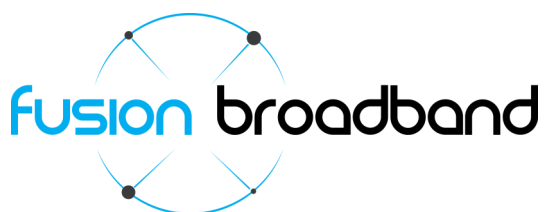


Fusion Broadband Bonding

Technical Brief



*Bonded Premium
nanoBonder
nanoBonder Lite
Mini Bonder*



Fusion Broadband Bonding Technical Brief

Fusion Broadband Bonding is a way to build a very fast business broadband connection by aggregating multiple connections together.

We can bond any number of connections and any type of connection as long as they are fundamentally stable in their speed profile; meaning that they can sustain a relatively consistent speed over a period of around 10 seconds.

Unlike other bonding technologies, when we bond connections (or legs) of different speeds we are able to provide the TOTAL aggregated speed of all the connections bonded, not just the number of legs multiplied by the speed of the slowest connection (typical of other bonding technologies).

More importantly we are able to bond together connections not only of different speeds and technologies, but also from different ISPs. This gives the customer a true broadband connection built on multi-carrier, multi-technology redundancy.

Fusion Broadband offers three bonding platforms:

- **Bonded Premium** (bond as many lines as you like)
- **nanoBonder** (bond up to two lines). nanoBonder also has a *lite* version that has some restriction (but offers a cheaper monthly subscription)
- **Mini Bonder** (bond two or three lines)

Data Distribution

When we bond together three connections of similar speed that are running for the same period of time, you will find that the data is quite evenly distributed between each of the connections.

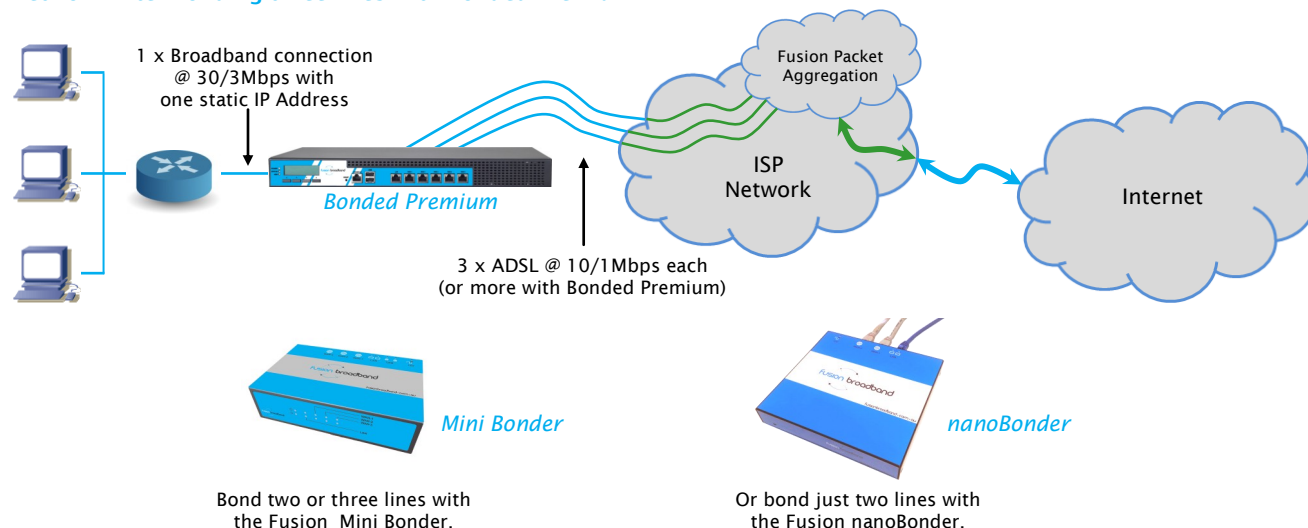
However, if you were to bond in two connections (for example one with a speed of 10Mbps down and 1Mbps up with another of 5Mbps down and 1Mbps up), you will find that in the uplink direction traffic volume is evenly distributed between the two connections as they are the same speed. However the downlink direction you will have the faster connection (10Mbps) as it carries twice as much data as the slower (5Mbps) connection. Latency differences can also impact how the data is distributed but to a lesser degree.

