LTE
is here and
ModemManager
is (almost) ready for it

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The road to LTE

Evolution in requirements

- 2G

  CS **voice** calls the key feature, while PS data communications just an add-on

- 3G

  Designed for both CS **voice** and **video** calls, plus PS **data** communications

- 4G

  Designed only for PS **data** communications

  - Data-transmission specific design targets:
    - Peak rate and rate at cell edge
    - Low latency
    - High capacity (spectral efficiency)
    - Spectrum flexibility

3GPP Evolution

- 2G:
  - **GSM** (r96): 14.4 kbit/s
  - **GPRS** (r97): (FL) 57.6 kbit/s, (RL) 28.8 kbit/s
  - **EDGE** (r98): (FL, RL) 236.8 kbit/s
- 3G:
  - **UMTS** (r99): (FL) 384 kbit/s [ITU: IMT-2000, true 3G]
  - **HSDPA** (r5): (FL) 14 Mbit/s
  - **HSUPA** (r6): (RL) 5.76 Mbit/s
  - **HSPA+** (r7,r8): (FL) 42 Mbit/s, (RL) 11.5 Mbit/s
    - **DC-HSDPA** (r8), **DC-HSUPA** (r9), **MC-HSDPA** (r10) (up to 168 Mbit/s)
- 4G:
  - **LTE** (r8): (FL) 300 Mbit/s, (RL) 75.4 Mbit/s
  - **LTE advanced** (r10): (FL) 1Gbit/s [ITU: IMT-Advanced, true 4G]

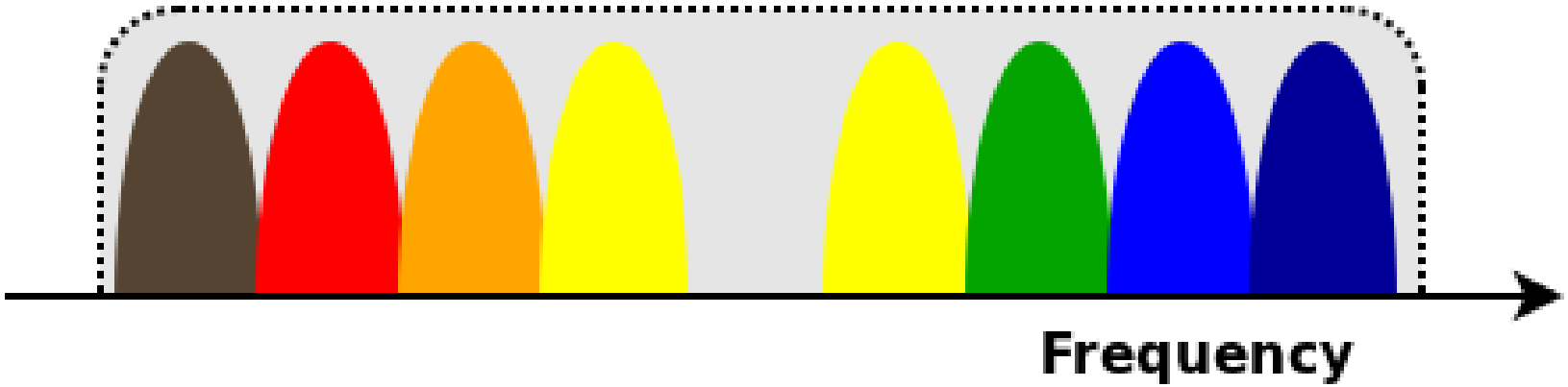
3GPP2 Evolution

- 2G:
  - **IS-95**: up to 14.4 kbit/s
- 3G:
  - **CDMA2000 1x**: (FL) 153 kbit/s
  - CDMA2000 **1xEV-DO**
    - **Rev 0**: (FL) 2.4 Mbit/s, (RL) 153 kbit/s [ITU: IMT-2000, true 3G]
    - **Rev A**: (FL) 3.1 Mbit/s, (RL) 1.8 Mbit/s
    - **Rev B**: (FL) 4.9 Mbit/s per carrier, up to 14.7 Mbit/s
- 4G:
  - ~~CDMA2000 1xEV-DO rev C, a.k.a. **UMB**~~ → **LTE**

