3G/4G Solutions with RouterOS

Brian Vargyas – Baltic Networks USA
MikroTik User Meeting USA 2015
Overview of this Presentation

• Why Cellular?
• M2M, IoT – Are you in it?
• New Features in RouterOS V6 for 3G/4G
• Cellular Frequency Band Plans (North America)
• Direct-IP Configuration (LTE Modems)
• PPP Configuration (3G Modems)
• SMS Configuration
• Live Demonstration
Why Cellular?

- Temporary Connections
- Backup Bandwidth Purposes
- Out of Band Network Management
- Sending SMS for Alert Notifications
- Receiving SMS and Executing Scripts
- Mobile Hotspot Deployment
- GPS Stratum 1 Time Server
- Revenue Opportunities!
M2M (Machine to Machine)

- M2M is the concept of a device sending data to another device.
- Extreme competition in data has carriers looking for “per device” revenue, even if it’s small data.
- Carriers are having to embrace “embedded devices” on their network besides smart phones.
- Typically 50MB/mo and under applications.
Internet of Things (IoT)

• Internet connected devices
• A network of M2M devices that exchange data between “things” to achieve greater value and service by communication and interoperability.
• By connecting your RouterOS solution to the Internet, you’ve now become part of the Internet of things!
M2M / IoT Growth

• More then 18.2 Billion devices today
• Expected 50.1 Billion by 2020
• Semi-Annual Growth Rate 5.3%
• Revenue of $1.4 Billion by Q2 2015
• Still a lot of market hype

(Gartner Research, Compass Intelligence)
M2M / 3G Applications

- Backup Application Bandwidth
- Public Safety Data Transmission
- Network Management
- Digital Signage / Kiosks
- Remote Monitoring / Security
- Transportation (GPS Data)
- Parking Meters / Vending
4G Applications

• Backup Internet Bandwidth
• Video Surveillance
• Video Entertainment (Netflix)
• Mobile/Fixed Hotspots
Revenue? Tell me more...

- Providing business customers “secondary” bandwidth to your primary WISP connection for business critical functions (credit card processing)
- Out of band remote monitoring of leased PtP links without having customer network access.
- Any application not requiring all you can eat bandwidth..
RouterOS Modem Types

- 3G/4G Modem – Use PPP Interfaces
- 4G LTE Modem – Use LTE tab in Interfaces (Currently only supported by DirectIP Modems)
Module Types

- Cellular modems come in both USB and mPCIe cards using USB signals.
- USB Modems are easier to obtain, but protrude out in front or side of your router.
- mPCIe cards are slick, built-in and look like a WiFi Card, but are typically more expensive.
- RB411u, RB912, RB953, RB922 series has mPCIe USB
- RB800 has mPCIe but no USB support
- Other RouterBOARDS with USB ports supported (Check Modem Power Requirements First)
USB Dongle Type Modems

(RB/951G with USB Port and MaxxWave LTE USB Modem)
mPCIe Modules w/RB912

- Integrated modules have more industrial applications.
- Requires Carrier Certification (In the USA)
RB/953 has two mPCIe Slots

• Perfect for Multi-Carrier or Load Balance
Tested 3G Cards

- ZTE 2718 (3G – CDMA - Sprint)
- ZTE MF206a (3G – UMTS - ATT/T-Mobile)
- No Verizon Experience

Over 100 more on WIKI.MIKROTIK.COM
Tested 4G North American Cards

- Sierra Wireless MC7700 Series
  - MC7700 – AT&T Certified
  - MC7710 – Europe Version
  - MC7750 – Verizon Certified** (Not Direct IP)

(EOL Sept 2014) – Stock still available
mPCIe Module Speeds

• Quadband GSM 850/900/1900/2100Mhz
• EVDO Rev A CDMA (3.1 Down / 1.8 Up)
• UMTS/HSDPA (7.2 Down / 2.0 Up)
• HSDPA+ 3.5G (28 Down / 5.8 Up)
• LTE (Long Term Evolution) (100 Down / 50 Up)
• LTE Advanced With 8Tx8R MIMO can Achieve 3.3Gbps Peak per Sector! (100Mhz Channel)
PCS 1800-1900Mhz Band Plan
700 Mhz LTE Band Plan
4G One size fits all solution??