A great deal of the work of the Bonder and Aggregation clusters is to reduce the amount of 'out of order' packets. We have a number of algorithms and settings we can apply to achieve the best result. By focusing on this we are able to provide a negligible impact on connection latency and in many cases you will find that a fully loaded bonded link has substantially lower latency than a fully loaded single link.

It is worth noting that we allow ALL traffic through the bonder; we perform no port filtering blocking and are transparent to all VPN traffic, HTTP and HTTPS traffic. In effect we behave as a transparent NTU (Network Termination Unit).



Network After Bonding three lines with Bonded Premium



Additional Fusion Features

Each Fusion Bonding system has a few additional features that you can select via the Fusion Bonding Admin Portal. Please note, these features are not available with [nanoBonder Lite](#).

- QoS (Quality of Service)
- Compression
- TCP Acceleration

QoS (Quality of Service)

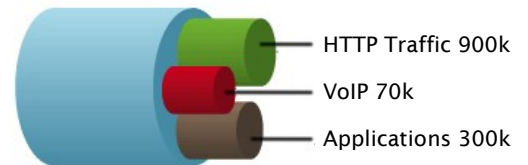
QoS refers to the ability of a network to offer an enhanced level of service to certain types of traffic. For example (in the diagram at right), Voice-over-IP (VoIP) traffic requires lower latency and jitter than web and email traffic. Fusion Bonding provides sophisticated QoS configurations that can be used to implement almost any type of traffic management strategy.

By enabling QoS on your bonded link, you are telling the bonder and the Fusion Aggregation clusters to manage the data flows through the bond according to the QoS profile.

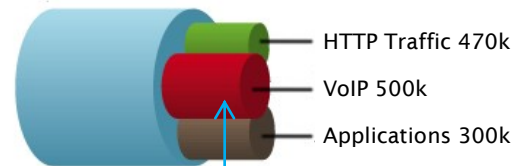
QoS will be mostly used when you have various applications using the available bandwidth of the bond and also where one application can impact the functionality of another by dominating the available bandwidth. For example, if you had a Remote Desktop session running you would prefer this to have a traffic priority over a download of an SW image. In this instance QoS will make sure the Remote Desktop session has sufficient bandwidth to run effectively whilst also allowing the software download to run/co-exist on the link.

Fusion Broadband has a standard default QoS profile which will, in most cases, be very effective. We also have the ability to adjust the profile if your NW uses different port numbers, protocols, source networks, destination networks, etc. Further technical information on QoS is available on page 5.

Before Fusion QoS



After enabling Fusion QoS



More bandwidth dedicated to VOIP (only if required)

Compression

Compression is a feature which, when enabled, will cause all the traffic flowing through the bond (in both directions) to be compressed. Please note that not all traffic is compressible. For example, a JPG image is NOT compressible as it is pre-compressed. Text based files are very compressible. Different traffic types are compressible by different amounts.

The effect of compression on highly compressible files is quite noticeable. Speed improvements in downloading or uploading highly compressible files can be up to 400%. Compression may not be for everyone though. There is a small penalty in latency when it is on, however the speed improvement often far outweighs this. As an example, two ADSL2+ connections each giving 0.875Mbps uplink when bonded will provide just over 1.6Mbps uplink. With compression enabled, if you were to send a highly compressible file it would upload in excess of 8Mbps! Further technical information on Compression is available on page 5.

