New ideas in control software for LR-systems with remote accessible, autonomous process cells

FESG

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

Bundesamt für Kartographie und Geodäsie

Dr. Reiner Dassing, Martin Ettl, Dr. Pierre Lauber, Andreas Leidig, Matthias Mühlbauer, Christian Plötz
(in combination with VLBI in cooperation with DLR and MPIfR)

Future requirements

LR

<u>See „The History and Future of Satellite Laser Ranging“(2):</u>
- [...] High Level of Automation [...] Fully automated [...] Semi-automated: Single Operator or Remote Operation[...]
- [...] Kilohertz Systems [...]

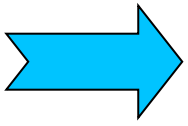
<u>See „The SLR 2000 Pseudo Operator“(3):</u>
- „[...] SLR 2000 Pseudo Operator (POP) controls or directs all aspects of the automated SLR 2000 system. [...] POP will monitor the health and safety of the system foremost and control the acquisition and tracking [...] of the satellites.“

LBI

<u>See IVS Memorandum 2006-008v01: VLBI2010 (1):</u>
- „[...] Increase observation density [...]“
- „[...] For the highest accuracy the global networks must be tied together. [...]“
- „[...] Automate operations and procedures at all stages[...] Flexibility to add/subtract stations on short notice [...] Automated diagnostic procedures and notification of personel when necessary [...]“
- „[...] Monitoring [...] will make it possible to account for factors [...]“
- „[...] new observing strategies [...]“

NSS

<u>See NTRIP: „Nutzung der Internet-Radio-Technologie zur Übertragung von GNSS-Daten“(4):</u>
- „[...] Echtzeitübertragung von GNSS-Daten [...]“
- „[...] Möglichkeit der Fernwartung [...]“



<u>Flexible, remote accessible, reliable, independent, automated and safe systems (throughout all technical levels)</u>

rthur; et. al.: IVS Memorandum 2006-008v01. „VLBI2010: Current and Future Requirements for Geodetic VLBI Systems“. Sept. 2004
rs.gsfc.nasa.gov/docs/degnan_0603.pdf (3) http://cddis.nasa.gov/slr2000/docs/pseudo_operator.pdf
s.bkg.bund.de/root_ftp/NTRIP/documentation/sapos03_gebhard.pdf

New ideas exemplary at the Satellite Observing System Wettzell

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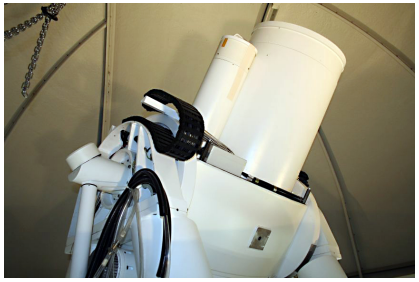
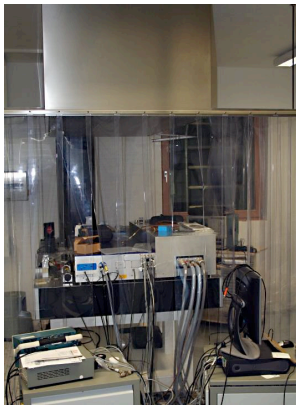
The components



Biaxialtelescope (50cm receive, 16cm send) Carl Zeiss AG Jena

Dome, Baader Planetarium GmbH



1kHz **Ti:SAP Laser**: 850nm / 425nm (IR / blue), HighQ Laser and Thales

Data-centers

tabase (Dell Power Edge)

Controlsystem (Industry PC)

Con
rece
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tor

Sensicam, webcams and video cams

Systemmonitoring (Boxer-PC, serial modules, SPS)

Eventtimer (1.2ps resolution)

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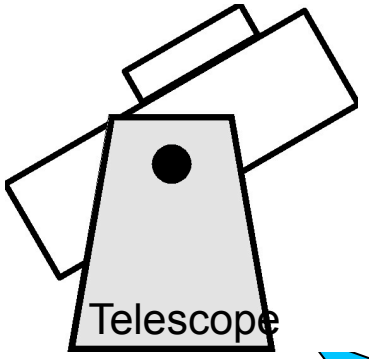
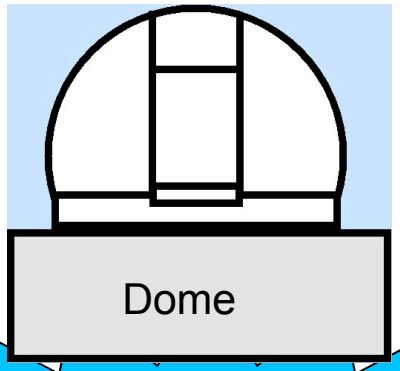
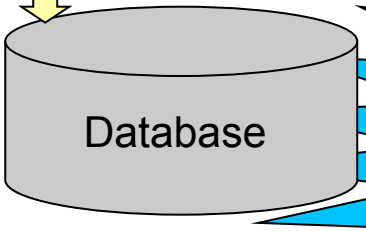
General view onto the different devices



