

Attacking BaseStations

Hendrik Schmidt <hschmidt@ernw.de> / @hendrks_
Brian Butterly <bbutterly@ernw.de> / @BadgeWizard

ERNW
providing security.

Who we are

- Old-school network geeks,
  working as security researchers for
- Germany based ERNW GmbH
  - Independent
  - Deep technical knowledge
  - Structured (assessment) approach
  - Business reasonable recommendations
  - We understand corporate

- Blog: *www.insinuator.net*

- Conference: *www.troopers.de*

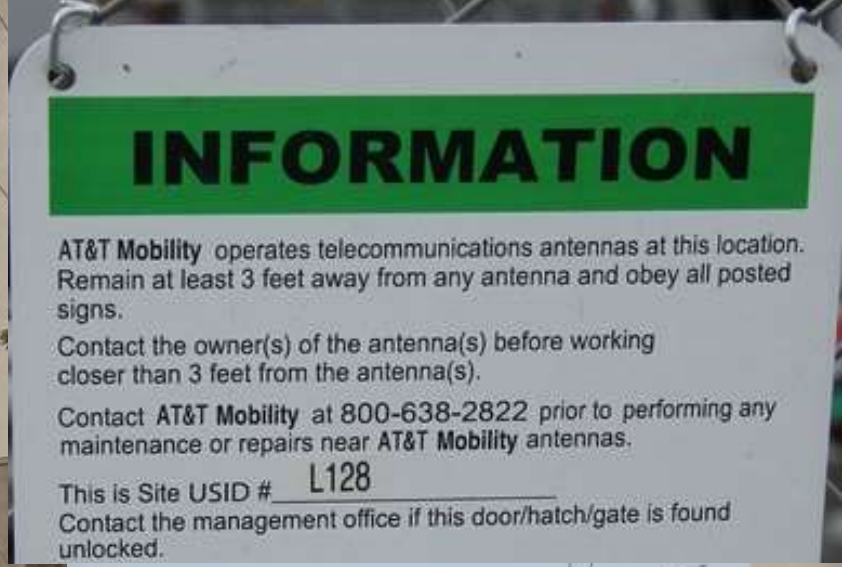


Motivation

- The 4G standard introduces a lot of new technologies providing modern services to the customer.
  - This includes features as VoLTE, *SON*, …….Trust and optional controls
- BaseStations are the big (and small) antennas in the field
- With our research we want to bring visibility to
  - How the environment works
  - What providers do
  - What vendors do




NO
TRESPASSING
NRS 207.200

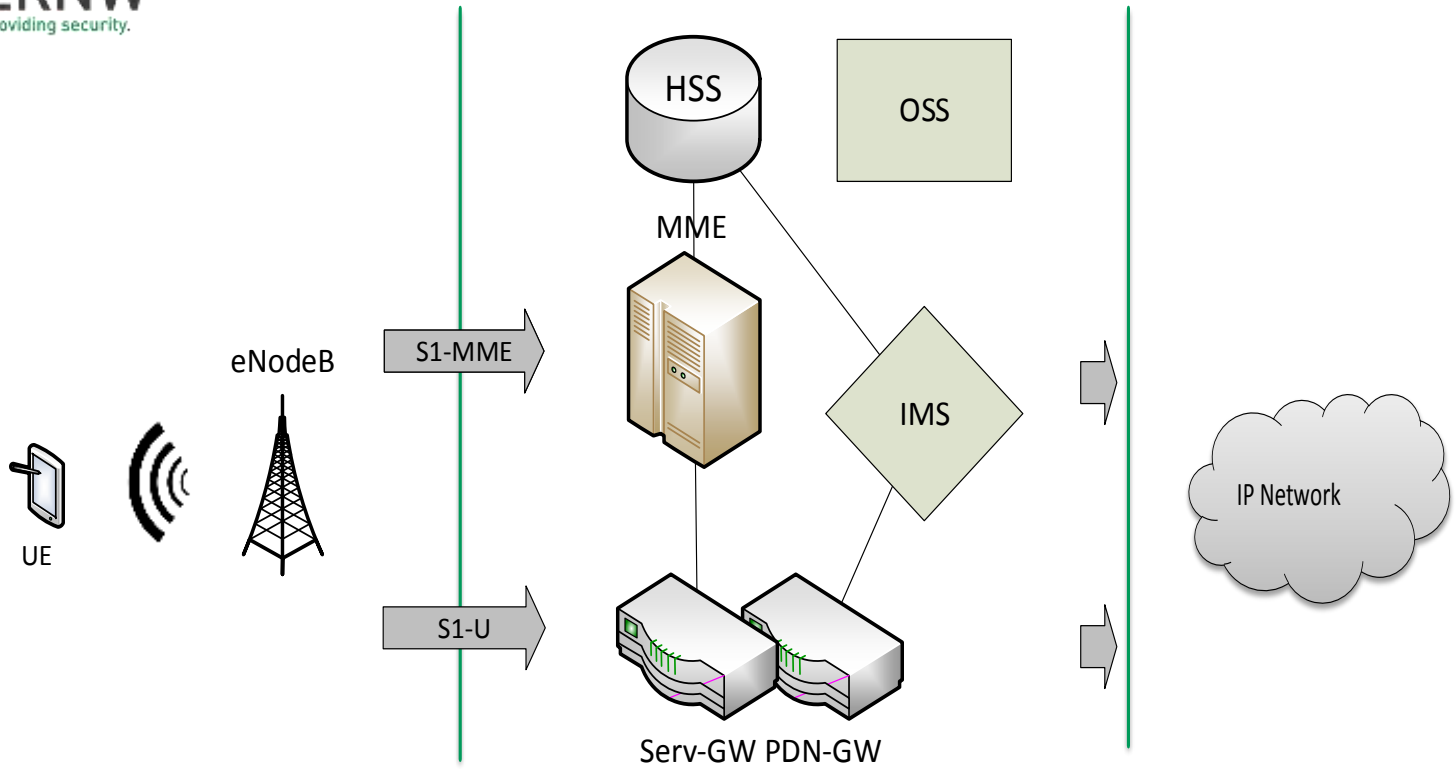

INFORMATION
AT&T Mobility operates telecommunications antennas at this location. Remain at least 3 feet away from any antenna and obey all posted signs.
Contact the owner(s) of the antenna(s) before working closer than 3 feet from the antenna(s).
Contact AT&T Mobility at 800-638-2822 prior to performing any maintenance or repairs near AT&T Mobility antennas.
This is Site USID # L128
Contact the management office if this door/hatch/gate is found unlocked.





Introduction

A 4G/LTE Telecommunication Network



eUTRAN

4G Core

ERNW
providing security.

Typical Environment?

Source:
worldlte.blogspot.com



ERNW
providing security.

Typical Environment?





ERNW
providing security.

The Idea

1. **Understand** BaseStation Setup
2. **Purchase** an old BaseStation out of the field
3. Get BS running in an **emulated environment**
4. Perform an evaluation of **configuration & security**



What we need:
Basestation Physical Setup

- Base Band Unit (BBU)
  - Usually standing on the ground
  - Including Power Distribution Unit (PDU) and Power Supply Unit (PSU)
- Remote Radio Head/Unit (RRH/RRU)
  - May be placed on the cell mast or on the ground
- Antenna
  - Come in various shapes and sizes
  - Nowadays often vector antennas

- All active parts are interconnected
  - BBU, RRU, sensors, power supply, vents



ERNW
providing security.

Power Supply

- Components run on -48V
  - Not +-48V (96V differential)
  - Basically just 48V connected the other way round

RRU

- Basically receives raw RF signals via Fiber and sends them out via Copper
  - Towards the antenna
- Usually capable of serving a specific frequency band

Most important Unit: the BBU

- Frame for holding power unit and **functional blades**
- Sometimes have a backplane for interconnection between components
  - Arbitrary PCB connectors
  - Multiple interfaces (LAN, UART, Arbitrary, CAN)
- Functional blades decide the network type
  - Ericsson: DUL/DUW/DUG -> Digitial Unit LTE/WCDMA/GSM
- Slots for multiple blades
  - Single BBU could serve GSM and WCDMA
  - Depends highly on specific BBU and blade combination
- Single blade can serve multiple cells
  - Using sector antennas a single mast could i.e. serve 4 cells in 4 different directions

ERNW
providing security.

