APPLICATION NOTE:
PPP COMMUNICATION WITH IOCONTROL

Overview

This note describes how to communicate between ioProject controllers (SNAP-LCE and SNAP Ultimate I/O) using PPP. The configuration files and strategy are for SNAP Ultimate I/O Learning Center configurations, but can be easily adapted to any strategy developed for a SNAP-LCE or SNAP Ultmate I/O.

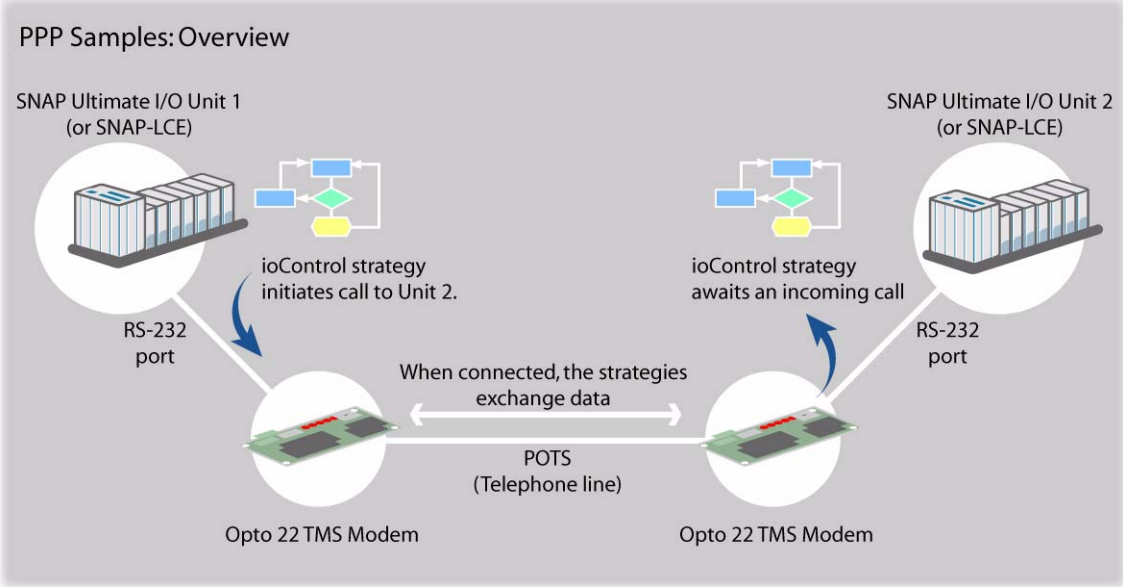


Figure 2-1: The physical architectureuUsed with the sample files

The sample configuration and strategy allow two controllers to communicate by modem, as shown above. In this sample, the two controllers take turns calling each other. The turn to call is determined by values of variables exchanged during each phone call. This sample sends a string between units. Peer-to-peer communication can also be achieved by using Scratch Pad commands through the open connection.

Sample Files

- PPP_Uio1.zip—ioControl strategy for a SNAP Ultimate I/O unit. This strategy initiates the first call.
- PPP_Uio2.zip—ioControl strategy for a SNAP Ultimate I/O unit. This strategy receives the first call.
- PPP_LCE.zip—ioControl strategy for a SNAP-LCE controller. This strategy initiates the first call.

- PPP_UioBrain1.otg—Configuration file for SNAP Ultimate I/O unit; includes sample configuration for PPP with an Opto 22 modem. This configuration is used with the I/O unit that initiates the first call.
- PPP_UioBrain2.otg—Configuration file for SNAP Ultimate I/O unit; includes sample configuration for PPP with an Opto 22 modem. This configuration is used with the I/O unit that receives the first call.

NOTE: The sample strategies are very similar, differing mainly in settings for variables that determine which strategy initiates a call. Pay careful attention to communication handles.

CONFIGURATION

To use PPP on SNAP Ultimate I/O, you must configure the PPP settings in ioManager. You can make these settings in an Opto Tag Database (*.otg) file that is downloaded to the SNAP Ultimate I/O unit, or you can inspect the PPP communications on the I/O unit or controller. This latter method is necessary if you are using a SNAP-LCE.

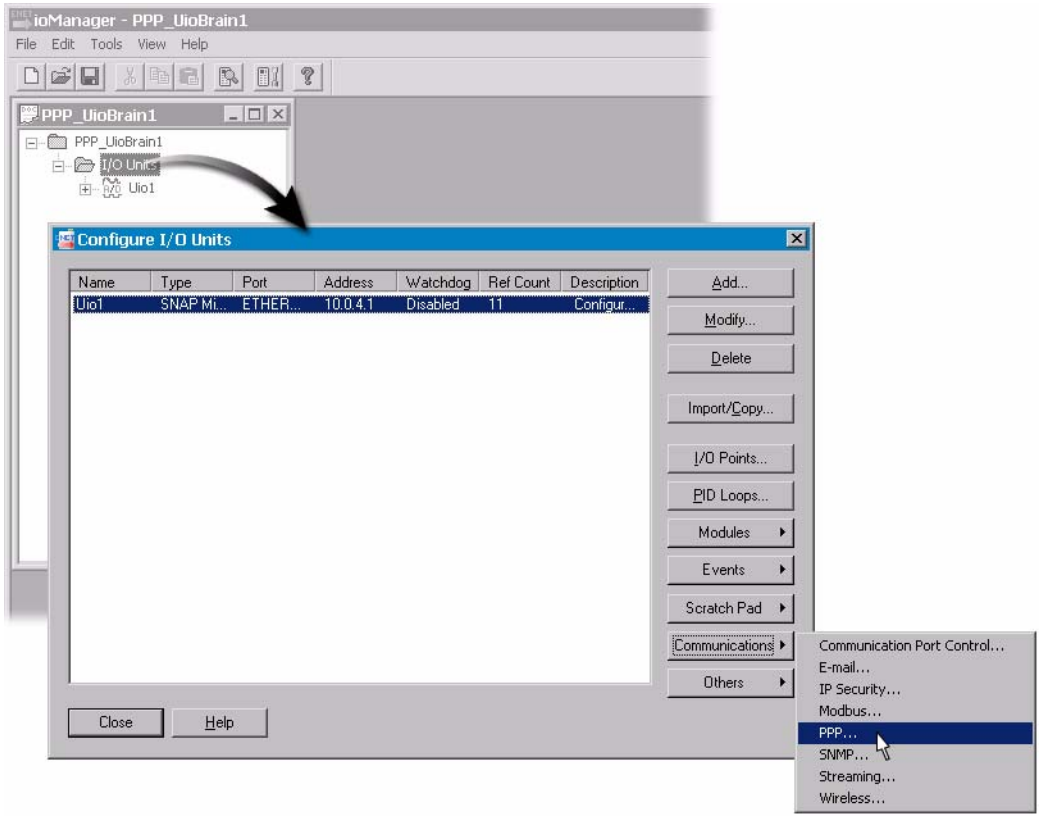
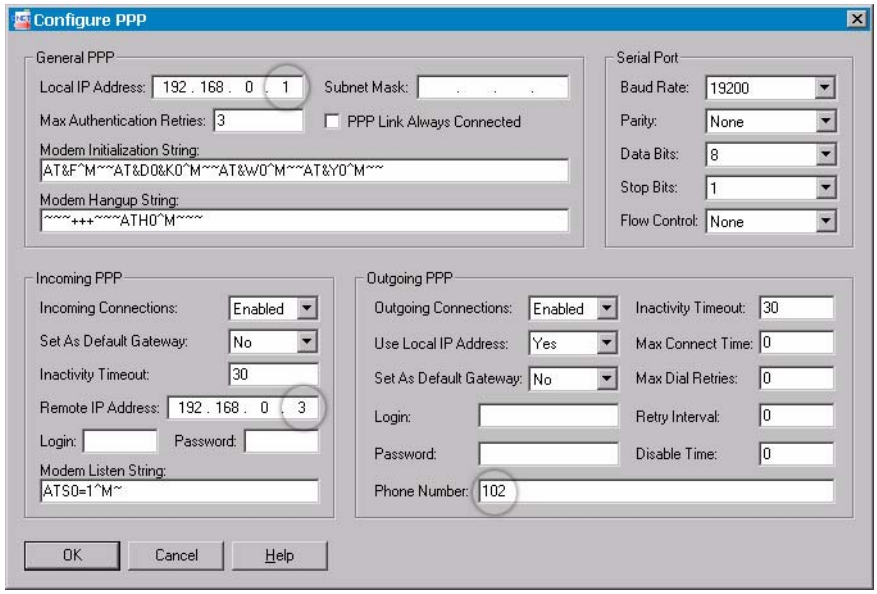


