

The most expensive GPS-antenna
installation ever?

Testing multiple GSM-R-rings deep inside
a mountain

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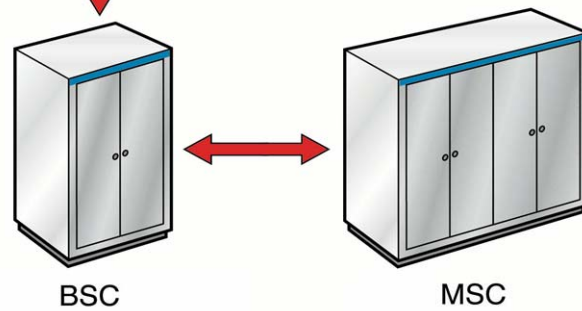
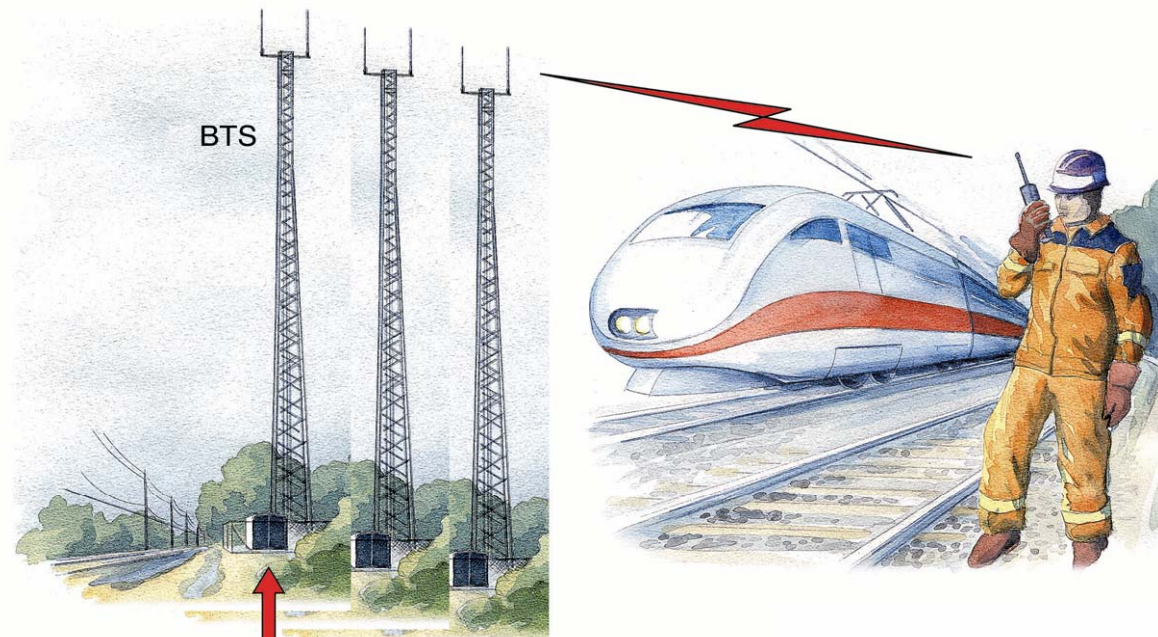


BANVERKET

- **The Swedish National Rail Administration**
(Swedish railway authority)
- **Infrastructure owner**
(We don't run any train services.)
- **11 700 km of railway**
- **Telecom operator as well**
 - GSM-R: 1,100 sites
 - Fibre optic network: 12,000 km
 - Intra phone network: 90 switches
- **Third largest land mass in Europe!**