Key features of LTE

OFDM

- Conventional OFDM in the downlink
- DFTS-OFDM in the uplink



In LTE
- Subcarrier spacing of 15 kHz
- 600 subcarriers in 10 MHz of spectrum

LTE releases 8 & 9

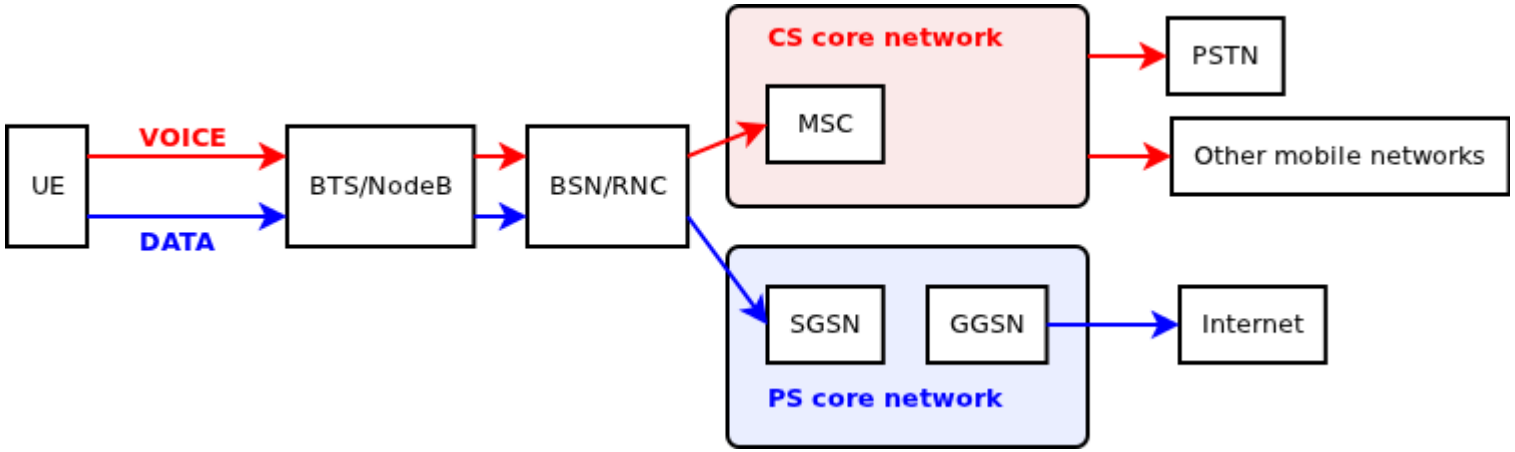
- Multiple antennas
  - Diversity, beam-foaming, spatial multiplexing
- Channel dependent scheduling and rate adaptation
- Spectrum flexibility
  - FDD and TDD support
  - Bandwidth flexibility
- Inter cell interference coordination
- Hybrid ARQ with Soft Combining
- MBSFN
  - Multicast/broadcast single-frequency network

LTE release 10 (LTE-Advanced)

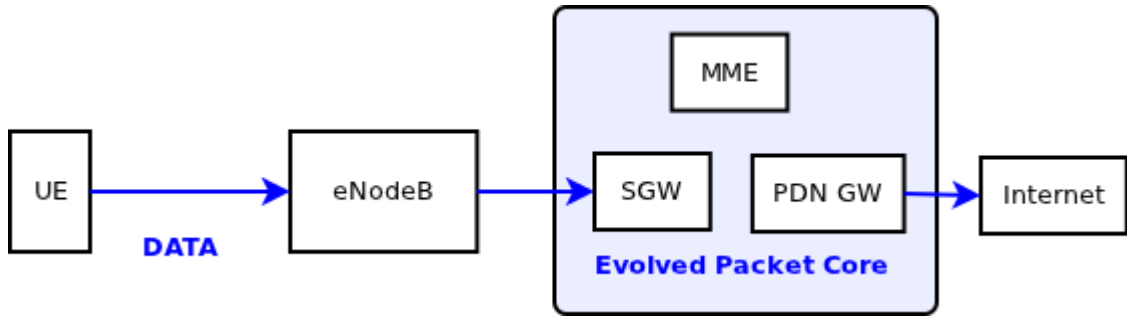
- Relaying
  - with LTE-based backhaul
- Heterogeneous deployments
  - with improved inter-cell interference handling
- Carrier aggregation
  - up to 5 carriers of up to 20MHz each