Figure 2-2: Accessing PPP communication settings in sample tag database files.

Configuration for UIO 1 (I/O unit initiating the first call)



Configuration for UIO 2 (I/O unit receiving the first call)

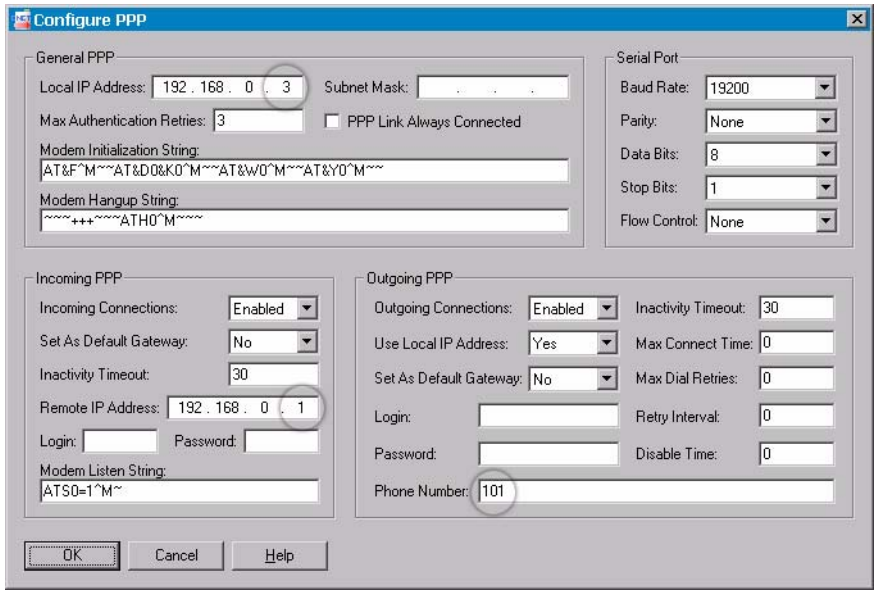


Figure 2-3: PPP configuration settings for SNAP Ultimate I/O

The above screens show the PPP settings for two SNAP Ultimate I/O units using Opto 22 modems. The brains are configured to call each other. Notice that all settings are identical except for Local Address, Remote Address, and Phone Number, which have been highlighted. Replace phone number with the complete phone number including area code and any special calling prefixes. For example, to call 1-951-555-5555, use 19515555555.