MobiSIR - system



GSM-R Infrastructure

1 MSC

11 BSC

ca 1,100 BTS

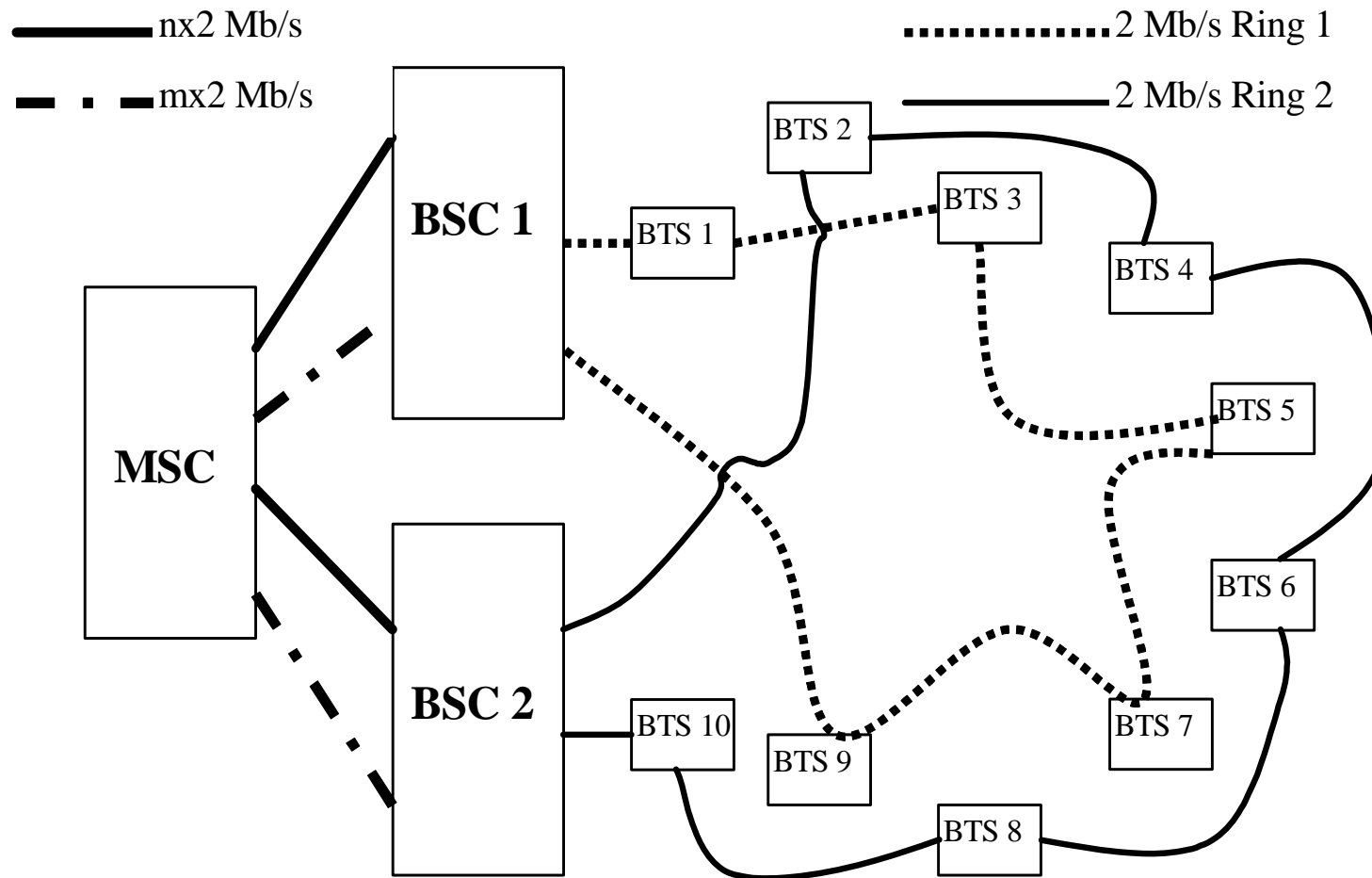
GSM-R or MobiSIR

- Frequency is 876-880 Mhz for the uplink and 921-925 for the downlink
- Roaming to public 900 MHz is designed and possible
- Voice group calls
- Voice broadcast services
- Location dependent addressing
- Functional addressing ("follow me")
- Enhanced Multi-level Precedence and Preemption