The Evolved Packet Core

2G/3G

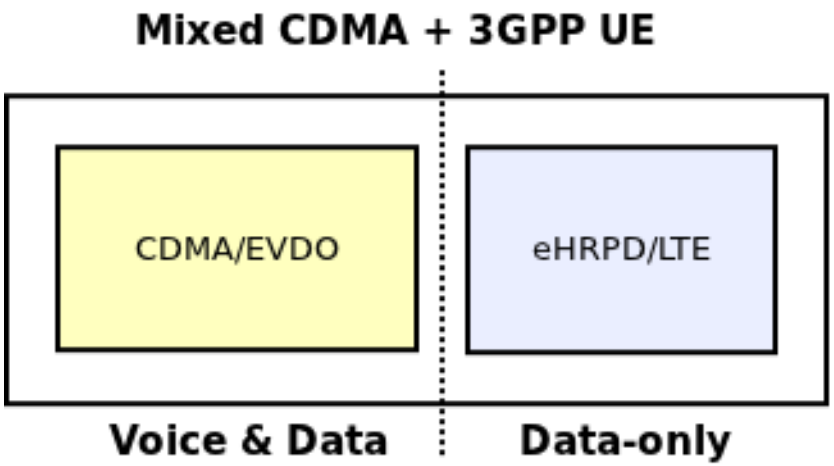


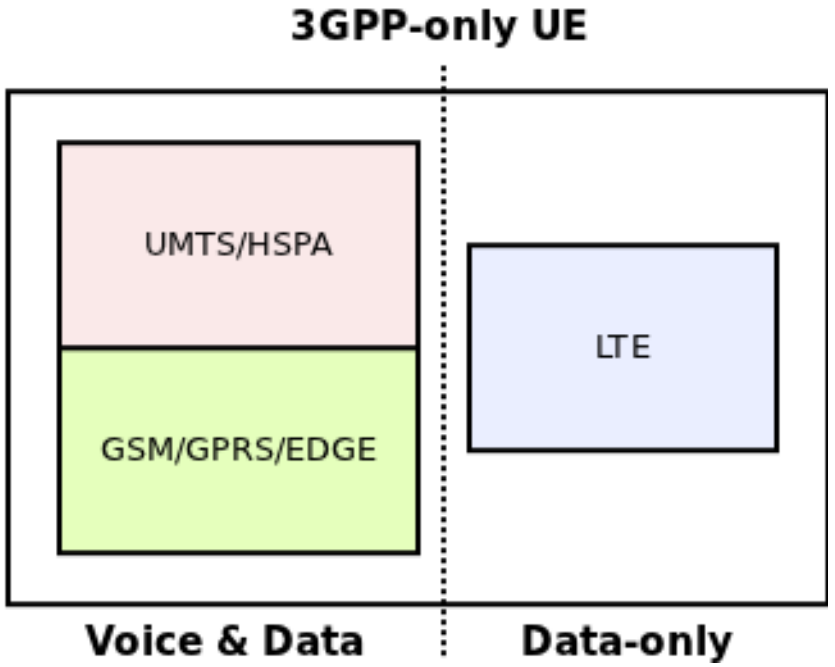
LTE



Handsets

- All IP-based services is the future... but the future is not here (yet)





