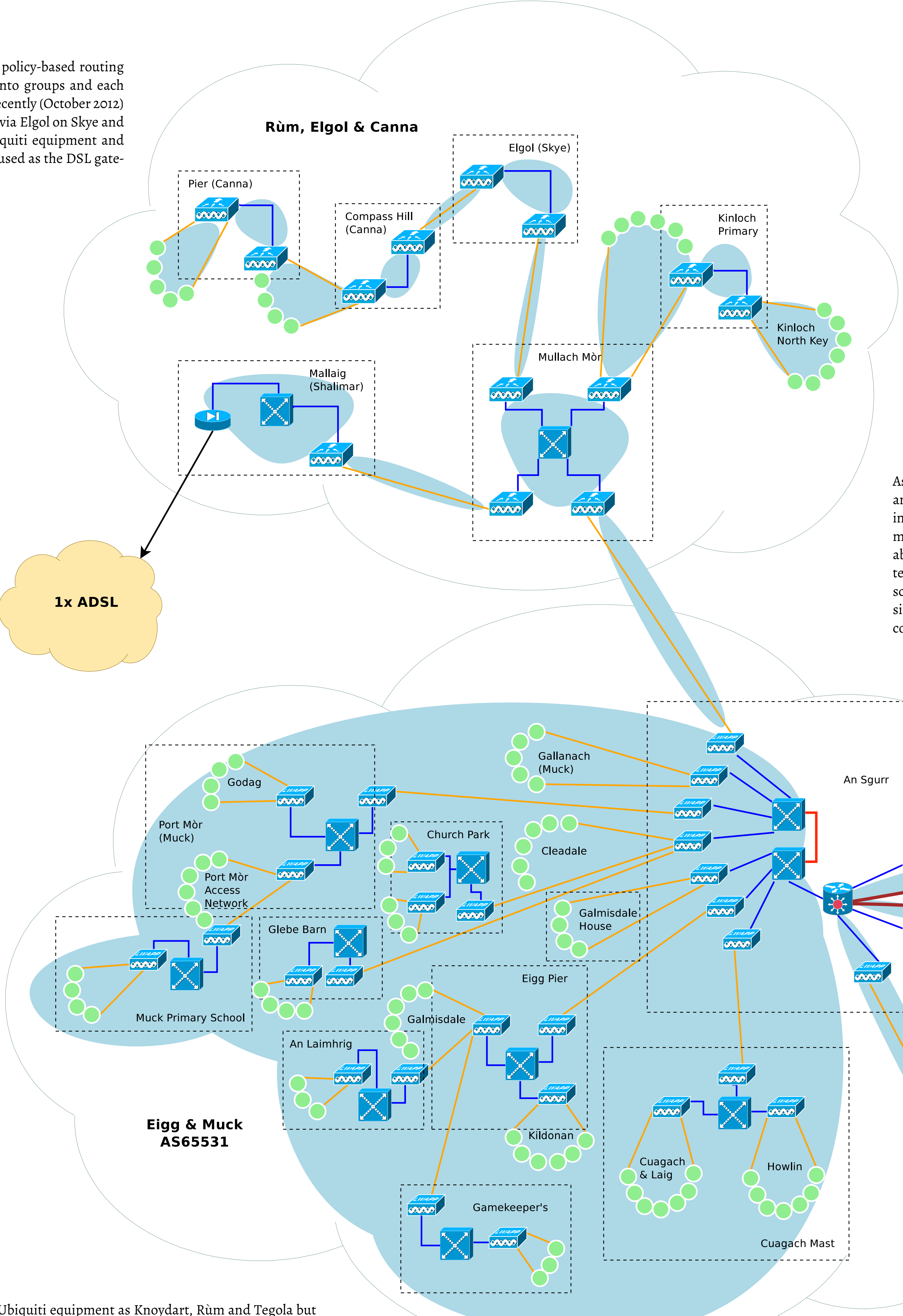


# Network Map of Hebnet, Knoydart and Tegola