Designed for high availability and reliability

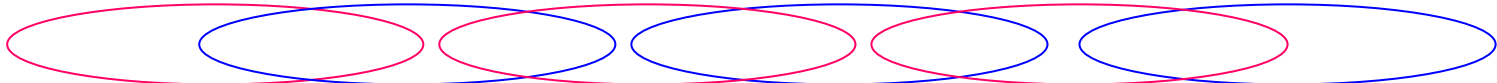
- Central system located inside a mountain
- The hardware in the central systems is fully redundant
- The transmission system is fully redundant
- Multiple transmitters in the BTS's
- Multiple antenna systems at each site
- Central system availability is 99,998%
- BTS availability target is 99,8 %
- Centralised surveillance

2 BTS-rings for redundancy on 1 railwaytrack

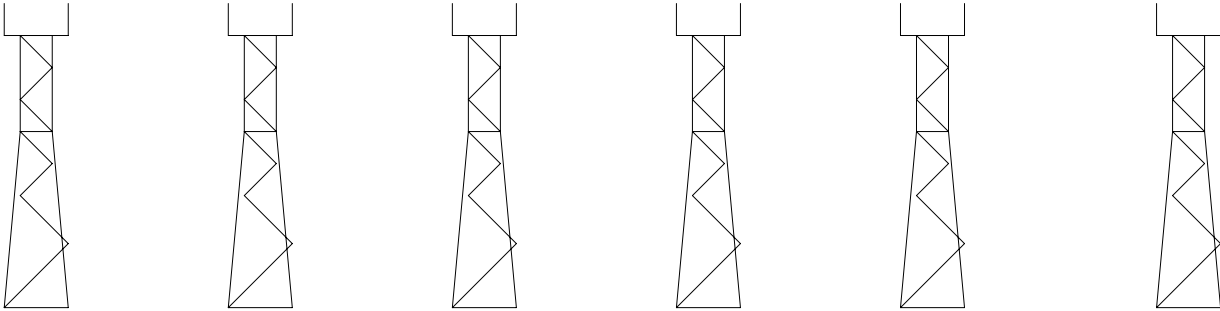
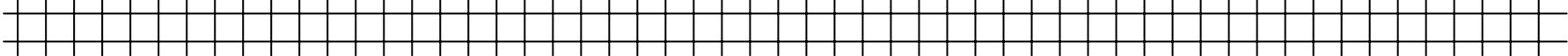