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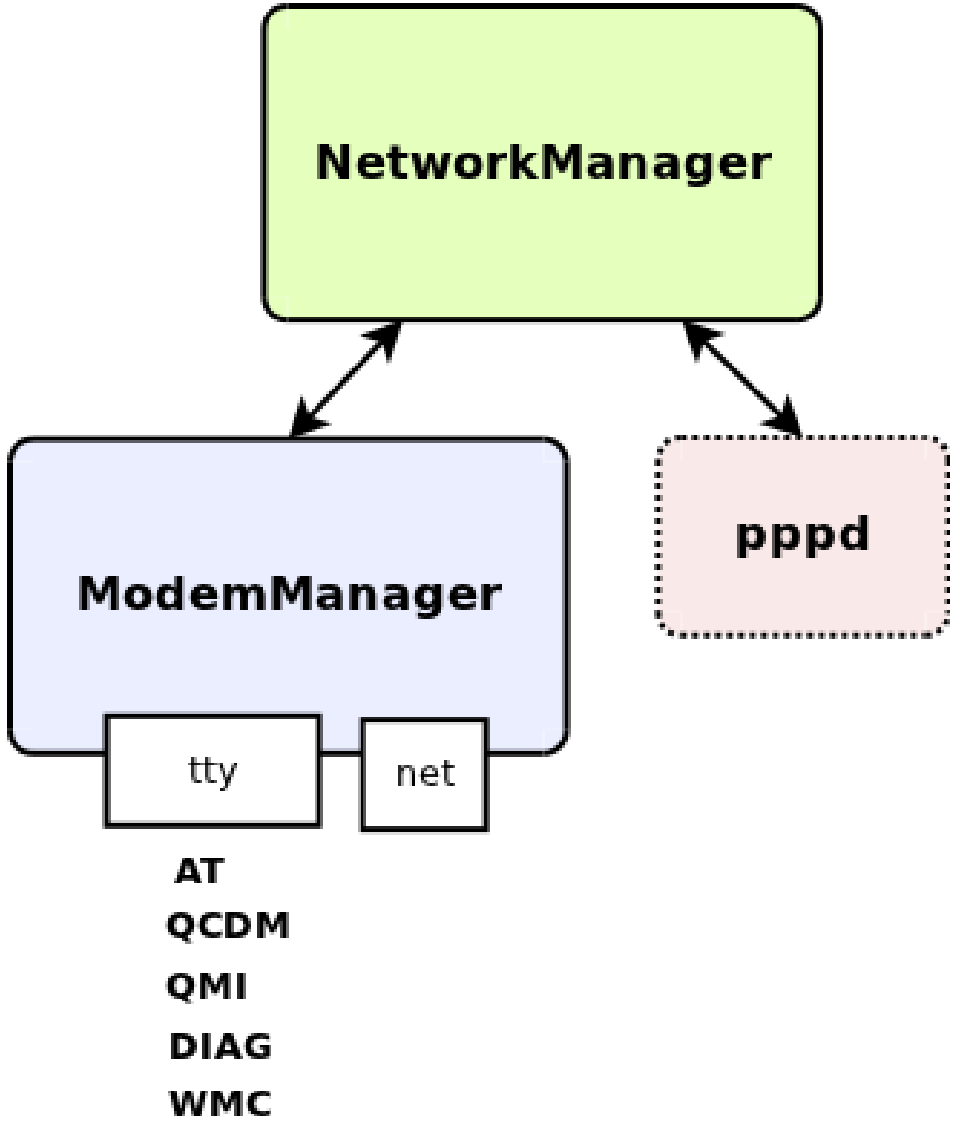
ModemManager 0.6

What is it?

- Dbus-activated daemon which controls and monitors Broadband(*) Modems
- Works (not only) with NetworkManager
- Extended with plugins for vendor-specific features



(*) POTS/Dial-up modems soon as well

0.5/git master overview

- **Probing** queries for:
  - Modem capabilities
  - Vendor and Product strings, if needed (only git master), for extended RS232-only modem support.
  - Port types
- **Split hierarchy**
  - One generic GObject for CDMA-based modems
    - Plus vendor/product-specific subclasses
  - One generic GObject for 3GPP-based modems
    - Plus vendor/product-specific subclasses

0.5/git master overview

- Additional **interfaces** are 'static', all modems export them, even if they don't support the specific features.
  - e.g SMS messaging or USSD support in 3GPP
- **State machine** not very clear
  - Global state machine is quite clear, but the commands to setup all interfaces/features are mixed.
  - Plugins can override specific steps with:
    - async methods
    - property overrides (not good for error reporting, and assumes that the main control port is AT.
- **Bearers** are hidden to the user; only one bearer can be used at a time
- dbus-glib

Supporting LTE modems

- New port types: QMI, WMC...
  - Some actions/behaviours can only be controlled though this new port types
  - Just released, MBIM 1.0 specs (*)
- Need to handle mixed CDMA+LTE modems
  - CDMA-based connection sequence usually just with ATDT#777
  - LTE-based connection sequence fully 3GPP-compliant (PDP context setup...)
  - Connection can (or cannot) transparently fallback from LTE to CDMA, handled by the eHSRP network
- In general, Need to handle handoffs to non-LTE connections, even in 3GPP-only modems.

