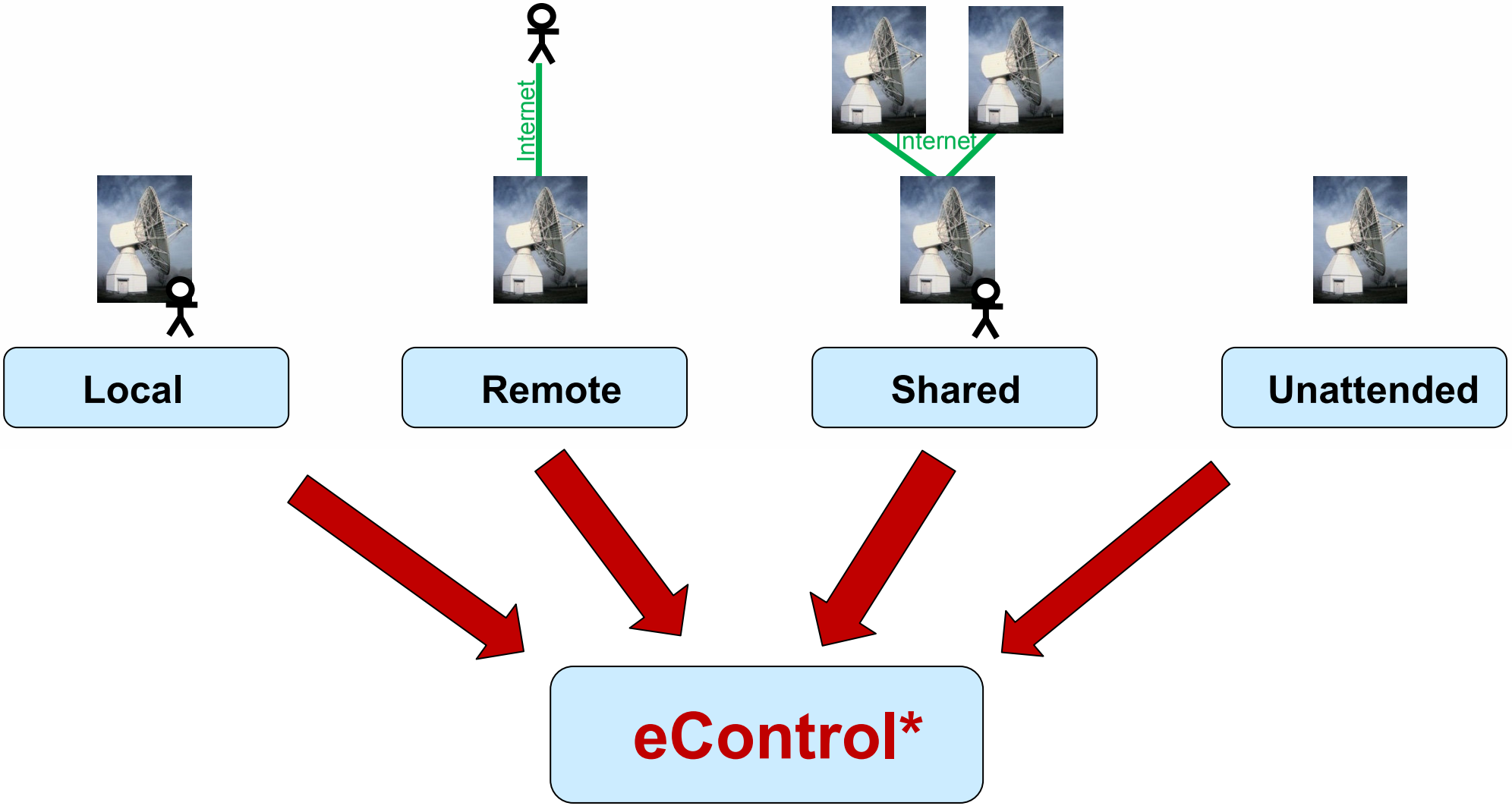
Shared

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

Unattended

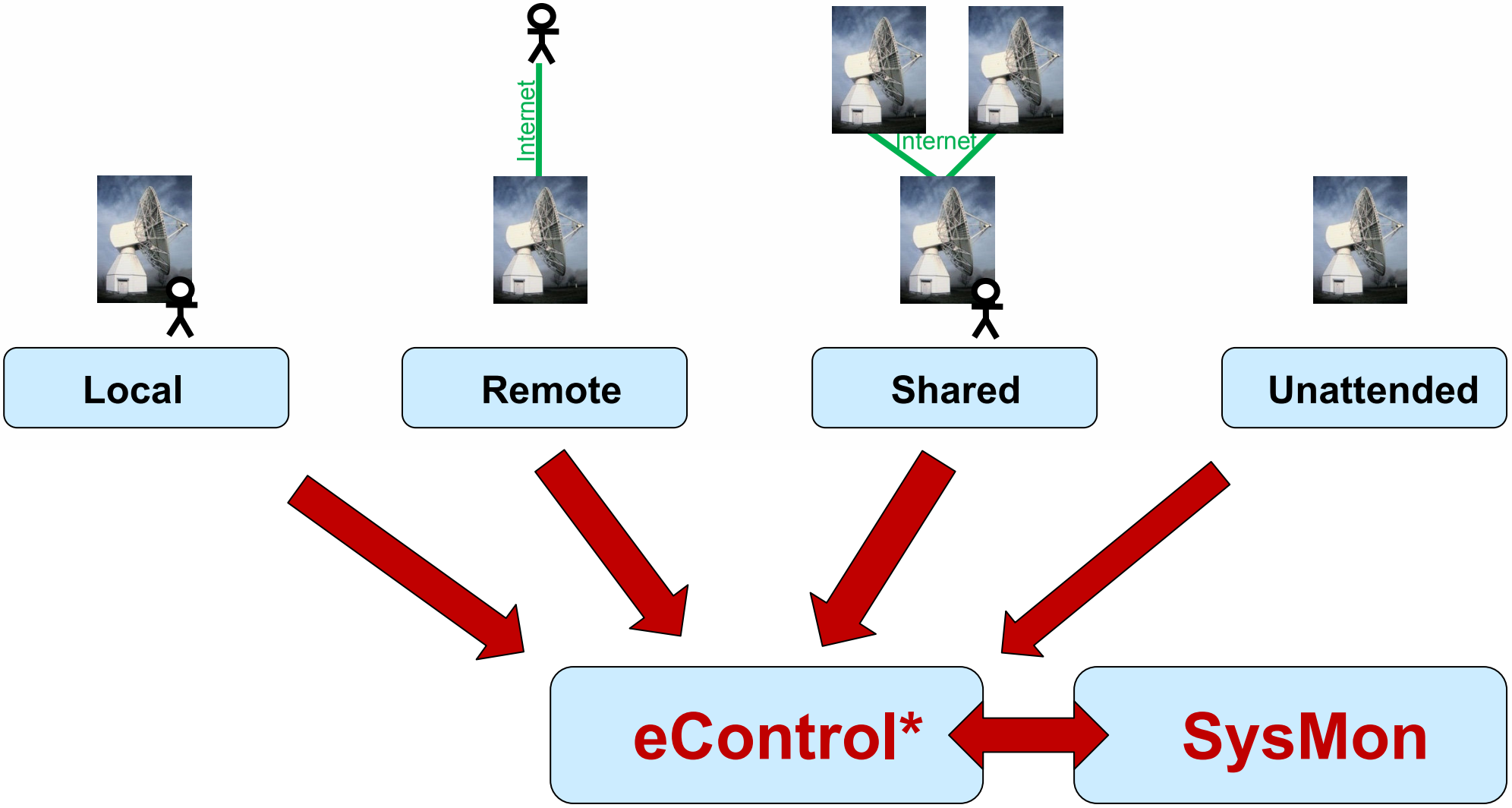
- Observations run autonomous, (semi-) automated and unattended