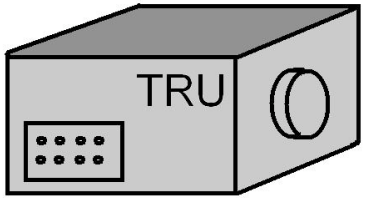



Laser

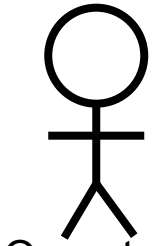
Data-centers



Controlsystem

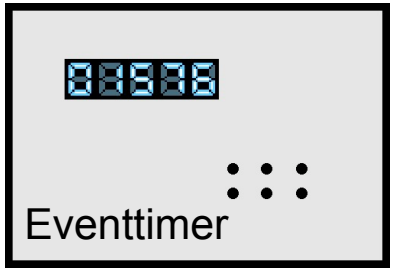


Receiver


Operator

Cameras


Monitoring



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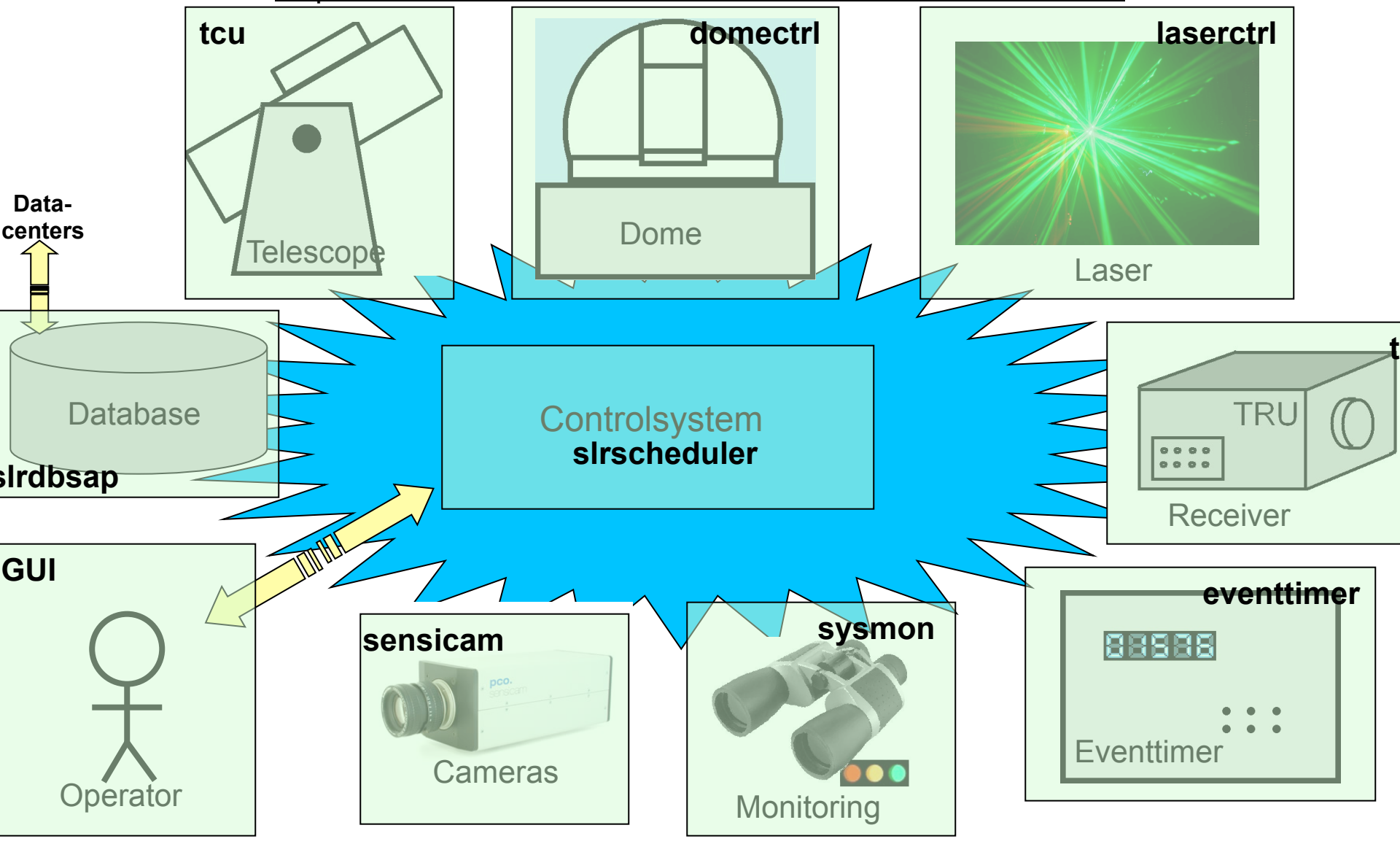
Representation of the different devices with software modules



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Communication platform to connect the software modules (spatial separation)

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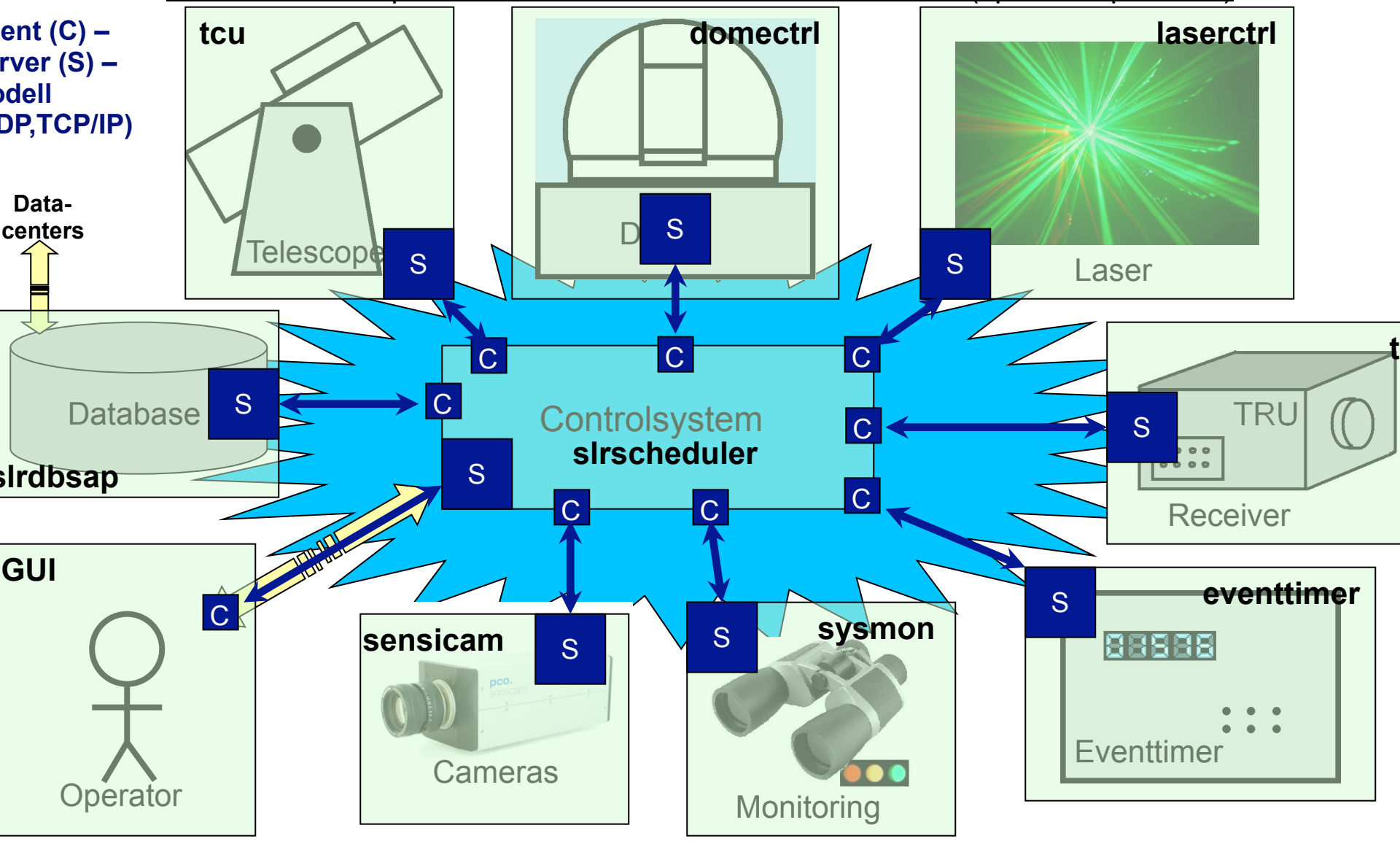
odell
DP,TCP/IP)