Variants of an eNodeB

- Come in different shapes and sizes.
  - Rack, “Small-Boxes“, Portable
- Different types for different size cells.
  - Macro (>100m), Micro (100m), Pico (20-50m), HeNB (10-20m)
  - (WiFi/WiMax)
- Termination Point for Encryption
  - RF channel encryption
  - Backend channel encryption

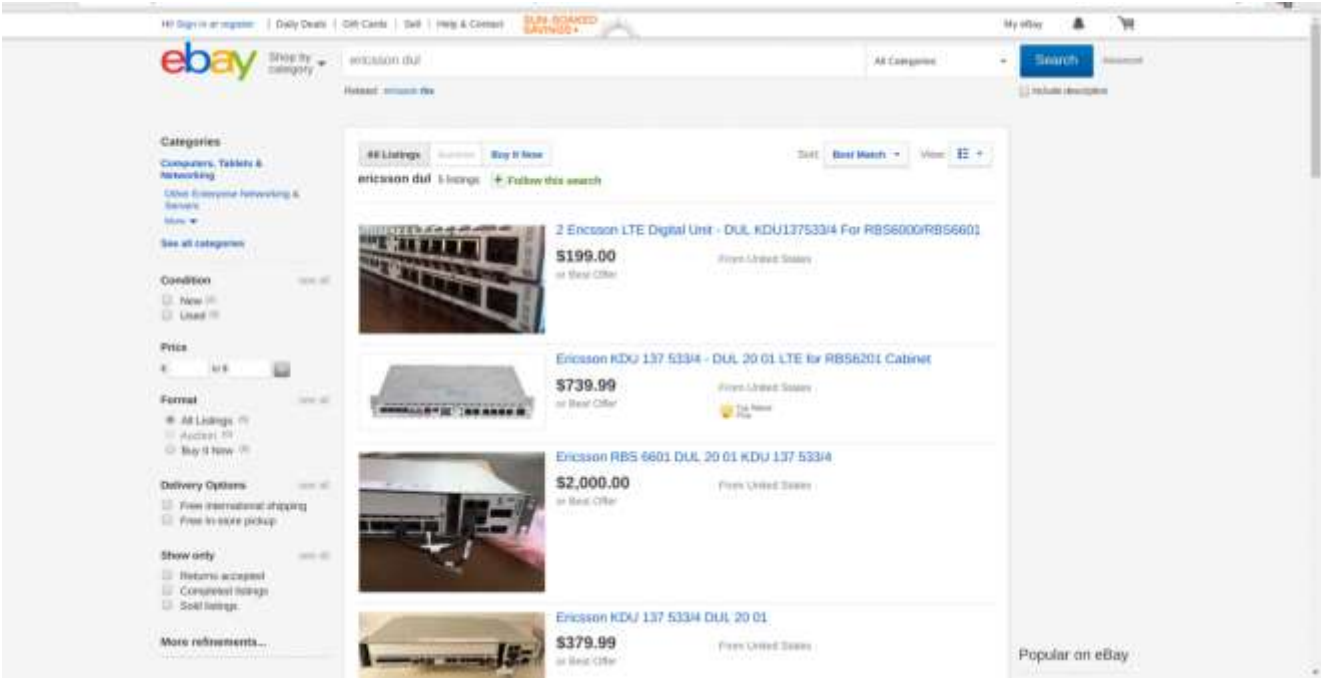




Implementing a Lab

Just a Quick HowTo

ERNW
providing security.



Ebay ☺

Some helpful words:

- Nokia - FlexiBTS
- Huawei – BBU + LMPT/UMPT
- Ericsson – RBS + DUL
- ALU – MBS

Lab Setup – What You Need

- A Basestation
  - The RRU is optional if you just want to play with the BTS itself
- Power Supply
  - -48V ~ 5A will be sufficient
- Power Connectors
  - Good luck ;-)
  - The devices sometimes have strange plugs, so you might need some time to find or make them
- Stack of network cables





ERNW
providing security.

Our Lab ☺

Let‘s start
reconnaissance!

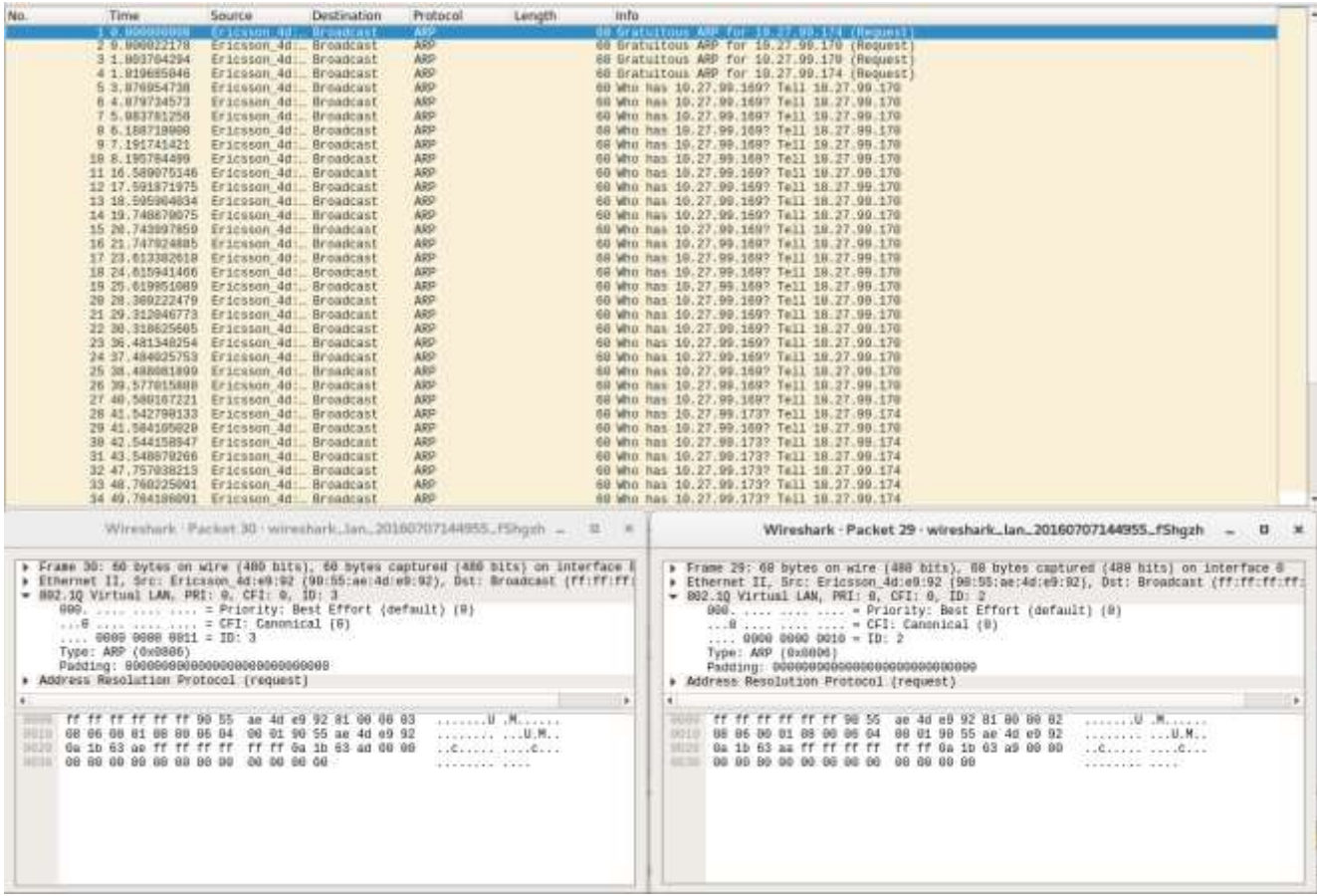


Ericsson RBS6601 - DUL
RJ-45 & Gbic Interfaces

- GPS
  - For timing or positioning (during setup)
- EC
  - Equipment Control
- AUX
  - Auxiliary Bus
- LMT A
  - Local maintenance terminal A
- LMT B
  - Local maintenance terminal B
- TN A
  - Backhaul Access – S1
- IDL
  - Inter-DUL-Link
- TN B
  - Backhaul Access – S1
- A, B, C, D, E, F
  - Interfaces towards RRU

ERNW
providing security.

The First Sniff ☺

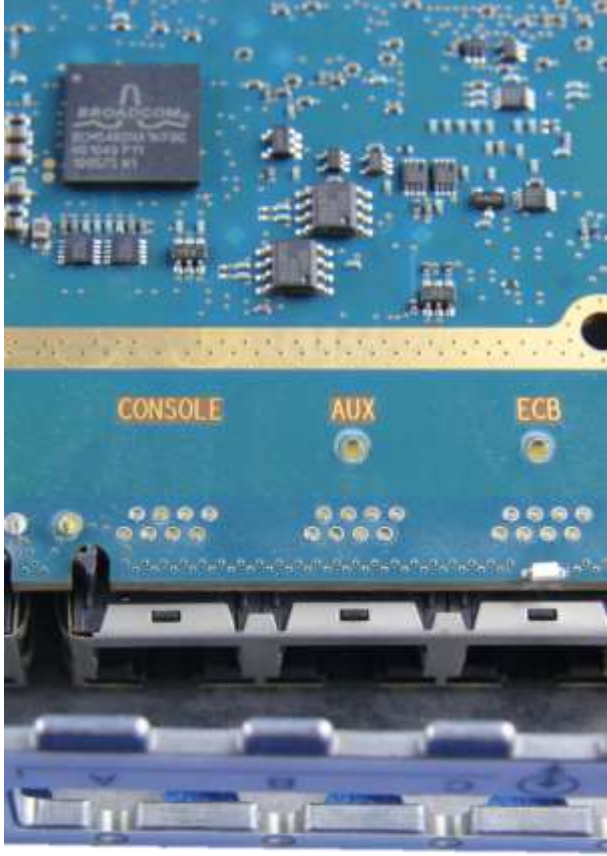


ERNW
providing security.

Let‘s get Started!