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



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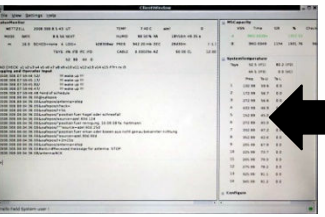
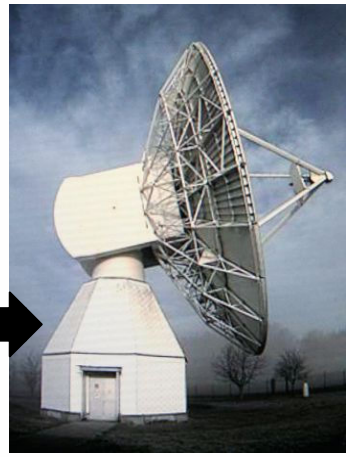
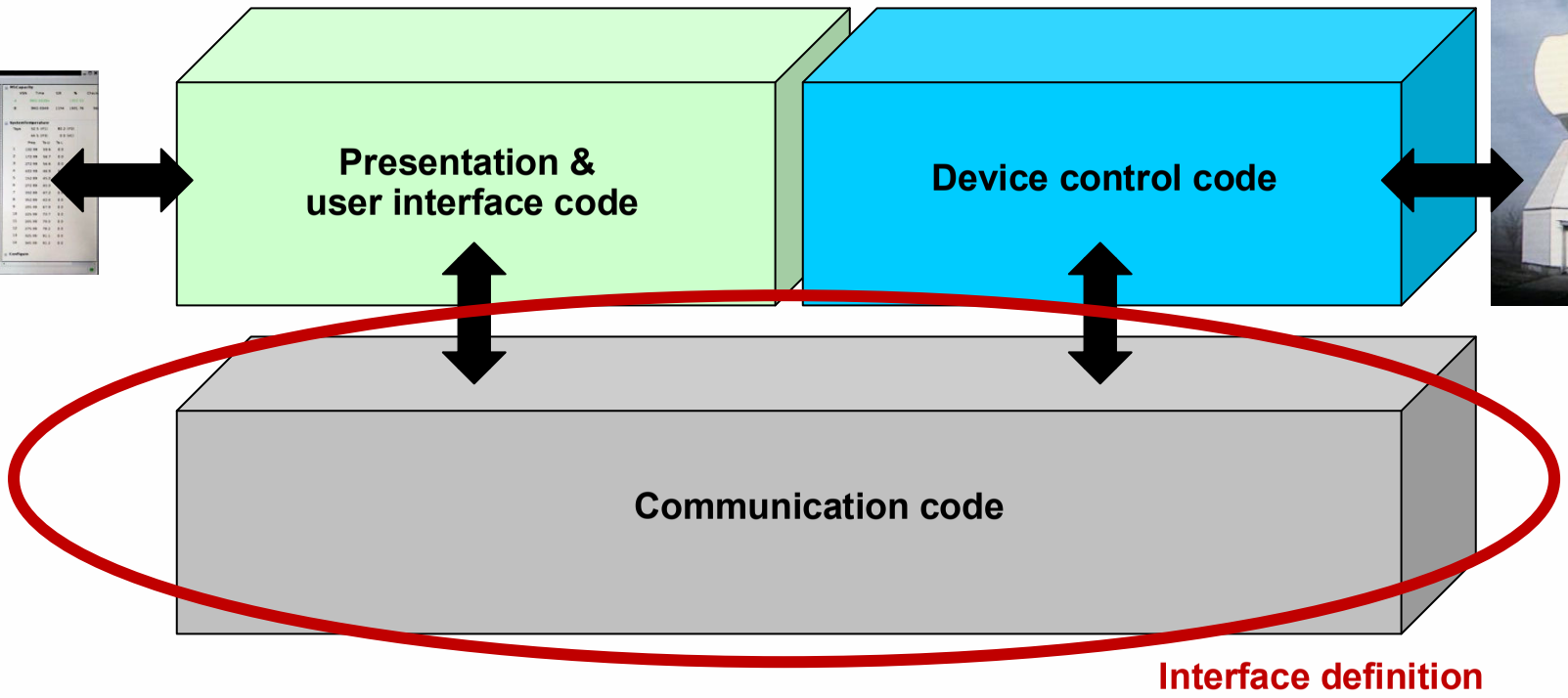
Wettzell's solution for remote control