TCP Acceleration

TCP Acceleration is a performance-enhancer that greatly increases throughput in some circumstances. It is helpful when bonding diverse types of Internet connections such as ADSL with cable or Wireless, or when a connection has high jitter or varying bandwidth. In these situations, the congestion control feature of TCP often reduces the available throughput on the bond to a small fraction of the expected throughput. With TCP Acceleration enabled the effect of TCP's congestion control is greatly reduced, giving you enhanced throughput.

As a general rule the default setting for TCP Acceleration is applied to ports 80 and 443 (http and https).

Like Compression, TCP Acceleration is not for everyone. The best way to see if it is effective is to try it and monitor the user's experience. Further technical information on TCP Acceleration is available on page 5.

Contact

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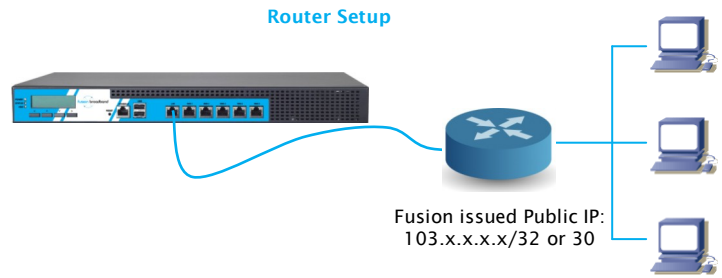
www.fusionbroadband.com.au
info@fusionbroadband.com.au
P:1300 553 526 F:03 8678 1269

How a Fusion Broadband Bonder fits within your Network.

When we bond a number of connections, we hand off to the business router's WAN port a single Ethernet based broadband connection; this is handed off as a single public static IP address. This IP address is NOT representative of the IP address of any of the underlying connections. It is your new bonded IP address.

This is configured on your router as a static IP address: WAN IP, Gateway and Netmask. Fusion Broadband supplies this new IP address.

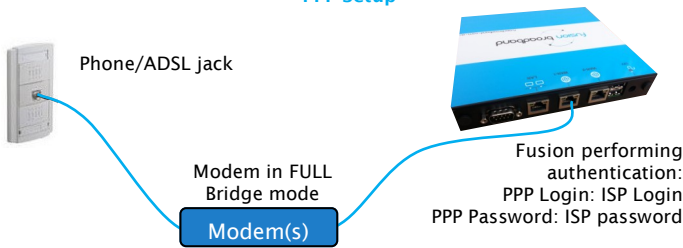
The Fusion Broadband bonder connects to the broadband connections via Ethernet. This allows us to connect to any type of broadband connection as Ethernet is a good standard medium. So, for ADSL we require that there is a Modem between the Phone outlet and the Bonder.



How we connect your Broadband Connections

In most cases the modem is configured in Full Bridge mode so the PPP authentication is performed by the Fusion bonder. However, there are three different ways we can connect to your Broadband connections:

PPP Setup



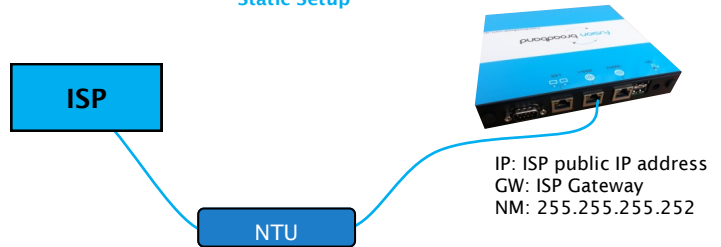
PPP

This is the most common method of connectivity where we typically have a modem in full bridge mode between the bonder and the phone jack (for ADSL).

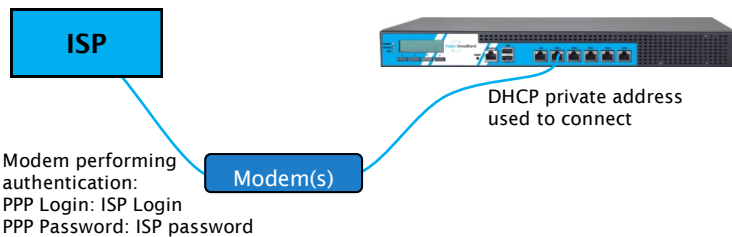
Static

This is where your ISP provides the connection where no authentication is needed and the service is presented with a public IP address, gateway and netmask.