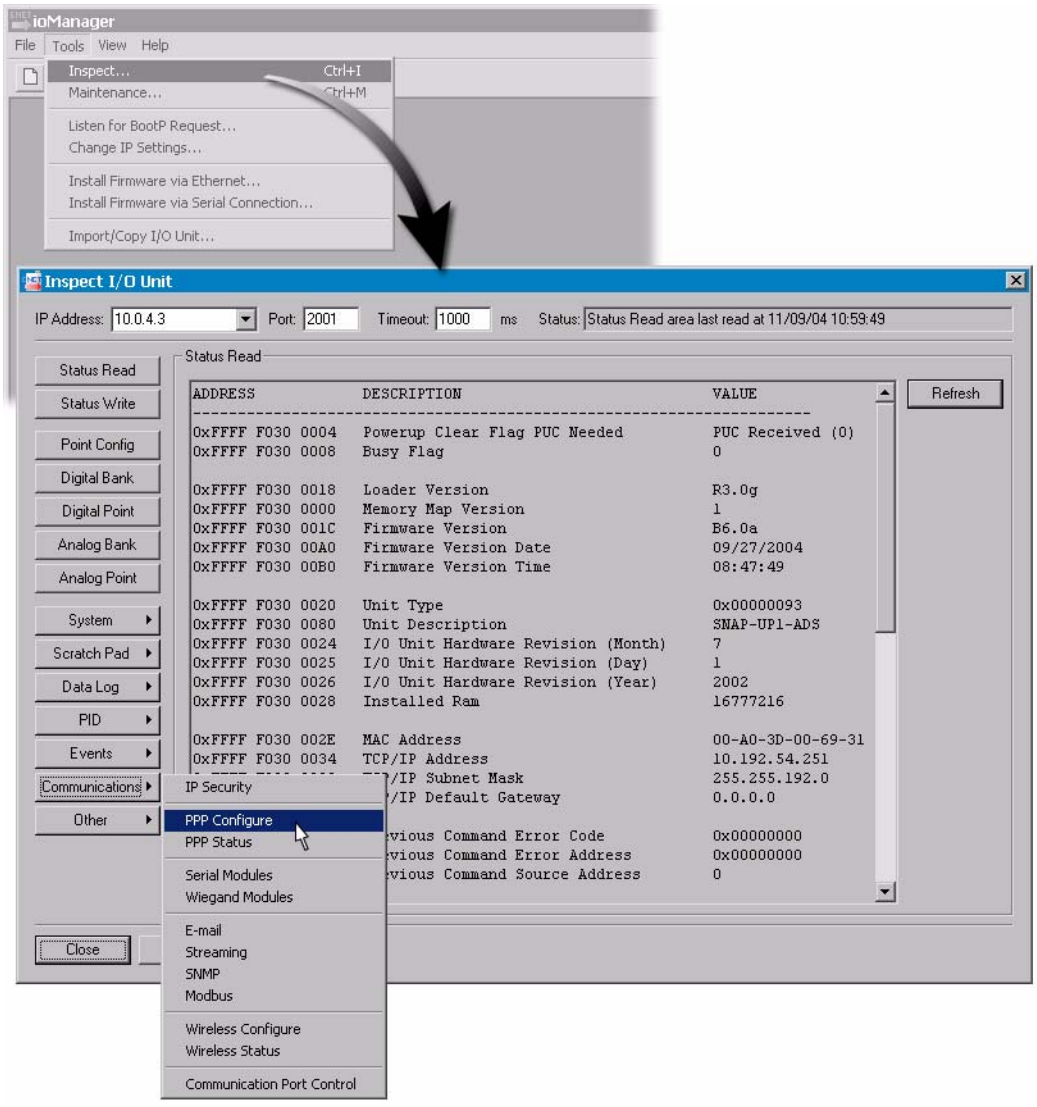


Figure 2-4: Using ioManager to view PPP configuration settings on a SNAP-LCE

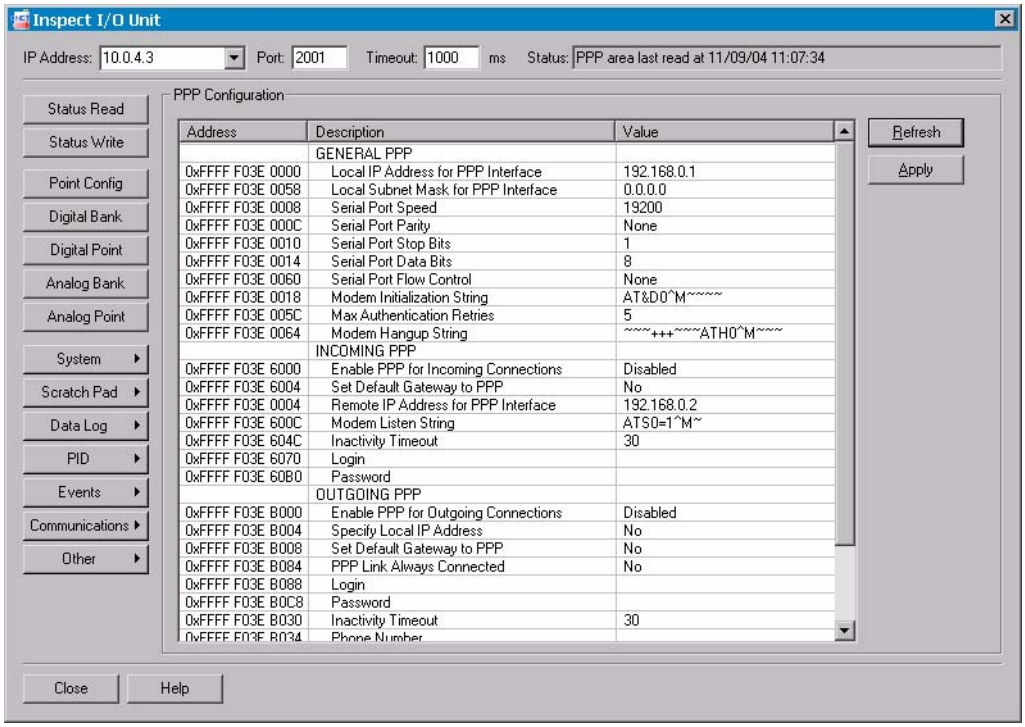
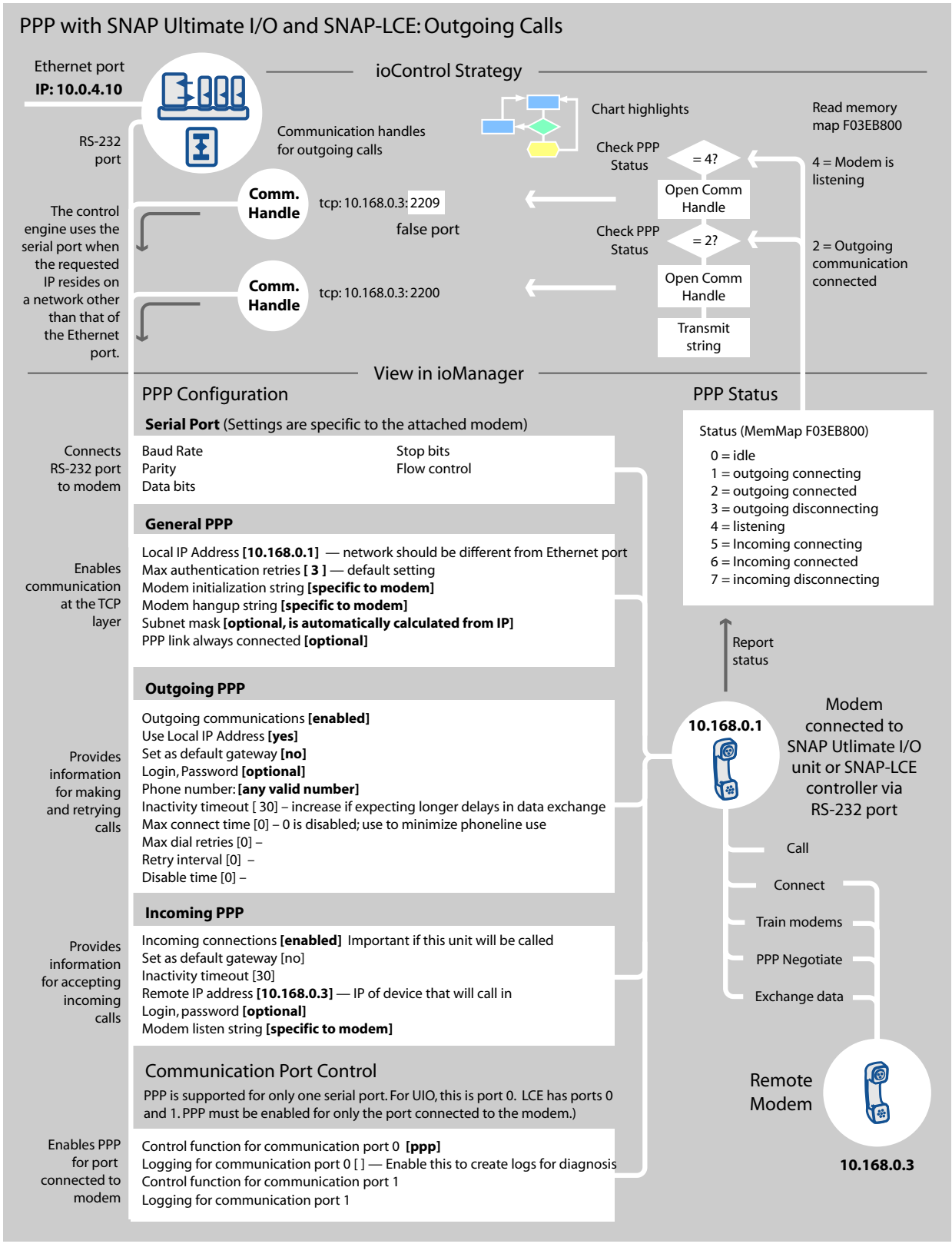