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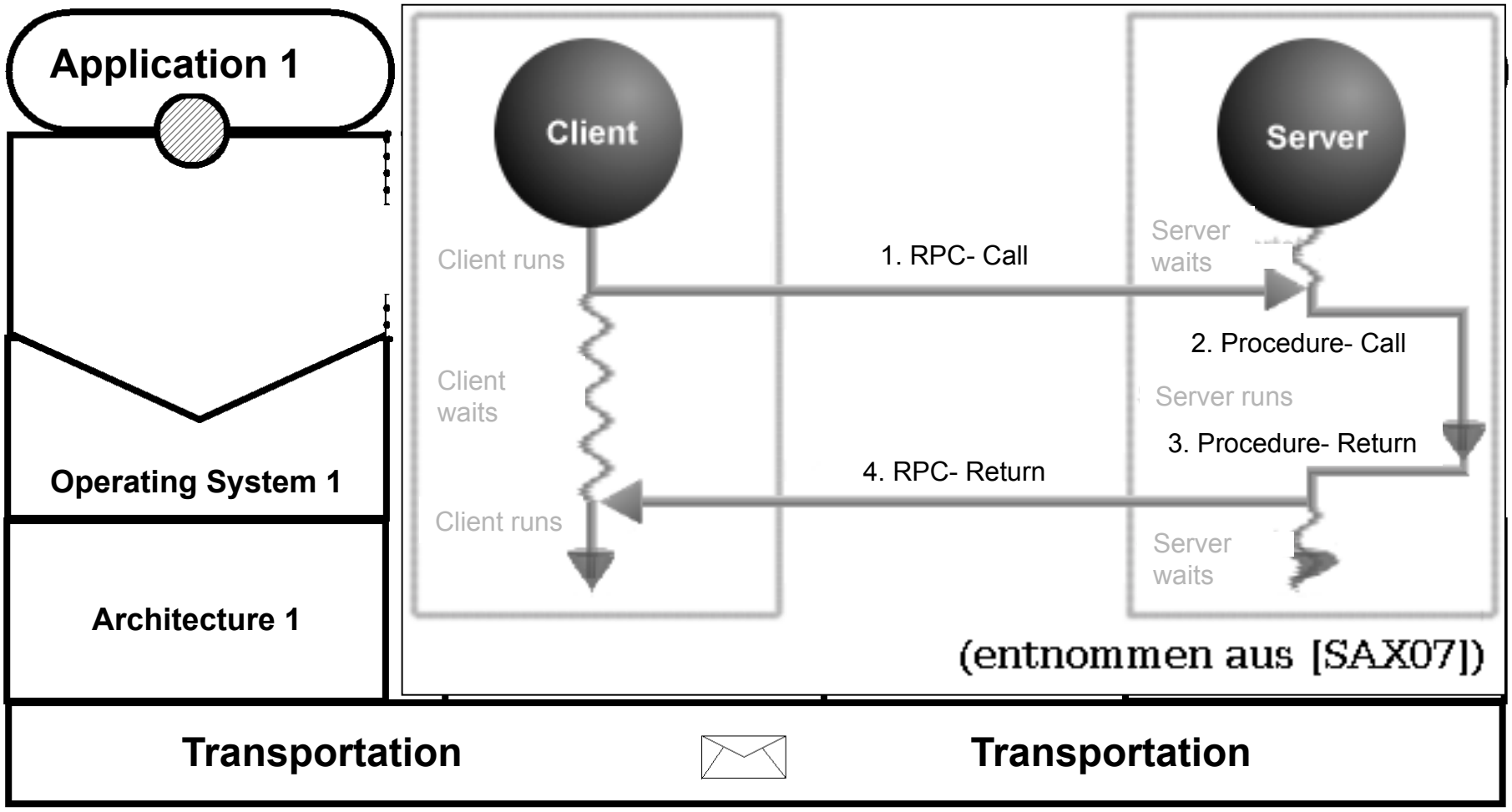
Middleware as communication platform



(nach [PUD01] a.a.O. S. 25)

Saxonia Systems: Remote Procedure Call, http://www.linuxfibel.de/rpc.htm, Download 23.04.2007
Puder, Arno; Römer, Kay: Middleware für vereteilte Systeme, 1.Auflage, dpunkt.verlag GmbH Heidelberg 2001

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Middleware-generator “idl2rpc” to simplify the programmin