Static Setup



DHCP



DHCP

In this scenario a modem will typically be performing the authentication and handing off to us a private DHCP derived address. Here you could be using an ADSL modem to perform all the authentication. Or you may have a 3G/4G modem set up for failover and the connection is handed off to the bonder as a private DHCP address.

There is no real performance penalty in having the modem perform the authentication, however we have found that the less you ask of the modem the more reliable they become. Having a modem in full bridge mode is a very basic task for any modem.

The Finer Technical Detail

Protocol Support/Port influence:

Bonding is 100% transparent to ALL protocols VPNs are fully supported IPsec, PPTP, etc.
Port forwarding is performed by the customer router; Bonding forwards ALL ports and does not block any ports.

Bonding Efficiency:

Bonding efficiency is nearly always greater than 85%. The level of bonding efficiency is related to the speed stability of the lines supporting the bond. In most cases Uplink bonding is 95% and Downlink is 90%

Compression:

Typical compression ratios of Compression running on Bonders are about 1.5-1.7x for plain text, about 2-4x for HTML, and of course 1.0x for JPEGs, PNGs and other pre-compressed data. Definitive benchmarking of compression effect is difficult as internet / broadband data is made up of an ever changing mix of types of data and levels it can be compressed.

QoS:

QoS is bi-directional on both data and control packets and 100% fully customisable. Default parameters (all customisable) are: 4 Classes of traffic (Real Time, Interactive, Routine, Bulk).

Reserved percentages for each are: 40%, 20%, 20%, 20% respectively.

Packet Filters and classes:

Real-time - 40% of bandwidth is reserved for real-time traffic.

ICMP packets up to 500 bytes

Inter-Asterisk eXchange version 2 (IAX2) traffic

SIP and H.323 control traffic

Packets with DSCP expedited forwarding requested

This profile will classify VoIP traffic correctly on networks using IAX2 or phones that send traffic with the DSCP expedited forwarding class. On other networks, it may be necessary to identify VoIP traffic using source or destination network matching.

Interactive - 20% of bandwidth is reserved for interactive traffic, classified as follows:

DNS traffic

Microsoft RDP traffic

TCP acknowledgements

SSH traffic. (To avoid classifying SCP traffic as interactive, SSH is limited to 20 packets per second per connection)

Routine

This is the default class. Packets not matching any filter are classified as routine. 20% of bandwidth is reserved for this traffic.

Bulk - 20% of bandwidth is reserved for bulk traffic, classified as follows.

FTP traffic On ports 20, 21 only; data traffic on other ports will not be matched.

HTTP/S traffic part of flows greater than 2 MB

Bond Security (two variants):

HMAC: Hash-based message authentication codes. Data is signed and verified using an HMAC code. The algorithm uses MD5 hashing and a 30-byte secret key. HMAC-MD5 is defined in RFC 2104; or

Encryption: Data is encrypted between bonders and our aggregation network using the DTLS 1.2 protocol. DTLS is based on SSL/TLS, and is defined in RFC 4347 and RFC 6347.

Three ciphers are available: AES 128, AES 256 or Salsa20 256

TCP Acceleration:

TCP Accelerating process for dealing with unstable Bonded connections or connections with high jitter. By default TCP Acceleration is enabled on Ports 80, 443 and 8080 (http and https traffic). Additional ports available by request.

Frequently Asked Questions (more FAQs are available on our website)

I need an additional broadband connection. How does Fusion Broadband help?

Fusion Broadband does not provide ADSL broadband connections. There are several carriers that do an excellent job at this so we leave it to them. We do however have many thousands of tests of connections all around Australia and can certainly point you in the direction for sourcing the best performing connections.

What happens if one of the broadband lines fails?