Figure 2-5: PPP Configuration settings for viewed in ioManager's Inspect mode

How the Sample Configuration Works



How the ioControl Sample works

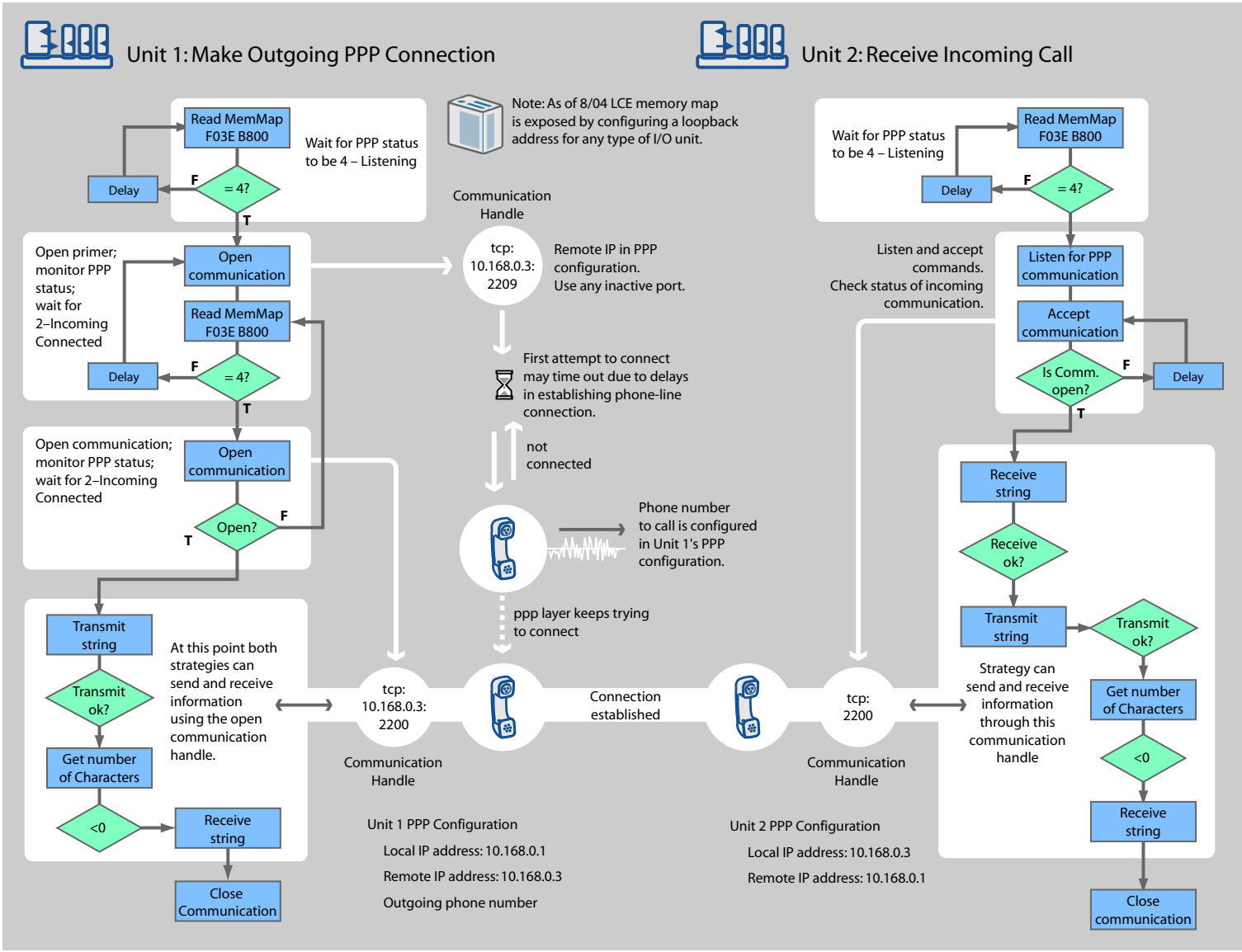


Figure 2-6: Main features of the sample ioControl strategy

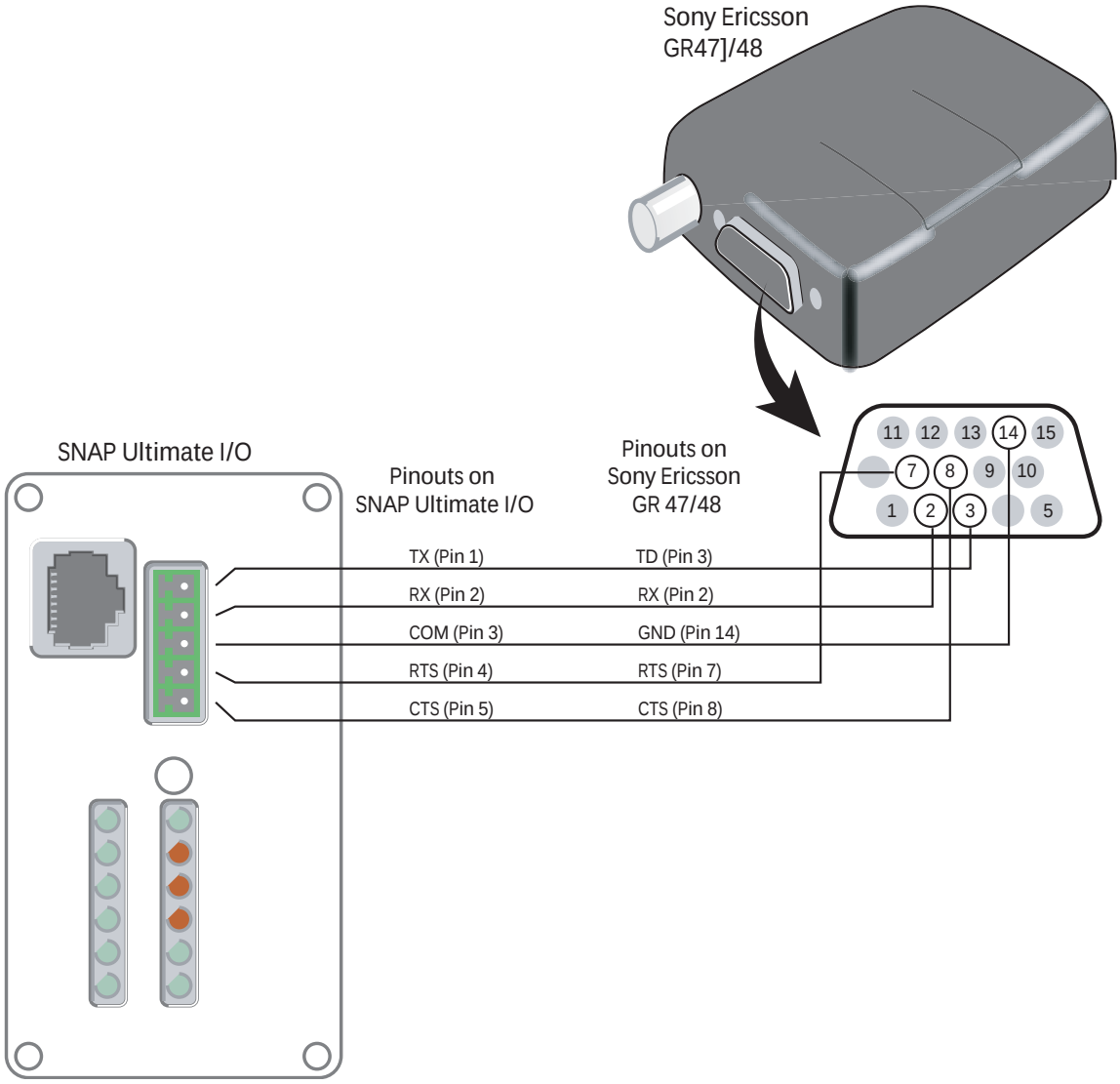
NOTE: Once the connection is established, there are a variety of ways to exchange information. The sample code transmits a string. Other methods include reading or writing to Scratch Pads.

USING A SONY ERICSSON GR47/GR48 WITH SNAP ULTIMATE I/O

The RS-232 port on the SNAP Ultimate I/O or SNAP-LCE can be connected to the 15-pin connector on the Sony Ericsson GR47/GR48 though the pinout connections shown bellow.

The following options are then possible:

- PPP Connection over GSM/GPRS
- SMS Text Messaging
- Email/FTP/SNMP over GSM



BRAIN MODEM CONFIGURATION FOR PPP

Several modems have been tested with the PPP implementation on SNAP Ethernet and SNAP Ultimate I/O units. The following list is a subset of the tested modems. Some modems tested were not included in this list because they have been discontinued or were never released to the public.

OptoTMSModem

This is a POTS modem that works with standard telephone lines.

Brain configuration:

```
Configuring SNAP Ethernet Brain for Use with OPTO TMS Modem and Circuit-switched
Data

Local IP Address for PPP Interface: Application dependent.
Local Subnet Mask for PPP Interface: Application dependent.
Serial Port Speed: 115200
Serial Port Parity: None
Serial Port Stop Bits: 1
Serial Port Data Bits: 8
Serial Port Flow Control: Hardware
Modem Initialization string:
if the OPTO TMS modem is manually configured (and settings stored to nvram)
prior to installation: ATS0=1^M~~
Otherwise, the initialization string must configure the modem and store settings
