Application Note 32

Using SNA/IP in RAW mode over IPsec

UK Support

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Contents

1 INTRODUCTION

1.1 Outline

This document describes how to configure two Digi TransPort routers to forward synchronous layer 2 data to each other via an IPsec encrypted link using SNA/IP in RAW mode. Layer 2 frames entering the synchronous serial port ("Sync Port") on one TransPort router are transparently forwarded over the IPsec tunnel to exit the Sync Port on the other TransPort router.

SNA is a proprietary, now legacy, networking protocol stack created by IBM in 1974: http://en.wikipedia.org/wiki/IBM_Systems_Network_Architecture

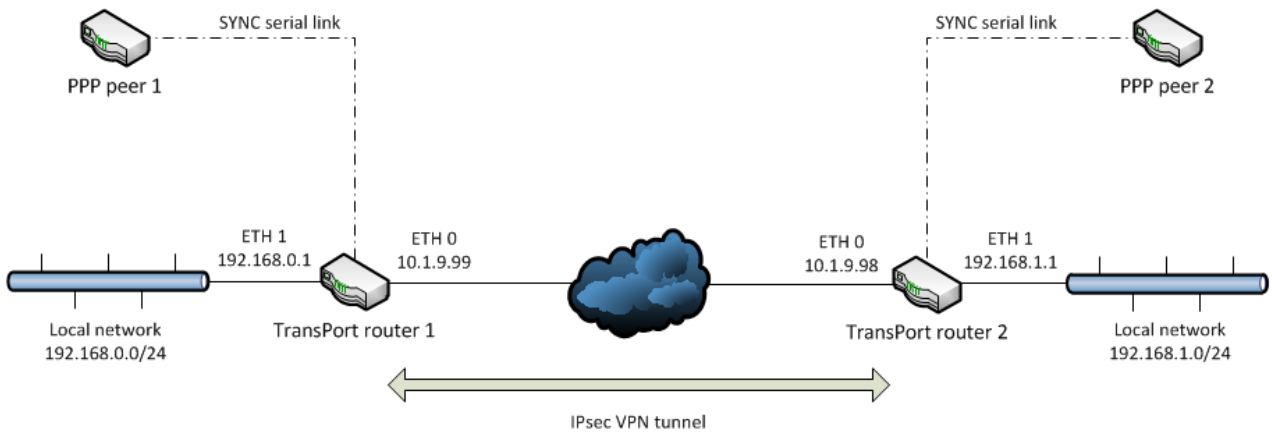
The Data-Link Switching (DLSw) tunnelling protocol is designed to tunnel un-routable (i.e. non-IP) protocols such as SNA over an IP network: http://en.wikipedia.org/wiki/Dlsw

SNA/IP (or "SNA over IP") functionality in TransPort routers uses the DLSw protocol to tunnel non-IP traffic over an IP network. In SNA/IP (DLSw) mode, to keep the traffic down to a minimum, only indications of state, status changes and layer 3 data are transmitted over the link. This is because SNA/IP mode traffic is mostly "poll-response", and keeping this off the link improves the responsiveness and reduces traffic load.

SNA/IP is used in RAW mode in this example. RAW mode means that every layer 2 frame sent into the Sync Port of TransPort router 1 will be sent across the IP link and will exit the Sync Port on TransPort router 2. Therefore SNA/IP in RAW mode can be used to send any layer 2 data over an IP network.

In a real world application the end devices could be any devices communicating with each other via any layer 2 protocol.

In this particular example PPP is used as the layer 2 protocol for communication between the end devices, which are referred to as "PPP peers":



The devices used as PPP peers during the testing of this Application Note were two additional TransPort routers, each with a synchronous serial port. Each PPP peer was connected to TransPort router 1 or 2 via a synchronous crossover serial cable.

Please note that in the remainder of this document the term “TransPort routers” refers to TransPort routers 1 and 2 in the diagram, which are providing the IPsec link for the end devices, which are referred to as “PPP peers”.

1.2 Assumptions

This guide has been written for use by technically competent personnel with a good understanding of the communications technologies used in the product, and of the requirements for their specific application.

The TransPort routers must have SNA/IP functionality enabled. Please note that this is **not** included as standard, but is available as an option on some models. Please contact uksupport@digi.com for further information.

The TransPort routers also need IPsec encryption functionality to be enabled. This is enabled as standard on some models, but is optional on other models. Please contact uksupport@digi.com for further information.

The configuration described in this Application Note assigns ETH 0 on each TransPort router as the WAN interface of each device. ETH 1 (logical) is designated as each router's LAN interface.

This Application Note applies to:

Model: Digi TransPort WR41v2 with SNA/IP functionality and IPsec encryption enabled

Other Compatible Models: Other Digi TransPort models with SNA/IP functionality and IPsec encryption enabled

Firmware versions: 5.123 and later

Configuration: This Application Note assumes that the devices are set to their factory default configurations. Most configuration commands are shown only if they differ from the factory default.

1.3 Corrections

Requests for corrections or amendments to this application note are welcome and should be addressed to: Tech.Support@digi.com

Requests for new application notes can be sent to the same address.

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1.4 Version

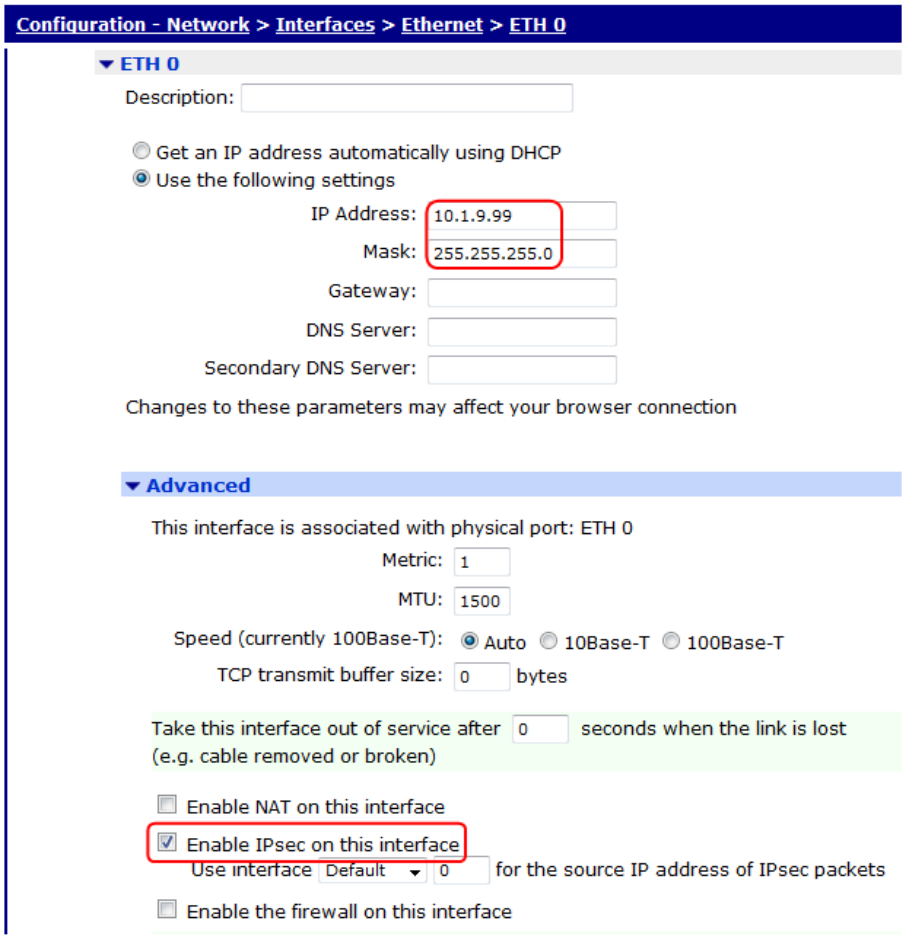
Version	Status
0.2	Published
1.0	Updated for new web GUI

