

Reliable cellular connections under Linux

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“Opengear is a leading provider of enterprise grade console servers, cellular routers and remote management solutions that enable our customers to easily tame IT complexity”

www.opengear.com

Opengear continued...

- Embedded hardware platforms (mainly ARM and x86 based)
- uClinux embedded Linux distribution (www.uclinux.org)

Cellular connections

- Why?
- How they work
- Typical setup for use as management connection
- Difficulties
- Solutions

Cellular management uses

- Out of band management interface
- SMS alerting and commands
- Failover internet connection
- Low barriers of entry
- Can be used where traditional infrastructure fails

Cell modem technologies



Originally...

- Originally RS232 interfaces (really just a phone)
- AT commands, with GSM extensions
 - Setting APN, retrieving RSSI etc
- PPP to tunnel IP over the serial connection
- Later USB with CDC ACM serial endpoints

Current Modems

- Still USB-Serial
- Mode switching required (`usb_modeswitch`, later kernel drivers (Option, Huawei etc))
- Multiple USB-serial endpoints (command, data, gps etc)
- Proprietary SDKs (i.e. CDMA modems with one USB-serial endpoint for all data, SMS)

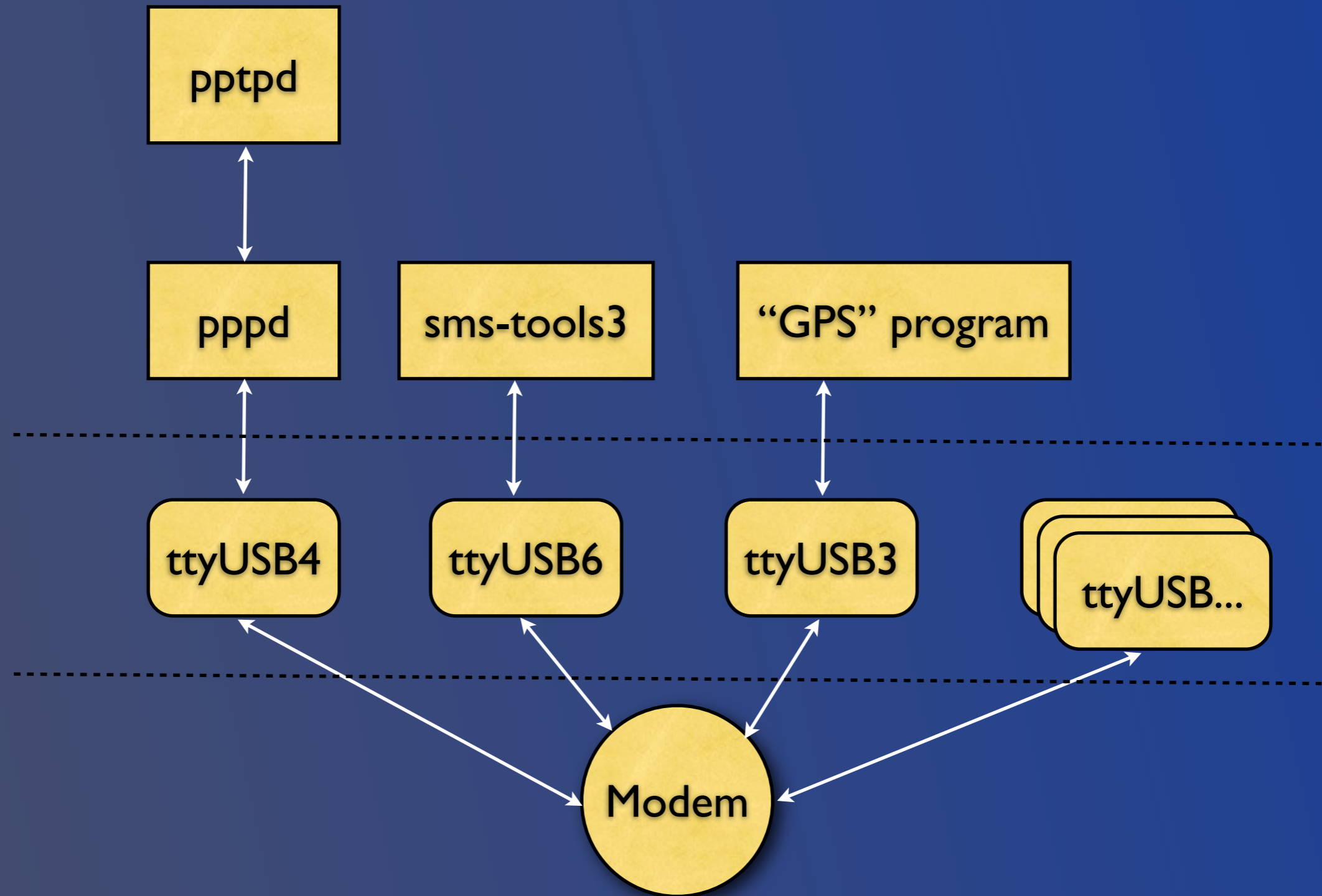
Moving forward

- 4G LTE etc.
- USB-serial and USB-ethernet endpoints
- Configuration over serial, DHCP over ethernet (faster, lower overheads)
- Sierra directIP, Qualcomm QMI/GOBI USB control endpoints. Supposedly a standard interface.

Completing the picture

- sms-tools3 to send and receive SMS over the command port
- PPP / DHCP to establish IP connection
- If NATed private IP - best to use outgoing VPN (PPTP, IPSec, OpenVPN etc)
- Usually want the IP connection as failover or triggered by SMS to limit data costs

Completing the picture



That's how it's meant to work

- When everything comes together, it works!
- But our goal is a rock solid, reliable, out of band cellular connection.

When things fail...

- PPP connections would be 'up' without receiving packets
- After a few days SMS sending and receiving would fail
- Applications would fail to open serial ports
- Kernel panics, kernel warnings (reboots an embedded device)

Causes

- Poor reception (check RSSI)
- Network and cellular congestion
- Power fluctuations
- Modem resets, device disappears from the USB bus and reappears (udev)
- USB-serial drivers buggy when they're removed in use (improving all the time)

Solutions

- Upgrade modem firmware (vendor's windows utilities)
- Harden or fix applications against the USB endpoints disappearing
 - Improve SIGHUP handlers
- Watchdog, watchdog, watchdogs

Watchdogs

Script that periodically runs a check, performing an action when the check fails

- ICMP ping to test IP connectivity, forcing a reconnect
- Driver liveness checks (looking at /dev/nodes) restarting applications, reloading drivers if things went wrong
- Fallback if things aren't right - reboot

Summary

- Cellular modems ultimately present like complicated, regular modems
- You can build a useful, unique access tool with them
- Failure modes that are peculiar to cellular modems

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