MANAGING THE CAR CLOUD CONNECTION.
CONNMAN, SYSTEMD, AND THE INTERNET.

BMW GROUP
BMW Car IT GmbH
IVI CONNECTIVITY.
GENERAL OVERVIEW.

- Apps in the car
- Software and Hardware Setups
- ConnMan Session API
- The Future

http://flic.kr/p/8Gu
EXPECTATIONS.

• Car owners expect their car to be integrated into their digital life.
• Services via Apps
INTERACTIONS.

- Knobs
- Touch
- Voice
SOFTWARE.
PARTITIONING.

![Diagram showing partitioning between Head Units and Smartphones](image_url)
HARDWARE SETUP.
STAND ALONE.

Cellular

Head Unit
HARDWARE SETUP.
CONNECTION BOX.

Head Unit

Connection Box

Cellular
HARDWARE SETUP.
SMARTPHONE AS UPLINK.
HARDWARE SETUP. MULTI LINKS.

- Head Unit
  - Bluetooth
  - Connection Box
    - Cellular
- Smartphone
HARDWARE SETUP.
FULL MONTY.

Head Unit

Connection Box

Smartphone

Cellular → WiFi/Bluetooth

Cellular → WiFi

WiFi/Bluetooth

WiFi
PROTOCOL STACKS. BASED ON IP.

- WiFi Display
  - Basically it replaces a HDMI-cable
  - a.k.a. Miracast
  - Uses WiFi Direct
- MirrorLink
  - USB, Wi-Fi, Bluetooth,
  - Real-Time Protocol (RTP, for audio)
  - Universal Plug and Play (UpnP)
  - VNC
- ...
CONNMAN.
SESSION API.

- App 1
  - Notify 1
  - Session 1
- App 2
  - Notify 2
  - Session 2
- App 3
  - Notify 3
  - Session 3

D-Bus

ConnMan

- 802.03
- 802.11
- 802.15
- Cellular

- WPA Supplicant
- BlueZ
- oFono

Linux Kernel

Per Application
- Configuration
- Routing
- Statistic
SESSION CONFIGURATION.

- AllowedBearers (e.g. ethernet, wireless, cellular...)
- Connection (e.g. local, internet)
- Priority
- EmergencyCall
- RoamingPolicy
SESSION CONFIGURATION.
KEEP IT UP TO DATE.

Configuration update needed because

- Roaming policy changes
- New customer (rental car)
- ...

Applications need to be blocked before configuration is updated
CONNMAN.
SESSION DYNAMIC CONFIGURATION.

App 1
Notify 1
Session 1

App 2
Notify 2
Session 2

Session 3
ConnMan

802.03
802.11
802.15
Cellular

WPA
Supplicant
BlueZ
oFono

Linux Kernel

remote

Notify 3
pold

D-Bus
CONNMAN.
IPTABLES AND POLICY ROUTING.

• Per application rules

```bash
iptables -t mangle -A OUTPUT -m owner --uid-owner 1234 -j MARK --set-mark 1234
```

• Global rules

```bash
iptables -t mangle -A INPUT -j CONNMARK --restore-mark
iptables -t mangle -A POSTROUTING -j CONNMARK --save-mark
```

• Policy routing

```bash
ip rule add fwmark 1234 table 1234
ip route add default via 1.2.3.4 dev wlan0 table 1234
```
Packet flow in Netfilter and General Networking

CONNMAN.
STATISTICS.

- Android uses two kernel modules:
  - `xt_qtaguid`: tags all traffic from/to sockets
  - `quota2`: Accounting and enforcing. Counters reported through NFLOG
- `netdev` maintainers suggested to use NFQUEUE
  - Look at all packets in userspace (zero copy)
  - Each packet has meta information attached (GID, UID, etc.)
  - Work in progress
SYSTEMD.

- DHCP library recently added
  - Based on ConnMan's gdhcp
  - ConnMan will use it in future
- systemctl supports 'only static/simple' setups
  - Network boot
- Needs to learn to handover
  - Work in progress
THANK YOU VERY MUCH FOR YOUR INTEREST.
RESOURCES.

01.org/connman
www.press.bmwgroup.com