2 CONFIGURATION

2.1 Configure WAN ethernet interfaces

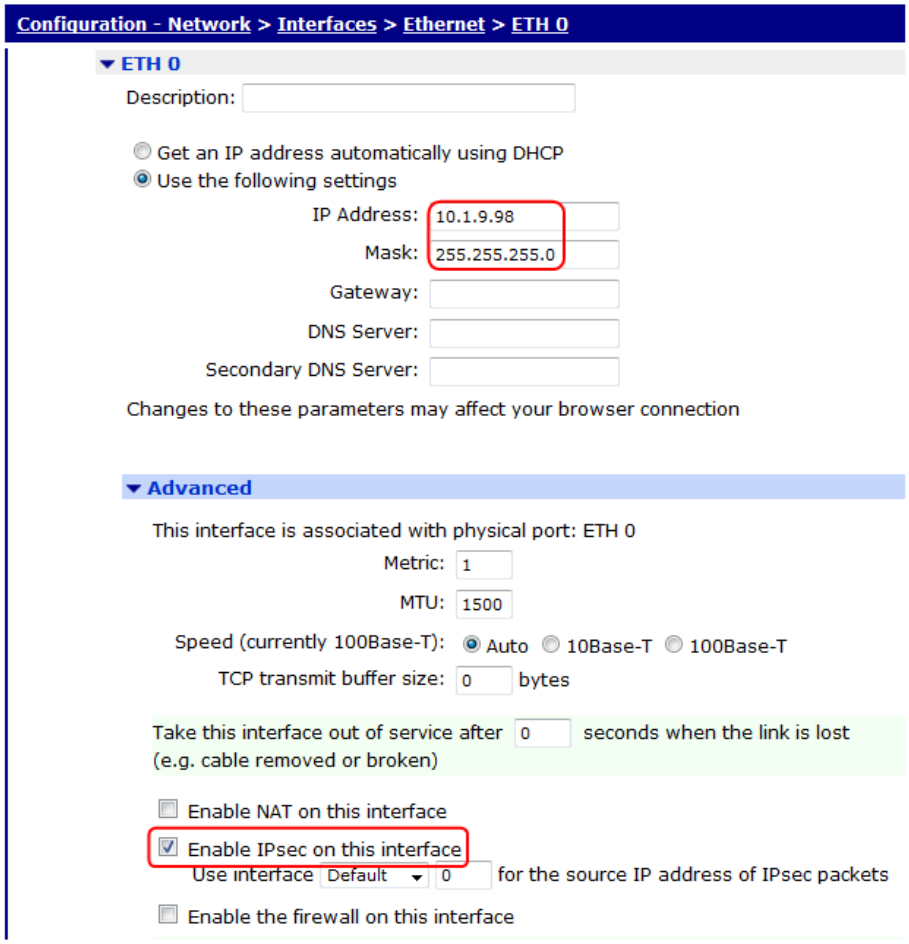
CONFIGURATION - NETWORK > INTERFACES > ETHERNET > ETH 0

2.1.1 Settings for TransPort router 1



Parameter	Setting	Description
IP Address	10.1.9.99	IP address assigned to ETH 0
Mask	255.255.255.0	Mask assigned to ETH 0
Enable IPsec on this interface	Ticked	Tick to enable IPsec

2.1.2 Settings for TransPort router 2

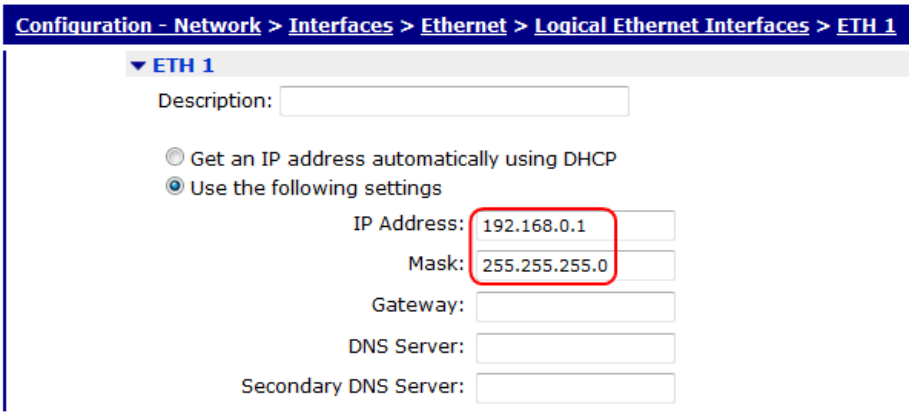


Parameter	Setting	Description
IP Address	10.1.9.98	IP address assigned to ETH 0
Mask	255.255.255.0	Mask assigned to ETH 0
Enable IPsec on this interface	Ticked	Tick to enable IPsec

2.2 Configure LAN (logical) ethernet interfaces

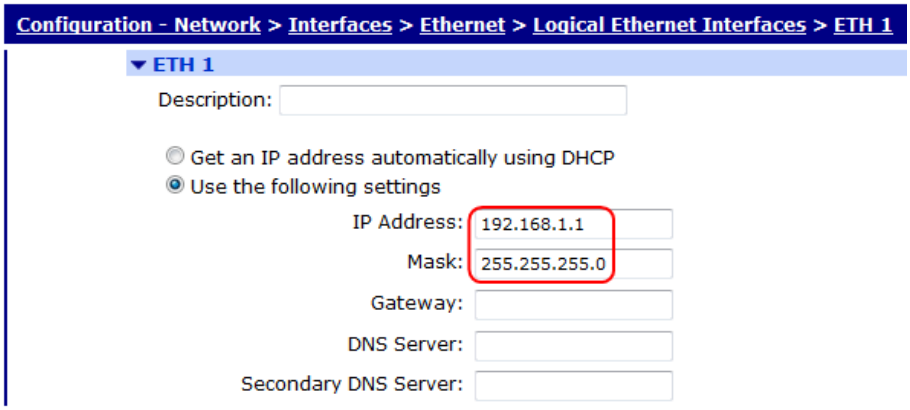
CONFIGURATION - NETWORK > INTERFACES > ETHERNET > LOGICAL ETHERNET INTERFACES > ETH 1

2.2.1 Settings for TransPort router 1



Parameter	Setting	Description
IP Address	192.168.0.1	IP address assigned to ETH 1
Mask	255.255.255.0	Mask assigned to ETH 1

2.2.2 Settings for TransPort router 2



Parameter	Setting	Description
IP Address	192.168.1.1	IP address assigned to ETH 1
Mask	255.255.255.0	Mask assigned to ETH 1