MobiSIR

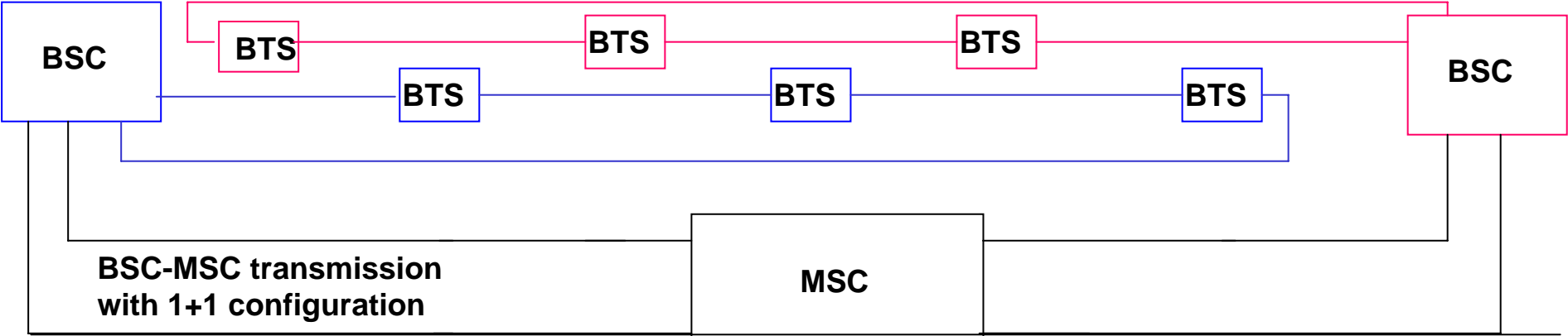
Radio Coverage



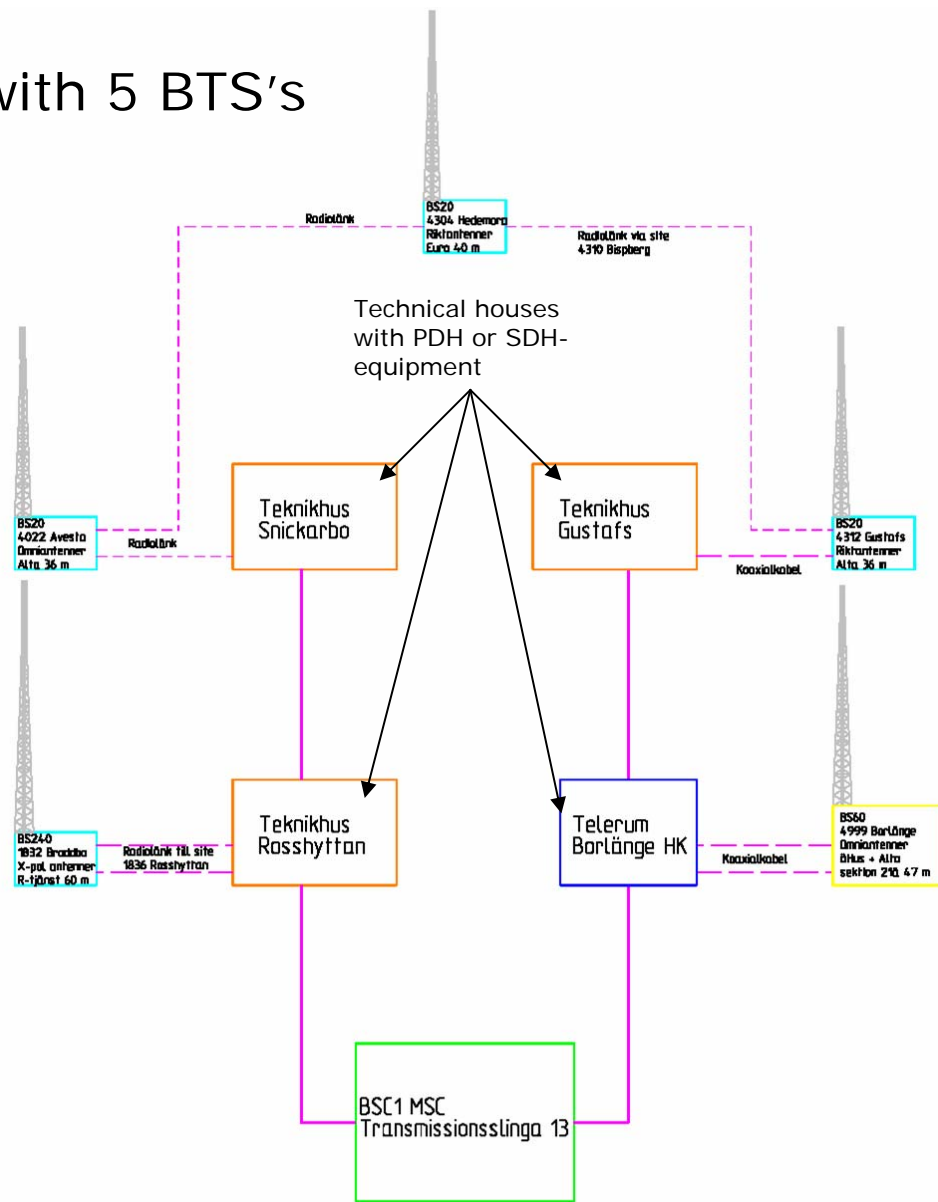
Optical cable
Coppercable



Loop configuration for BTS-BSC communication



GSM-R-ring with 5 BTS's



Pendulum WM-11 Wandermeter



- Built-in Rubidium reference
- One channel measurement at a time
- Portable and runs on both 230 VAC or 48 VDC
- Good for on-site faultfinding
- For longer observation times, connection to a PC is recommended