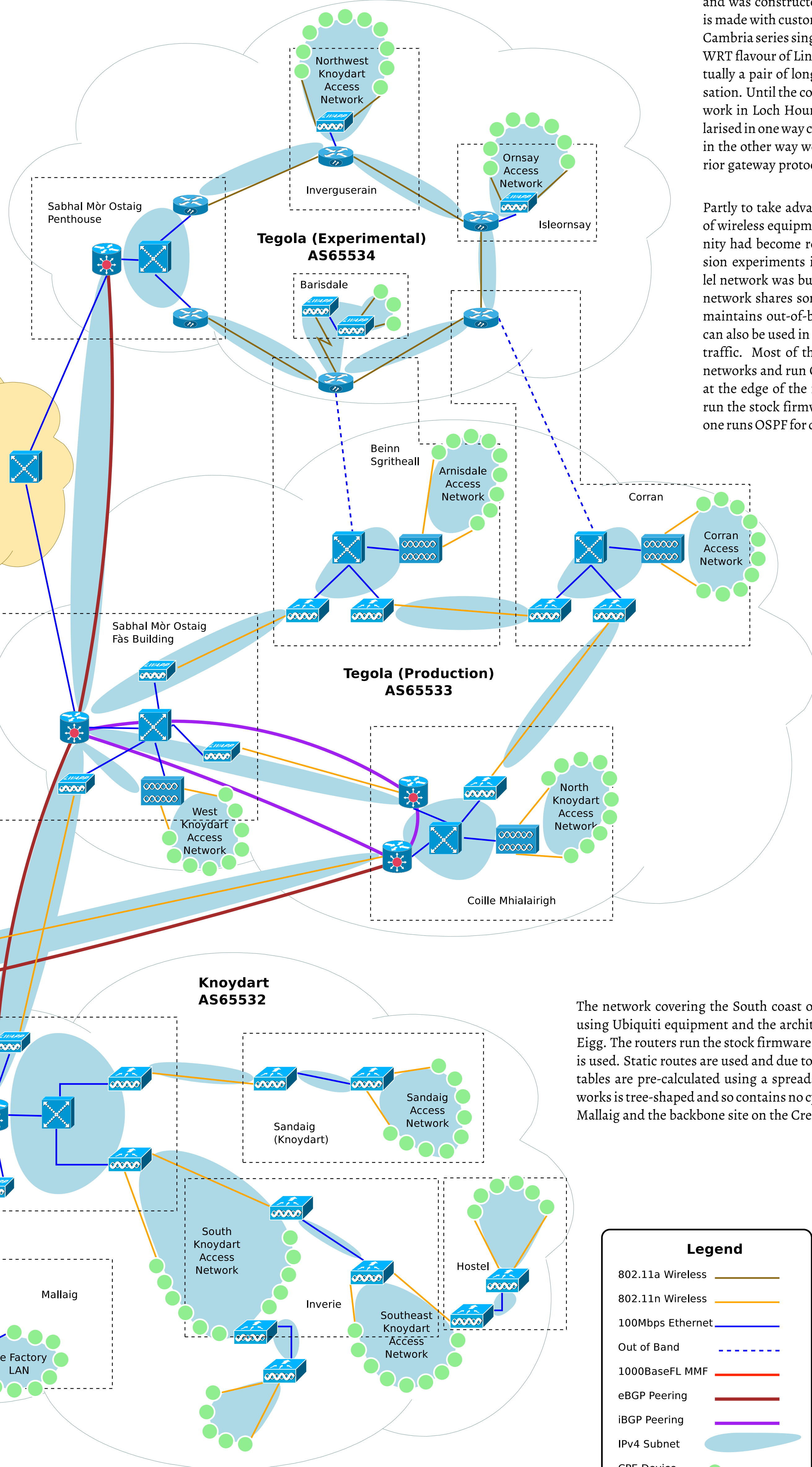
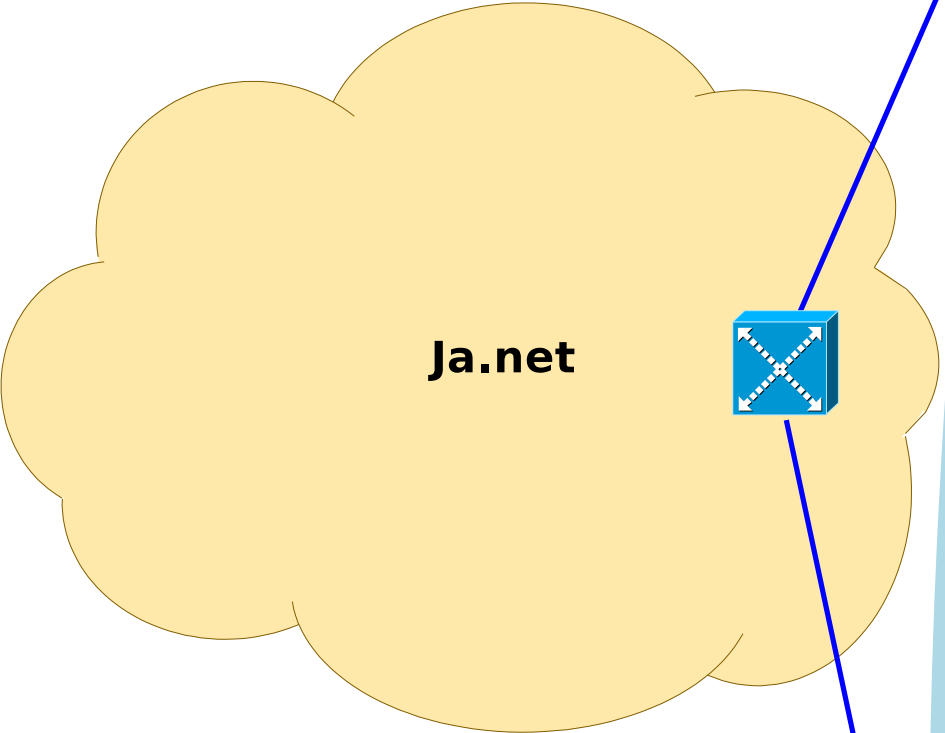
## October 2012