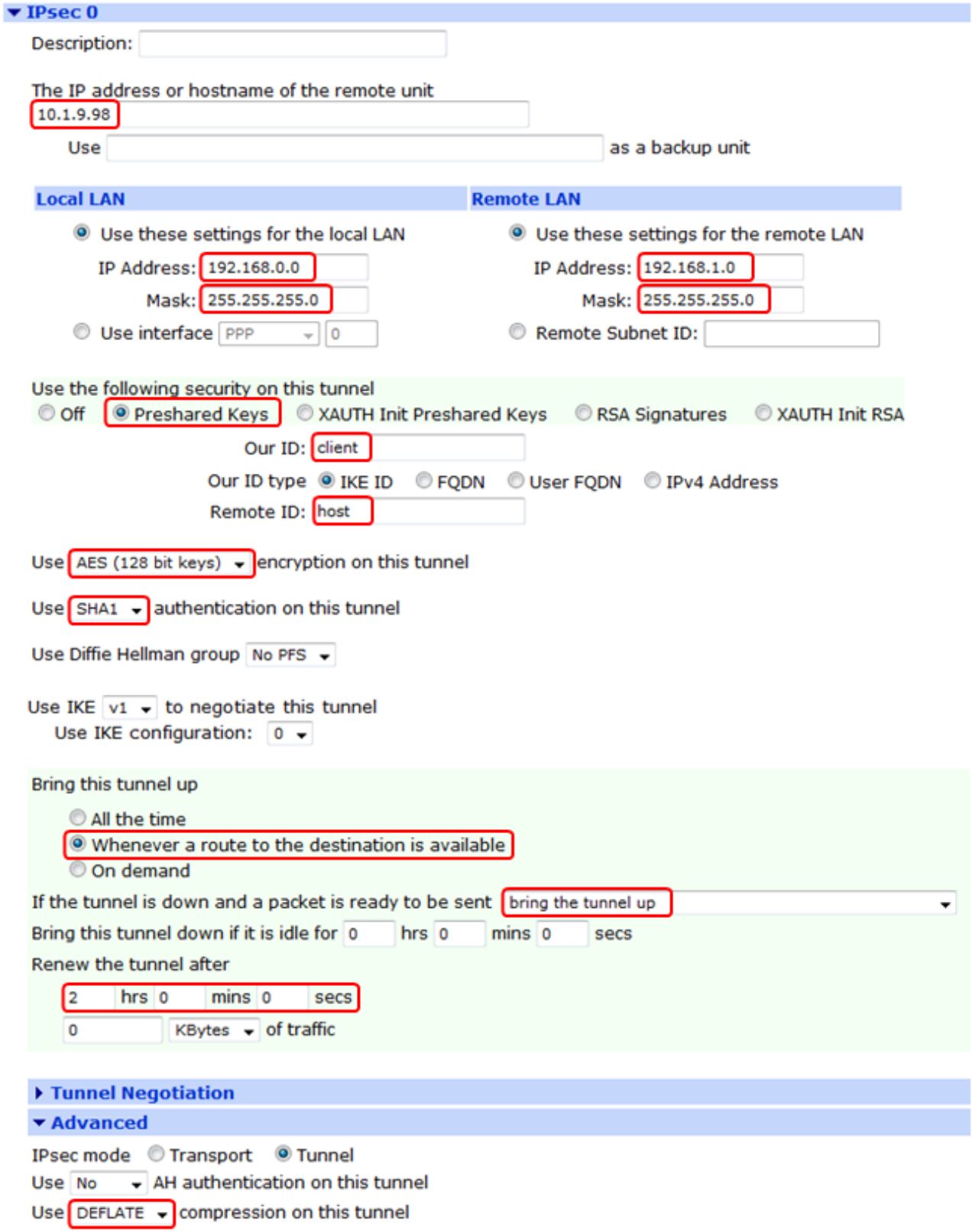
2.3 Configure IPsec

2.3.1 Settings for TransPort router 1

CONFIGURATION - NETWORK > VIRTUAL PRIVATE NETWORKING (VPN) > IPSEC > IKE > IKE 0

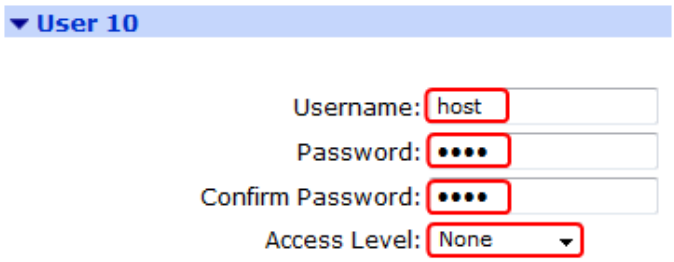
Parameter	Setting	Description
Encryption	3DES	Encryption algorithm
Authentication	SHA1	Authentication algorithm
Mode	Aggressive	Initiation mode
Renegotiate after	2 hours	Lifetime of the IKE session

CONFIGURATION-NETWORK > VIRTUAL PRIVATE NETWORKING (VPN) > IPSEC > IPSEC TUNNELS > IPSEC 0



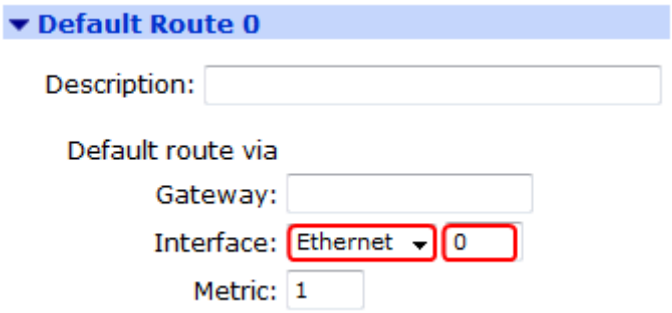
Parameter	Setting	Description
Peer IP/hostname	10.1.9.98	Remote WAN IP address
Local LAN IP address	192.168.0.0	Local ETH 1 (LAN) address
Local LAN mask	255.255.255.0	Local ETH 1 (LAN) mask
Remote LAN IP address	192.168.1.0	Remote ETH 1 (LAN) address
Remote LAN mask	255.255.255.0	Remote ETH 1 (LAN) mask
Security method	Preshared Keys	
Our ID	client	
Remote ID	host	
Encryption	AES 128	
Authentication	SHA1	
Bring this tunnel up	Whenever a route to the destination is available	This router will initiate the tunnel negotiation
If the tunnel is down	Bring the tunnel up	
Renew then tunnel after	2 hours	
Compression method	DEFLATE	

CONFIGURATION - SECURITY > USERS > USER 10 - 14 > USER 10



Parameter	Setting	Description
Username	host	ID of TransPort router 2
Password	test	The preshared key
Confirm Password	test	The preshared key
Access Level	None	No access level required for a preshared key

CONFIGURATION - NETWORK > IP ROUTING/FORWARDING > STATIC ROUTES > DEFAULT ROUTE 0



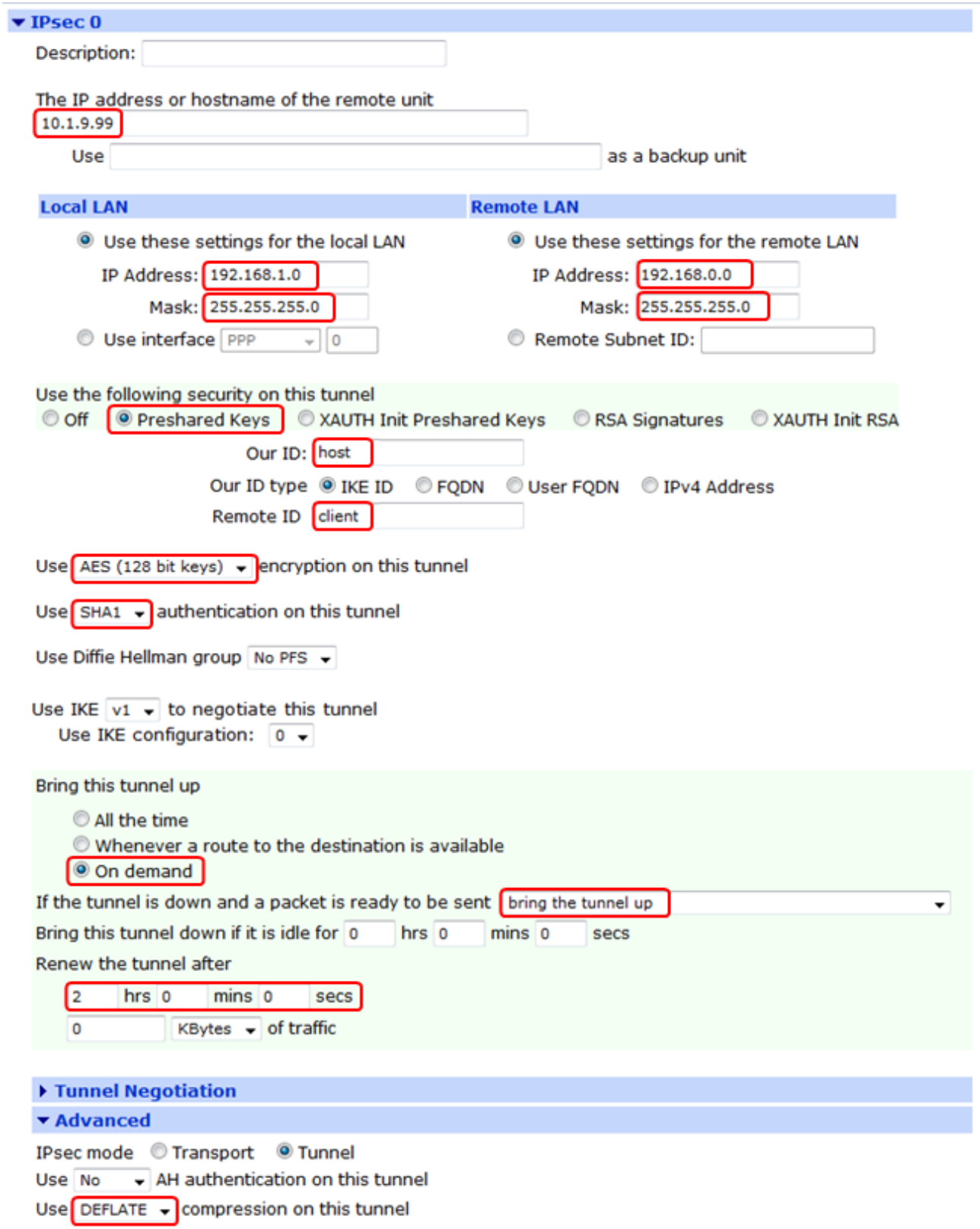
Parameter	Setting	Description
Interface name	Ethernet	Configure the default route to be via ETH 0
Interface number	0	Configure the default route to be via ETH 0

2.3.2 Settings for TransPort router 2

CONFIGURATION - NETWORK > VIRTUAL PRIVATE NETWORKING (VPN) > IPSEC > IKE > IKE 0

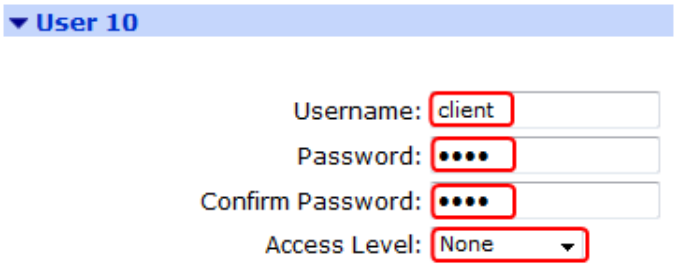
Parameter	Setting	Description
Encryption	3DES	Encryption algorithm
Authentication	SHA1	Authentication algorithm
Mode	Aggressive	Initiation mode
Renegotiate after	2 hours	Lifetime of the IKE session