stmain.c

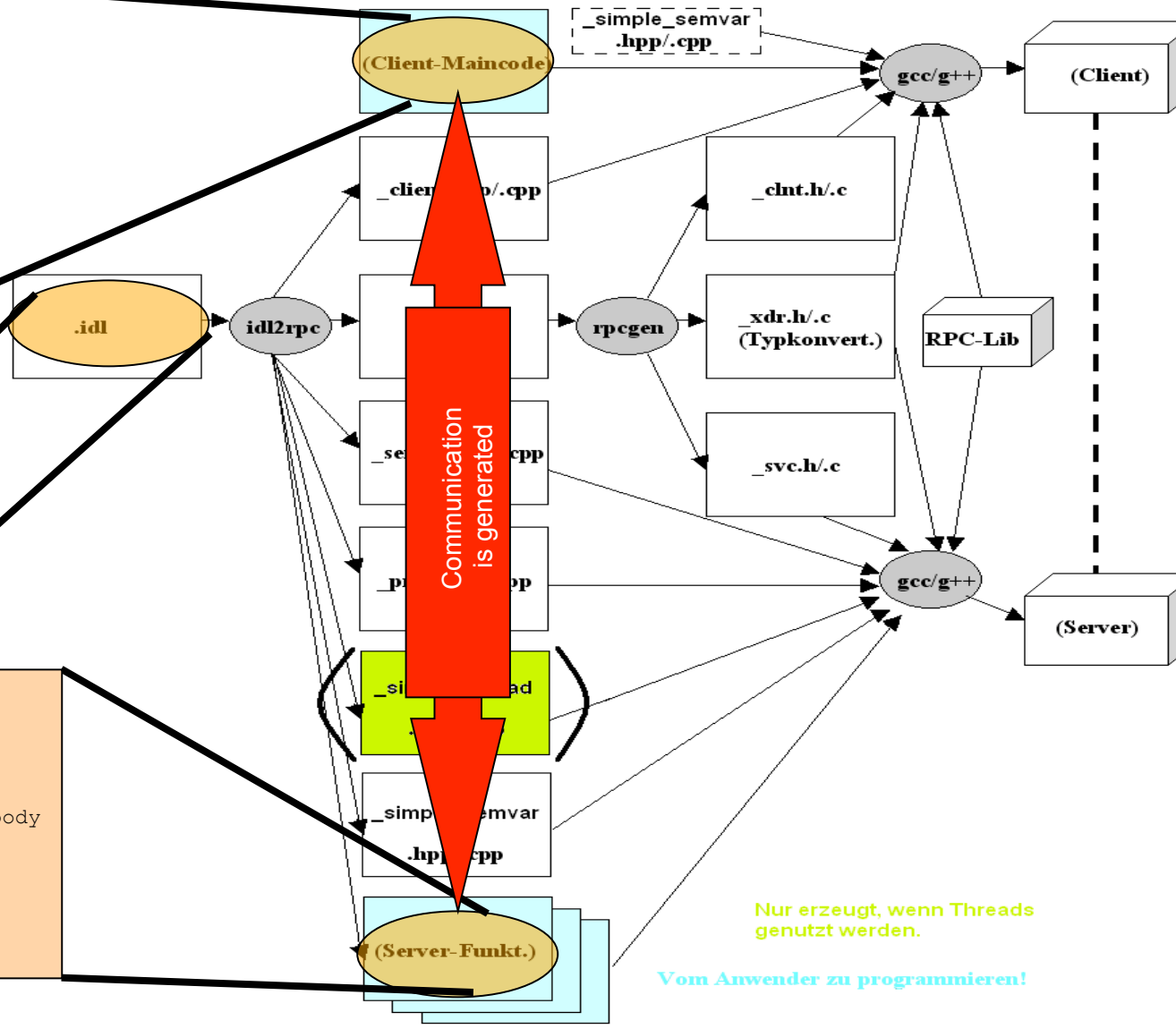
```
nclude „test_client.hpp“

t main ()

 test_client CClient(127.0.0.1);
 ...
 iError = CClient.iGetTemp (fTemp);
 std::cout << fTemp << std::endl;
 ...
```

est.idl

```
nterface test

   int iGetTemp (out float fTemp);
;
```

est_server.cpp

```
.
nt test_server::iGetTemp (float & fTemp)
            throw (test_interface_throw)

// USERDEFMETHODEBEG: Userdefined methode body
    ...  Temperature request and return ...
    return OK;
// USERDEFMETHODEEND

..
```



Interface description – middleware generator

Middleware-generator to simplify the programming: interface definition example

```
const MYCONST1 = 0;
const MYCONST2 = 0x3333;
const MYCONST3 = 12345;
const MYCONST4 = "Hallo";
const MYCONST6 = MYCONST1;

typedef struct {
char cVar1;
char cVar2;
char cVar3;
char cVar4;
} MYTYPE;

typedef struct {
unsigned int iVar1;
int iVar2;
MYTYPE SVar3;
} MYTYPE_COMBINATION;
```

```
interface test
{
// This is a comment
void vFunc ();
int iGet ();
unsigned int uiGet ();
void vSet (in int iVal);
void vSetUnsigned (in unsigned int iVal);
void vGet (out int iVal);
void vSetAndGet (inout int iVal);
void vSetString (in string strText);
void vGetString (out string strText);
void vSetAndGetString (inout string strText);
void vSetMulti (in int iVal, in string strText);
void vGetMulti (out int iVal, out string strText);
void vSetAndGetMulti (inout int iVal, inout string strText);
void vSetArray (in unsigned int Array <>);
void vGetArray (out unsigned int Array <>);
void vSetAndGetArray (inout unsigned int Array <>);
void vSetMultiArray (in unsigned int Array <><><>);
void vGetMultiArray (out unsigned int Array <><><>);
void vSetAndGetMultiArray (inout unsigned int Array <><><>);
};
```