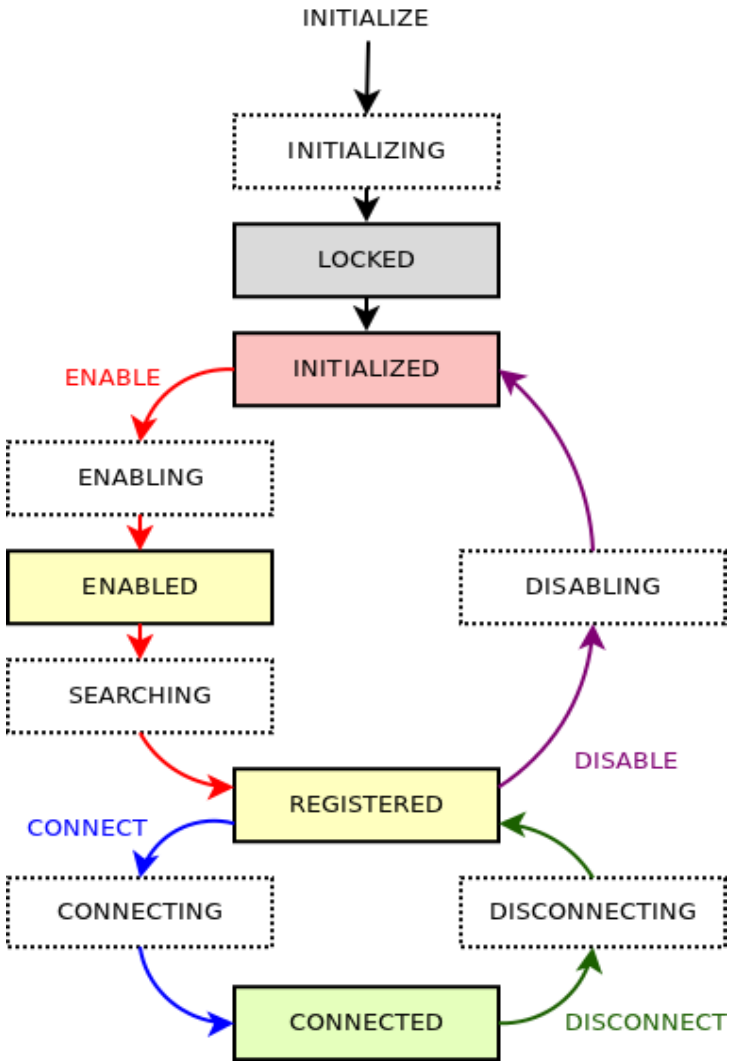
(*) not sure if good or bad news

0.6-api branch overview

- **Probing** updated:
  - Don't query capabilities
- **Common hierarchy**
  - One generic GObject for “Broadband” modems (either 3GPP, CDMA or both)
    - Plus vendor/product-specific subclasses
  - One generic GObject for “POTS” modems
    - (not yet)
- Additional **interfaces** are 'dynamic', modems export them only if they support the specific features.
  - e.g SMS messaging or USSD support in 3GPP

0.6-api branch overview

- **State machine** much more clear.
  - Global state machine for the modem, plus per-interface state machines
  - Plugins can override all the specific steps of the per-interface state machine, via async methods.
  - There is no assumption on the type of port to be used.
  - Error reporting in every step.



0.6-api branch overview

- **Bearers** are exposed to the user; and the user can configure and activate/deactive them independently
- GDBus
  - Using the new standard ObjectManager interface

As of today...

- Core/generic features 95% ready
- Plugins 5% ready
- Help porting the plugins to the new codebase highly welcome
- Help testing already ported plugins welcome

Thanks!

- Mailing list:

  network-manager-list (at) gnome.org

- Repository:

  git clone git://anongit.freedesktop.org/ModemManager/ModemManager

  git checkout 06-api

- IRC:

  #nm in FreeNode