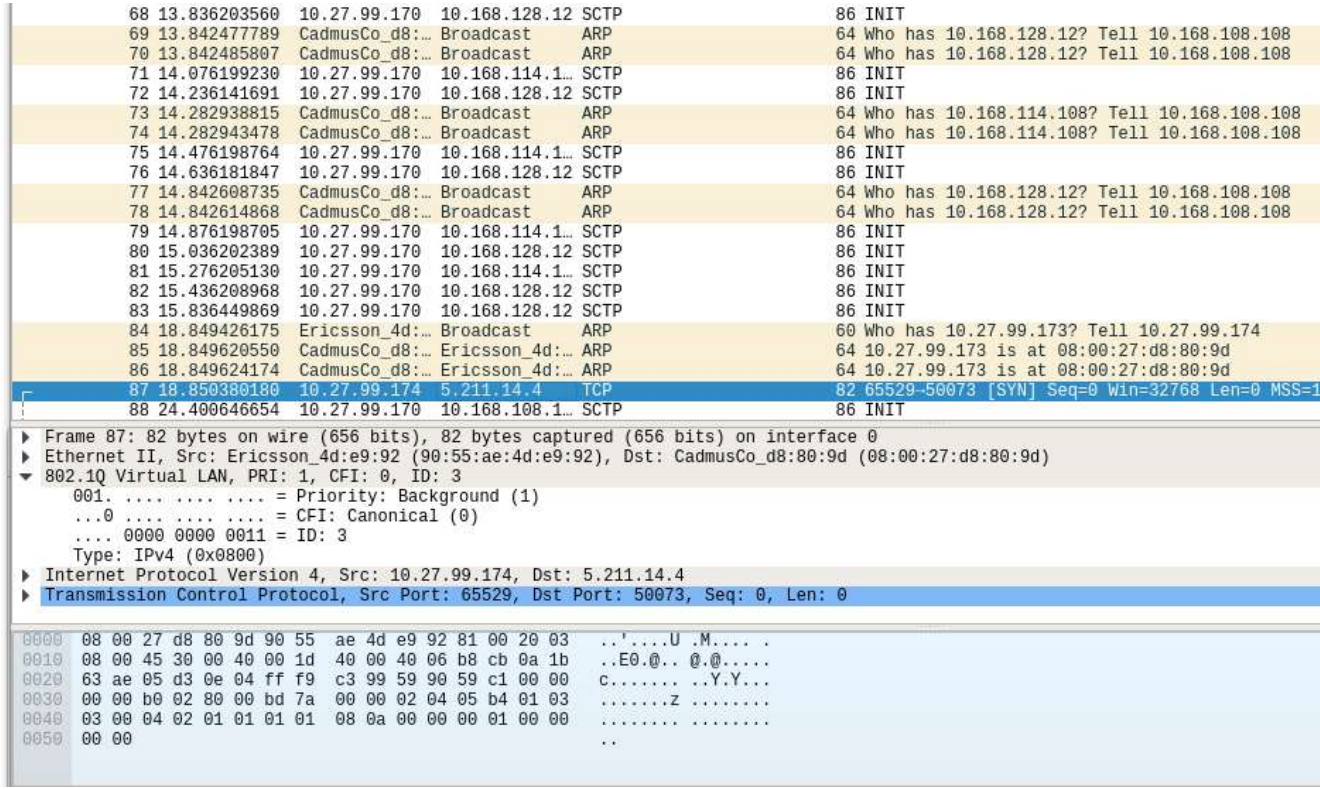
- The most important interfaces of our setup:
  - Vlan 3: Signalling
  - Vlan 2: O&M

- You see a lot of traffic, the eNB is designed to operate almost as standalone
  → Not that many modifications needed



ERNW
providing security.

The Second Sniff





Attacking the BS

- Signalling Traffic
- Local Maintenance Interface
- Remote OAM Interface
- Physically

- Our goals: Understanding the device, configuration access and finally – getting root

→ Keep in mind: this is a real BTS like out in the field

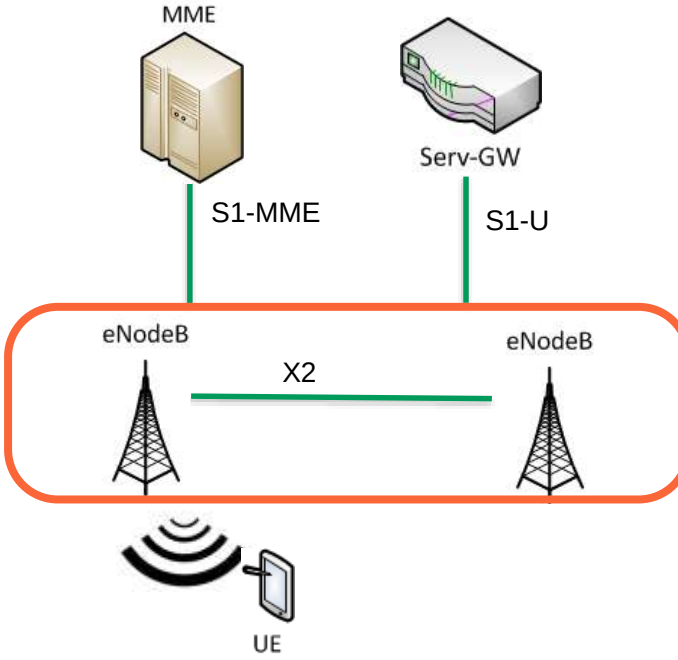


The Transport Interface

Access to, or How to Build Your Own Provider Network

S1-Interface

- S1 interface is divided into two parts
  - S1-MME (Control Plane)
    - Carries signalling messages between base station and MME
  - S1-U (User Plane)
    - Carries user data between base station and Serving GW



ERNW
providing security.

S1-Interface

- After the host 10.27.99.169 on VLAN 2 becomes available the eNodeB activates communication over the S1-Interface

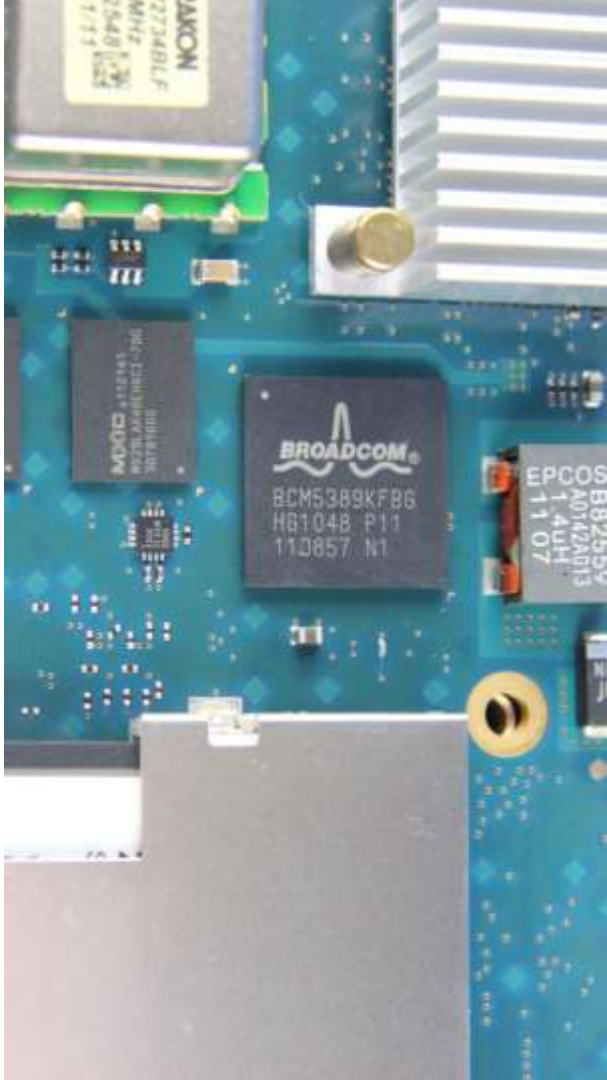
- Using SCTP it tried to reach 7 different hosts by SCTP INIT request to establish a connection