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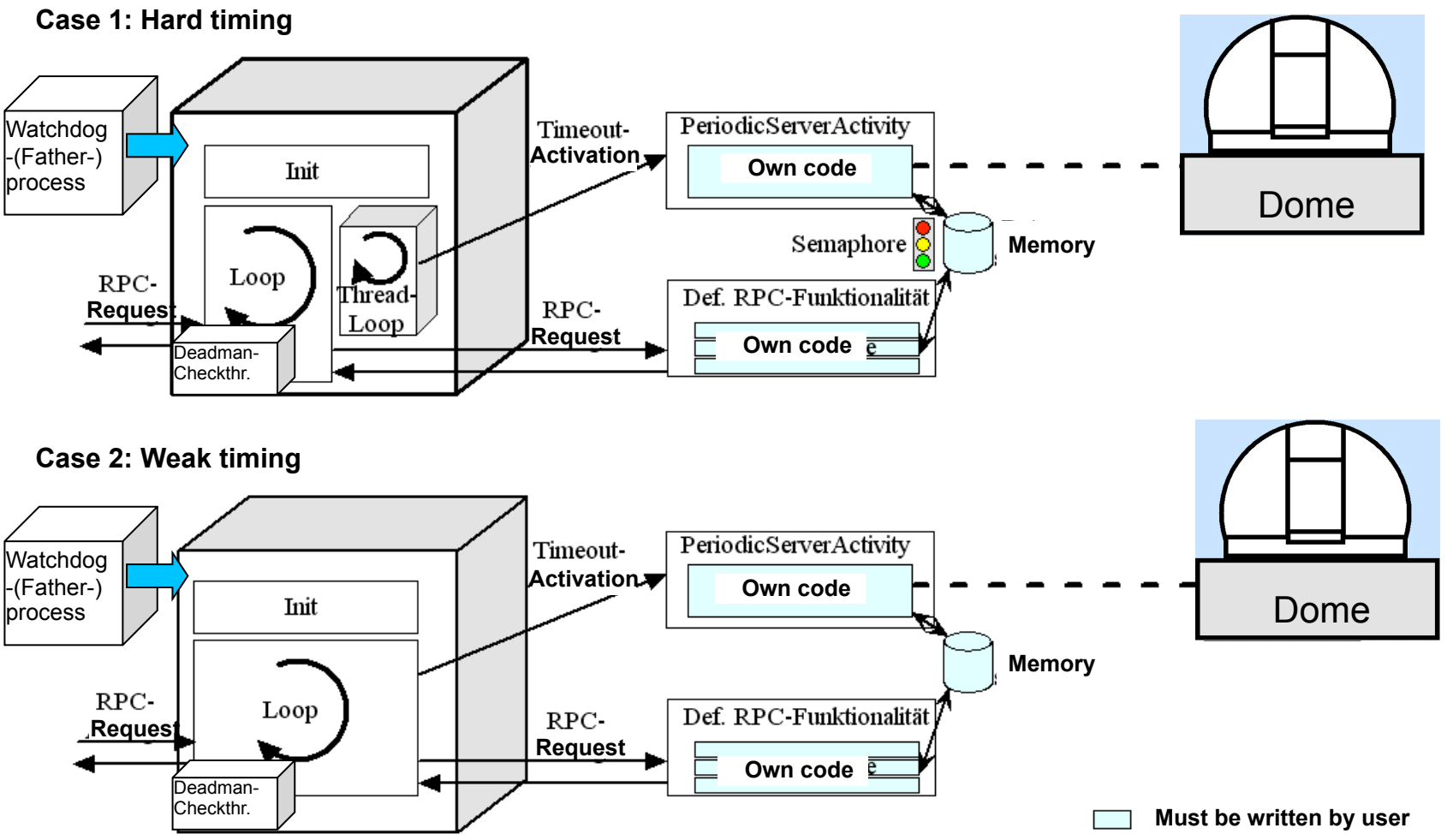
Autonomous process cells on the basis of the middleware-generator “idl2rpc”



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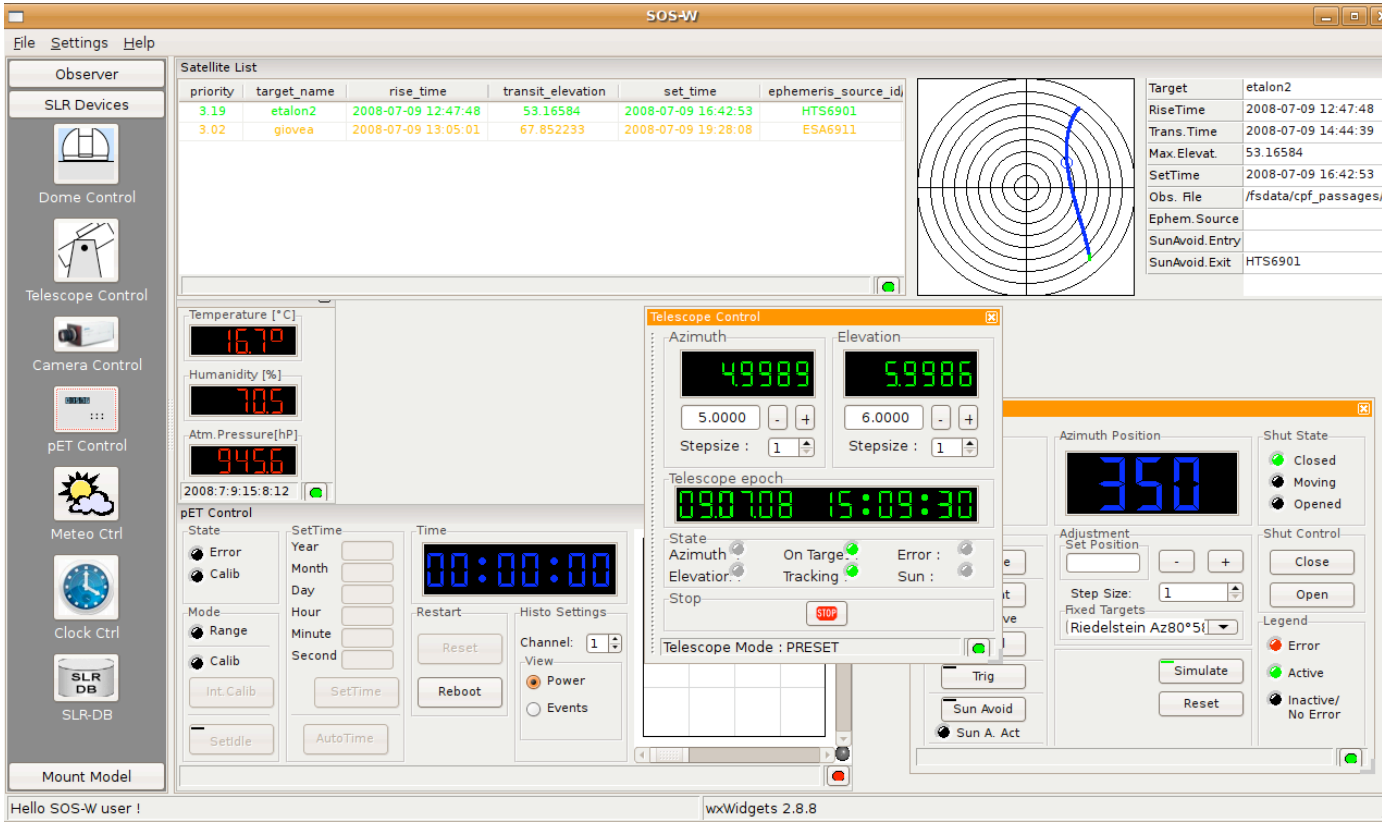
User interaction with graphical user interface

- 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)



