

How the CCC Camp 2019 LTE network works

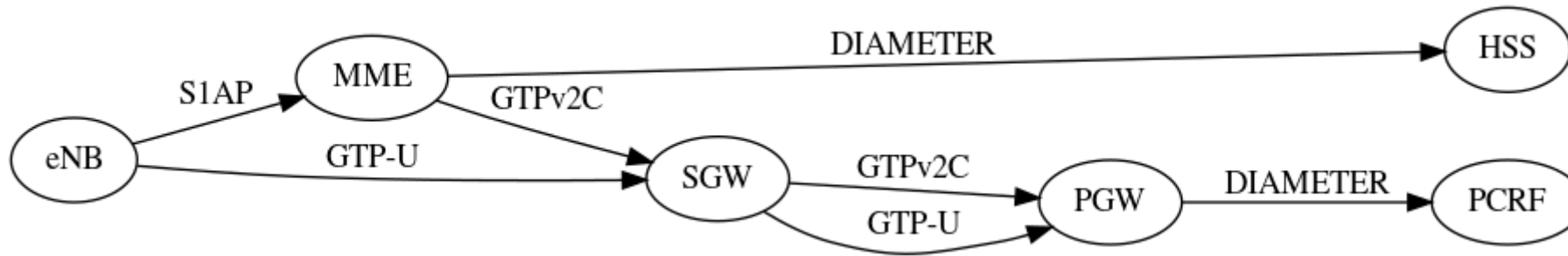
Harald Welte <laforge@gnumonks.org>

Intro

- we had GSM networks at CCC events since 2008
 - Initially using proprietary, E1-attached Siemens BTS and OpenBSC (later OsmoBSC)
- we had GSM networks at European Hacker Camps since 2009 (HAR)
- we had UMTS (3G) for a few years now, too
 - using Osmocom stack with OsmoHNBGW / OsmoMSC / OsmoSGSN
- I'm still involved with developing the related software, but have handed over actual network operation at CCC events to a team around lynxis and bibor
 - this means I have time for playing with LTE

LTE

- new network elements with new acronyms



LTE

- new protocols on all layers of all interfaces
 - S1AP between eNodeB and MME
 - GTPv2C between MME and SGW and SGW and PGW
 - DIAMETER between everyone and HSS

FOSS LTE software

- srsLTE for eNodeB and UE
 - main focus on UE; eNodeB features somewhat limited
 - super simplistic srsEPC suitable for only the scarcest of use cases
- OpenAirInterface
 - obscure code base; difficult to build
 - very research oriented
 - RAN part under non-free, non-opensource but *source available* license
- nextepc
 - the clear underdog
 - very capable; many features (SGs, handover on X2 and S1, SBc)
 - readable code!

- Implements all key LTE network (EPC) elements
 - MME
 - SGW
 - PGW
 - HSS
 - PCRF