1	0.000000000	10.27.99.170	10.168.113.12	SCTP	86	INIT
4	0.400078216	10.27.99.170	10.168.113.12	SCTP	86	INIT
5	0.800055018	10.27.99.170	10.168.113.12	SCTP	86	INIT
6	1.200068064	10.27.99.170	10.168.113.12	SCTP	86	INIT
9	1.600097273	10.27.99.170	10.168.113.12	SCTP	86	INIT
10	2.000097083	10.27.99.170	10.168.113.12	SCTP	86	INIT
11	2.400088190	10.27.99.170	10.168.113.12	SCTP	86	INIT
22	4.104433928	10.27.99.170	10.168.105.108	SCTP	86	INIT
23	4.104592561	10.27.99.170	10.168.111.12	SCTP	86	INIT
28	4.296097420	10.27.99.170	10.168.105.108	SCTP	86	INIT
29	4.296108916	10.27.99.170	10.168.111.12	SCTP	86	INIT
32	4.696156330	10.27.99.170	10.168.105.108	SCTP	86	INIT
33	4.696169402	10.27.99.170	10.168.111.12	SCTP	86	INIT
34	5.096153686	10.27.99.170	10.168.105.108	SCTP	86	INIT
35	5.096166153	10.27.99.170	10.168.111.12	SCTP	86	INIT
40	5.496140257	10.27.99.170	10.168.105.108	SCTP	86	INIT
41	5.496153582	10.27.99.170	10.168.111.12	SCTP	86	INIT
42	5.896177502	10.27.99.170	10.168.105.108	SCTP	86	INIT
43	5.896190156	10.27.99.170	10.168.111.12	SCTP	86	INIT
48	6.296157138	10.27.99.170	10.168.105.108	SCTP	86	INIT
49	6.296170488	10.27.99.170	10.168.111.12	SCTP	86	INIT
50	6.696177961	10.27.99.170	10.168.105.108	SCTP	86	INIT
51	6.696200706	10.27.99.170	10.168.111.12	SCTP	86	INIT
52	7.096135747	10.27.99.170	10.168.105.108	SCTP	86	INIT
53	7.096146406	10.27.99.170	10.168.111.12	SCTP	86	INIT
54	12.284666659	10.27.99.170	10.168.114.108	SCTP	86	INIT
57	12.476111702	10.27.99.170	10.168.114.108	SCTP	86	INIT
58	12.844428930	10.27.99.170	10.168.128.12	SCTP	86	INIT
61	12.876174719	10.27.99.170	10.168.114.108	SCTP	86	INIT
62	13.036120357	10.27.99.170	10.168.128.12	SCTP	86	INIT
63	13.276192800	10.27.99.170	10.168.114.108	SCTP	86	INIT
66	13.436199062	10.27.99.170	10.168.128.12	SCTP	86	INIT
67	13.676148344	10.27.99.170	10.168.114.108	SCTP	86	INIT
68	13.836203560	10.27.99.170	10.168.128.12	SCTP	86	INIT
71	14.076199230	10.27.99.170	10.168.114.108	SCTP	86	INIT
72	14.236141691	10.27.99.170	10.168.128.12	SCTP	86	INIT
75	14.476198764	10.27.99.170	10.168.114.108	SCTP	86	INIT
76	14.636181847	10.27.99.170	10.168.128.12	SCTP	86	INIT
79	14.876198705	10.27.99.170	10.168.114.108	SCTP	86	INIT
80	15.036202389	10.27.99.170	10.168.128.12	SCTP	86	INIT
81	15.276205130	10.27.99.170	10.168.114.108	SCTP	86	INIT
82	15.436208968	10.27.99.170	10.168.128.12	SCTP	86	INIT
83	15.836449869	10.27.99.170	10.168.128.12	SCTP	86	INIT
88	24.400646654	10.27.99.170	10.168.108.108	SCTP	86	INIT

ERNW
providing security.

From 3GPP TS 33.401

- "In order to protect **the S1 and X2 control plane** as required by clause 5.3.4a, it is **required to implement IPsec** ESP according to RFC 4303 [7] as specified by TS 33.210 [5]. For both **S1-MME and X2-C**, IKEv2 certificates based authentication according to TS 33.310 [6] shall be implemented"
  - "NOTE 1: In case control plane **interfaces are trusted** (e.g. physically protected), there is **no need to use protection** according to TS 33.210 [5] and TS 33.310 [6]."
- "In order to protect the **S1 and X2 user plane** as required by clause 5.3.4, it is **required to implement IPsec** ESP according to RFC 4303 [7] as profiled by TS 33.210 [5], with confidentiality, integrity and replay protection."
  - "NOTE 2: In case S1 and X2 user plane **interfaces are trusted** (e.g. physically protected), the use of IPsec/IKEv2 based **protection is not needed**."
- "In order to achieve such protection, IPsec ESP according to RFC 4303 [7] as profiled by TS 33.210 [5] **shall be implemented for all O&M related traffic**, i.e. the management plane, with confidentiality, integrity and replay protection."
  - "NOTE 2: In case the S1 management plane **interfaces are trusted** (e.g. physically protected), the use of protection based on IPsec/IKEv2 or equivalent mechanisms is **not needed**."

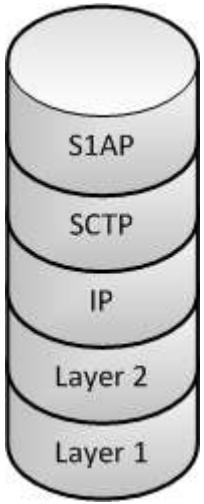


S1-AP

- S1 Application Protocol (S1AP), designed by 3GPP for the S1 interface
- Specified in 3GPP TS36.413

- Necessary for several procedures between MME and eNodeB
- Also supports transparent transport procedures from MME to the user equipment

- SCTP Destination Port 36412



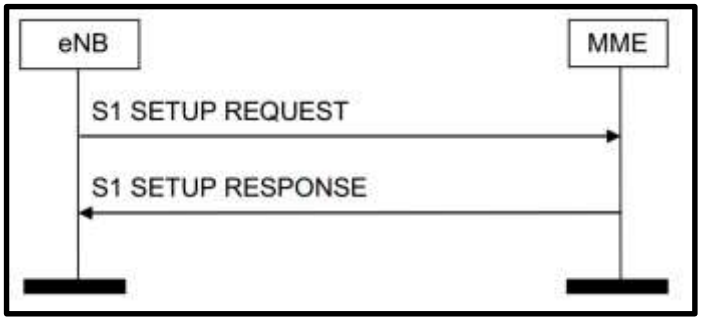
S1AP and X2AP Functions Overview

- E-RAB management functions (setup, management, modifying)
- An "Initial Context transfer" function to establish a S1UE context in the eNodeB to setup E-RABs, IP connectivity and NAS signaling.
- UE Capability Info Indication function: providing UE capability information.
- Mobility functions for UE, active in LTE network in case of change of the eNodeB or RAN (e.g. location change).
- Paging: provides the capability for the MME to page the UE.
- NAS signaling transport
- S1 UE context release/modification functions: modify and release UE context information
- Status transfer: transferring Packet Data Convergence Protocol (PDCP) SN, defined at [31],
- status information between two eNodeBs.
- Trace functions
- Location Reporting functions
- LPPa (LTE Positioning Protocol Annex) signaling transport: providing the transfer of LPPa messages between eNodeB and E-SMLC.
- S1 CDMA2000 tunneling functions: carrying CDMA2000 signaling messages between the UE and the CDMA2000 RAT.
- Warning message transmission
- RAN Information Management (RIM) functions: transferring RAN system information between two RAN nodes.
- Configuration Transfer functions: requesting and transferring RAN configuration information



Let‘s get Started!

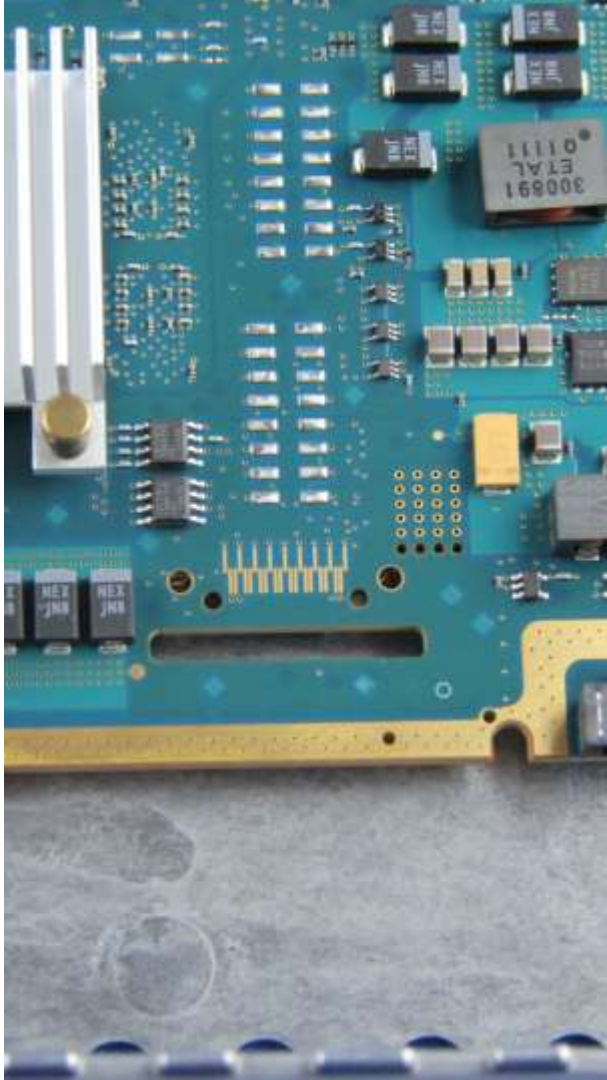
- S1-MME: Basically, only the S1 Setup Request is needed.
  - fake_mme.py



ERNW
providing security.