to nvram as follows: AT&FX1S0=1S37=0&K3&D0^M~AT&W0^M~~AT&Y0^M~ Max
Authentication Retries:5
Modem Hangup string:  = ~~~+++~~~ATH0^M~~~
Incoming PPP:Enabled
Incoming PPP - Set Default Gateway to PPP: Yes
Incoming PPP - Remote IP Address for PPP Interface: Application dependent
Incoming PPP - Modem Listen String: ATS0=1^M~~
Incoming PPP - Inactivity Timeout: Application dependent. Suggested
value is 30s.
Incoming PPP - Login: Application dependent.
Incoming PPP - Password: Application dependent.
Outgoing PPP:Enabled
Outgoing PPP - Specify Local IP Address: Application dependent.
Outgoing PPP - Set Default Gateway to PPP: Yes
Outgoing PPP - PPP Link Always Connected: No
Outgoing PPP - Login: Application dependent.
Outgoing PPP - Password: Application dependent.
Outgoing PPP - Inactivity Timeout: Application dependent. Suggested
value is 15s.
Outgoing PPP - Phone Number: Application dependent.
Outgoing PPP - Max Connect Time: Application dependent. Suggested
value is 60s.
Outgoing PPP - Max Dial Retries: Application dependent. Suggested value is 5.
Outgoing PPP - Retry Interval: Application dependent. Suggested value is 60s.
Outgoing PPP - Disable Time: Application dependent. Suggested value is 600s.
```

Description of the initialization string:
AT&F^M~ATX1S0=1S37=0&K3&D0+MS=V34^M~AT&W0^M~~AT&Y0^M~

Explanation of Commands:

&F - restore factory default settings (start from known state)

X1 - Transmit result codes (Required to interoperate with Opto 22 brain)

S0=1 - Answer on the first ring. This needs to be stored to the device so it will continue to answer even in the rare case that power to it might get cycled but power to the brain is not. In which case, the brain has no way to know that the device needs to have an s0=1 command sent to it.

