

## **Important wifi considerations for NMEA 0183 multiplexers.**

### **TCP versus UDP**

TCP and UDP are both network protocols used for wifi connections.

**TCP** is a safe network protocol that guarantees data integrity, i.e. it checks if all transmitted data packets are received in good order by the receiving end of the communications link. Lost or garbled data packets are retransmitted.

**UDP** is a "broadcast protocol" without error checking.

Brookhouse wifi multiplexers (iMux Mk3) only work with the TCP protocol. This is not because UDP is not available, but in our opinion UDP is unsuitable for transmission of navigation data, especially for AIS and waypoint information.

TCP places higher demands on the wifi hardware and this is the reason small wifi modules as used in other wifi-capable multiplexers only support a single TCP session. UDP is used for multiple connections because it is simpler and requires less processing power and other resources in the wifi hardware.

Our wifi multiplexers, the Brookhouse iMux and iMux-ST, have more powerful wifi capabilities and support multiple simultaneous TCP sessions, up to 16, so there is no need to use the UDP protocol.

### **Why is this important?**

When using UDP there is no way to determine if the connection via wifi is good or bad. The recipient, e.g. an iPad or laptop computer does not know if data has been lost. There can be many factors that determine the quality of any wifi connection, especially on a boat. It can be that the equipment is being used at the limit of the wifi range, there may be interference by other radio equipment etc. Again, when using UDP there is no way to be sure if all data that is transmitted is correctly received. Reception may be perfect or 50% or more of transmitted data may be lost.

We see that on more and more boats multiple devices are used for navigation, because it is so convenient. For example in busy shipping areas the task of checking AIS targets can be delegated to a crew member with his/her personal iPad, while another iPad or laptop, also connected via wifi, is used for other navigation tasks, for instrument displays or for a racing app. Popular marine apps for i-devices are iNavX, NMEA-Remote and iRegatta, often used at the same time on different iPads or iPhones. If due to the limitation of a single TCP connection for the given multiplexer, UDP is the only protocol to allow multiple

connections via wifi, this can pose risks, including safety risks when relying on AIS.

Updated NMEA 0183 data from GPS and instruments is usually transmitted with a frequency of once per second or faster. If data from a wind instrument, a depth sounder or a GPS is lost due to unsuccessful UDP transmission, this may not present a big problem as new transmissions will follow soon. It is a different story with AIS or transfer of one or more waypoints. If data from an AIS target is lost, it may take some time before another transmission from that target is received, especially if it is a class-B AIS target. It may well be a target within close proximity, presenting a navigation hazard of which most up to date positional data and course is essential for safe navigation.

Waypoint transfer is a once-only operation. If waypoint data is lost, this will be hard to detect.

By always using safe TCP protocol sessions, also if multiple connections are required, the Brookhouse iMux avoids all data-loss problems.

## **Security**

A secure wifi network requires a password (WEP, WPA, WPA-2), before anyone can tap into the data available in that network. NMEA data of a vessel's navigation system may not be particularly confidential, but security is nevertheless important to avoid (accidental) joining the network by other vessels. An open network without security allows anyone to connect. This can easily happen when in port or at an anchorage, where there may be other vessels in wifi range.

The Brookhouse iMux has WPA-2 security. The preset unique password (key) is based on the serial number and is only known to the owner. The password only has to be entered the first time. Computers and i-devices remember the password and can be set up to automatically connect when the iMux wifi network is detected.

## **Integration with on-board wifi networks**

Integration of the wifi multiplexer with another wifi network on board the vessel in practical terms means that a (wireless) connection is established between the wifi multiplexer and an on-board (3G/4G) router. Users, connected to the router via wifi or an ethernet cable (RJ45) can access the NMEA data stream the same way as via a direct wifi connection with the multiplexer.

## Advantages of integration

Internet access and navigation data are available without changing the connection from the multiplexer to the router access point in the i-device or computer's wifi network settings. This means that e.g. grib files for wind prediction, marine weather forecasts or email can be obtained via the 3G/4G Internet connection without interruption of the navigation software.

On larger vessels, integration of the wifi multiplexer with the on-board network extends wifi range and accessibility of navigation data via wifi or ethernet cable anywhere on the vessel, where needed.

## Technical realisation of integration

The network term for this form of integration is WDS (Wireless Distribution System) bridging. This feature is now supported by the Brookhouse iMux. The router also has to support this feature to make the bridging work. An example of 3G/4G routers that do support this feature are several TP-Link models. We used TP-Link for testing at Brookhouse, but there are other routers that support WDS. The iMux does not need to be configured to enable the WDS feature. All that needs to be done is setting the iMux SSID and WPA-2 key in the WDS settings of the router. The connection between router and iMux is automatically established by the router.

**TP-LINK®** 3G Wireless N Router  
Model No. TL-MR3020

**Wireless Settings**

Wireless Network Name: Brookhouse\_TLMR3020 (Also called the SSID)  
Region: New Zealand  
Warning: Ensure you select a correct country to conform local law. Incorrect settings may cause interference.  
Channel: 6  
Mode: 11bgn mixed  
Channel Width: Auto

Enable Wireless Router Radio  
 Enable SSID Broadcast  
 Enable WDS Bridging

SSID(to be bridged): Brookhouse\_iMux\_2199  
BSSID(to be bridged): AC-CF-23-02-43-9C Example:00-1D-0F-11-22-33  
Survey  
Key type: WPA-PSK/WPA2-PSK  
WEP Index: 1  
Auth type: open  
Password: Brookhouse13102212

Save

**Wireless Settings Help**

**Note:** The operating distance or range of your wireless connection varies significantly based on the physical placement of the Router. For best results, place your Router.

- Near the center of the area in which your wireless stations will operate.
- In an elevated location such as a high shelf.
- Away from the potential sources of interference, such as PCs, microwaves, and cordless phones.
- With the Antenna in the upright position.
- Away from large metal surfaces.

**Note:** Failure to follow these guidelines can result in significant performance degradation or inability to wirelessly connect to the Router.

**Wireless Network Name** - Enter a value of up to 32 characters. The same Name (SSID) must be assigned to all wireless devices in your network.

**Region** - Select your region from the pull-down list. This field specifies the region where the wireless function of the Router can be used. It may be illegal to use the wireless function of the Router in a region other than one of those specified in this field. If your country or region is not listed, please contact your local government agency for assistance.

**Channel** - This field determines which operating frequency will be used. It is not necessary to change the wireless channel unless you notice interference problems with another nearby access point. If you select auto, then AP will choose the best channel automatically.

**Mode** - If all of the wireless devices connected with this wireless router can connect in the same transmission mode(eg. 802.11b), you can choose "Only" mode(eg. 11b only). If you have some devices that use a different transmission mode, choose the appropriate "Mixed" mode.

**Channel Width** - The bandwidth of the wireless

## **Configuration of the wifi multiplexer**

At Brookhouse we don't expect skippers or marine electronics installers to also be network specialists. We have therefore endeavoured to keep things simple where configuration of our iMux multiplexers is concerned. The Brookhouse iMux can be installed "out of the box". All wifi settings are preset, without losing any of the powerful features. If integration with an on-board network is required, configuration of the router, usually via its internal HTML setup pages, is sufficient.

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