If any of the services that you have connected to Fusion fails, the system will automatically keep supporting your network. There will be no disruption to your service except that your bandwidth will drop a little from the lost connection. When the failed service comes back up it will be automatically reconnected usually between 5-10 minutes just to make sure it's really back on line and performing well.

What do I need to do to my existing network?

Nothing! The Fusion system will present to your network a single Ethernet connection. In most cases there are little changes to your existing network or systems. All you will have is a new public IP address/range.

Does Fusion support VPN traffic?

Yes. Fusion supports all traffic and all traffic is bonded.

Ordering, Provisioning and Installation

The ordering, provisioning and installation process is quite simple.

Once ordered and the order is checked and entered into our systems, a welcome email message is sent out with a *Getting Started Guide* for you. You will also receive an email requesting *Configuration Details* (PPP details or connection details of all the connections we are bonding).

Once these are submitted, we provision the bonder and send it out to the customer or IT partner.

Once the bonder is configured by Fusion a *Service ID* form is emailed out. This form contains all information about your Bonded service. A copy of the *Service ID* form also comes in the box with the bonder. It contains the following information:

- Your bonded WAN IP address
- What your Business router should be set to
- The PPP details of the connections we are bonding

Please note: There is **no** configuration interface on the bonder and there nothing onsite to do insofar as configuring the bonder.

Once delivered, you are ready to install the bonding system in the network. Make connections to the Bonder following the port assignments detailed on the *Service ID* form.

By logging into the Fusion Portal (refer below) from any active browser you can check to see the status of the connections while you are installing a Fusion Bonder.

Post Installation

Once your Fusion Bonder is installed and running, Fusion will perform a number of tests on the connected services to correctly set their operating speed. By doing this we are able to extract out the best speed and the lowest possible latency for your connection. Once the testing is completed a Bond Speed test report is send out detailing the speeds of each of the connections and of the bond in both directions.

The Fusion Client Portal

Your login to the Fusion Portal allows you to see the current status of each of the configured services, their speed and status. The Fusion Portal allows you to manage a single bond or if you have multiple bonds, you can manage them all.

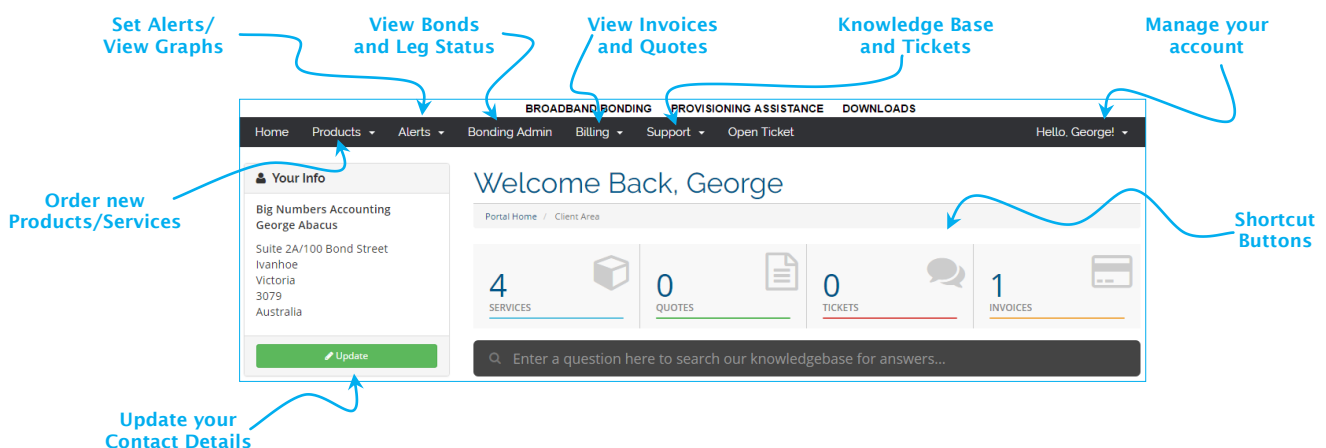
Bonding Admin is your view into your bonded connection. From here you are able to activate/deactivate:

- QoS - Quality of Service
- Compression
- TCP Acceleration

Additional details of this can be found in the Fusion Knowledge-Base. You are also able to change broadband services from being active to inactive as well as selecting them to perform as a failover connection. You can also restart the bonder if required from here.