• Yes! Sierra Wireless MC7354!
• Pentaband chipset
• Supports Sprint, AT&T, Verizon Wireless
• AT Command Carrier Selection
• Expensive Solution!
BUT......

• Requires QMI mode interface
• DirectIP interfaces are going away in favor of QMI.
• RouterOS 6.x only supports DirectIP
• RouterOS 7 will support QMI
• QMI Backport will not be done
Lower cost LTE on the way.....

- RouterOS 6.28 fixed support for ZTE MF823 (External USB Modem – European LTE 900/2100Mhz Support)
- ZTE ZM8620 Testing to begin shortly Supporting LTE FDD
- 7 Bands Supported
- Currently only AT&T/T-Mobile
- GPS and Standard AT Commands
RouterOS LTE Summary

• Add supported 4G device
  – Direct-IP Interface only
  – QMI mode coming in RouterOS V7.x
  – Verify SIM card activated with carrier

• Setup APN in LTE interface

• Enable LTE interface

• Enable DHCP-CLIENT on lte1 interface

• Verify Running LTE Interface
Special LTE Configuration

[admin@Cellular Modem] /port firmware> print
  directory: firmware
  ignore-directip-modem: no
[admin@Cellular Modem] /port firmware>
Firmware directory

• Designed to side-load GOBI firmware
• Allows GOBI module to take on new carrier identity by keeping firmware files in “files” area of RouterOS.
• Simply change directory setting
• Must POWER CYCLE! (Gobi won’t grab new firmware unless powered off/on)
Ignore-directip-modem

- If set to “NO” – Use direct-ip driver of modem and configure using “LTE” interface tab.
- If set to “YES” – Ignore direct-ip mode and let user select modem channel and use standard PPP interface to interact with the modem.
- PPP mode good if you want to use SMS mode along with data call (assuming modem has multiple channels)
LTE Config: Setup LTE Interface
## LTE Config: Verify Info Channel and Signal

<table>
<thead>
<tr>
<th><strong>Interface</strong></th>
<th><strong>le1</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Status</strong></td>
<td>call in progress</td>
</tr>
<tr>
<td><strong>PIN Status</strong></td>
<td>no password required</td>
</tr>
<tr>
<td><strong>Functionality</strong></td>
<td>full</td>
</tr>
<tr>
<td><strong>Manufacturer</strong></td>
<td>Sierra Wireless, Incorporated</td>
</tr>
<tr>
<td><strong>Model</strong></td>
<td>MC7700</td>
</tr>
<tr>
<td><strong>Revision</strong></td>
<td>SW19200X_03.05.20.03ap r5600 camd-en-10527 2012/11/18 12:06:50</td>
</tr>
<tr>
<td><strong>Serial Number</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Current Operator</strong></td>
<td>AT&amp;T</td>
</tr>
<tr>
<td><strong>Current Cell ID</strong></td>
<td>53960215</td>
</tr>
<tr>
<td><strong>Access Technology</strong></td>
<td>Evolved 3G (LTE)</td>
</tr>
<tr>
<td><strong>Signal Strength</strong></td>
<td>-79 dBm</td>
</tr>
<tr>
<td><strong>Frame Error Rate</strong></td>
<td>n/a</td>
</tr>
<tr>
<td><strong>User Command</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td></td>
</tr>
<tr>
<td><strong>EARFCN</strong></td>
<td>(band B4, channel 2200, bandwidth 10 Mhz)</td>
</tr>
<tr>
<td><strong>IMEI</strong></td>
<td>012626000091999</td>
</tr>
<tr>
<td><strong>IMSI</strong></td>
<td>310410514196395</td>
</tr>
<tr>
<td><strong>UICC</strong></td>
<td>89014103255141963950</td>
</tr>
<tr>
<td><strong>RSSI</strong></td>
<td></td>
</tr>
<tr>
<td><strong>RSRP</strong></td>
<td>-103 dBm</td>
</tr>
<tr>
<td><strong>RSRQ</strong></td>
<td>-10 dB</td>
</tr>
<tr>
<td><strong>SINR</strong></td>
<td>15 dB</td>
</tr>
</tbody>
</table>
LTE Config: DHCP Settings
LTE Gotcha’s