The network on Rùm was the first to use a policy-based routing arrangement where users were separated into groups and each group uses a different DSL line at Mallaig. Recently (October 2012) the network was extended around to Canna via Elgol on Skye and also connected to Eigg. It uses mostly Ubiquiti equipment and static routing. A Cisco 2800 series router is used as the DSL gateway in Mallaig.



The community networks benefit from a high quality connection to the Ja.net academic backbone through facilities made available by Sabhal Mòr Ostaig, the UHI Gaelic college on Skye.

As of October 2012, the networks on Knoydart, Eigg, and the two Tegola networks peer with each other using BGP, in exactly the same way that the networks that make up the Internet connect. This means that each is able to maintain its own architecture and policies internally but nevertheless can have a consistent macroscopic view of this network of networks. Mutual "transit" means that each network can share its upstream connection with the others for fail-over and resiliency.



The first iteration of the Tegola network began in 2008 and was constructed as a ring around Loch Hourn. It is made with custom hardware based on the Gateworks Cambria series single board computer running the OpenWRT flavour of Linux. Each inter-site connection is actually a pair of long-haul links with orthogonal polarisation. Until the commissioning of the production network in Loch Hourn in the summer of 2012, links polarised in one way carried user traffic and links polarised in the other way were used for experiments. The interior gateway protocol is OSPF.

Partly to take advantage of a significant drop in price of wireless equipment, and partly because the community had become reliant on the network and on occasion experiments interfered with live traffic, a parallel network was built in the summer of 2012. The new network shares some physical space with the old, and maintains out-of-band links for instrumentation that can also be used in emergencies to re-route production traffic. Most of the access routers are from Ubiquiti networks and run OpenWRT. Most of the devices used at the edge of the network are also from Ubiquiti but run the stock firmware. Like the old network, the new one runs OSPF for dynamic routing within the network.

The network covering the South coast of the Knoydart peninsula was built using Ubiquiti equipment and the architecture is based on that of Rùm and Eigg. The routers run the stock firmware and IP routing rather than bridging is used. Static routes are used and due to the size of the network, the routing tables are pre-calculated using a spreadsheet. This works because the networks is tree-shaped and so contains no cycles or loops. OSPF is used between Mallaig and the backbone site on the Creagan Dearga to facilitate fail-over.

The network on Eigg is built with the same Ubiquiti equipment as Knoydart, Rùm and Tegola but the architecture is radically different. Like Knoydart it is tree-shaped and loop-free, and it is quite a large tree indeed. It also employs no routing internally, the entire network being one large bridge. Furthermore network address translation is used at the edge node so that the backbone does not need to know anything about the edge subnets. This works quite well except for problems with some application protocols such as SIP that are NAT-unfriendly. The exception, as with Knoydart, is that IP routing and OSPF is used on the connection between the backbone router on the Sgurr of Eigg and the DSL lines in Arisaig.

At various locations in Mallaig and Arisaig the individual networks maintain connections to the Internet using the only alternative that is readily and cheaply available – DSL lines. This generally works but can be problematic since it is a retail consumer product and neither designed nor intended as an interconnection medium for telecommunications carriers.

**Legend**

- 802.11a Wireless
- 802.11n Wireless
- 100Mbps Ethernet
- Out of Band
- 1000BaseFL MMF
- eBGP Peering
- iBGP Peering
- IPv4 Subnet
- CPE Device
- Core Router (BGP)
- Wireless Router
- Wireless Bridge
- Ethernet Switch