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

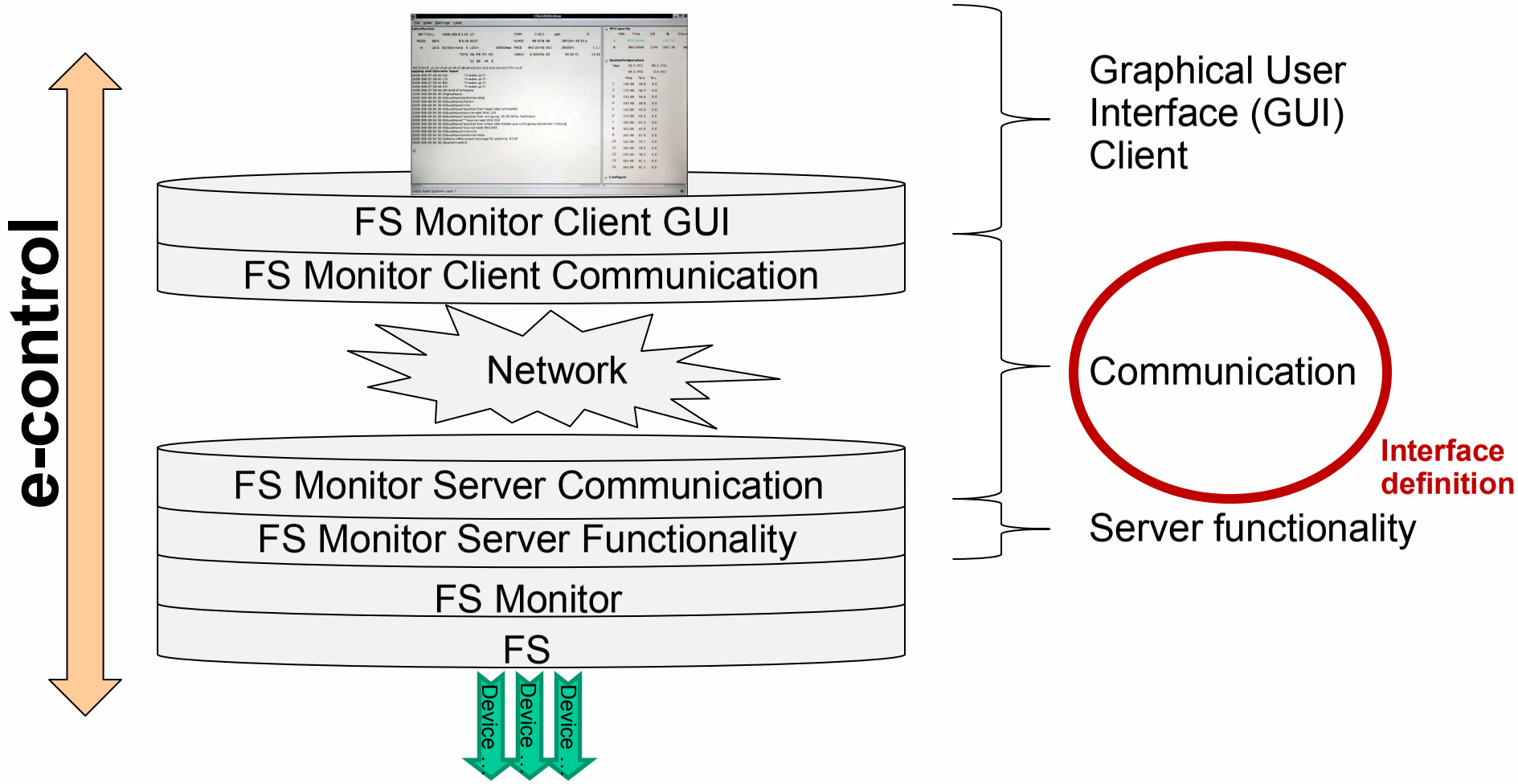




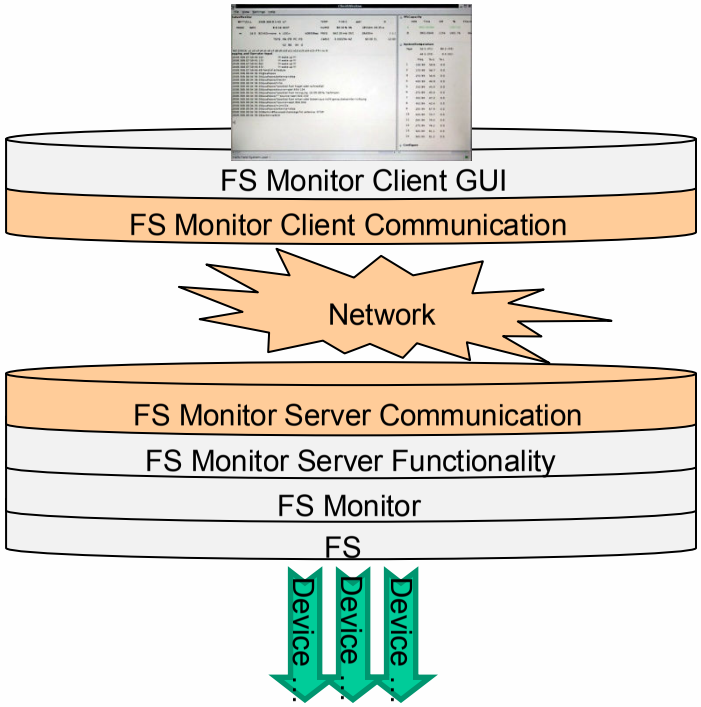


Strict design-separation of these parts

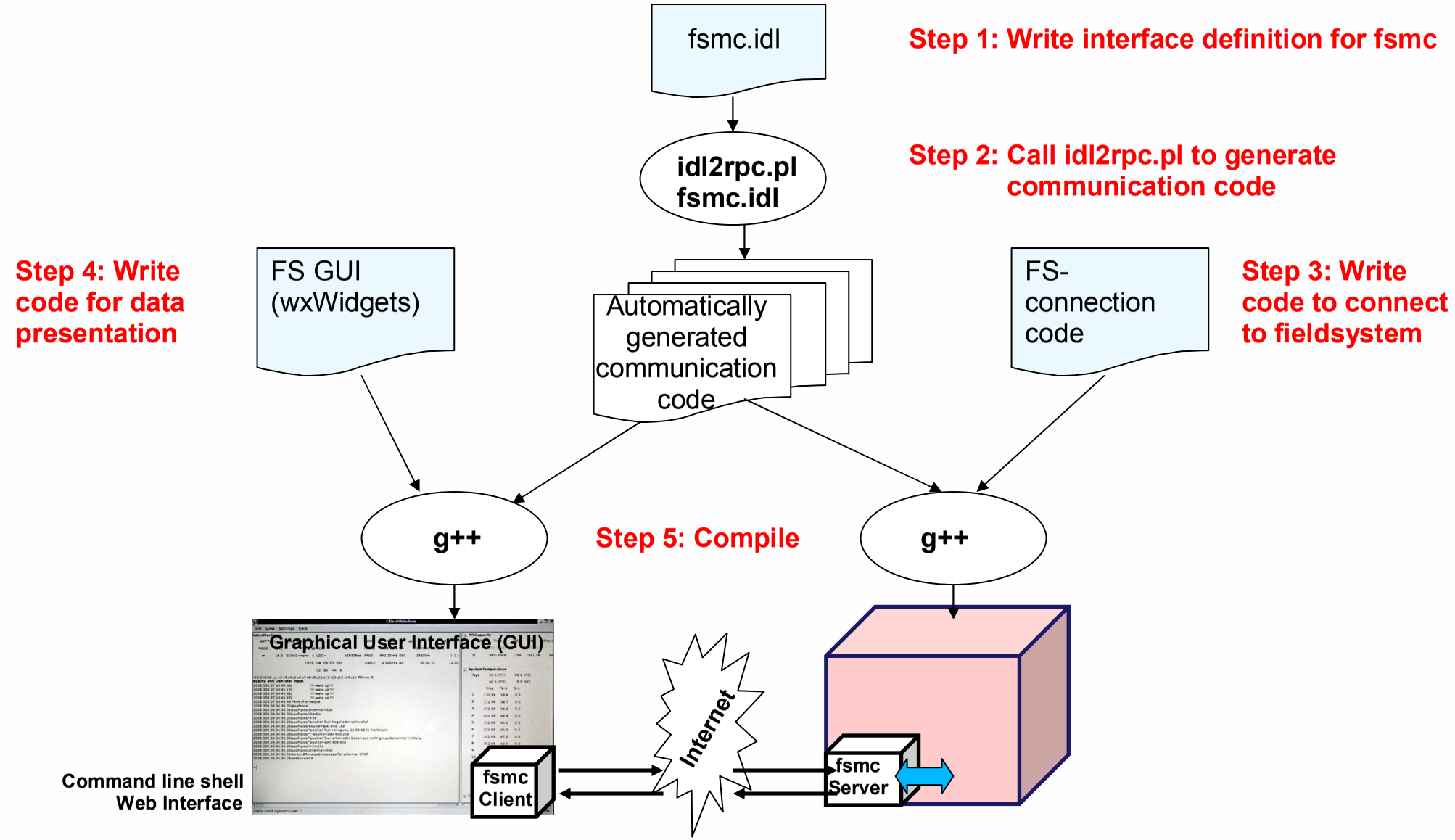
The idea: remote attendance and control of VLBI telescopes Wettzell, O'Higgins/Antarctica and TIGO/Concepción