N1 - Automode detection enabled

S37=0 - Desired Line connection speed set to automode(deprecated, but included for backwards compatibility)

&K3 - Enable hardware (RTS/CTS) flow control

&D0 - ignore DTR (Opto 22 brain serial port does not implement the DTR signal)

&W0 - store these settings to non-volatile memory on the modem, in Profile 0.

&Y0 - Always load profile 0 when rebooting or resetting.

This initialization string was used for testing and integration. The initialization string may need to be modified to integrate the modem with particular applications (for instance, to limit the connection speed, or enable/disable various types of error correction.) To do this, the customer will need access to a document describing the AT commands supported by this modem.

Modem configuration:

Configuring OPTO TMS Modem for Use with SNAP Ethernet Brain and Circuit-switched Data

The following AT commands should be entered into the OPTO TMS Modem:

They can either be entered manually into modem and stored before installation or the brain can be configured to enter them into the modem on powerup. (See associated BrainCfg.txt file for proper init string.)

AT&F

ATX1S0=1N1S37=0&K3&D0

AT&W0

AT&Y0

The last 2 commands store these settings to non-volatile memory in profile 0 and instruct the modem to use profile 0 on power-up and reset.

Explanation of Commands:

&F - restore factory default settings (start from known state)

X1 - Transmit result codes (Required to interoperate with Opto 22 brain)

S0=1 - Answer on the first ring. This needs to be stored to the device so it will continue to answer even in the rare case that power to it might get cycled but power to the brain is not. In which case, the brain has no way to know that the device needs to have an s0=1 command sent to it.

N1 - Automode detection enabled

S37=0 - Desired Line connection speed set to automode (deprecated, but included for backwards compatibility)

&K3 - Enable hardware (RTS/CTS) flow control

&D0 - ignore DTR (Opto 22 brain serial port does not implement the DTR signal)

```
&W0 - store these settings to non-volatile memory on the modem, in Profile 0.
&Y0 - Always load profile 0 when rebooting or resetting.
```

Motorola ir1200

This is a wireless modem that works with the iDEN standard used by Nextel.

Brain configuration (cct-sw-dat):

```
Configuring SNAP Ethernet Brain for Use with Motorola ir1200 and Circuit-
switched Data

Local IP Address for PPP Interface: Application dependent.
Local Subnet Mask for PPP Interface: Application dependent.
Serial Port Speed: 115200 (for EIO and UIO 5307, for UIO 5407 use 57600)
Serial Port Parity: None
Serial Port Stop Bits: 1
Serial Port Data Bits: 8
Serial Port Flow Control: Hardware
Modem Initialization string: ATS0=1^M~~
Max Authentication Retries:5
Modem Hangup string:  = ~~~+++~~~ATH0^M~~~
Incoming PPP:Enabled
Incoming PPP - Set Default Gateway to PPP: Yes
Incoming PPP - Remote IP Address for PPP Interface: Application dependent
Incoming PPP - Modem Listen String: ATS0=1^M~~
Incoming PPP - Inactivity Timeout: Application dependent. Suggested
value is 30s.
Incoming PPP - Login: Application dependent.
Incoming PPP - Password: Application dependent.
Outgoing PPP:Enabled
Outgoing PPP - Specify Local IP Address: Application dependent.
Outgoing PPP - Set Default Gateway to PPP: Yes
Outgoing PPP - PPP Link Always Connected: No
Outgoing PPP - Login: Application dependent.
Outgoing PPP - Password: Application dependent.
Outgoing PPP - Inactivity Timeout: Application dependent. Suggested
value is 15s.
Outgoing PPP - Phone Number: Application dependent.
Outgoing PPP - Max Connect Time: Application dependent. Suggested
value is 60s.
Outgoing PPP - Max Dial Retries: Application dependent. Suggested value is 5.
Outgoing PPP - Retry Interval: Application dependent. Suggested value is 60s.
Outgoing PPP - Disable Time: Application dependent. Suggested value is 600s.
```

Modem configuration (cct-sw-dat):

```
Nextel iR1200 (Circuit Switched Data Mode) (This is the default shipping mode)

Configuration Programmed into iR1200 modem prior to connecting it to the brain.

ats0=1s7=120s30=0v1x4q0e0&c1&d0
at+icf=3,0
```

```
at+ifc=2,2
at+IPR=115200  (For EIO, or UIO 5307), for UIO 5407 use at+IPR=57600
at+ws45=0
at+ws46=23
at&W0
at&w2
at&y0
ERROR
atz
OK
at&v
Active User Image: 0
E0 Q0 V1 X4 &C1 &D0  &K0
S0:001 S2:043 S3:013 S4:010  S5:008  S6:010
S7:120 S8:002 S9:006 S10:014 S12:050 S30:000
+IFC     : 2,2                 : Flow Control
+ICF     : 3,0                 : Character Framing
+FCLASS  : 0                   : Service Class
+WS45    : 0                   : DTE-Side Stack
+WS46    : 23                  : WDS-Side Stack
```

Brain configuration (pkt-sw-dat):

```
Brain Configuration:

Local IP Address for PPP Interface: n/a
Local Subnet Mask for PPP Interface: n/a
Serial Port Speed: 115200 (for EIO and UIO 5307, for UIO 5407 use 57600)
Serial Port Parity: None
Serial Port Stop Bits: 1
Serial Port Data Bits: 8
Serial Port Flow Control: Hardware
Modem Initialization string:
Max Authentication Retries:5
Modem Hangup string: ^t~~~+++~~~ATH^M~~~
Incoming PPP: Disabled
Incoming PPP - Set Default Gateway to PPP: n/a
Incoming PPP - Remote IP Address for PPP Interface: n/a
Incoming PPP - Modem Listen String: n/a
Incoming PPP - Inactivity Timeout: n/a
Incoming PPP - Login: n/a
Incoming PPP - Password: n/a
Outgoing PPP:Enabled
Outgoing PPP - Specify Local IP Address: No
Outgoing PPP - Set Default Gateway to PPP: Yes
Outgoing PPP - PPP Link Always Connected: Yes
Outgoing PPP - Login: Application dependent.
Outgoing PPP - Password: Application dependent.
Outgoing PPP - Inactivity Timeout: 0
Outgoing PPP - Phone Number: "s=2"
Outgoing PPP - Max Connect Time: 0
Outgoing PPP - Max Dial Retries: 0
Outgoing PPP - Retry Interval: 0
```

```
Outgoing PPP - Disable Time: 0

Testing with Nextel's packet switched service suggested the outgoing login and
password can be anything.
```