CONFIGURATION-NETWORK > VIRTUAL PRIVATE NETWORKING (VPN) > IPSEC > IPSEC TUNNELS > IPSEC 0



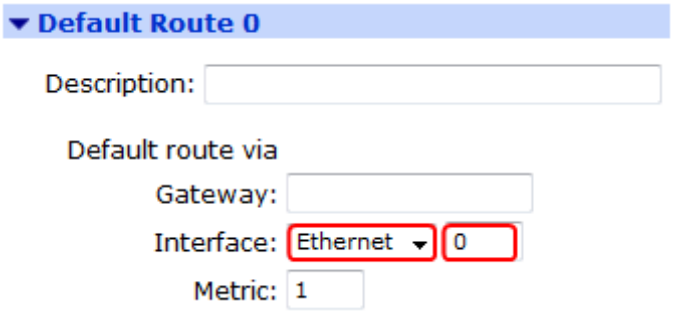
Parameter	Setting	Description
Peer IP/hostname	10.1.9.99	Remote WAN IP address
Local LAN IP address	192.168.1.0	Local ETH 1 (LAN) address
Local LAN mask	255.255.255.0	Local ETH 1 (LAN) mask
Remote LAN IP address	192.168.0.0	Remote ETH 1 (LAN) address
Remote LAN mask	255.255.255.0	Remote ETH 1 (LAN) mask
Security method	Preshared Keys	
Our ID	host	
Remote ID	client	
Encryption	AES 128	
Authentication	SHA1	
Bring this tunnel up	On demand	TransPort router 1 will initiate the tunnel negotiation
If the tunnel is down	Bring the tunnel up	
Renew then tunnel after	2 hours	
Compression method	DEFLATE	

CONFIGURATION - SECURITY > USERS > USER 10 - 14 > USER 10



Parameter	Setting	Description
Username	client	ID of TransPort router 1
Password	test	The preshared key
Confirm Password	test	The preshared key
Access Level	None	No access level required for a preshared key

CONFIGURATION - NETWORK > IP ROUTING/FORWARDING > STATIC ROUTES > DEFAULT ROUTE 0



Parameter	Setting	Description
Interface name	Ethernet	Configure the default route to be via ETH 0
Interface number	0	Configure the default route to be via ETH 0

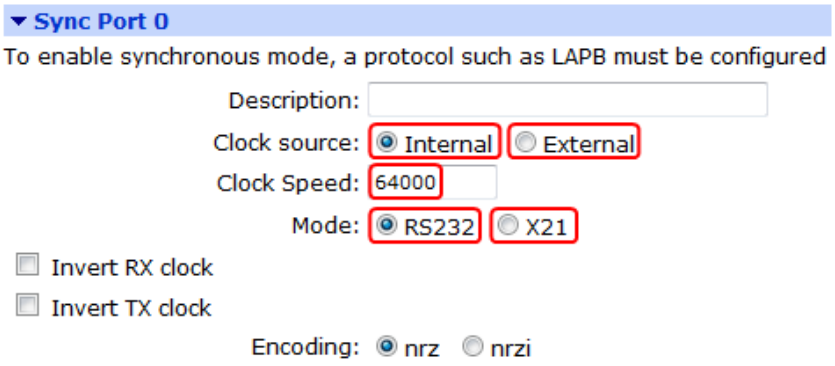
2.4 Configure synchronous ports

It is necessary to configure the synchronous port on each TransPort router.

Each TransPort router has a synchronous serial link to one of the “end devices”. It is important that for devices at each end of a physical synchronous serial link, one device is configured to generate the Sync clock signal and the other device is configured to use an external clock signal (i.e. the clock signal generated by the other device). In this example PPP peer 1 and TransPort router 1 are at each end of a physical synchronous serial link, as are PPP peer 2 and TransPort router 2.

Repeat the following configuration step for **both** TransPort routers:

CONFIGURATION - NETWORK > INTERFACES > SERIAL > SERIAL PORT 0 > SYNC PORT 0



If the port is operating in RS232 mode

Set the “Mode” parameter to “RS232”.

If Sync Port 0 is to generate the clock signal, then set the “Clock source” parameter to “Internal” and set the “Clock Speed” parameter to an appropriate value in bits per second.

If Sync Port 0 is not generating the clock signal, then set the “Clock source” parameter to “External”.

If the port is operating in X.21 mode

Set the “Mode” parameter to “X21”.

If Sync Port 0 is to generate the clock signal, then set the “Clock source” parameter to “Internal” and set the “Clock Speed” parameter to an appropriate value in bits per second.

If Sync Port 0 is not generating the clock signal, then set the “Clock source” parameter to “External”.

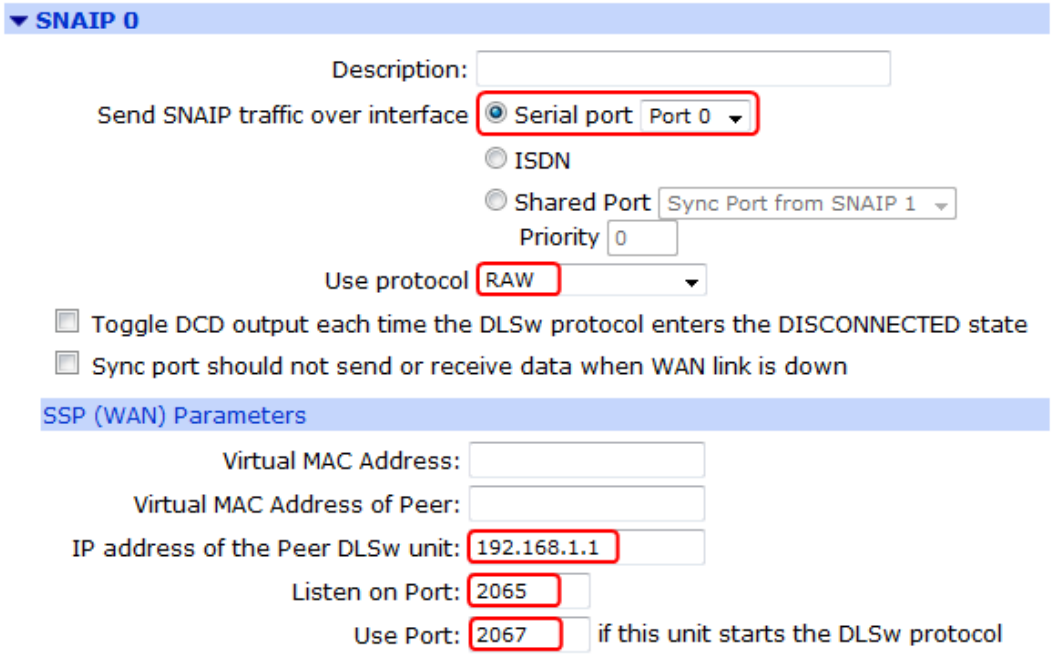
2.5 Configure SNA/IP

SNA/IP must be configured with:

- The physical Sync port number to use
- The type of data transfer (e.g. RAW)
- The IP address of the peer
- The source and destination port numbers

2.5.1 Settings for TransPort router 1

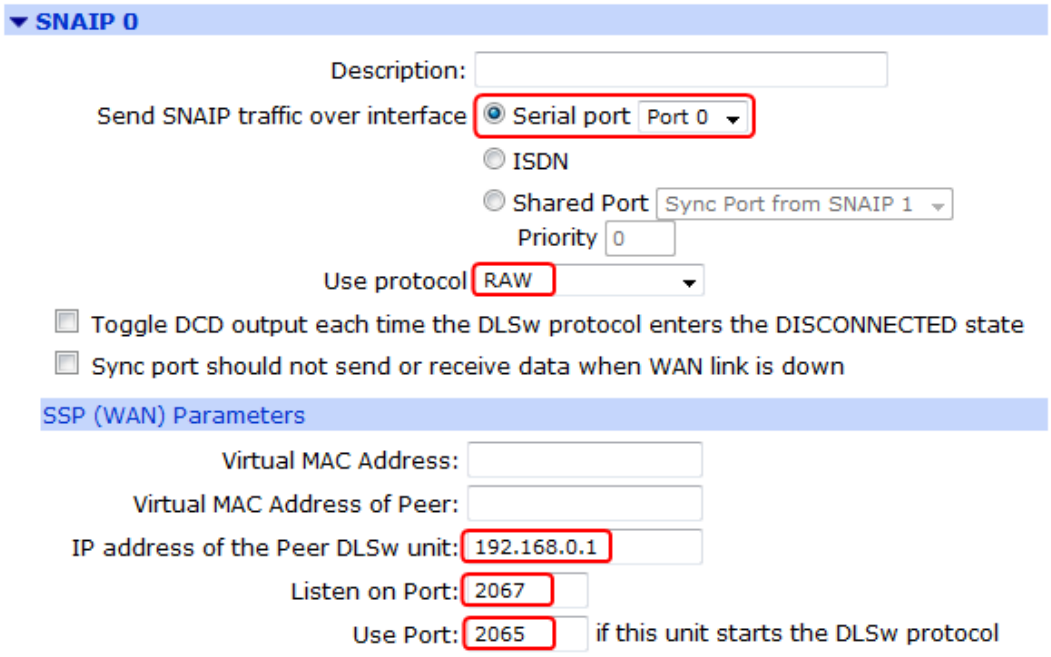
CONFIGURATION - NETWORK > LEGACY PROTOCOLS > SNA OVER IP > SNA/IP 0



Parameter	Setting	Description
Send SNA/IP traffic	Port	
Sync port	Port 0	
Protocol	RAW	
IP address	192.168.1.1	
Read Port	2065	
Write Port	2067	