SyncWatch

GPS Antenna
Optional

GSM Antenna
Optional



Measure In

Ref In

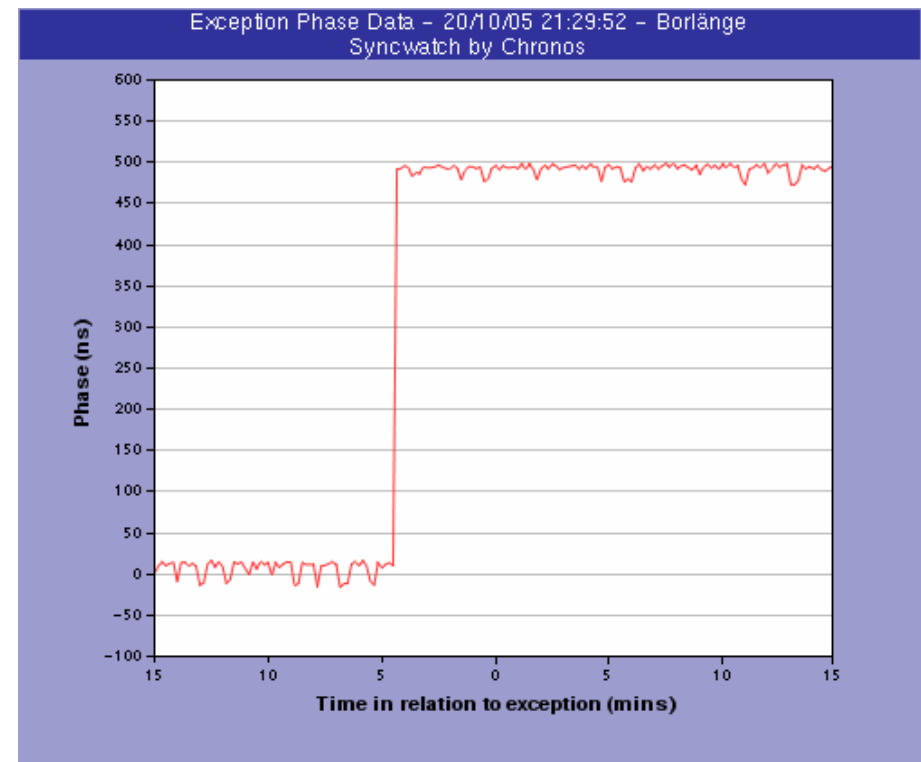
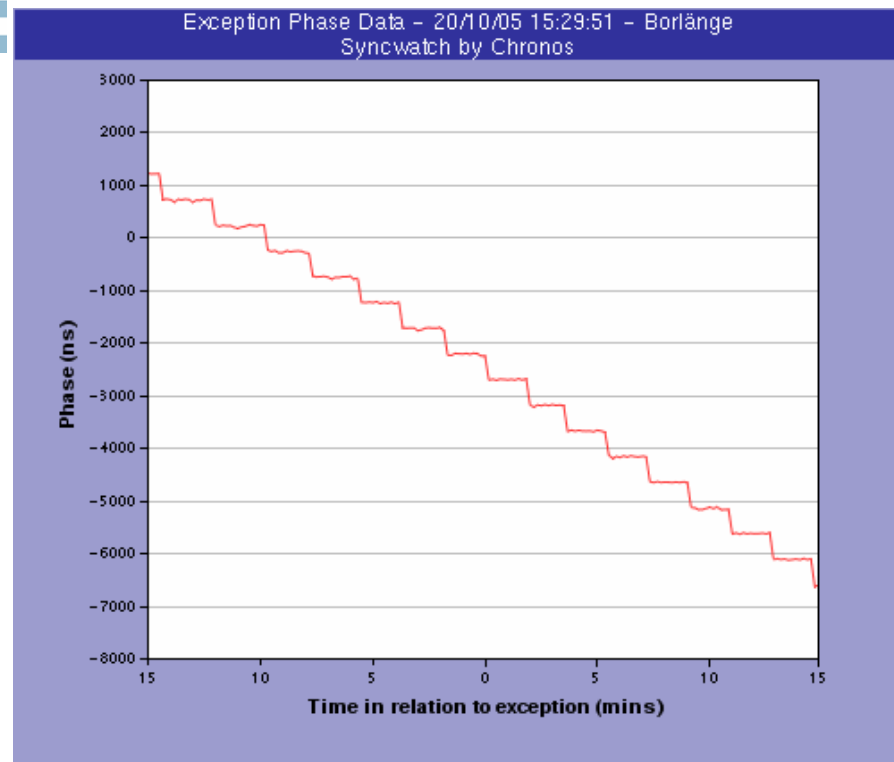
Aux Out