Modem configuration (pkt-sw-dat):

```
Nextel iR1200 Modem (Packet Switched Data Mode)

If there is an IP address (out of the box):
Atz2
at+IPR=115200  (For EIO, or UIO 5307), for UIO 5407 use at+IPR=57600
AT+IFC=2,2
At&d0e0
At&w2
No master reset is necessary
```

MultTech MultiModem MTCBA-C

```
This is a wireless modem that works with the CDMA standard. This modem is
specifically configured for SPRINT. A similar model is available that is
configured for Verizon.
```

Brain configuration and modem configuration for both cct-sw-dat and pkt-sw-dat:

```
MTCBA-C
MultiModem - CDMA Wireless Modem

0. Specifications
Power: 5-32V DC, 400mA avg, 700mA maximum current @ 5V

Operating Temperature: -30C to +70C

0.5 Activation.
Multitech provided the following instructions for activation:
The following numbers must be provided by your SPRINT agent to
complete OTA activation:

MDN (10 digit phone number),
MSID (another 10
digit number),
OTKSL (6 digit lock code, also known as SPC or Service
Programming Code.)

e.g.
MDN     619.804.7312
MSID    760.612.2162
OTKSL(SPC)  002258

These are entered as follows:
AT+WSPC=1,<SPC> ==> OK
AT+WMDN=<MDN> ==>OK
AT+WCMT=1 ==>OK
```

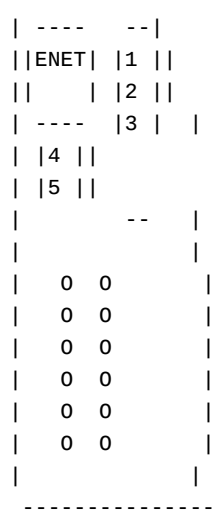
```
wait for 10 seconds before issuing next command.
AT+WSPC=1,<SPC> ==>OK
AT+WIMI=31000<MSID> ==> OK
AT+WCMT=1 ==>OK
wait for 10 seconds before issuing next command.
AT+WIOTA=4 ==> OK to clear any previous IOTA attempts
AT+WIOTA=1 ==>;+WOAP
           ==>"Preparing Data Services"
   ==>OK
   this requires 3 minutes to complete.
           ==>;+WOAR:"Please Retry"

Here's the return:
aatt++WWIIOOTTAA==11
+WOAP:"Preparing Data Services"

OK

+WOAE:"IOTA error 1012"

**** attempt manual activation: Manual activation requires the following
additional parameters:
AAA Shared Secret
NAI
HA Primary IP
HA Secondary IP

e.g.
AAA Shared Secret is: opto22
NAI is: telemetryurgentod244@sprintpcs.com
HA Primary IP: 68.28.57.77
HA Secondary IP: 68.28.49.77
HA SS should be set to: secret
Make sure these changes are in the Profile 1 and this profile is active.

These are entered as follows:
at$qcmipp=0
at$qcmipep=0
at$qcmipp=1
at$qcmipnai=<NAI>,1
at$qcmipmass=<AAA shared secret>,1
at$qcmippha=<HA Primary IP>,1
at$qcmipsha=<HA Secondary IP>,1
at$qcmipep=1
at$qcmip=2


1. Installation

Antenna: dual band cellular/PCS w/SMA connector
Power Connector: 2.5mm miniature power jack

LED Indicators
```

TD. Transmit Data. Lit when modem is transmitting data.
RD. Receive Data. Lit when modem is receiving data.
CD. Carrier Detect. Lit when data connection has been established.
LS. Line Status. Continuous on state indicates that the wireless modem is not registered on the network.
Flashing state indicates registration on network.
Off state. Modem is off (not ready) or in download mode.
TR. Terminal Ready. Commonly called Data Terminal Ready. This is a readiness signal from the PC.
PWR. Power. Indicates presence of DC power when lit.

Modem RS-232 15 connector pinout

PIN EIA CCIT Designation
1 DCD 109 Data Carrier Direct
6 RX 104 Receive Data (out)
2 TX 103 Transmit Data
8 DTR 108.2 Data Terminal Ready
9 GND Signal Ground
7 DSR 107 Data Set Ready
12 RTS 105 Request to Send
11 CTS 106 Clear to Send
RS 232
13 RI 125 Ring Indicator
4 MICROPHONE(+)
5 MICROPHONE (-)
10 SPEAKER (+)Audio
15 SPEAKER (-)
14 RESET To reset, connect to GND momentarily. Open for normal operation.