Also indicated is the actual speed passing through the bond/individual connections at that point in time. To update, just click the 'refresh' button on your browser.

In addition to this you are also able to set *Alerts* on each of the connected services and of the bond. These alerts can be set to inform you if a single leg/connection has failed or if a Bond has gone down. You have the ability to set alarms and who the recipient(s) of the alarm is for based on different levels of severity.



The Fusion Bonding Admin Portal (cont)

By clicking **[Bonding Admin]**, you can see your bonded services in more detail.

The screenshot shows the Fusion Bonding Admin Portal interface. The top navigation bar includes Home, Products, Alerts, Bonding Admin, Billing, Support, and Open Ticket. The user is logged in as 'Hello, George!'.

Bonds Section:

Description	Services	Traffic	Details
Big Numbers_Ivanhoe	●●●●	↓538.33 Kbps ↑89.75 Kbps	⊕
Big Numbers_Home Office	●●●●	↓14.07 Kbps ↑17.63 Kbps	⊕
Big Numbers_Head Office	●●●●	↓2.48 Mbps ↑206.36 Kbps	⊕

Leg Status Legend:

- Up
- Down
- ★ Testing
- Idle
- Offline
- Failover, Up
- Failover, Down

Fusion Broadband Bonding - Big Numbers Section:

Status:

- Customer: Big Numbers_Head Office
- Description: Ivanhoe_Vic
- Profile: FB8I5-lbXg6-BSCJl-7sIM1
- Speed / Traffic: ↓5.48 Mbps ↑178.27 Kbps
- QoS Profile: On Off Default
- Compression: On Off
- TCP Acceleration: On Off
- Tunnel Authentication: -
- Control: [Restart Bond](#)

PPPoE Legs:

Status	Link Mode	Current Rate	Failover	Interface	IP Address	PPP Username	PPP Password
●	Active	↓1.44 Mbps ↑20.19 Kbps	Off	Port 2	123.123.123.123	PPPUUsername1	PPPPassword1
●	Active	↓1.5 Mbps ↑15.85 Kbps	Off	Port 4	123.123.123.124	PPPUUsername2	PPPPassword2
●	Active	↓1.44 Mbps ↑22.43 Kbps	Off	Port 3	123.123.123.125	PPPUUsername3	PPPPassword3

Static Legs:

Status	Link Mode	Current Rate	Failover	Interface	IP
●	Active	↓1.15 Mbps ↑170.2 Kbps	Off	Port 6	168.214.10.4

Router IPs:

IP	Netmask	Interface
103.1.x.x	255.255.255.252	Port 1 - LAN

Annotations:

- Current Bonds (this customer has three):** Points to the Bonds table.
- Current Leg Status:** Points to the Services column in the Bonds table.
- Current speed of traffic:** Points to the Traffic column in the Bonds table.
- Click [+] to view the details of the bond:** Points to the Details column in the Bonds table.
- Restart Bond Button:** Points to the Restart Bond button in the Control section.
- Click to set alarms and view statistics on the Leg:** Points to the status icons in the PPPoE Legs table.
- Click to change status of leg to Idle or to set as Failover:** Points to the Link Mode dropdown in the PPPoE Legs table.
- Switches for QoS, Compression and TCP Acceleration:** Points to the QoS Profile, Compression, and TCP Acceleration controls.
- Individual PPPoE Information:** Points to the PPP Username and Password columns in the PPPoE Legs table.
- This bond has an SHDSL connection bonded also (set as a static connection):** Points to the Static Legs table.
- Your IP Address:** Points to the IP address in the Router IPs table.