2.5.2 Settings for TransPort router 2

CONFIGURATION - NETWORK > LEGACY PROTOCOLS > SNA OVER IP > SNA/IP 0

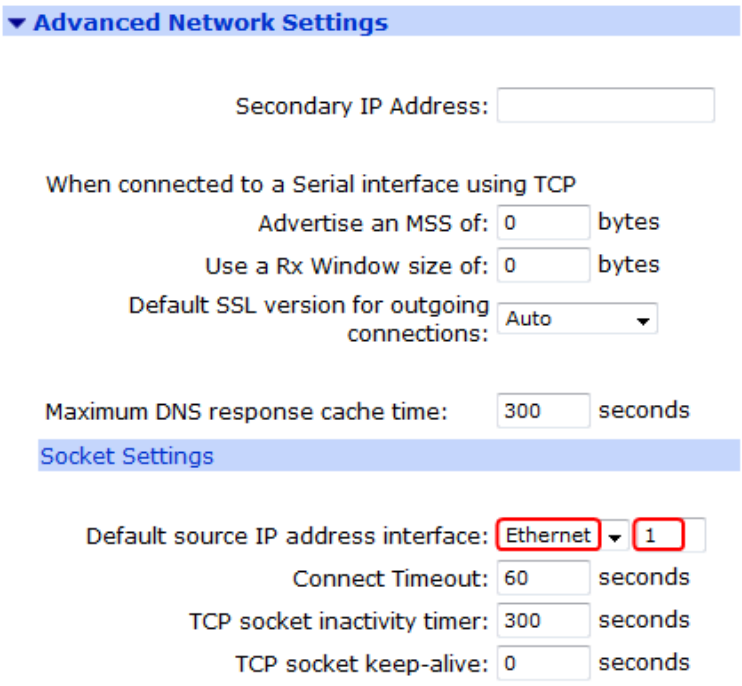


Parameter	Setting	Description
Layer 1 interface	Port	
Sync port	Port 0	
Protocol	RAW	
IP address	192.168.0.1	
Read Port	2067	
Write Port	2065	

2.5.3 Set the source IP address for the SNA/IP packets

In order to ensure that the SNA/IP packets are sent through the IPsec tunnel, it is necessary to explicitly configure each TransPort router to use the IP address of ETH 1 as the source address for the SNA/IP packets.

On **both** TransPort routers navigate to **Configuration - Network > Advanced Network Settings** then set the following parameters under "Socket Settings":



Parameter	Setting	Description
Default source IP address interface name	Ethernet	
Default source IP address interface number	1	

2.6 Save the configuration changes

On **both** TransPort routers navigate to **Administration - Save configuration** then save the changes to the current power up profile.

3 TESTING

3.1 Check the IPsec tunnel

On either or both TransPort routers, navigate to
Management - Connections > Virtual Private Networking (VPN) > IPsec > IPsec Tunnels
then check that the IPsec security associations are present.

SAs reported by TransPort router 1:

Outbound V1 SAs

#	Peer IP Addr	Local Network	Remote Network	AH	ESP Auth	ESP Enc	IP Comp
0	10.1.9.98	192.168.0.0/24	192.168.1.0/24	N/A	SHA1	AES(128)	DEFLATE Ratio 0.33 Reset

Remove All

Inbound V1 SAs

#	Peer IP Addr	Local Network	Remote Network	AH	ESP Auth	ESP Enc	IP Comp
0	10.1.9.98	192.168.0.0/24	192.168.1.0/24	N/A	SHA1	AES(128)	DEFLATE Ratio 0.22 Reset

Remove All

SAs reported by TransPort router 2:

Outbound V1 SAs

#	Peer IP Addr	Local Network	Remote Network	AH	ESP Auth	ESP Enc	IP Comp
0	10.1.9.99	192.168.1.0/24	192.168.0.0/24	N/A	SHA1	AES(128)	DEFLATE Ratio 0.33 Reset

Remove All

Inbound V1 SAs

#	Peer IP Addr	Local Network	Remote Network	AH	ESP Auth	ESP Enc	IP Comp
0	10.1.9.99	192.168.1.0/24	192.168.0.0/24	N/A	SHA1	AES(128)	DEFLATE Ratio 0.22 Reset

Remove All

3.2 Use the analyser to trace packets

On either or both TransPort routers, navigate to **Management - Analyser > Settings** then tick only the following check boxes:

- Layer 1 (Physical)
- Layer 2 (Link)
- Layer 3 (Network)
- Enable SNAIP trace
- Raw SYNC Sources: SYNC 3 (Physical Port 0)
- IP Sources: ETH 0 and ETH 1:

Under “IP Packet Filters” enter **~192.168.1.1** into the “IP Addresses” field.

Navigate to **Management - Analyser > Trace** then click the “Clear Trace” button.

Send some data into one of the synchronous ports then click on the “Refresh” button under **Management - Analyser > Trace**.

The analyser trace should show SNA/IP encapsulating the layer 2 data within the IPsec tunnel.