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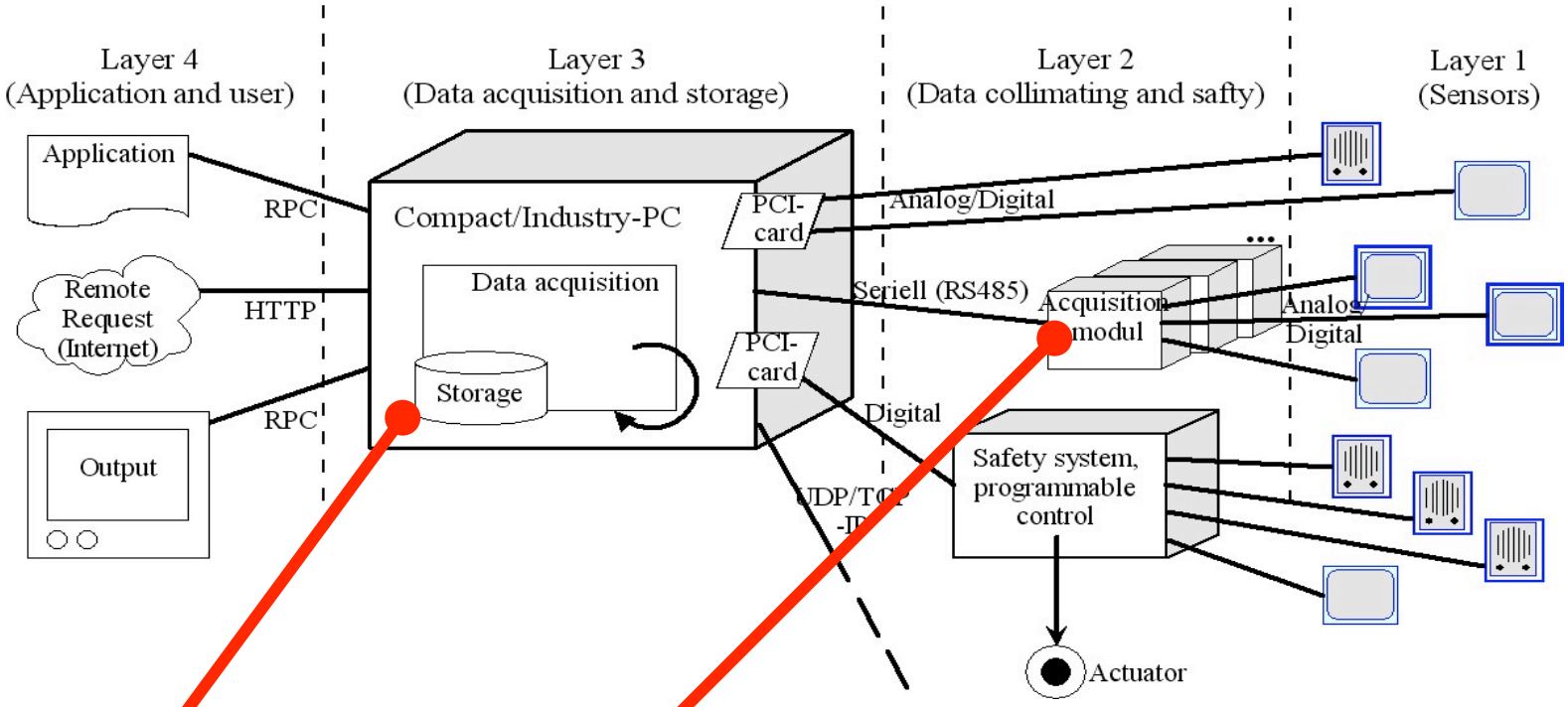
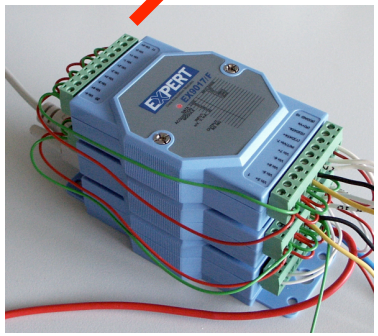
Additional control of the system by system monitoring





- Standard equipment on standard, robust architectures
- Modular, multi-layer system
- Open for several devices and sonsors
- Passive system for monitoring without actuators
- Linux-operating system (maybe minimal installation)
- Open Source
- C/C++
- Communication internal with idl2rpc-generator
- Vendor independence

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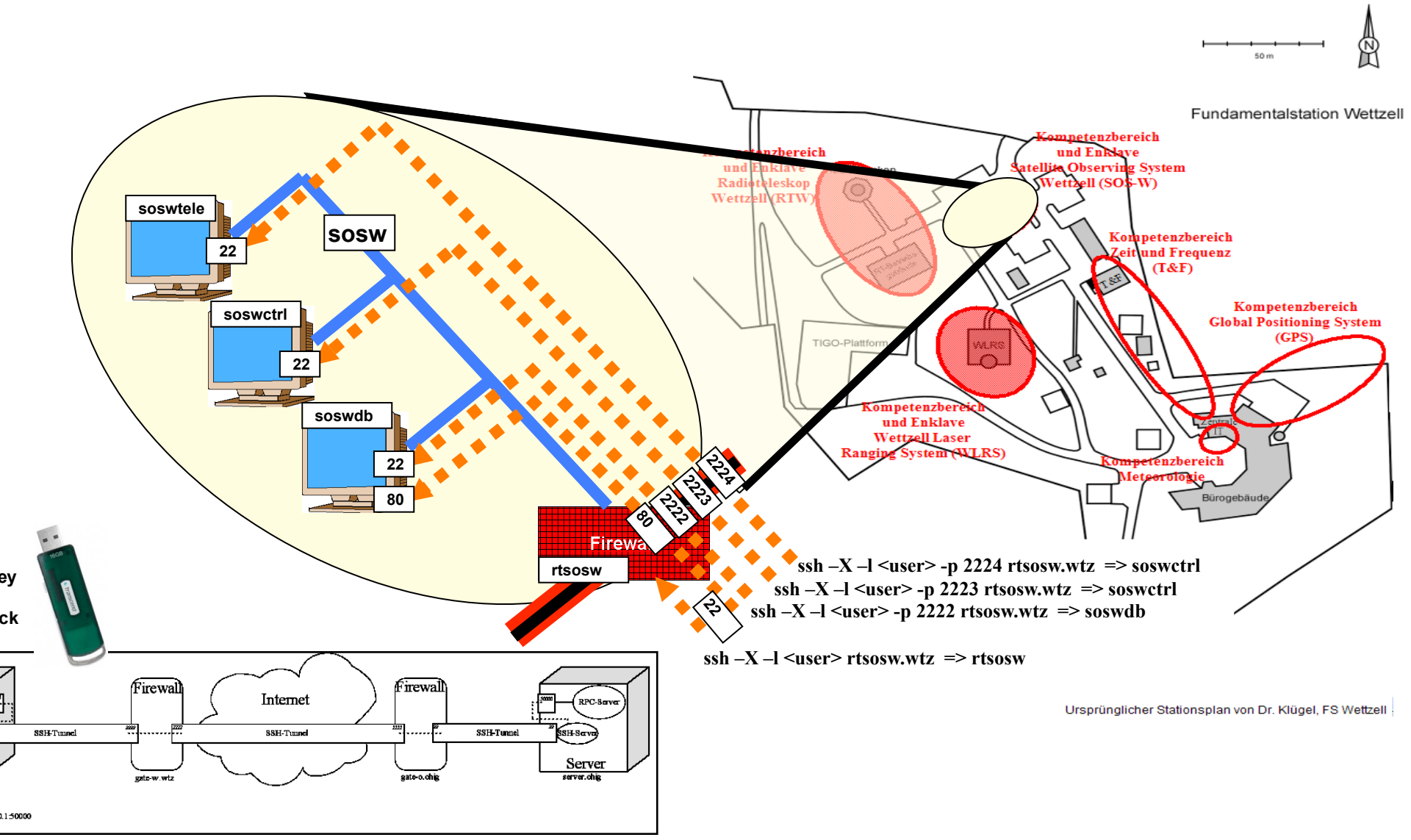
Security by usage of security enclaves