The communication – with a remote procedure call middleware and ssh

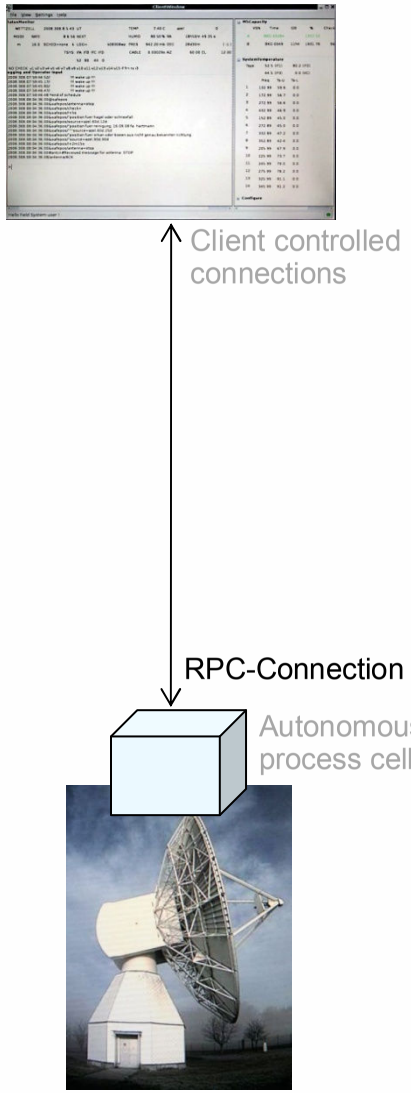


The communication – using a middleware generator

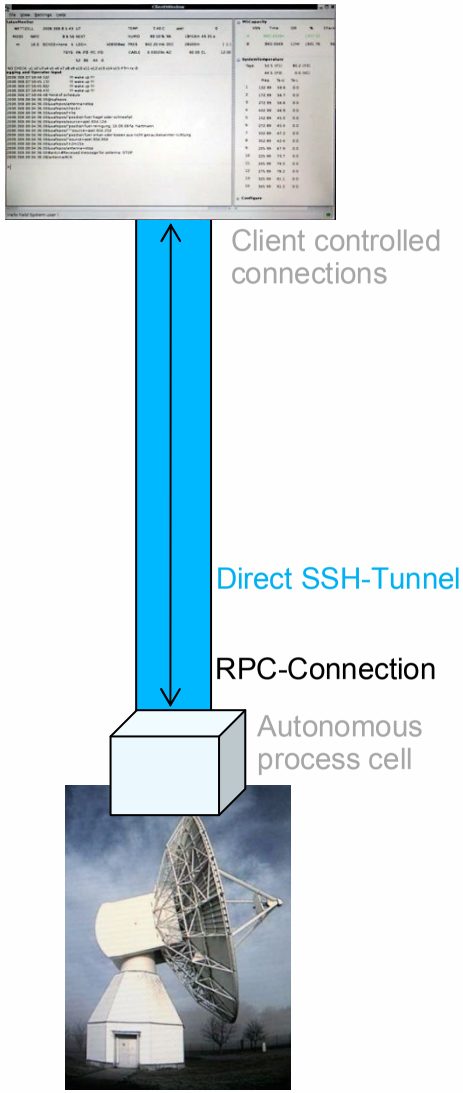


SSH as security layer

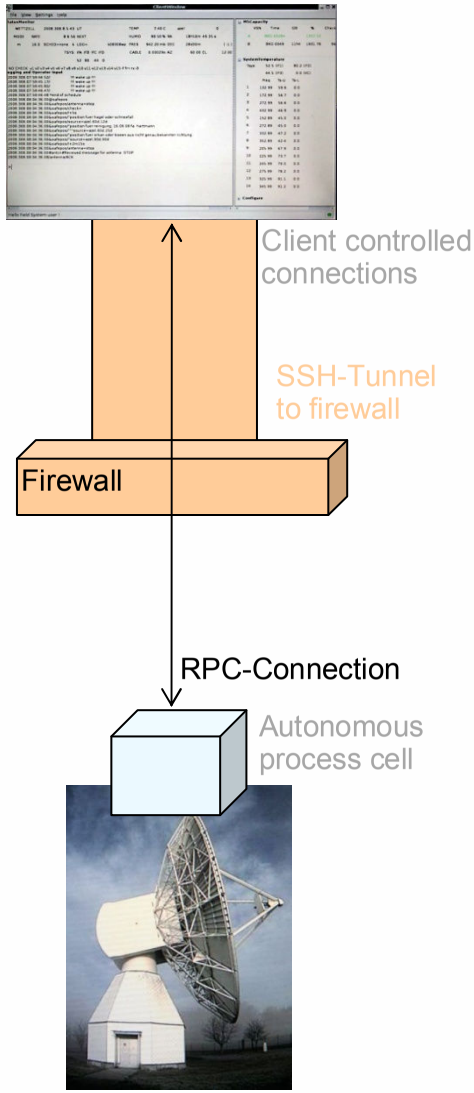
Possibility 1:
Direct access



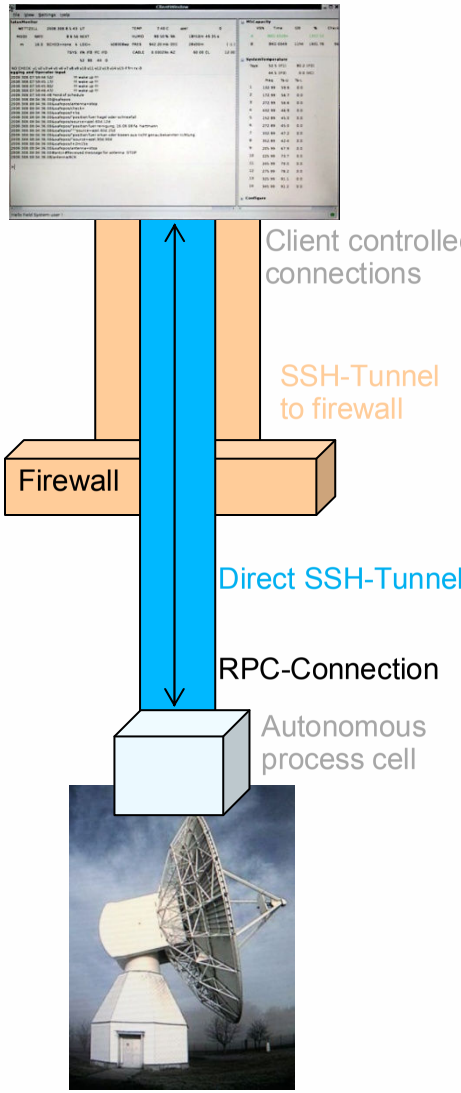
Possibility 2:
Access via direct SSH-Tunnel



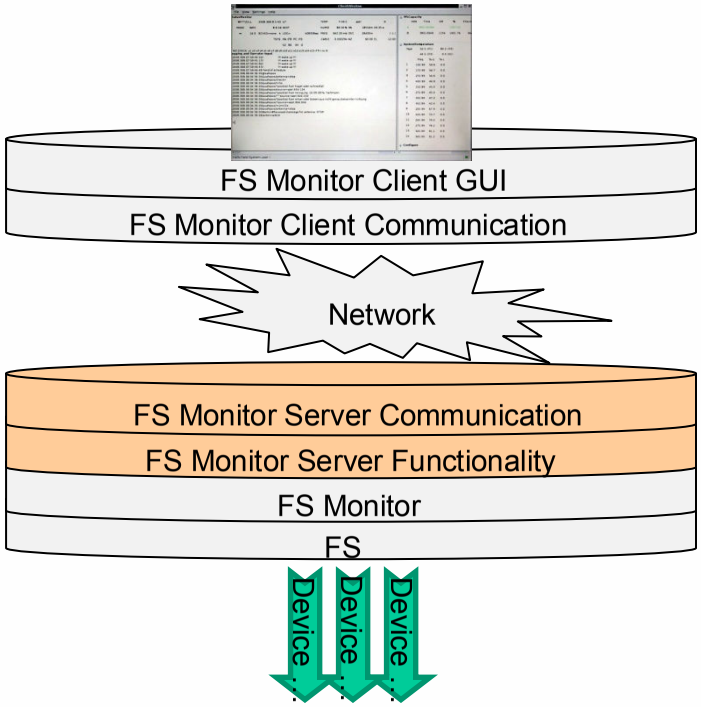
Possibility 3:
Access via SSH-Tunnel to firewall