Working with S1AP

- After S1 Setup Request, a couple of messages can be sent.
- S1AP Scanner published in the past (www.insinuator.net)
  - S1AP_enum
  - S1AP Dizzy Scripts
- New scripts:
  - fake_mme.py
  - sctp_mitm.py





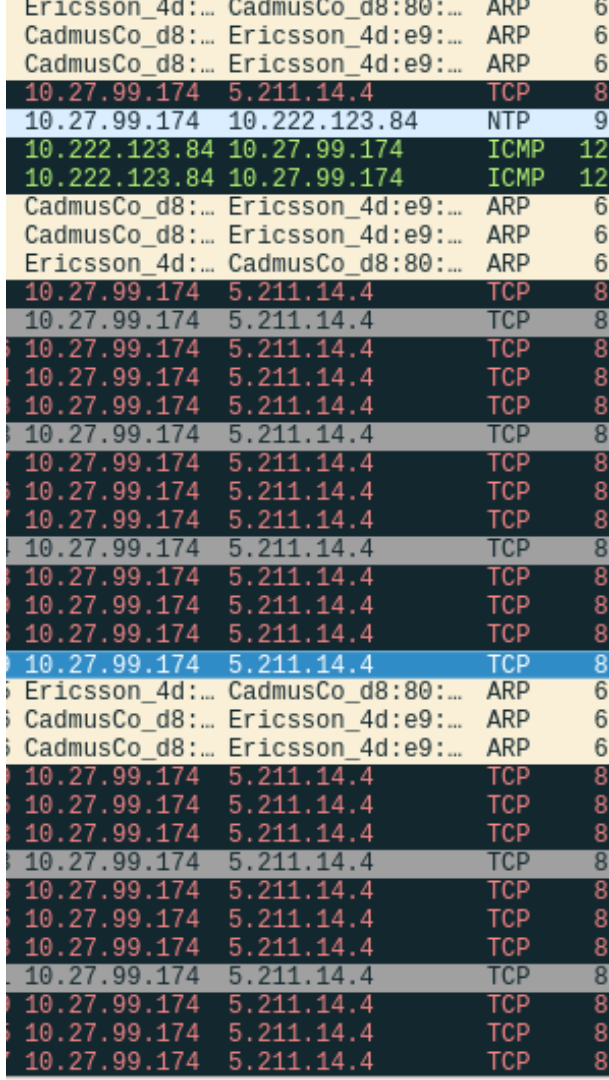
Operations & Maintenance Network

Attacking the Local and Remote Maintenance Interface

ERNW
providing security.

OAM Network

- After the host 10.27.99.173 on VLAN 3 becomes available the eNodeB starts searching for an NTP
- It also tries to establish a TCP session to some management system





Nmap Results

```
Increasing send delay for 10.27.99.174 from 0 to 5 due to 45 out of 149 dropped probes since last increase.
Nmap scan report for 10.27.99.174
Host is up, received arp-response (0.00042s latency).
Scanned at 2015-12-28 19:16:02 CET for 842s
Not shown: 65529 closed ports
Reason: 65529 resets
PORT     STATE SERVICE    REASON       VERSION
21/tcp   open  ftp        syn-ack ttl 64
22/tcp   open  ssh        syn-ack ttl 64 (protocol 2.0)
| ssh-hostkey:
|   1024 39:6b:50:b5:68:ea:cf:f9:1b:85:48:dc:cb:5f:9c:dc (DSA)
| ssh-dss
AAAAB3NzaC1kc3MAAACBAKjBoRJD3xs/PDF7i8Zh6VVNlnykkT0aZ/OJoZM0Qb/2Zm1SruM5bYkwAczqstUWXygtgSTmP4
Dv5VHNkmR5Gb5KIe2e5GXNp4HACdAVjThkpBzK27ai+Pj+CXIHQxHcZIMgJyQDA29oCg5KFk9lbtdDkiocabW/KyuAQmxB0
mIVAAAAFQCPdjPIB+E7/0QKPKXG0pcRgIibLQAAAIBLD689UE2fmlufS53dHWsgxm9SsGD4GgP4bnRfV+G494PNfimiVv0W
oqAeDFtVqQLlxZHU2pJ275kgRyDHcp4fTaPssxZpIjyVNiZkjLjDVeZb8D562E4PnG3BVFy2VcMrq4klbO02wKwE5zQrLQfGf7O
o1rv81+1OdpZzU3N48wAAAIEAhj3FTj4i2s8vKEVXzUtdK081YHhyvOJO77niYmJ+jG2IOtt4tJpuNfvdc19ab2wtrqerQ1R6KTA9
2InhktEZvS2e4peeVho0htYoDlDQTybpw5v/LaX8c0/7vtcKJt7On+A0rZwCAd2ScQxNKpcyJAqNf9J+esFJXo9KONWkpms=
|   1024 e8:c6:48:a5:f8:7b:ed:c3:6b:30:86:a6:42:c6:04:a6 (RSA)
|_ssh-rsa
AAAAB3NzaC1yc2EAAAABIwAAAIEAz4L21u3pCegfIuLO+iz8te/XmrNhNSeCFf9SCwd8GYL7D1yktvdhn3kFPb+4gwM2B+sIn
hs0TM6+bt7HfW7AU0cPTMy3kgLxvOKU9V+Sm8QzvZSJkkKmbfnwRHY7IVvFSHNZPghWupcDUb7h7z+h3Q3BlcZP7ZQIFPd
3zXEyxIM=
23/tcp   open  telnet     syn-ack ttl 64
80/tcp   open  http       syn-ack ttl 64 WEBS - OSE web server
| http-methods:
|_  Supported Methods: GET HEAD POST
|_http-server-header: WEBS - OSE web server
|_http-title: 404 URL Not Found
8443/tcp open  tcpwrapped syn-ack ttl 64
|_xmlrpc-methods: ERROR: Script execution failed (use -d to debug)
56834/tcp open  unknown    syn-ack ttl 64
```

ERNW
providing security.

Maintenance Terminals

- The workflow
  1. Fault-State of BaseStation (NoService)
  2. Engineer moves on-site
  3. Engineer connects to BTS with $tool
  4. Engineer accesses debug information
  5. Engineer adjusts configuration



ERNW
providing security.



RBS Element Management Applications

Available Installer

Platform	without Java VM	Instructions
Windows	Download (2.6M)	View

Windows Instructions:

Instructions

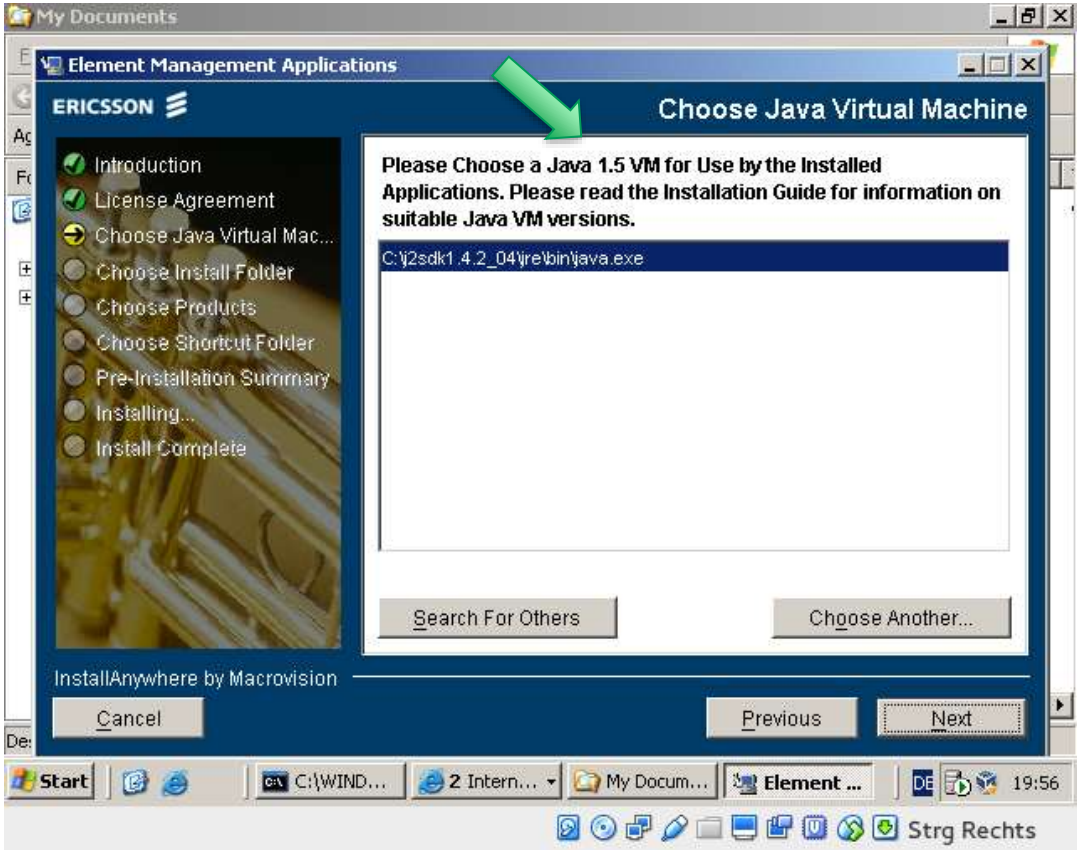
- After downloading, double-click `em_install.exe`