10/100 Base T
LAN

Alarm
Relay

Power

Problems experienced in GSM rings.



The SSU that's now a multi-channel sync. Tester!

Fully manageable
Synchronization
Supply Unit

Up to 160 outputs

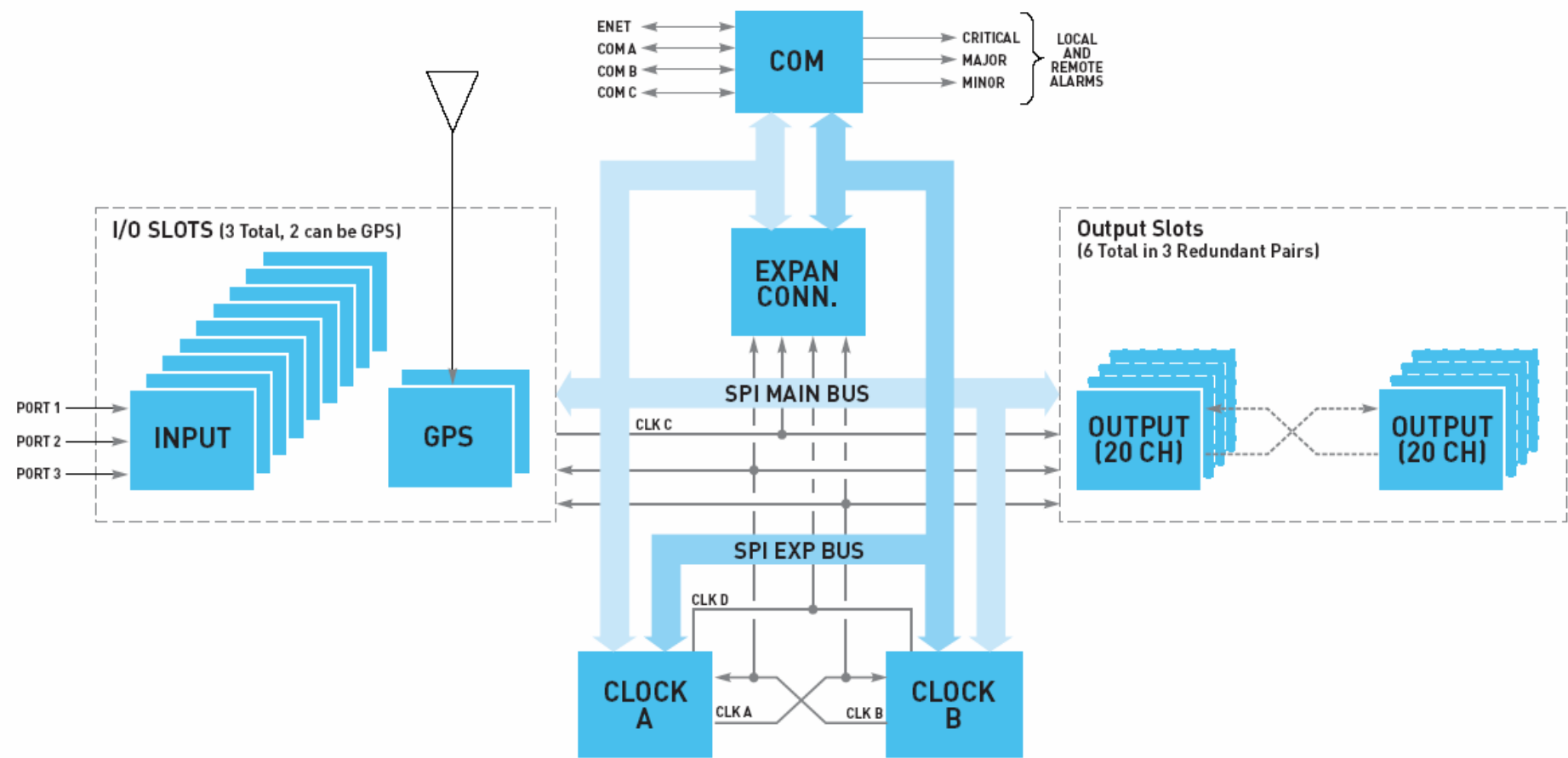
Single or dual GPS
modules t

Superior holdover
performance

We uses no output
cards only 6 input
cards you could call it
a SMU or Sync
Monitoring Unit



The SSU-2000 is a very flexible platform



The SSU-2000 is mounted in a transport case.



The SSU-2000 connectors at the rear of the unit



The view of the SSU-2000 in theSynCraft software

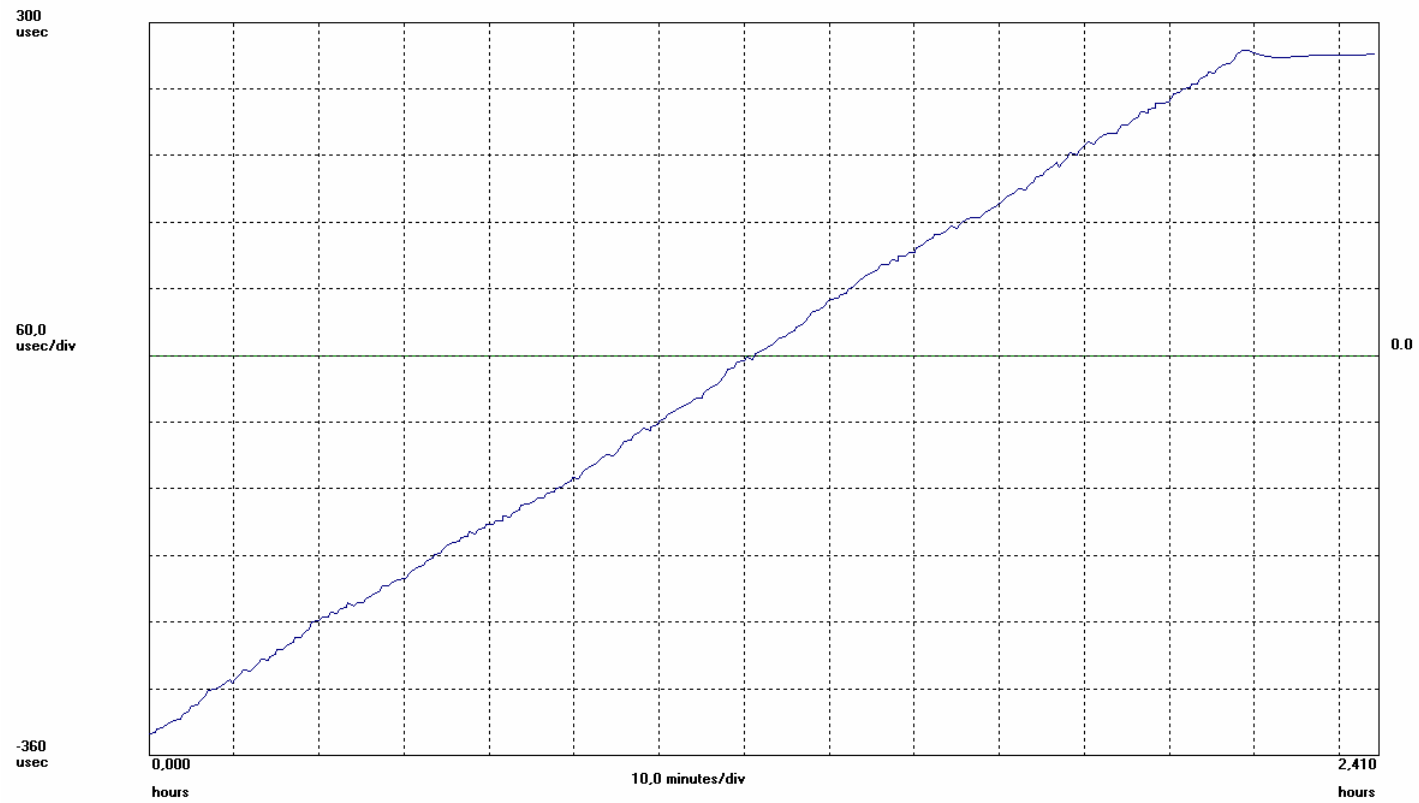
The screenshot displays the SynCraft software interface for a 'Blg Portabla SSU-2000'. The main window is titled 'Physical View: Main Shelf' and shows a detailed diagram of the hardware components. The diagram includes a 'Type 1 Clock' module, a 'Communications' section with 'LOCAL SERIAL PORT' and 'GTE' labels, and six 'E1 Input (3 Port)' modules. Each module has various status indicators such as 'POWER', 'STATUS', and 'PORT 1', 'PORT 2', 'PORT 3'. The status bar at the bottom indicates 'System: SSU_2000', 'Reference: REFURNS', 'Clock: CLK-A', and 'Status: CRITICAL'. A log window at the bottom right shows several system events.