Possibility 4:
Access via direct SSH-Tunnel over SSH-Tunnel to firewall

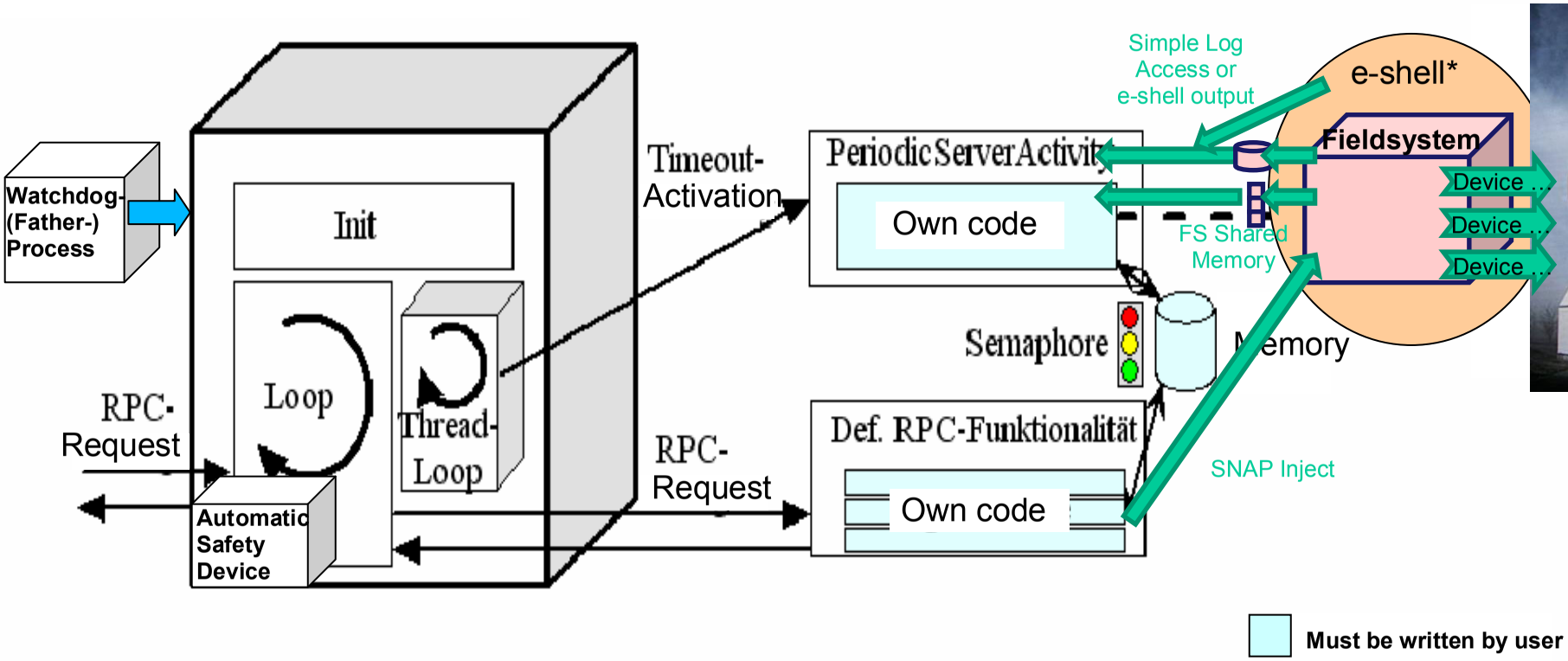


Server extension to existing control software – remote accessible, autonomous process cells