• Upgrading from older RouterOS, LTE Interface may recognize 3G cards as LTE if they have direct-ip support. It may work, it may not --- It is suggested to “ignore direct-ip”

• PPP interface may be created with LTE cards due to the GPS channel being detected by RouterOS. GPS support for direct-ip cards is still a work in progress.
RouterOS 3G/4G PPP Summary

• Add supported 3G/4G device
  – Direct-IP Mode Disable (If Supported)
  – Verify SIM card activated with carrier
• Setup PPP interface, Enabled Advanced Mode
• Setup Data Channel & Info Channel
• Setup APN if required
• Enable Interface
PPP Config: Find Info/Data Channel

[admin@MikroTik] > /system serial-terminal usbl channel=3
[Ctrl-A is the prefix key]

ati
Manufacturer: Sierra Wireless, Incorporated
Model: MC7700
Revision: SWI9200X_03.05.20.03ap r5600 carmd-en-10527 2012/11/18 12:06:50
IMEI: 012626000091999
IMEI SV: 15
FSN: CAH3111017110
3GPP Release 8
+GCAP: +CGSM

OK

[admin@MikroTik] > /system serial-terminal usbl channel=4
[Ctrl-A is the prefix key]

Sierra Wireless, Incorporated
MC7700
APP1

OK
PPP Config: Set Interface Settings

[Image of PPP interface settings with highlighted options: Name, Type, Port, Data Channel, Info Channel, Modem Init, APN, Status, and More options]
PPP Config: PPP Settings
PPP Config: Verify Info Settings
3G Configuration Reminders

- Don’t forget to add a SRC-NAT rule to masquerade your ppp-out1 interface.
- If your carrier charges for connect time, select that you want to dial on demand vs. always on.
- Some carriers will give you private address space, depends on APN you connect to.
- Make sure you are using the default profile and not trying to do encryption.
RouterOS SMS Applications

- RouterOS Supports sending SMS messages by script to any mobile device.
- Only works with GSM/UMTS, Not CDMA
- RouterOS can accept SMS messages and trigger scripts to run
- Applications Include:
  - Remote Router Reboot
  - Check Voltage or Signal Strength and SMS Back
Sending SMS from the Router

- Command line example to send an SMS:
  - `/tool sms send usb2 "29111222" channel=0 message="Help!"`
- SMS can be sent while the port is in-use by other service (PPP or terminal)
Receiving SMS

- Turn on receiving the SMS
  - specify “port” and “channel”
  - set “secret” (required)
  - set “allowed-number” (optional)

- Received SMSs are stored in /tool sms inbox

- SMS message format
  - :cmd SECRET script NAME [[ VAR[=VAL] ] ... ]
• Setting Up SMS
  Receive and Verifying
Troubleshooting

- Can you talk to the modem at all? Try using serial terminal to talk to the modem!
- Disable Direct-IP Mode
- Verify Firmware Directory & Files (GOBI Only)
- Is the SIM card requiring the PIN? Disable PIN request, or, enter your PIN in winbox!
- Consult MikroTik WiKi and any 3G/GPRS AT Command Reference!
A Note on GPS......

- We have successfully tested GPS functions only with the ZTE 2718 module. (Sprint)
- With the correct GPS antenna (passive) attached, we’re able to sync RouterOS time and make it a stratum one time server.
- SNMP GPS data is available to the dude server for asset tracking and monitoring.
References / Live Demonstration

- [http://wiki.mikrotik.com/wiki/Supported_Hardware#3G_cards](http://wiki.mikrotik.com/wiki/Supported_Hardware#3G_cards)
- [http://forum.mikrotik.com](http://forum.mikrotik.com)
- [http://www.mikrotik.com](http://www.mikrotik.com)
- [http://www.balticnetworks.com](http://www.balticnetworks.com)

Thank You!