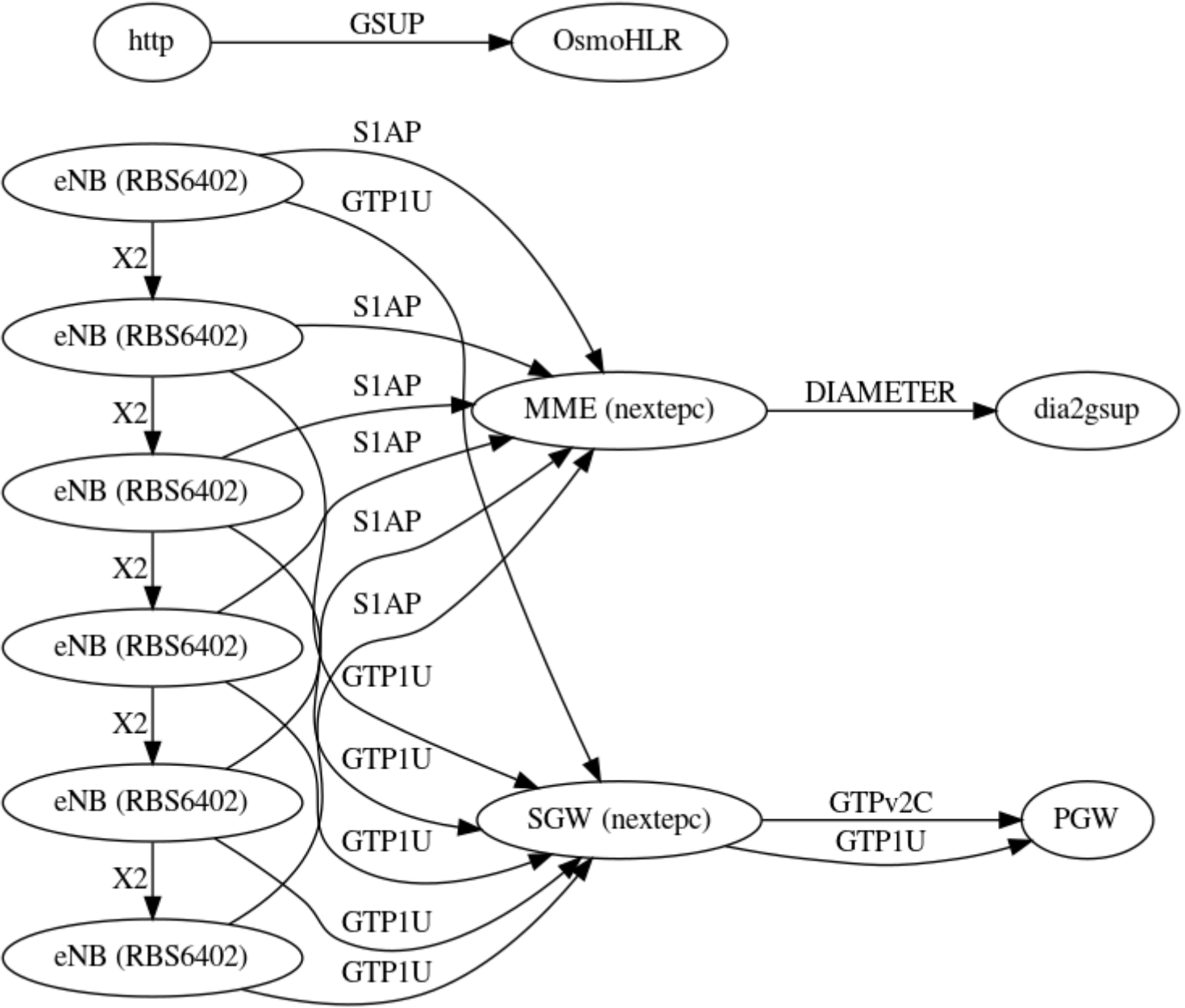
interfacing with Osmocom 2G/3G core

- shared subscriber (and key) database
 - LTE: HSS, speaking DIAMETER
 - 2G/3G: HLR, speaking MAP (Osmocom:GSUP)
- We need a so-called *inter-working function* (IWF)
 - translate from DIAMETER to GSUP and vice-versa

osmo_dia2gsup

- Best FOSS DIAMETER support contained in Erlang/OTP
- Fairwaves contributed GSUP protocol codec in Erlang
- I wrote a translator for the two minimal procedures
 - AuthInfo (Obtain authentication tuples)
 - UpdateLocation (registration)
- code at https://git.osmocom.org/erlang/osmo_dia2gsup/

Network layout (logical)



Network layout (physical)

- 6 eNodeBs distributed around the camp inside select Datenklos
 - Ericsson RBS6402 with 23dBm in Band 7
 - back-haul over regular CCC Ethernet as separate VLAN
- Stratum-0 NTP server with GPS receiver for eNB clock sync
 - built on Raspi 3B with gpsd + ntpd
- Lenovo x240 Laptop running qemu-kvm for core network
 - runs nextepc MME, SGW, PGW
 - runs osmo_dia2gsup for translating DIAMETER to GSUP
- Querying Camp 2G/3G OsmoHLR for subscriber data

Radio paramters

- Telefonica O2 has provided (borrowed) 10 MHz of spectrum in Band 7 (2600 MHz)
- We can use it either as one channel @ 10 MHz or two chnannels @ 5 MHz
 - first four days were operated using 5 MHz channels (3 eNB on each channel)
 - last day was operated using 10 MHz channels (6 eNB on same channel)

