Reliable cellular connections under Linux

Toby Smith
Engineer at Opengear
toby.smith@opengear.com
“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
• 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

- pptpd
- pppd
- sms-tools3
- “GPS” program
- ttyUSB4
- ttyUSB6
- ttyUSB3
- ttyUSB...

Modem
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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