The example trace below from **TransPort router 1** shows the start of the negotiation of the layer 2 PPP session between the two end devices (PPP peers). For clarity, only the initial part of the negotiation process is shown. Due to the transparent nature of the way in which SNA/IP operates, the PPP peers are not aware of TransPort routers 1 and 2 or the IPsec tunnel – that is, from the perspective of the PPP peers, the layer 2 communication between them takes place as if they were physically connected to each other.

```
A PPP frame (FF 03) is received in through Sync Port 0 from PPP peer 1:
   -----   10-9-2012  19:13:40.760   ------
   SYN 3 DCE to DTE:

   FF 03 C0 21 01 0A 00 12 01 04 05 DC 02 06 00 00     □@!.......\....
   00 00 07 02 08 02                                   ......
   ----------
SNA/IP processes the PPP frame:
   -----   10-9-2012  19:13:40.760   ------
   SNAIP HDLC B3CHAN UI from DCE to DTE: COMMAND
                                       FF,03,

   C0 21 01 0A 00 12 01 04 05 DC 02 06 00 00 00 00     @!.......\......
   07 02 08 02                                         ....
   ----------
   -----   10-9-2012  19:13:40.760   ------
   SNAIP 0 Event: EV_DLC_INFO SAP:00 STA:FF

   DISCONNECTED -> DISCONNECTED
   ----------
A TCP SYN packet is sent to TransPort router 2 to initiate a TCP connection over the
IPsec tunnel:
-----   10-9-2012  19:13:40.760   ------
45 00 00 2C 00 05 00 00 F9 06 3F 74 C0 A8 00 01     E.........tÀ¨..
C0 A8 01 01 09 34 08 13 15 E7 34 7F 00 00 00 00     À¨...4...ç4.....
60 02 20 00 9A 62 00 00 02 04 05 78                 ....šb.....x

ER 0-host From LOC TO REM     IFACE: ETH 0
45             IP Ver:        4
               Hdr Len:       20
00             TOS:           Routine
               Delay:         Normal
               Throughput:    Normal
               Reliability:   Normal
00 2C          Length:        44
00 05          ID:            5
00 00          Frag Offset:   0
               Congestion:    Normal
                              May Fragment
                              Last Fragment
F9             TTL:           249
06             Proto:         TCP
3F 74          Checksum:      16244
C0 A8 00 01    Src IP:        192.168.0.1
C0 A8 01 01    Dst IP:        192.168.1.1
TCP:
09 34          SRC Port:      ??? (2356)
08 13          DST Port:      ??? (2067)
15 E7 34 7F    SEQ Number:    367473791
00 00 00 00    ACK Number:    0
60 02          Flags
               Data Offset    24
                              SYN
```

```
20 00          Window:        8192
9A 62          Checksum:      39522
00 00          URG Ptr:       0
02             TCP_OPT:       MSS (1400)
----------
A TCP SYN ACK reply packet is received from TransPort router 2:
   -----   10-9-2012  19:13:40.760   ------
   45 00 00 2C 00 3F 00 00 FA 06 3E 3A C0 A8 01 01     E..........À¨..
   C0 A8 00 01 08 13 09 34 AE E5 BD 63 15 E7 34 80     À¨.....4®å½c.ç4€
   60 12 20 00 2E D0 00 00 02 04 04 B0                 .....Ð.....°

   IP (Cont) From REM TO LOC     IFACE: ETH 0
   45             IP Ver:        4
                  Hdr Len:       20
   00             TOS:           Routine
                  Delay:         Normal
                  Throughput:    Normal
                  Reliability:   Normal
   00 2C          Length:        44
   00 3F          ID:            63
   00 00          Frag Offset:   0
                  Congestion:    Normal
                                 May Fragment
                                 Last Fragment
   FA             TTL:           250
   06             Proto:         TCP
   3E 3A          Checksum:      15930
   C0 A8 01 01    Src IP:        192.168.1.1
   C0 A8 00 01    Dst IP:        192.168.0.1
   TCP:
   08 13          SRC Port:      ??? (2067)
   09 34          DST Port:      ??? (2356)
   AE E5 BD 63    SEQ Number:    2934291811
   15 E7 34 80    ACK Number:    367473792
   60 12          Flags
                  Data Offset    24
                                 SYN
                                 ACK
   20 00          Window:        8192
   2E D0          Checksum:      11984
   00 00          URG Ptr:       0
   02             TCP_OPT:       MSS (1200)
   ----------
A TCP ACK packet is sent to TransPort router 2, completing the TCP
“3-way handshake” and establishing the connection:
-----   10-9-2012  19:13:40.760   ------
45 00 00 28 00 06 00 00 FA 06 3E 77 C0 A8 00 01     E.........wÀ¨..
C0 A8 01 01 09 34 08 13 15 E7 34 80 AE E5 BD 64     À¨...4...ç4€®å½d
50 10 20 00 45 89 00 00                             P...E‰..

ER 0-host From LOC TO REM     IFACE: ETH 0
45             IP Ver:        4
               Hdr Len:       20
00             TOS:           Routine
               Delay:         Normal
               Throughput:    Normal
               Reliability:   Normal
00 28          Length:        40
00 06          ID:            6
00 00          Frag Offset:   0
               Congestion:    Normal
                              May Fragment
```

```
                              Last Fragment
FA             TTL:           250
06             Proto:         TCP
3E 77          Checksum:      15991
C0 A8 00 01    Src IP:        192.168.0.1
C0 A8 01 01    Dst IP:        192.168.1.1
TCP:
09 34          SRC Port:      ??? (2356)
08 13          DST Port:      ??? (2067)
15 E7 34 80    SEQ Number:    367473792
AE E5 BD 64    ACK Number:    2934291812
50 10          Flags
               Data Offset    20
                              ACK
20 00          Window:        8192
45 89          Checksum:      17801
00 00          URG Ptr:       0
----------
The PPP frame (FF 03) is sent to TransPort router 2 via the TCP connection:
-----   10-9-2012  19:13:40.770   ------
45 00 00 4E 00 07 00 00 FA 06 3E 50 C0 A8 00 01     E..N.......PÀ¨..
C0 A8 01 01 09 34 08 13 15 E7 34 80 AE E5 BD 64     À¨...4...ç4€®å½d
50 18 20 00 32 09 00 00 31 10 00 16 00 00 00 00     P...2...1.......
00 00 00 00 00 00 0A 00 FF 03 C0 21 01 0A 00 12     ..........À.....
01 04 05 DC 02 06 00 00 00 00 07 02 08 02           ...Ü..........

ER 0-host From LOC TO REM     IFACE: ETH 0
45             IP Ver:        4
               Hdr Len:       20
00             TOS:           Routine
               Delay:         Normal
               Throughput:    Normal
               Reliability:   Normal
00 4E          Length:        78
00 07          ID:            7
00 00          Frag Offset:   0
               Congestion:    Normal
                              May Fragment
                              Last Fragment
FA             TTL:           250
06             Proto:         TCP
3E 50          Checksum:      15952
C0 A8 00 01    Src IP:        192.168.0.1
C0 A8 01 01    Dst IP:        192.168.1.1
TCP:
09 34          SRC Port:      ??? (2356)
08 13          DST Port:      ??? (2067)
15 E7 34 80    SEQ Number:    367473792
AE E5 BD 64    ACK Number:    2934291812
50 18          Flags
               Data Offset    20
                              PSH
                              ACK
20 00          Window:        8192
32 09          Checksum:      12809
00 00          URG Ptr:       0
----------
TransPort router 2 establishes a separate TCP connection, for the data that will be
sent from TransPort router 2 to TransPort router 1.

TransPort router 2 initiates connection with TCP SYN packet:
   -----   10-9-2012  19:13:40.770   ------
```

```
   45 00 00 2C 00 40 00 00 F9 06 3F 39 C0 A8 01 01     E.........9À¨..
   C0 A8 00 01 05 D3 08 11 86 BC 6B 89 00 00 00 00     À¨...Ó..†¼k‰....
   60 02 20 00 F6 AD 00 00 02 04 04 B0                 ....ö-.....°

   IP (Cont) From REM TO LOC     IFACE: ETH 0
   45             IP Ver:        4
                  Hdr Len:       20
   00             TOS:           Routine
                  Delay:         Normal
                  Throughput:    Normal
                  Reliability:   Normal
   00 2C          Length:        44
   00 40          ID:            64
   00 00          Frag Offset:   0
                  Congestion:    Normal
                                 May Fragment
                                 Last Fragment
   F9             TTL:           249
   06             Proto:         TCP
   3F 39          Checksum:      16185
   C0 A8 01 01    Src IP:        192.168.1.1
   C0 A8 00 01    Dst IP:        192.168.0.1
   TCP:
   05 D3          SRC Port:      ??? (1491)
   08 11          DST Port:      ??? (2065)
   86 BC 6B 89    SEQ Number:    2260495241
   00 00 00 00    ACK Number:    0
   60 02          Flags
                  Data Offset    24
                                 SYN
   20 00          Window:        8192
   F6 AD          Checksum:      63149
   00 00          URG Ptr:       0
   02             TCP_OPT:       MSS (1200)
   ----------
TransPort router 1 replies with TCP SYN ACK packet:
-----   10-9-2012  19:13:40.770   ------
45 00 00 2C 00 08 00 00 FA 06 3E 71 C0 A8 00 01     E.........qÀ¨..
C0 A8 01 01 08 11 05 D3 3E 28 92 E7 86 BC 6B 8A     À¨.....Ó..’ç†¼kŠ
60 12 20 00 25 8D 00 00 02 04 04 B0                 .....%.....°

ER 0-host From LOC TO REM     IFACE: ETH 0
45             IP Ver:        4
               Hdr Len:       20
00             TOS:           Routine
               Delay:         Normal
               Throughput:    Normal
               Reliability:   Normal
00 2C          Length:        44
00 08          ID:            8
00 00          Frag Offset:   0
               Congestion:    Normal
                              May Fragment
                              Last Fragment
FA             TTL:           250
06             Proto:         TCP
3E 71          Checksum:      15985
C0 A8 00 01    Src IP:        192.168.0.1
C0 A8 01 01    Dst IP:        192.168.1.1
TCP:
08 11          SRC Port:      ??? (2065)
05 D3          DST Port:      ??? (1491)
```

```
3E 28 92 E7    SEQ Number:     1042846439
86 BC 6B 8A    ACK Number:     2260495242
60 12          Flags
               Data Offset     24
                               SYN
                               ACK
20 00          Window:         8192
25 8D          Checksum:       9613
00 00          URG Ptr:        0
02             TCP_OPT:        MSS (1200)
----------
TransPort router 2 completes connection with TCP ACK packet:
   -----   10-9-2012  19:13:40.770   ------
   45 00 00 28 00 41 00 00 FA 06 3E 3C C0 A8 01 01     E....A......À¨..
   C0 A8 00 01 05 D3 08 11 86 BC 6B 8A 3E 28 92 E8     À¨...Ó..†¼kŠ..’è
   50 10 20 00 3C 46 00 00                             P....F..

   IP (Cont) From REM TO LOC     IFACE: ETH 0
   45             IP Ver:        4
                  Hdr Len:       20
   00             TOS:           Routine
                  Delay:         Normal
                  Throughput:    Normal
                  Reliability:   Normal
   00 28          Length:        40
   00 41          ID:            65
   00 00          Frag Offset:   0
                  Congestion:    Normal
                                 May Fragment
                                 Last Fragment
   FA             TTL:           250
   06             Proto:         TCP
   3E 3C          Checksum:      15932
   C0 A8 01 01    Src IP:        192.168.1.1
   C0 A8 00 01    Dst IP:        192.168.0.1
   TCP:
   05 D3          SRC Port:      ??? (1491)
   08 11          DST Port:      ??? (2065)
   86 BC 6B 8A    SEQ Number:    2260495242
   3E 28 92 E8    ACK Number:    1042846440
   50 10          Flags
                  Data Offset    20
                                 ACK
   20 00          Window:        8192
   3C 46          Checksum:      15430
   00 00          URG Ptr:       0
   ----------
A PPP reply frame (FF 03) is received from TransPort router 2 via the second TCP
connection:
   -----   10-9-2012  19:13:40.780   ------
   45 00 00 53 00 42 00 00 FA 06 3E 10 C0 A8 01 01     E..S.B......À¨..
   C0 A8 00 01 05 D3 08 11 86 BC 6B 8A 3E 28 92 E8     À¨...Ó..†¼kŠ..’è
   50 18 20 00 69 83 00 00 31 10 00 1B 00 00 00 00     P...iƒ..1.......
   00 00 00 00 00 00 0A 00 FF 03 C0 21 01 0A 00 17     ..........À!....
   01 04 05 DC 02 06 00 00 00 00 03 05 C2 23 05 07     ...Ü........Â#..
   02 08 02                                            ...

   IP (Cont) From REM TO LOC     IFACE: ETH 0
   45             IP Ver:        4
                  Hdr Len:       20
   00             TOS:           Routine
                  Delay:         Normal
```

```
                  Throughput:    Normal
                  Reliability:   Normal
   00 53          Length:        83
   00 42          ID:            66
   00 00          Frag Offset:   0
                  Congestion:    Normal
                                 May Fragment
                                 Last Fragment
   FA             TTL:           250
   06             Proto:         TCP
   3E 10          Checksum:      15888
   C0 A8 01 01    Src IP:        192.168.1.1
   C0 A8 00 01    Dst IP:        192.168.0.1
   TCP:
   05 D3          SRC Port:      ??? (1491)
   08 11          DST Port:      ??? (2065)
   86 BC 6B 8A    SEQ Number:    2260495242
   3E 28 92 E8    ACK Number:    1042846440
   50 18          Flags
                  Data Offset    20
                                 PSH
                                 ACK
   20 00          Window:        8192
   69 83          Checksum:      27011
   00 00          URG Ptr:       0
   ----------
   -----   10-9-2012  19:13:40.780   ------
   SNAIP 0 Event: EV_INFOFRAME SAP:00 STA:FF

   CONNECTED -> CONNECTED
   ----------
```