Results (1/2)

- Telekom technician Peter "@33dBm" Schmidt has done some testing
 - first test with 5MHz channels:
<https://twitter.com/33dBm/status/1165393409852563457>
 - problems with neighbor selection due to dual-frequency network
 - Average throughput 33.6 Mbps down / 9.1 Mbps up)

Idle (CampLTE / LTE)

DL EARFCN 3225 PCI 498 RSRP -116.0 dBm RSRQ -6.4 dB



Map



15 x



0 km/h



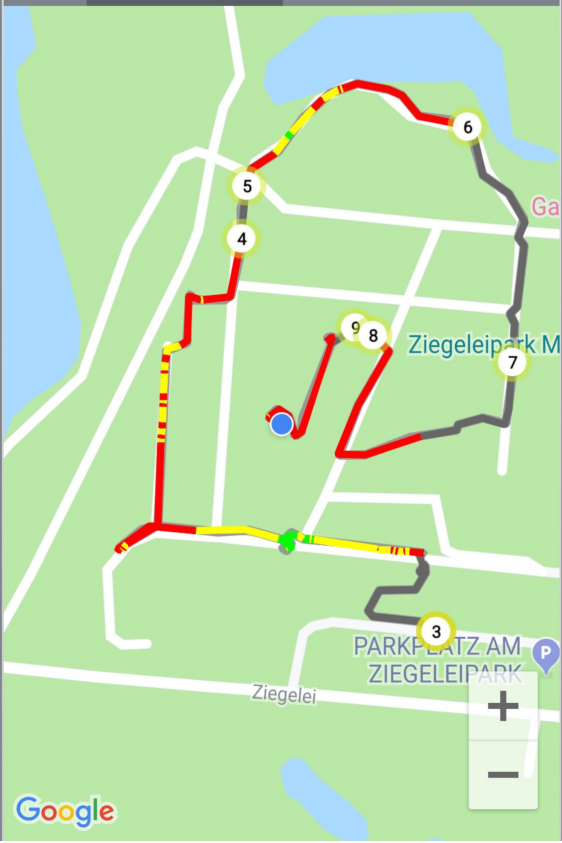
87



0s



4 m

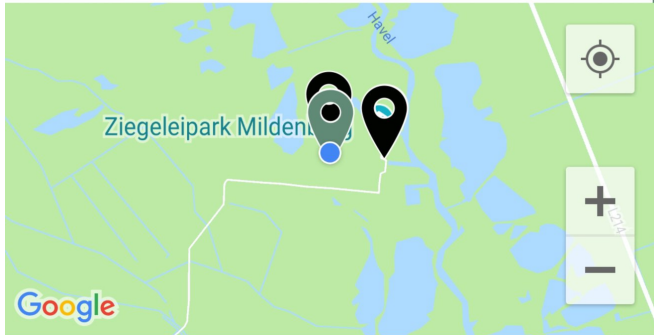


Google



Results (2/2)

- Telekom technician Peter "@33dBm" Schmidt has done some testing
 - second test with 10 MHz channels:
<https://twitter.com/33dBm/status/1165576180961095680>
 - better neighbor selection
 - improved throughput (Average 62.7 Mbps down / 20.8 Mbps up)



Min: 52 ms Ø: 55 ms

Download Max: 64.3 Mbit/s Ø: 62.7 Mbit/s

Upload Max: 20.8 Mbit/s Ø: 20.8 Mbit/s

Cellular Information

Table with 2 columns: Cellular Information (Provider, Technology, Level, MCC-MNC) and values (CampLTE, LTE, [-62..-59] dBm, 901-42).

Thanks

- to the Camp GSM team for operating 2G/3G
- to Eventphone / POC for handling user registration UI and voice interconnect
- to Sukchan Lee (@acetcom) for writing nextepc
- to Dieter Spaar for all of his support during the past 10 years
- to Peter Schmidt (@33dBm) for professional rive (bike ride) testing
- to Telefonica O2 Germany for lending us some of their Band 7 frequencies

EOF

End of File