Ready System: SSU_2000 Reference: REFURNS Clock: CLK-A Status: CRITICAL

```
SSU_2000 07-09-12 12:14:21 692 COMPLD
SSU_2000 07-09-12 12:14:21 EVT
RTRY-PRMTR-PBO:SSU_2000:693;
SSU_2000 07-09-12 12:14:23 693 COMPLD
SSU_2000 07-09-12 12:14:23 EVT
SSU_2000 07-09-12 12:14:25 EVT
SSU_2000 07-09-12 12:14:27 EVT
RTRY-PRMTR-PBO:SSU_2000:694;
SSU_2000 07-09-12 12:14:29 694 COMPLD
RTRY-PRMTR-PBO:SSU_2000:695;
SSU_2000 07-09-12 12:14:33 695 COMPLD
```

2-Mb/s-trib after a soft reset of a SDH-node

Symmetricom TimeMonitor Analyzer
Phase deviation in units of time: $F_s=566,1$ MHz; $F_0=2,0480000$ MHz; 2007-10-22 12:28:08
SSU-2000; SSU_2000 S1A08-03 CLK-A PHA; Samples: 4916



What problems have we found?

- Faulty oscillator cards in BTS's (a total of 200)
- Mis configured xDSL modems (line timing vs transparent timing)
- SDH elements timing the E1-output cards faulty
- SDH elements squelching outputs when rings re-configure
- BSC not providing revertive switching as required
- BTS's turned the wrong way
- Return current from the track circuit current disturbing the E1-lines to the BTS's

The most expensive GPS-antenna installation ever?



Basic GPS-antenna cable installation tool



De luxe GPS-antenna cable installation tool



The new “easy-entry” cover on the cable jointing chamber and the remains of the old “civil defence”-type in the background



The remains of the old cable ducting





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