SNA/IP processes the PPP reply frame (FF 03) and it is sent out of Sync Port 0 to PPP peer 1:

```
-----   10-9-2012  19:13:40.780   ------
SYN 3 DTE to DCE:

FF 03 C0 21 01 0A 00 17 01 04 05 DC 02 06 00 00     □@!.......\....
00 00 03 05 C2 23 05 07 02 08 02                    ....B#.....
----------
-----   10-9-2012  19:13:40.780   ------
SNAIP HDLC B3CHAN UI from DTE to DCE: RESPONSE
                                      FF,03,

C0 21 01 0A 00 17 01 04 05 DC 02 06 00 00 00 00     @!.......\......
03 05 C2 23 05 07 02 08 02                          ..B#.....
----------
```

At this stage bidirectional layer 2 communication between the two PPP peers has been established. Two TCP connections have been created between TransPort router 1 and TransPort router 2 over the IPsec tunnel - one TCP connection for each direction of data flow.

PPP frames from PPP peer 1 that enter the Sync Port of TransPort router 1 are transparently forwarded via the first TCP connection to TransPort router 2, which sends the de-encapsulated PPP frames out of its Sync Port to PPP peer 2.

PPP frames from PPP peer 2 that enter the Sync Port of TransPort router 2 are transparently forwarded via the second TCP connection to TransPort router 1, which sends the de-encapsulated PPP frames out of its Sync Port to PPP peer 1.

4 CONFIGURATION FILES

4.1 TransPort router configuration files

This is the configuration file for TransPort router 1:

```
wifinode 0 enabled OFF
wifinode 0 ssid "digi.router.SN:%s"
wifinode 0 esharedkey "LDplTgRYQk9G"
eth 0 IPaddr "10.1.9.99"
eth 0 ipsec 1
eth 0 bridge ON
eth 0 ipanon ON
eth 1 IPaddr "192.168.0.1"
eth 1 ipanon ON
addp 0 enable ON
snaip 0 l1iface "PORT"
snaip 0 IPaddr "192.168.1.1"
snaip 0 protocol "RAW"
lapb 0 ans OFF
lapb 0 tinact 120
lapb 1 tinact 120
lapb 3 dtemode 0
lapb 4 dtemode 0
lapb 5 dtemode 0
lapb 6 dtemode 0
sy 0 clksrc "int"
ip 0 cidr ON
def_route 0 ll_ent "ETH"
eroute 0 peerip "10.1.9.98"
eroute 0 peerid "host"
eroute 0 ourid "client"
eroute 0 locip "192.168.0.0"
eroute 0 locmsk "255.255.255.0"
eroute 0 remip "192.168.1.0"
eroute 0 remmsk "255.255.255.0"
eroute 0 ESPauth "SHA1"
eroute 0 ESPenc "AES"
eroute 0 IPCOMPalg "DEFLATE"
eroute 0 ltime 7200
eroute 0 authmeth "PRESHARED"
eroute 0 nosa "TRY"
eroute 0 autosa 1
eroute 0 enckeybits 128
dhcp 0 IPmin "192.168.1.100"
dhcp 0 respdelms 500
dhcp 0 mask "255.255.255.0"
dhcp 0 gateway "192.168.1.1"
dhcp 0 DNS "192.168.1.1"
sockopt 0 gp_ipent "ETH"
sockopt 0 gp_ipadd 1
ppp 0 timeout 300
ppp 1 name "W-WAN"
ppp 1 phonenum "*98*1#"
ppp 1 IPaddr "0.0.0.0"
ppp 1 timeout 0
ppp 1 use_modem 1
ppp 1 aodion 1
ppp 1 autoassert 1
```

```
ppp 1 r_chap OFF
ppp 3 defpak 16
ppp 4 defpak 16
ike 0 encalg "3DES"
ike 0 authalg "SHA1"
ike 0 ltime 7200
ike 0 aggressive ON
modemcc 0 asy_add 7
modemcc 0 info_asy_add 5
modemcc 0 init_str "+CGQREQ=1"
modemcc 0 init_str1 "+CGQMIN=1"
modemcc 0 apn "Your.APN.goes.here"
modemcc 0 link_retries 10
modemcc 0 stat_retries 30
modemcc 0 sms_access 1
modemcc 0 sms_concat 0
modemcc 0 init_str_2 "+CGQREQ=1"
modemcc 0 init_str1_2 "+CGQMIN=1"
modemcc 0 apn_2 "Your.APN.goes.here"
modemcc 0 link_retries_2 10
modemcc 0 stat_retries_2 30
ana 0 anon ON
ana 0 l1on ON
ana 0 xoton OFF
ana 0 snaipon ON
ana 0 lapdon 0
ana 0 syon 8
ana 0 lapbon 0
ana 0 ipaddfilt "~192.168.1.1"
ana 0 logsize 180
cmd 0 unitid "ss%s>"
cmd 0 cmdnua "99"
cmd 0 hostname "digi.router"
cmd 0 asyled_mode 2
cmd 0 tremto 1200
user 0 access 0
user 1 name "username"
user 1 epassword "KD5lSVJDVVg="
user 1 access 0
user 2 access 0
user 3 access 0
user 4 access 0
user 5 access 0
user 6 access 0
user 7 access 0
user 8 access 0
user 9 access 0
user 10 name "host"
user 10 epassword "LDplTg=="
user 10 access 4
local 0 transaccess 2
sslsvr 0 certfile "cert01.pem"
sslsvr 0 keyfile "privrsa.pem"
ssh 0 hostkey1 "privSSH.pem"
ssh 0 nb_listen 5
ssh 0 v1 OFF
idigi 0 ssl ON
idigi 0 sms_optin ON
```