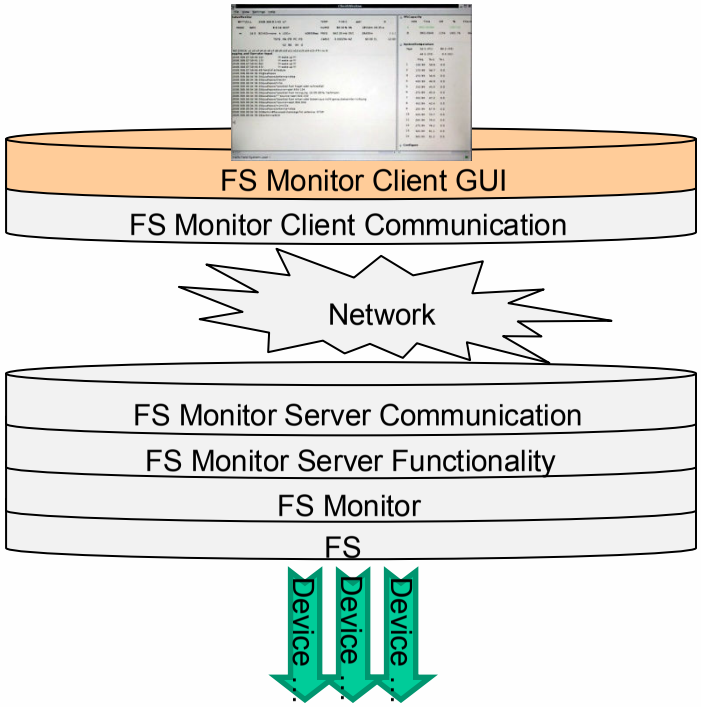


A fieldsystem extension – autonomous process cells

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

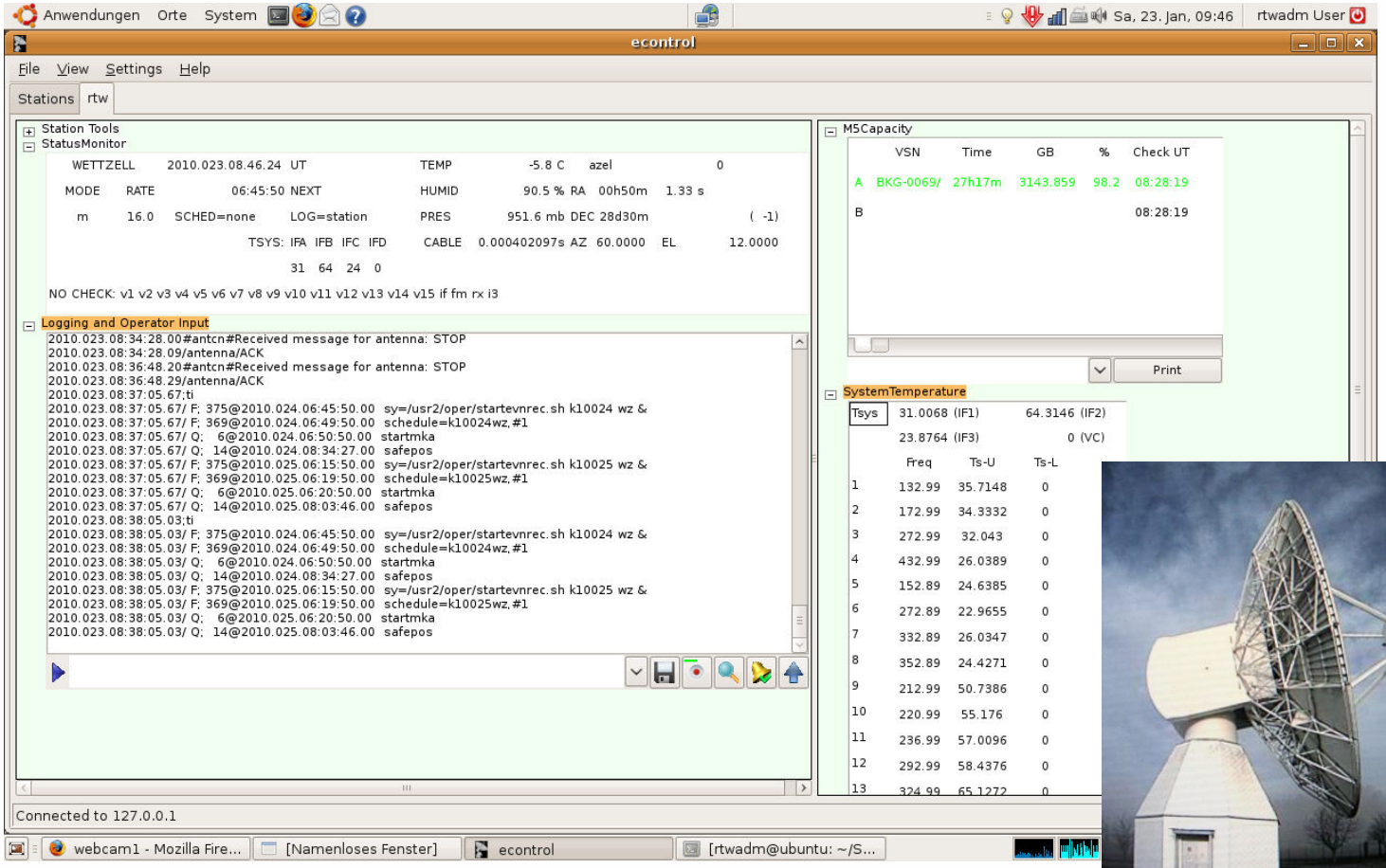


The client – remote (graphical) user interface



The client – graphical, textual or browser based

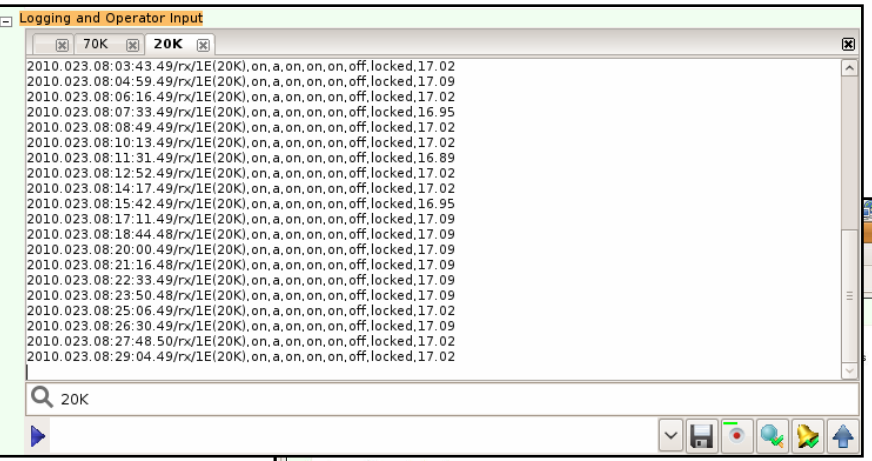
- Separation of control and presentation logic
- Interchangeability of presentation layer (console shell (ncurses), graphical user interface (wxWidgets), web access via Browser, web service, …)
- Remote controllable via client-server-architecture on idl2rpc-middle-ware
- Modularity in window units and additionally possible, separately created administration user interfaces for each device
- Basis for graphical user interface: wxWidgets (C++ based Open-Source-Framework for platform independent development of graphical user interfaces)



Webcam

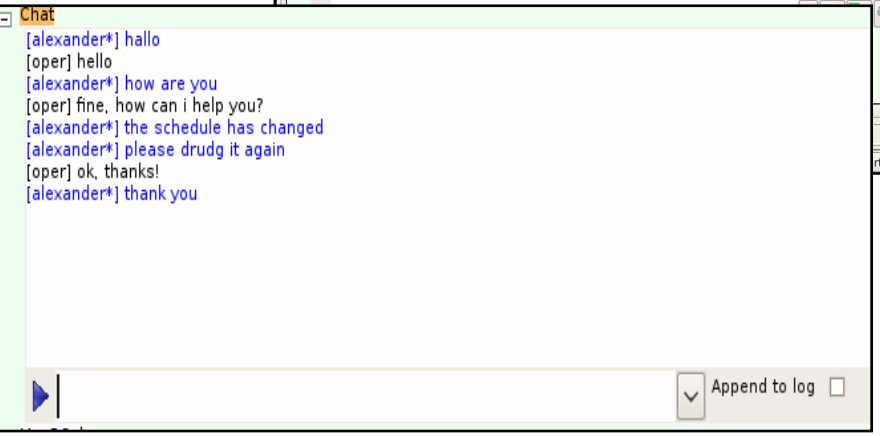
The client – graphical, textual or browser based