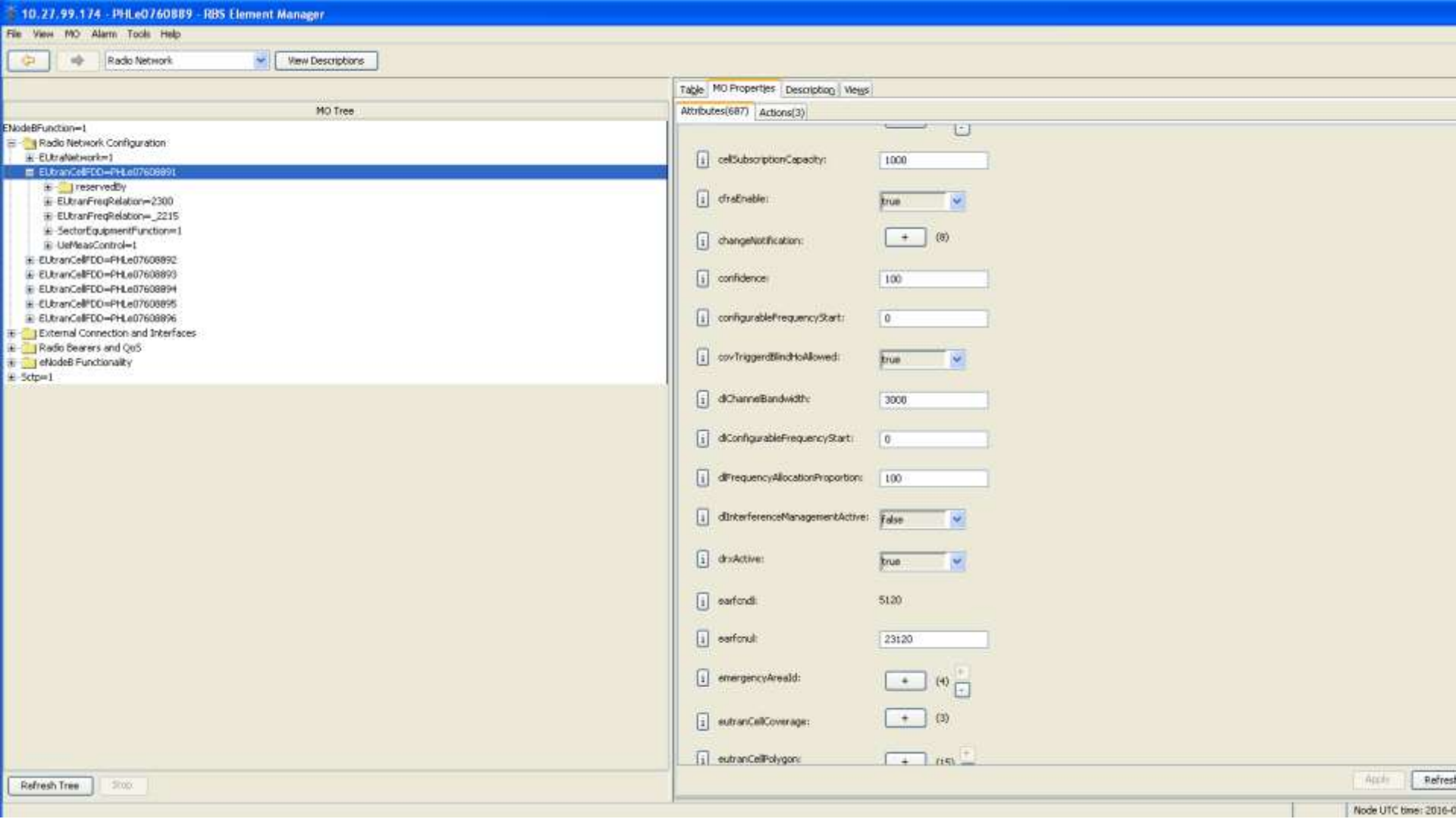
Notes

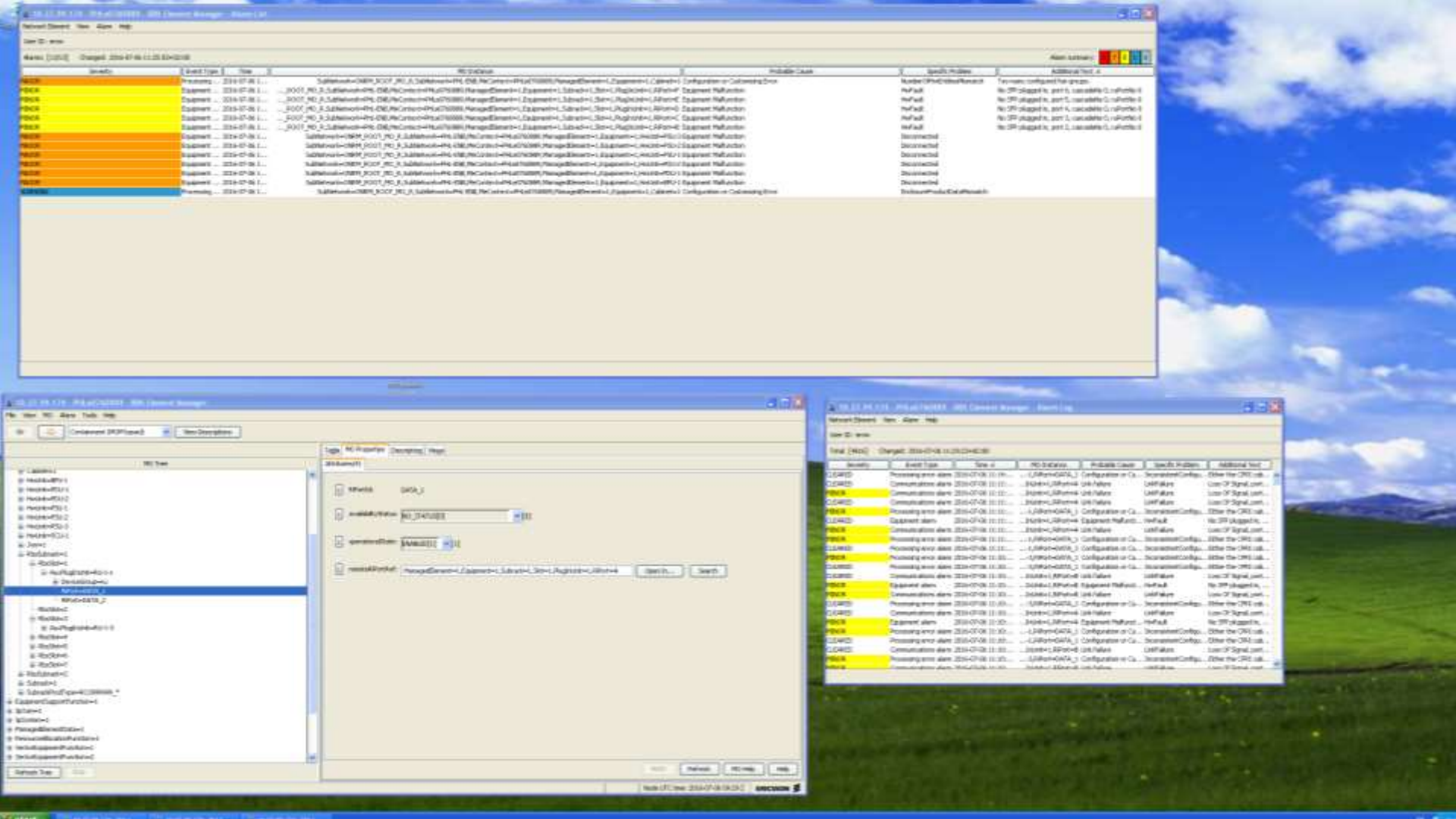
- You may need to install a Java Runtime Environment (JRE) 5.0 of the latest update. You can download one from Oracle's Java web site.

LMT Software Installation

... and Windows XP ...




10.27.99.174 - PHLe0760889 - RBS Element Manager
File View MO Alarm Tools Help
Radio Network
View Descriptions
MO Tree
ENodeBFunction=1
Radio Network Configuration
EUtraNetwork=1
EUtranCellFDD=PHLe07608891
reservedBy
EUtranFreqRelation=2300
EUtranFreqRelation=_2215
SectorEquipmentFunction=1
UeMeasControl=1
EUtranCellFDD=PHLe07608892
EUtranCellFDD=PHLe07608893
EUtranCellFDD=PHLe07608894
EUtranCellFDD=PHLe07608895
EUtranCellFDD=PHLe07608896
External Connection and Interfaces
Radio Bearers and QoS
eNodeB Functionality
Sctp=1
Refresh Tree
Stop
Table
MO Properties
Description
Views
Attributes(687)
Actions(3)
cellSubscriptionCapacity: 1000
cfraEnable: true
changeNotification: (8)
confidence: 100
configurableFrequencyStart: 0
covTriggerdBlindHoAllowed: true
dlChannelBandwidth: 3000
dlConfigurableFrequencyStart: 0
dlFrequencyAllocationProportion: 100
dlInterferenceManagementActive: false
drxActive: true
earfcndl: 5120
earfcnul: 23120
emergencyAreaId: (4)
eutranCellCoverage: (3)
eutranCellPolygon: (15)
Apply
Refresh
Node UTC time: 2016-0



ERNW
providing security.

More on eNB Security

> "Setting up and configuring eNBs **shall be authenticated and authorized** so that attackers shall not be able to modify the eNB settings and software configurations via local or remote access. "

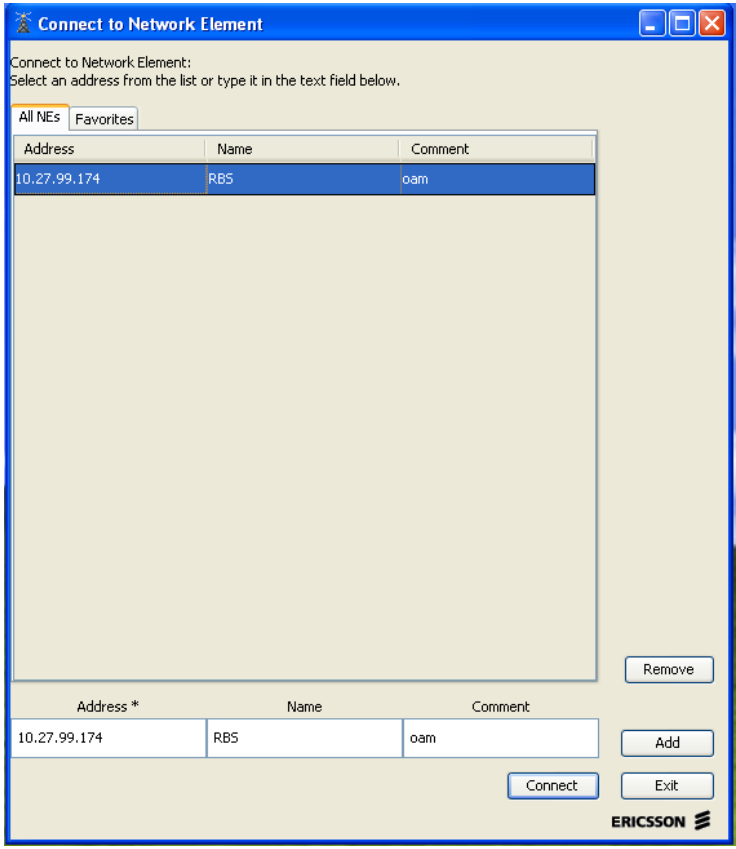
- But, anyhow: 4G BaseStations are *yet another Network Device with IP connection*.