Brain RS-232 port pin diagram



```
Communication Cable Diagram
MTCBA-C              Brain RS-232 port
pin               pin
2 ----------------- 1 TD
6 ----------------- 2 RD
9 ----------------- 3 GND
11----------------- 5 CTS !
12----------------- 4 RTS !


2. Brain Configuration for packet-switched data bearer

IMPORTANT: This modem is compatible with brain firmware R5.1g and higher when
used with packet-switched data bearer services

If modem is connected to serial port on top of brain, make sure:
0xFFFF F031 0400 Control Function for Communication Port 0 = PPP (1)
0xFFFF F031 0408 Control Function for Communication Port 1 = not PPP

If modem is connected to serial port on rack,
0xFFFF F031 0400 Control Function for Communication Port 0 = not PPP
0xFFFF F031 0408 Control Function for Communication Port 1 = PPP (1)

Also, the following settings should be used for the PPP Configure fields:

Local IP Address for PPP Interface: N/A, the 1xRTT network will dynamically
assign an IP address to the module when it attaches to the network.

Local Subnet Mask for PPP Interface: N/A
Serial Port Speed: 115200
Serial Port Parity: None
Serial Port Stop Bits: 1
Serial Port Data Bits: 8
Serial Port Flow Control: Hardware
Modem Initialization string: ATE0&D0^M~~AT&W^M~~
Max Authentication Retries:5
Modem Hangup string: ^t~~~~~+++~~~~~ATH^M~~AT^M~~ATE0&D0^M~~

Incoming PPP:Disabled
All other incoming PPP fields: N/A

Outgoing PPP:Enabled
Outgoing PPP - Specify Local IP Address: No
Outgoing PPP - Set Default Gateway to PPP: Yes
Outgoing PPP - PPP Link Always Connected: Yes
Outgoing PPP - Login& Outgoing PPP - Password: The value of these
fields depends on the wireless carrier.

For instance, for Verizon Wireless these values are:

Login: 10digitphonenumber@vzw3g.com
where 10digitphonenumber is the 10 digit phone number assigned to the
```

```
module. For instance 9095554444@vzw3g.com.
Password:vzw

For Sprint, Login and Password should be left blank.

Outgoing PPP - Inactivity Timeout: 0
Outgoing PPP - Phone Number: #777
Outgoing PPP - Max Connect Time: 0
Outgoing PPP - Max Dial Retries: 0
Outgoing PPP - Retry Interval: 0
Outgoing PPP - Disable Time: 0


3. Brain configuration - circuit switched data bearer

If modem is connected to serial port on top of brain, make sure:
0xFFFF F031 0400 Control Function for Communication Port 0 = PPP (1)
0xFFFF F031 0408 Control Function for Communication Port 1 = not PPP

If modem is connected to serial port on rack,
0xFFFF F031 0400 Control Function for Communication Port 0 = not PPP
0xFFFF F031 0408 Control Function for Communication Port 1 = PPP (1)

Also, the following settings should be used for the PPP Configure
fields:
Local IP Address for PPP Interface: Application dependent.
Local Subnet Mask for PPP Interface: Application dependent.
Serial Port Speed: 115200
Serial Port Parity: None
Serial Port Stop Bits: 1
Serial Port Data Bits: 8
Serial Port Flow Control: Hardware
Modem Initialization string: ATE0&D0S0=1$QCVAD=4^M~~AT&W^M~~
Max Authentication Retries:5
Modem Hangup string: ~~~+++~~~ATH0^M~~AT^M~~ATE0&D0S0=1$QCVAD=4^M~
Incoming PPP:Enabled
Incoming PPP - Set Default Gateway to PPP: Yes
Incoming PPP - Remote IP Address for PPP Interface: Application
dependent.
Incoming PPP - Modem Listen String: ATE0&D0S0=1$QCVAD=4^M~~
Incoming PPP - Inactivity Timeout: Application dependent. Suggested
value is 30s.
Incoming PPP - Login: Application dependent.
Incoming PPP - Password: Application dependent.
Outgoing PPP:Enabled
Outgoing PPP - Specify Local IP Address: Application dependent.
Outgoing PPP - Set Default Gateway to PPP: Yes
Outgoing PPP - PPP Link Always Connected: No
Outgoing PPP - Login: Application dependent.
Outgoing PPP - Password: Application dependent.
Outgoing PPP - Inactivity Timeout: Application dependent. Suggested
value is 15s.
```

Outgoing PPP - Phone Number: Application dependent.
Outgoing PPP - Max Connect Time: Application dependent. Suggested value is 60s.
Outgoing PPP - Max Dial Retries: Application dependent. Suggested value is 5.
Outgoing PPP - Retry Interval: Application dependent. Suggested value is 60s.
Outgoing PPP - Disable Time: Application dependent. Suggested value is 600s.

4. Modem bugs

1. Impacts CSD. &D, E etc. cfg stored to NVRAM do not survive power cycle or +CFUN.
This is a bug. ATZ re-applies settings from NVRAM. We include important settings in the dial string, hangup string and initialization string to ensure they are utilized; however, if power to the modem is cycled (for instance while it is listening for incoming calls) without power to the brain cycling, these important settings will be lost.

SonyEricsson GT-48

This is a wireless modem that works with the GSM standard.

Modem configuration (pkt-sw-dat):

Configuring Sony Ericsson GT48 for use with SNAP Ethernet Brain and GPRS bearer

The following AT command should be entered into the GT48:
AT&F (sets baud to 9600bps)
ATE0Q0&D0
AT+IPR=57600 (sets baud to 57600bps, unit does not appear to operate correctly at 115200bps)
// this next line is only required if you need to use an APN that is not default
// for your account
AT+CGDCONT=1,"IP","yourapnname"
AT&W

Note: The GT48 does not require the DTR toggle (or TO_IN tied hi) as the GM28. It turns on as soon as power is applied. However, if AT+CFUN or hold TO_IN to grnd is used to shut the modem off, then TO_IN must be toggled to grnd or DTR low to high to start modem back up.
Device doesn't implement LCP Echo Request/Response. Returns Code reject to the brain. This code reject as interpreted as an LCP echo response.

Brain configuration (pkt-sw-dat):

Configuring SNAP Ethernet Brain for Use with Sony Ericsson GT48 and GPRS bearer

0xFFFF F03E 0000 Local IP address for PPP interface = n/a
0xFFFF F03E 0058 Local Subnet Mask for PPP interface = n/a
0xFFFF F03E 0008 Serial Port Speed = 57600
0xFFFF F03E 000C Serial port parity = None
0xFFFF F03E 0010 Serial port stop bits = 1

```
0xFFFF F03E 0014 Serial port data bits  = 8
0xFFFF F03E 0060 Serial Port Flow Control = Hardware
0xFFFF F03E 0018 Modem Initialization String =
where apnname should be replaced with the name of the apn you are using.
0xFFFF F03E 005C Max authentication retries = 3
0xFFFF F03E 0064 Modem Hangup String = ^t~~~+++~~~ATH0^M~~~
0xFFFF F03E 6000 Enable for Incoming= Disabled
0xFFFF F03E 600C Modem Listen String = n/a
0xFFFF F03E B000 Outgoing PPP= Enabled
0xFFFF F03E B004 Specify local IP address = No
0xFFFF F03E B008 Set default gateway to PPP = Yes
0xFFFF F03E B084 PPP link always connected = Yes
0xFFFF F03E B088 Login = depends on policy of access point
0xFFFF F03E B0C8 Password = depends on policy of access point
0xFFFF F03E B030 Inactivity timeout = 0
0xFFFF F03E B034 Phone number  = *99***1#
0xFFFF F03E B074 Max connect time = 0
0xFFFF F03E B078 Max dial retries = 0
0xFFFF F03E B07C Retry interval = 0
0xFFFF F03E B080 Disable time = 0
```