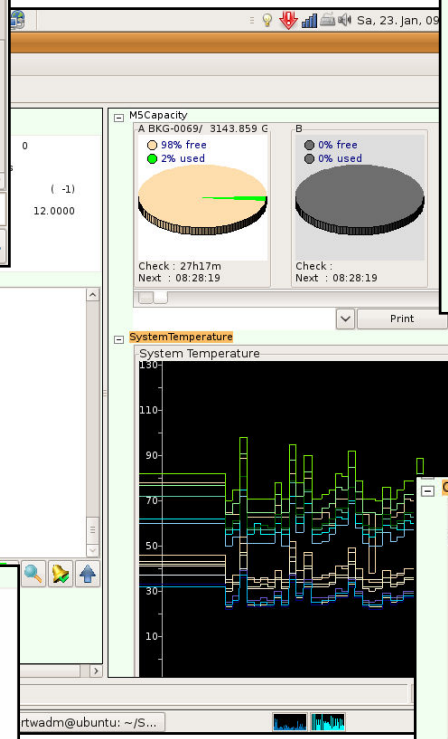
Graphic and Classic main interface

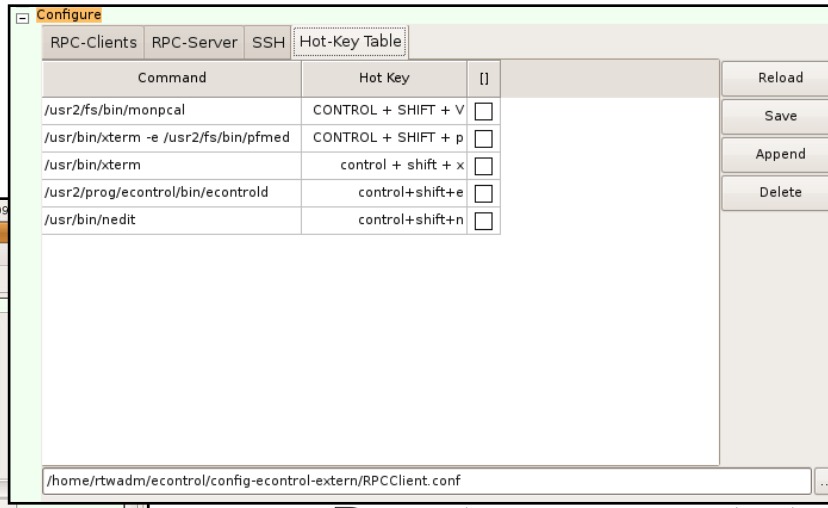


Logbook

Chat

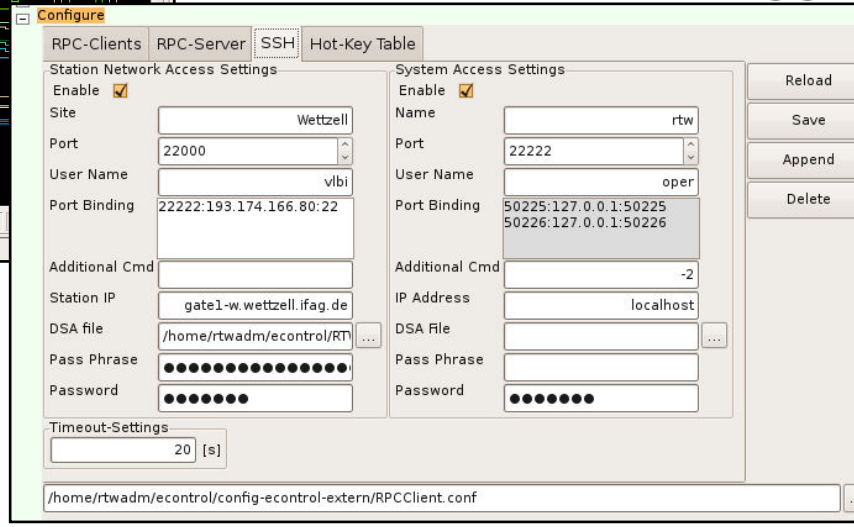






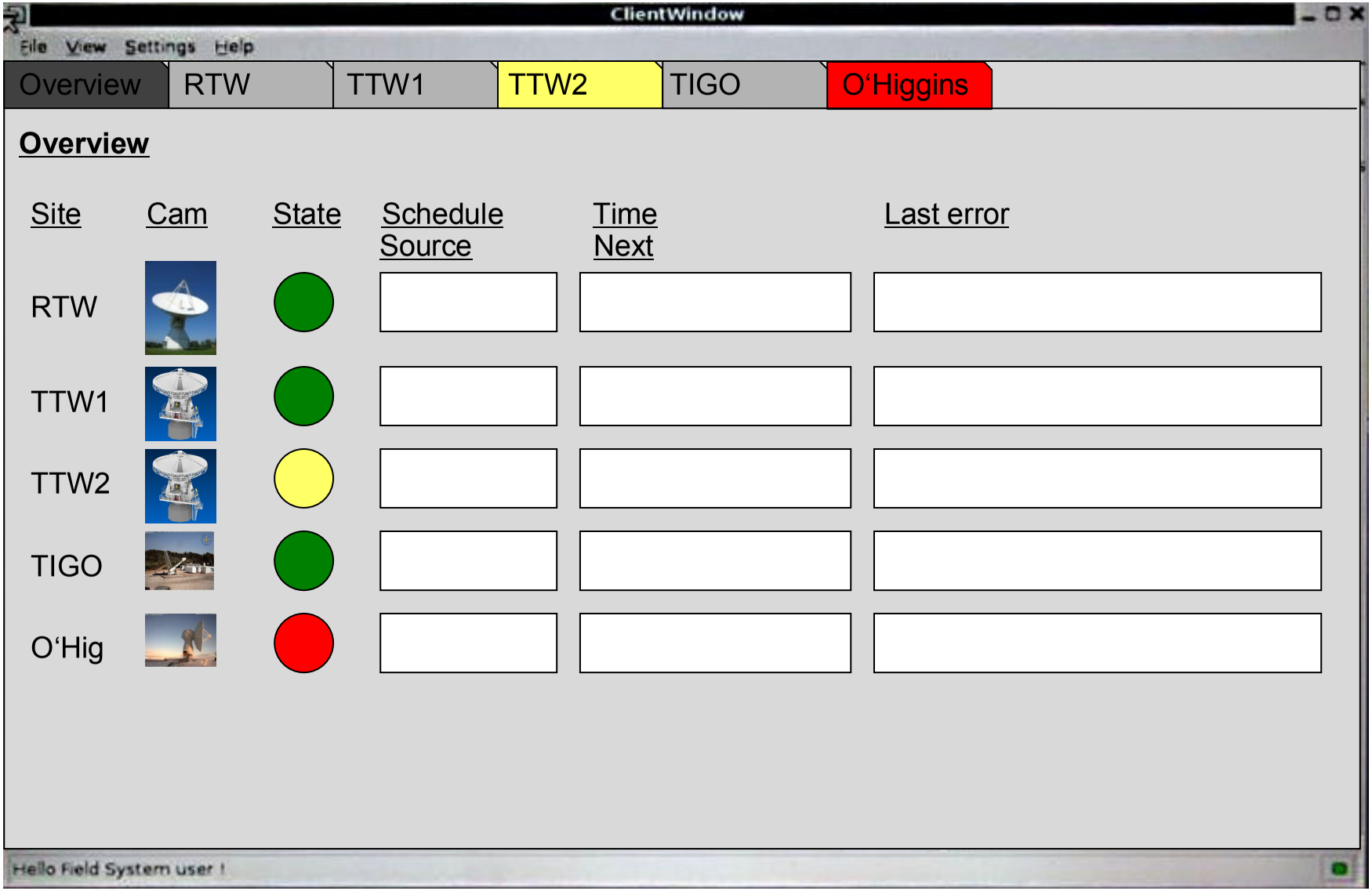
Remote program startu

SSH

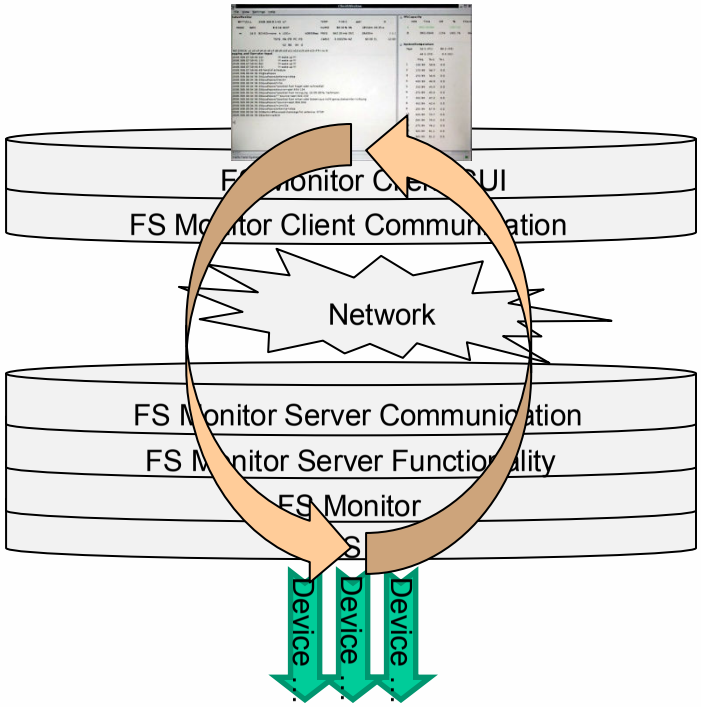


The client – graphical, textual or browser based

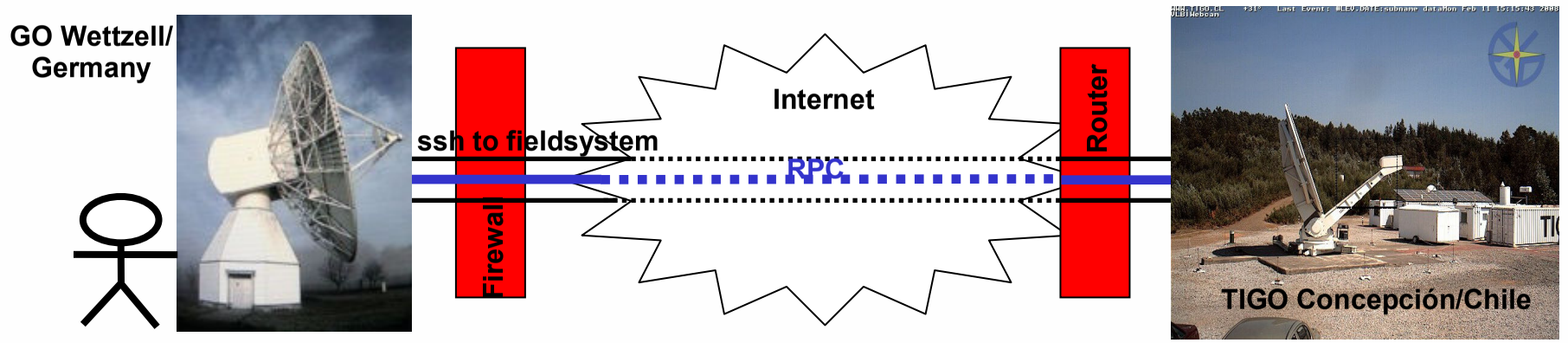
Planned overview and all-in-one control for several sites