From 3GPP TS 33.401

ERNW
providing security.

What we see

- FTP, Telnet, and SSH
- EM with totally outdated Java
- EM is not asking for a password
- EM is based on HTTP and GIOP
  - Transmits current configuration data of the BTS
  - Configuration changes can be made
  - Unauthorized!



Well...

```
[hschmidt@hslaptop ~]$ ssh -oKexAlgorithms=+diffie-hellman-group1-sha1 rbs@10.27.99.174
rbs@10.27.99.174's password:
PTY allocation request failed on channel 0
Welcome to OSE Shell OSE5.5.
$
```

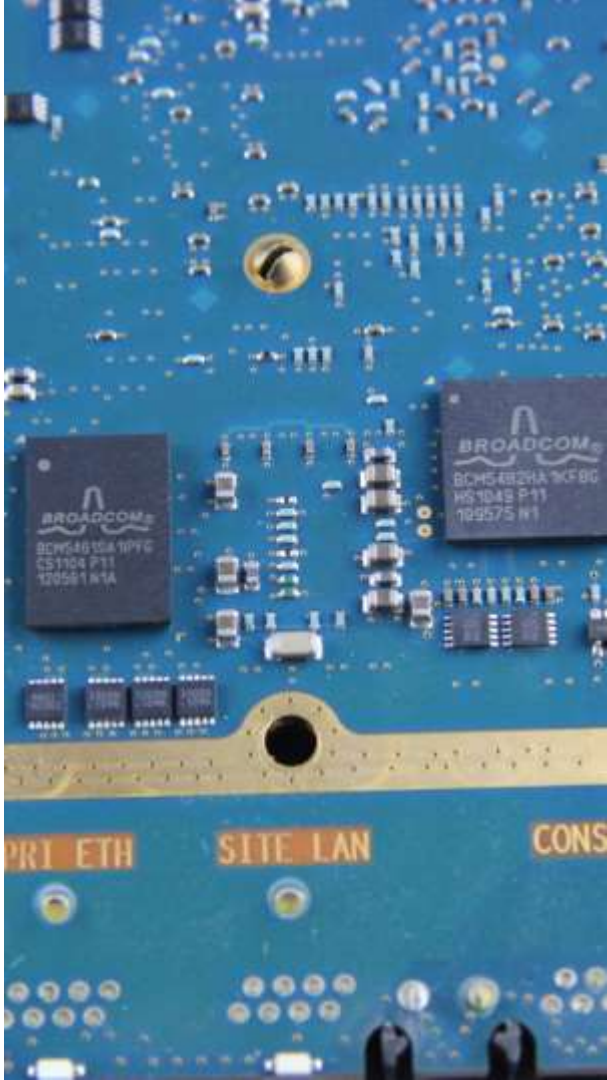
- Username: rbs / cellouser
  - Password: rbs

```
[hschmidt@hslaptop security]$ ls -al
insgesamt 48
drwxr-xr-x  4 hschmidt users 4096 14. Okt 18:43 .
drwxr-xr-x 19 hschmidt users 4096 14. Okt 18:46 ..
-rw-r--r--  1 hschmidt users 1498 14. Okt 18:43 SecurityManagement.prp
-rw-r--r--  1 hschmidt users   70 14. Okt 18:43 banner.fc
-rw-r--r--  1 hschmidt users    0 14. Okt 18:43 banner.txt
-rw-r--r--  1 hschmidt users   17 14. Okt 18:43 corbasecurity
drwxr-xr-x  2 hschmidt users 4096 14. Okt 18:41 esa
drwxr-xr-x  2 hschmidt users 4096 14. Okt 18:41 ipsec
-rw-r--r--  1 hschmidt users   52 14. Okt 18:43 iptransmode.cfg
-rw-r--r--  1 hschmidt users   65 14. Okt 18:43 passwd
-rw-r--r--  1 hschmidt users  958 14. Okt 18:43 security.cfg
-rw-r--r--  1 hschmidt users  668 14. Okt 18:43 ssh_host_dsa_key
-rw-r--r--  1 hschmidt users  534 14. Okt 18:43 ssh_host_rsa_key
[hschmidt@hslaptop security]$ cat passwd
cellouser:xxxelzYE09bDM:1234:1234:Cello User:/home/dir:/bin/tcsh
```

ERNW
providing security.

Webserver

- Running *WEBS - OSE web server*
  - EM Download
  - XML Configuration
- Java JDK (1.1.6, 1.2.1, 1.3.1, 1.4.2, 1.5.0, 1.6.0)
- Somehow, not very load resistant
  → Leading to a DoS of the whole machine





Insights

“No magic behind”

ERNW
providing security.

What We've Seen so far

- The device was obviously not wiped
- No IPSEC on S1 interface
- Hardcoded & default credentials
  - rbs – rbs
  - cellouser - rbs
- Telnet in use
- Unencrypted maintenance interface



ERNW
providing security.

Well…

- RTOS OSE 5.5
  - Running on a Motorola MPC 85xx
  - Assisted by FPGA + ARM
- GZIP Volumes and Files
  - Starting with 1F 8B

- Holding the OS on a Flashdisk

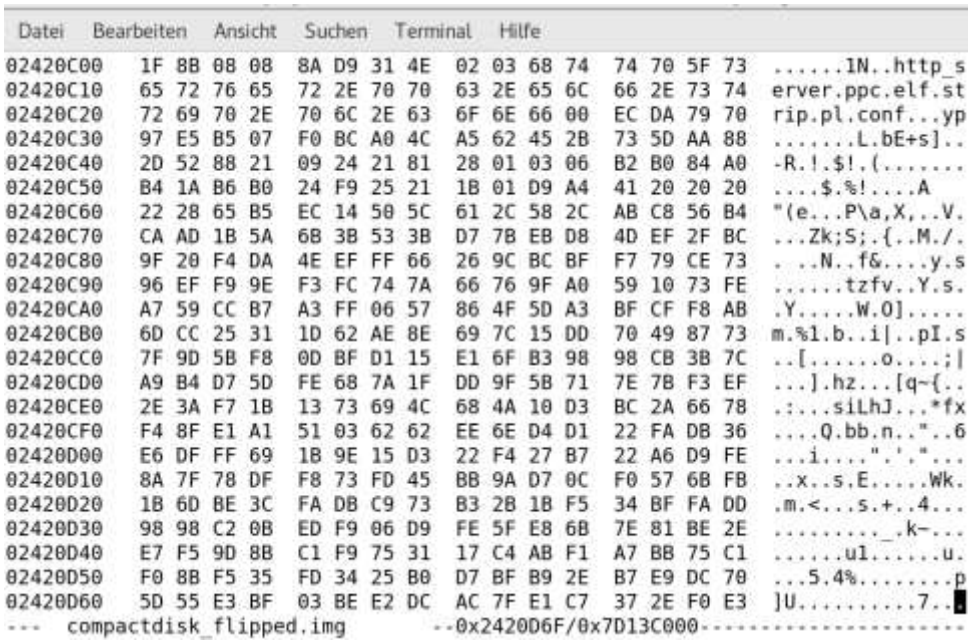


```
.....................................
.............! #"%$'&)(+*-,/.10325476
98;:=<?>A@CBEDGFIHKJMLONQPSRUTWVYX[Z
]\_^a`cbedgfihkjmlonqpsrutwvyx{z}|.~
```

The Disk

- Image must be flipped first
- PPC Binaries have format of *.ppc.elf.strip.pl.conf
- Files are gziped

→ Enables us to extract configuration data (e.g. IPSec keys) and to do reverse engineering





Ramlog

```
$ rld
rld
Displaying ramlog virtual range 0x0 - 0x3af7
__RAMLOG_SESSION_START__
0.000:BOS detected board type: gpm3blue
0.000:Number of items in the board param list=192
0.000:INFO: system pool cleared from address 0x09400000 to 0x097fffff
0.000:Detected Motorola MPC 85xx, pvr: 0x80210022
0.000:cpu_hal_85xx: init_cpu
0.000:L1CSR0=0, L1CSR1=0
0.000:mm: Using extended addressing for physical addresses.
[…]
1.3655:Timestamp format tick.usec: (1 tick = 4000 micro seconds)
1.3655:Starting HEAP
1.3960:Starting FSS
1.3979:Starting PTHREADS
1.3981:initPthreads called, not needed from OSE5.5.
1.3994:Starting GZIP volume.
2.0097:Starting RAM PMM
2.0102:PM regions= 200
2.0134:PMM: Magic not found.
2.0139:PMM: Cold start
2.0220:PMM: Restore phase completed
2.0224:Starting PM
2.0245:Starting SHELLD
2.0258:OSE5 core basic services started.
2.2744:rmm_offspring: disconnecting: 0x1001C
2.2761:rmm: disconnecting offspring due to: client killed.
2.2792:core: Starting DEVMAN
```

And the BS belongs to…?