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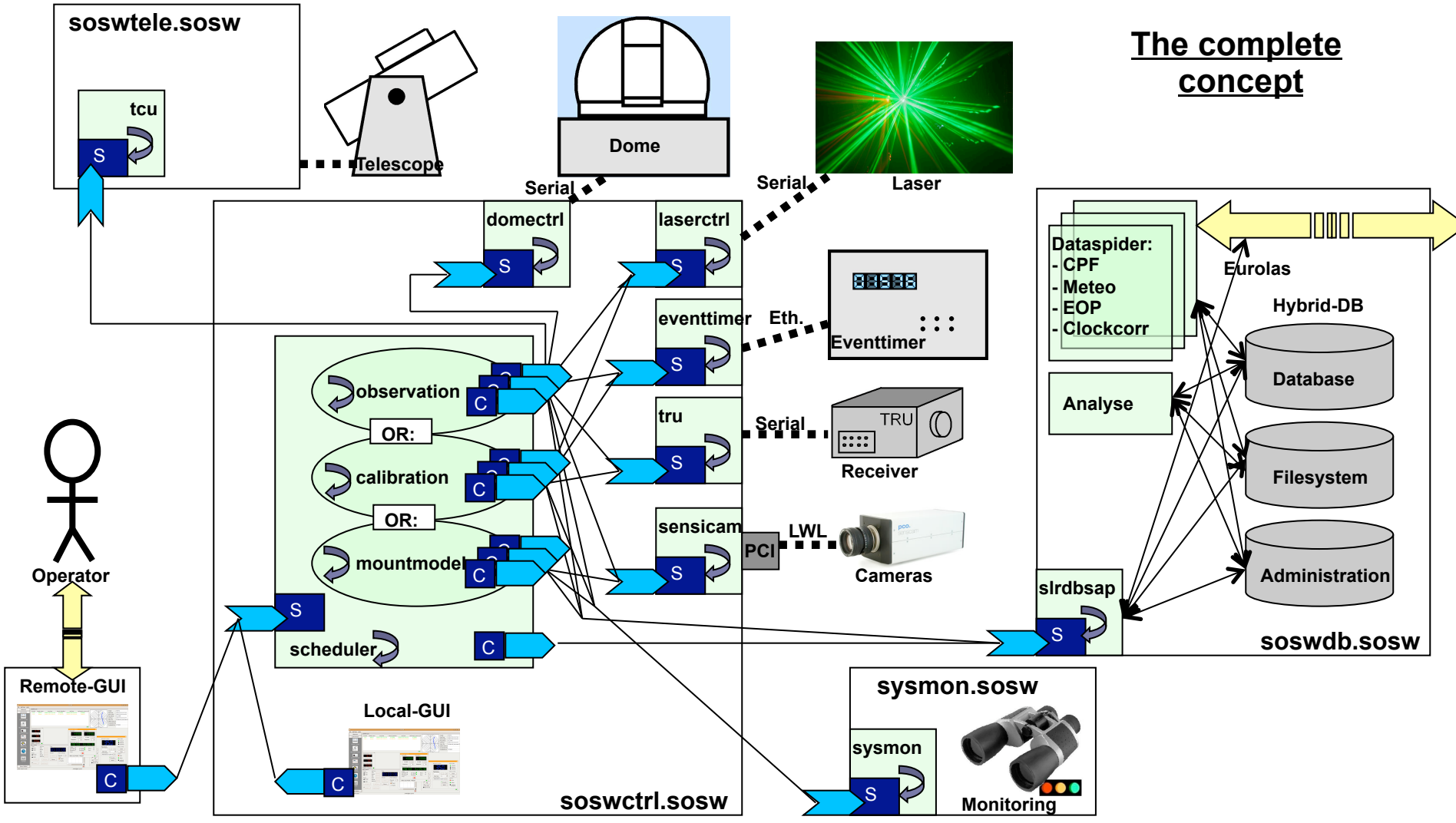
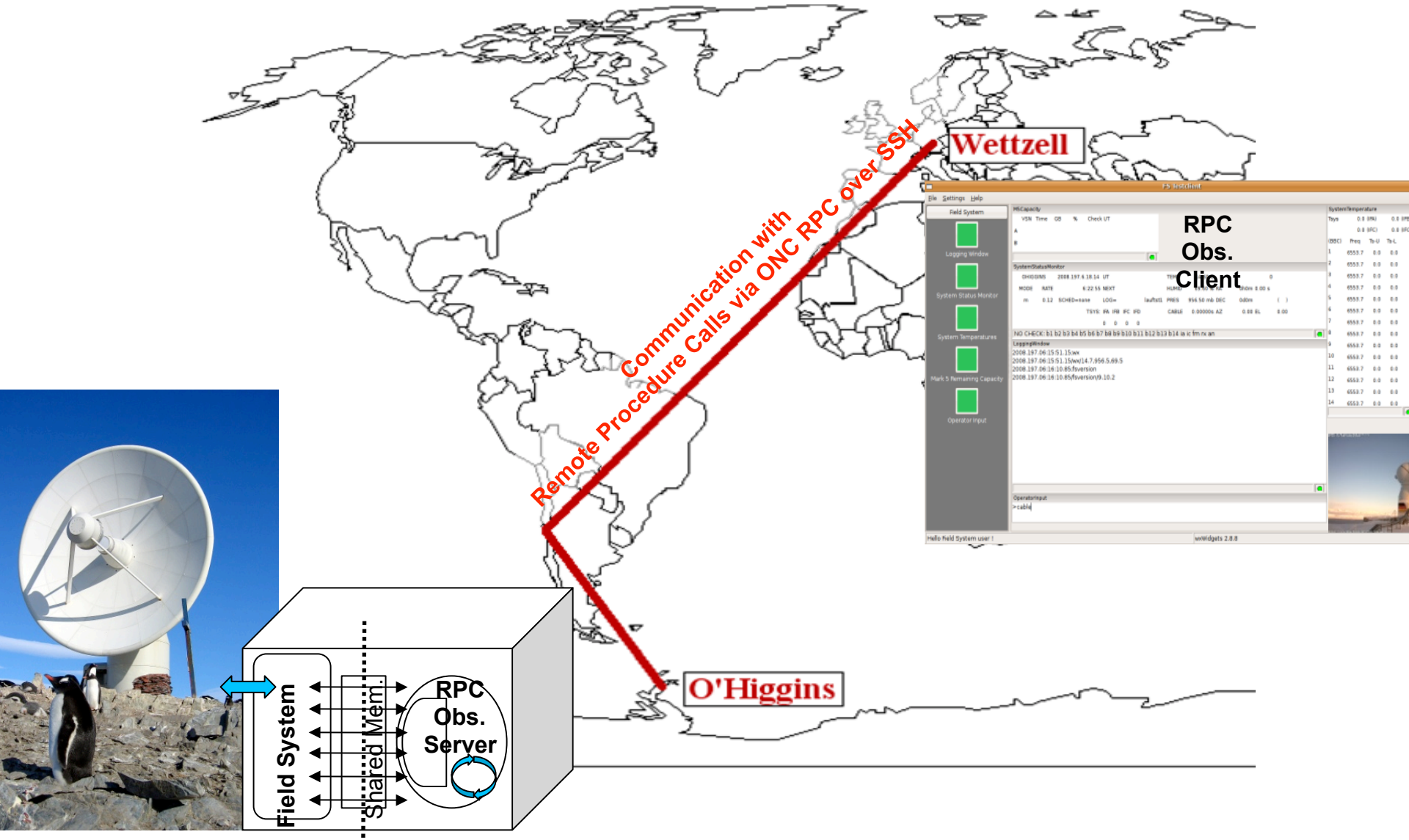