This is the configuration file for TransPort router 2:

```
wifinode 0 enabled OFF
wifinode 0 ssid "digi.router.SN:%s"
eth 0 IPaddr "10.1.9.98"
eth 0 ipsec 1
eth 0 bridge ON
eth 1 IPaddr "192.168.1.1"
addp 0 enable ON
snaip 0 l1iface "PORT"
snaip 0 IPaddr "192.168.0.1"
snaip 0 r_IPport 2067
snaip 0 w_IPport 2065
snaip 0 protocol "RAW"
lapb 0 ans OFF
lapb 0 tinact 120
lapb 1 tinact 120
lapb 3 dtemode 0
lapb 4 dtemode 0
lapb 5 dtemode 0
lapb 6 dtemode 0
ip 0 cidr ON
def_route 0 ll_ent "ETH"
eroute 0 peerip "10.1.9.99"
eroute 0 peerid "client"
eroute 0 ourid "host"
eroute 0 locip "192.168.1.0"
eroute 0 locmsk "255.255.255.0"
eroute 0 remip "192.168.0.0"
eroute 0 remmsk "255.255.255.0"
eroute 0 ESPauth "SHA1"
eroute 0 ESPenc "AES"
eroute 0 IPCOMPalg "DEFLATE"
eroute 0 ltime 7200
eroute 0 authmeth "PRESHARED"
eroute 0 nosa "TRY"
eroute 0 enckeybits 128
dhcp 0 IPmin "192.168.1.100"
dhcp 0 respdelms 500
dhcp 0 mask "255.255.255.0"
dhcp 0 gateway "192.168.1.1"
dhcp 0 DNS "192.168.1.1"
sockopt 0 gp_ipent "ETH"
sockopt 0 gp_ipadd 1
ppp 0 timeout 300
ppp 1 name "W-WAN"
ppp 1 phonenum "*98*1#"
ppp 1 IPaddr "0.0.0.0"
ppp 1 timeout 0
ppp 1 use_modem 1
ppp 1 aodion 1
ppp 1 autoassert 1
ppp 1 ipanon ON
ppp 1 r_chap OFF
ppp 3 defpak 16
ppp 4 defpak 16
ike 0 encalg "3DES"
ike 0 authalg "SHA1"
ike 0 ltime 7200
ike 0 aggressive ON
```

```
modemcc 0 asy_add 7
modemcc 0 info_asy_add 5
modemcc 0 init_str "+CGQREQ=1"
modemcc 0 init_str1 "+CGQMIN=1"
modemcc 0 apn "Your.APN.goes.here"
modemcc 0 link_retries 10
modemcc 0 stat_retries 30
modemcc 0 sms_access 1
modemcc 0 sms_concat 0
modemcc 0 init_str_2 "+CGQREQ=1"
modemcc 0 init_str1_2 "+CGQMIN=1"
modemcc 0 apn_2 "Your.APN.goes.here"
modemcc 0 link_retries_2 10
modemcc 0 stat_retries_2 30
ana 0 anon ON
ana 0 l1on ON
ana 0 lapdon 0
ana 0 asyon 1
ana 0 logsize 45
cmd 0 unitid "ss%s>"
cmd 0 cmdnua "99"
cmd 0 hostname "digi.router"
cmd 0 asyled_mode 2
cmd 0 tremto 1200
user 0 access 0
user 1 name "username"
user 1 epassword "KD5lSVJDVVg="
user 1 access 0
user 2 access 0
user 3 access 0
user 4 access 0
user 5 access 0
user 6 access 0
user 7 access 0
user 8 access 0
user 9 access 0
user 10 name "client"
user 10 epassword "LDplTg=="
user 10 access 4
local 0 transaccess 2
sslsvr 0 certfile "cert01.pem"
sslsvr 0 keyfile "privrsa.pem"
ssh 0 hostkey1 "privSSH.pem"
ssh 0 nb_listen 5
ssh 0 v1 OFF
idigi 0 ssl ON
idigi 0 sms_optin ON
```

4.2 TransPort router firmware and hardware information

This is the firmware and hardware information for TransPort router 1:

```
Digi TransPort WR41-UXS1-WV1-XX(WR41v2) Ser#:188379 HW Revision: 3203a
Software Build Ver5162.  Aug 13 2012 04:58:22  MW
ARM Bios Ver 6.75 v41 399MHz B256-M256-F80-O180,0 MAC:00042d02dfdb
Power Up Profile: 0
Async Driver              Revision: 1.19  Int clk
Wi-Fi                     Revision: 2.0
Ethernet Driver           Revision: 1.11
Firewall                  Revision: 1.0
EventEdit                 Revision: 1.0
Timer Module              Revision: 1.1
(B)USBHOST                Revision: 1.0
SNA o IP                  Revision: 1.02
L2TP                      Revision: 1.10
PPTP                      Revision: 1.00
TACPLUS                   Revision: 1.00
MODBUS                    Revision: 0.00
RealPort                  Revision: 0.00
MultiTX                   Revision: 1.00
LAPB                      Revision: 1.12
X25 Layer                 Revision: 1.19
MACRO                     Revision: 1.0
PAD                       Revision: 1.4
V120                      Revision: 1.16
TPAD Interface            Revision: 1.12
GPS                       Revision: 1.0
SCRIBATSK                 Revision: 1.0
BASTSK                    Revision: 1.0
PYTHON                    Revision: 1.0
ARM Sync Driver           Revision: 1.18
TCP (HASH mode)           Revision: 1.14
TCP Utils                 Revision: 1.13
PPP                       Revision: 1.19
WEB                       Revision: 1.5
SMTP                      Revision: 1.1
FTP Client                Revision: 1.5
FTP                       Revision: 1.4
IKE                       Revision: 1.0
PollANS                   Revision: 1.2
PPPOE                     Revision: 1.0
BRIDGE                    Revision: 1.1
MODEM CC (GOBI UMTS)      Revision: 1.4
FLASH Write               Revision: 1.2
Command Interpreter       Revision: 1.38
SSLCLI                    Revision: 1.0
OSPF                      Revision: 1.0
BGP                       Revision: 1.0
QOS                       Revision: 1.0
PWRCTRL                   Revision: 1.0
RADIUS Client             Revision: 1.0
SSH Server                Revision: 1.0
SCP                       Revision: 1.0
CERT                      Revision: 1.0
LowPrio                   Revision: 1.0
Tunnel                    Revision: 1.2
OVPN                      Revision: 1.2
```

```
QDL                     Revision: 1.0
WiMax                   Revision: 1.0
iDigi                   Revision: 2.0
```

This is the firmware and hardware information for TransPort router 2:

```
Digi TransPort WR41-UXS1-WV1-XX(WR41v2) Ser#:131940 HW Revision: 3202a
Software Build Ver5162.  Aug 13 2012 04:58:22  MW
ARM Bios Ver 6.75 v41 399MHz B256-M256-F80-O180,0 MAC:00042d020364
Power Up Profile: 0
Async Driver              Revision: 1.19  Int clk
Wi-Fi                     Revision: 2.0
Ethernet Driver           Revision: 1.11
Firewall                  Revision: 1.0
EventEdit                 Revision: 1.0
Timer Module              Revision: 1.1
(B)USBHOST                Revision: 1.0
SNA o IP                  Revision: 1.02
L2TP                      Revision: 1.10
PPTP                      Revision: 1.00
TACPLUS                   Revision: 1.00
MODBUS                    Revision: 0.00
RealPort                  Revision: 0.00
MultiTX                   Revision: 1.00
LAPB                      Revision: 1.12
X25 Layer                 Revision: 1.19
MACRO                     Revision: 1.0
PAD                       Revision: 1.4
V120                      Revision: 1.16
TPAD Interface            Revision: 1.12
GPS                       Revision: 1.0
SCRIBATSK                 Revision: 1.0
BASTSK                    Revision: 1.0
PYTHON                    Revision: 1.0
ARM Sync Driver           Revision: 1.18
TCP (HASH mode)           Revision: 1.14
TCP Utils                 Revision: 1.13
PPP                       Revision: 1.19
WEB                       Revision: 1.5
SMTP                      Revision: 1.1
FTP Client                Revision: 1.5
FTP                       Revision: 1.4
IKE                       Revision: 1.0
PollANS                   Revision: 1.2
PPPOE                     Revision: 1.0
BRIDGE                    Revision: 1.1
MODEM CC (GOBI UMTS)      Revision: 1.4
FLASH Write               Revision: 1.2
Command Interpreter       Revision: 1.38
SSLCLI                    Revision: 1.0
OSPF                      Revision: 1.0
BGP                       Revision: 1.0
QOS                       Revision: 1.0
PWRCTRL                   Revision: 1.0
RADIUS Client             Revision: 1.0
SSH Server                Revision: 1.0
SCP                       Revision: 1.0
CERT                      Revision: 1.0
LowPrio                   Revision: 1.0
Tunnel                    Revision: 1.2
OVPN                      Revision: 1.2
QDL                       Revision: 1.0
WiMax                     Revision: 1.0
iDigi                     Revision: 2.0
```