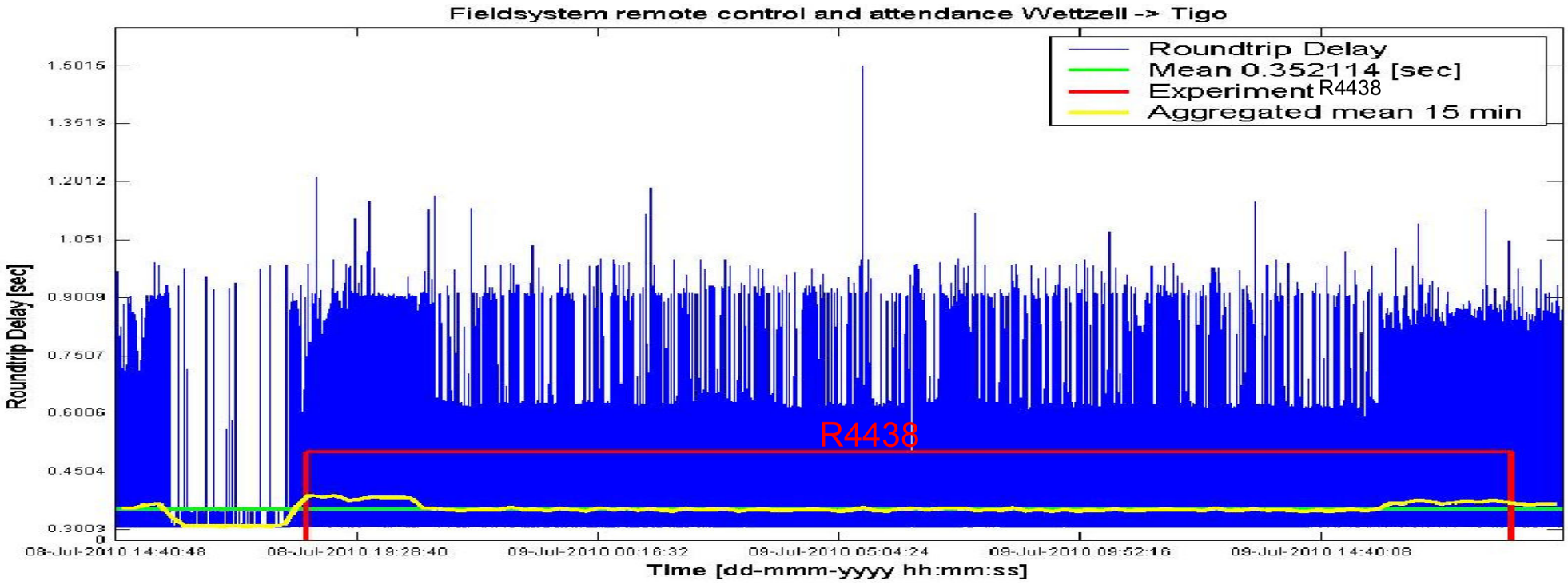


The first complete shared observation tests – Wettzell and TIGO

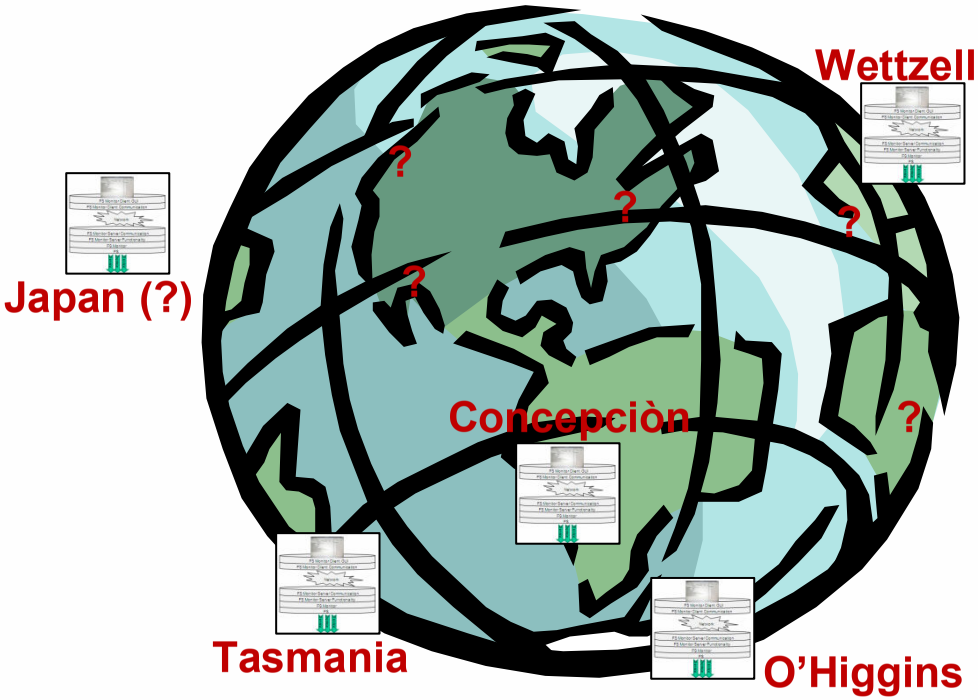


The first complete shared observation tests (IVS-session R4438)





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

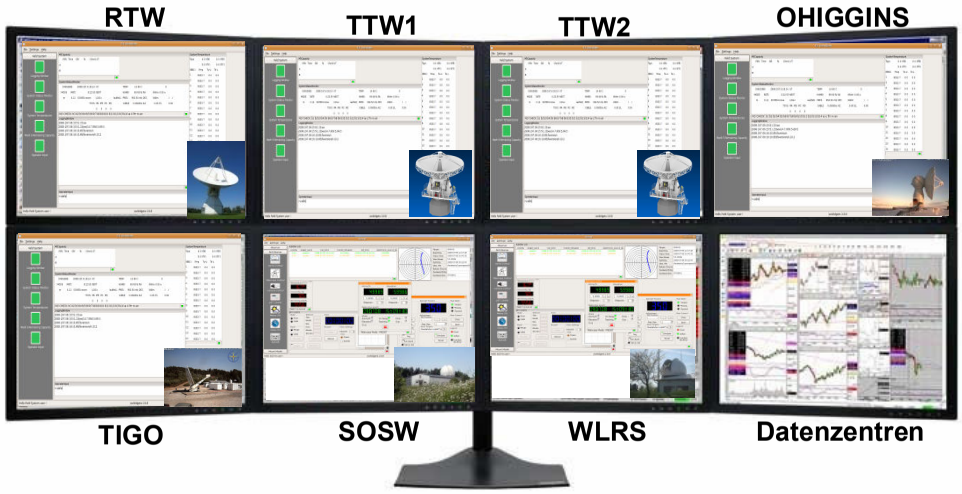
3) Development of an **additional monitoring systems** to realize a stable system overview

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!