Remote control example with VLBI station GARS O'Higgins

The idea – remote control of VLBI at O'Higgins/Antarctica



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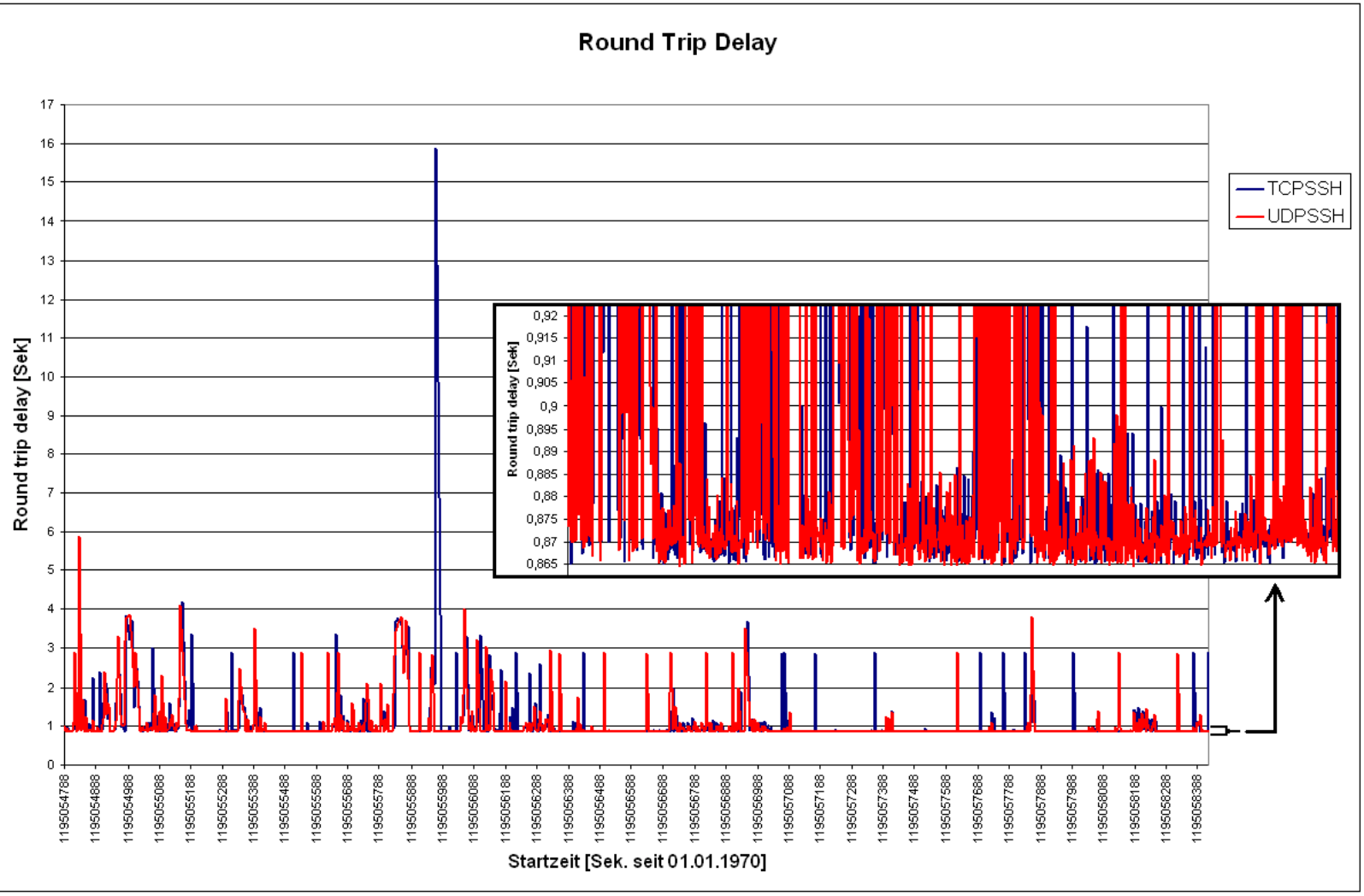

First test during VLBI-campagn 02/2007 (first remote con- trolled experimen is planed for cam pagne 02/2008)

Thank you!