- Looks like a BaseStation from the US ☺

```
c/logfiles/alarm_event/ALARM_LOG.xml:1f1;x4;x4;EUtranCellFDD;SubNetwork=ONRM_
ROOT_MO_R,SubNetwork=PHL-
ENB,MeContext=PHLe0760889,ManagedElement=1,ENodeBFunction=1,EUtranCellFDD=P
HLe07608893;417;135588376835330000;SubNetwork=ONRM_ROOT_MO_R,SubNetwork=
PHL-ENB,MeContext=PHLe0760889;356;6;ServiceUnavailable;0;S1 Connection failure for
PLMN mcc:311 mnc:660;SubNetwork=ONRM_ROOT_MO_R,SubNetwork=PHL-
ENB,MeContext=PHLe0760889_415;;0;2;0;0;
```

ERNW
providing security.

Using passwd

- We have the users cellouser and rbs
  - By the way, rbs is not in the passwd file
- While checking for use of hardcoded passwords in the management tool, we changed the user for rbs using passwd
- Afterwards cellouser's password was also change to the password



ERNW
providing security.

SSH

- SSH access to the device is enabled
- Sadly the only supported key exchange algorithm is disabled by default in current ssh clients
  - ssh -oKexAlgorithms=+diffie-hellman-group1-sha1 rbs@10.27.99.174



ERNW
providing security.

Cell & UE Traces

- The eNodeB is able to create both traces for cells and UEs
- We found a set of traces on the device

- Sadly the traces seem to be purely cell traces
  - Containing data on packet loss etc.
  - No “interesting” information

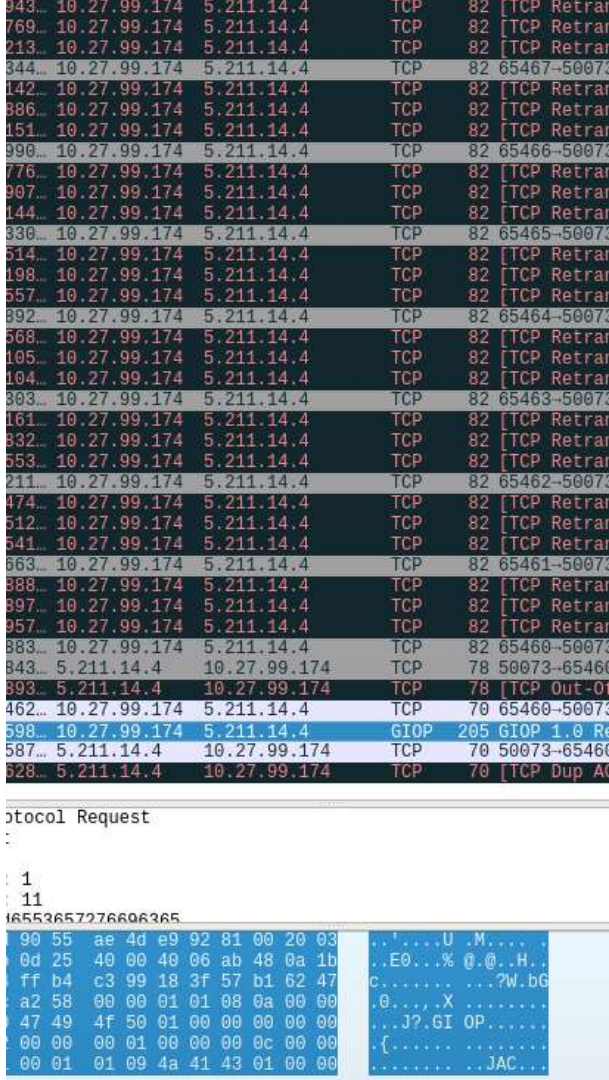
```
$ cat CellTraceFilesLocation
cat CellTraceFilesLocation
/c/pm_data
$ cat UeTraceFilesLocation
cat UeTraceFilesLocation
/c/pm_data
$ ls
ls
Directory '/j/pm_data/'
A20160706.0930-0945:1.xml.gz
A20160706.0945-1000:1.xml.gz
A20160706.1000-1015:1.xml.gz
A20160706.1015-1030:1.xml.gz
A20160706.1030-1045:1.xml.gz
A20160706.1045-1100:1.xml.gz
A20160706.1100-1115:1.xml.gz
A20160706.1115-1130:1.xml.gz
A20160706.1130-1145:1.xml.gz
A20160706.1145-1200:1.xml.gz
A20160706.1200-1215:1.xml.gz
A20160706.1215-1230:1.xml.gz
A20160706.1230-1245:1.xml.gz
A20150413.0500-0515:1.xml.gz
A20150413.0515-0530:1.xml.gz
A20150413.0530-0545:1.xml.gz
A20150413.0545-0600:1.xml.gz
A20150413.0600-0615:1.xml.gz
A20150413.0615-0630:1.xml.gz
A20150413.0630-0645:1.xml.gz
A20150413.0645-0700:1.xml.gz
A20150413.0700-0715:1.xml.gz
A20150413.0715-0730:1.xml.gz
A20150413.0730-0745:1.xml.gz
A20150413.0800-0815:1.xml.gz
A20150413.0815-0830:1.xml.gz
A20150413.0830-0845:1.xml.gz
A20150413.0845-0900:1.xml.gz
A20150413.0900-0915:1.xml.gz
A20150413.0915-0930:1.xml.gz
A20150413.0930-0945:1.xml.gz
A20150413.0945-1000:1.xml.gz
A20150413.1000-1015:1.xml.gz
A20150413.1015-1030:1.xml.gz
A20150413.1030-1045:1.xml.gz
A20150413.1045-1100:1.xml.gz
A20150413.1100-1115:1.xml.gz
A20150413.1115-1130:1.xml.gz
A20150413.1130-1145:1.xml.gz
A20150413.1145-1200:1.xml.gz
A20150413.1200-1215:1.xml.gz
A20150413.1215-1230:1.xml.gz
A20150413.1230-1245:1.xml.gz
```

ERNW
providing security.

GIOP Remote Session

- The eNodeB ties to establish a TCP session with 5.211.14.4
- When connected it sends a simple GIOP request
- Seems to be: Java IDL: Interoperable Naming Service (INS)

```
root@eNodeB-ROUTE:~# nc -l 50073
GIOP{    JACnode
                NameService_is_a+IDL:omg.org/CosNaming/NamingContextExt:1.0
```



ERNW
providing security.

IP Address: 5.211.14.4

- This is the only public IP address the device talks to
- Strangely (reminder of the operator: MetroPCS, USA) the IP address is located in Iran
- From the dates we've seen the eNodeB was initially provisioned and setup in 2013
  - The IP address range was registered in 2012 for an Iranian telco

```
% This is the RIPE Database query service.
% The objects are in RPSL format.
%
% The RIPE Database is subject to Terms and Conditions.
% See http://www.ripe.net/db/support/db-terms-conditions.pdf

% Note: this output has been filtered.
%       To receive output for a database update, use the "-B" flag.

% Information related to '5.211.0.0 - 5.211.255.255'

% Abuse contact for '5.211.0.0 - 5.211.255.255' is 'abuse@mci.ir'

inetnum:        5.211.0.0 - 5.211.255.255
netname:        GPRS
descr:          LTE
country:        IR
admin-c:        RL7844-RIPE
tech-c:         RL7844-RIPE
status:         ASSIGNED PA
mnt-by:         MCCI-MNT
created:        2015-02-18T10:58:50Z
last-modified:  2015-02-18T10:58:50Z
source:         RIPE

person:         Reza Taham Latibari
address:        Hamrah Tower - Kordestan High way cross Vanak st.Tehran Iran
phone:          +98 21 88640934
nic-hdl:        RL7844-RIPE
mnt-by:         MCCI-MNT
created:        2012-09-05T13:41:38Z
last-modified:  2012-09-05T13:41:39Z
source:         RIPE # Filtered

% Information related to '5.211.0.0/16AS197207'

route:          5.211.0.0/16
descr:          New services for 4G
origin:         AS197207
mnt-by:         MCCI-MNT
created:        2015-02-18T11:49:18Z
last-modified:  2015-02-18T11:49:18Z
source:         RIPE

% This query was served by the RIPE Database Query Service version 1.87.4 (BLAARKOP)
```



IP Address: 5.211.14.4

- Looks strange?
- Well, we can not disprove:
  - The IP address range might have been shared/let/lent
  - The operator might have misused public IPs privately
- The port seems to be down





ERNW
providing security.

Summary

- Signalling: Security based on IPSec, but Attackers might be able to get the keys easily via local access
- OAM: Hardcoded passwords, weak management protocols
- Physical Access: LMT, no local encryption, debug interfaces

Thank you for your Attention!





hschmidt@ernw.de
bbutterly@ernw.de

@hendrks_
@BadgeWizard

www.ernw.de

www.insinuator.net