

Community Networking in Scotland

Networks on the periphery of Europe

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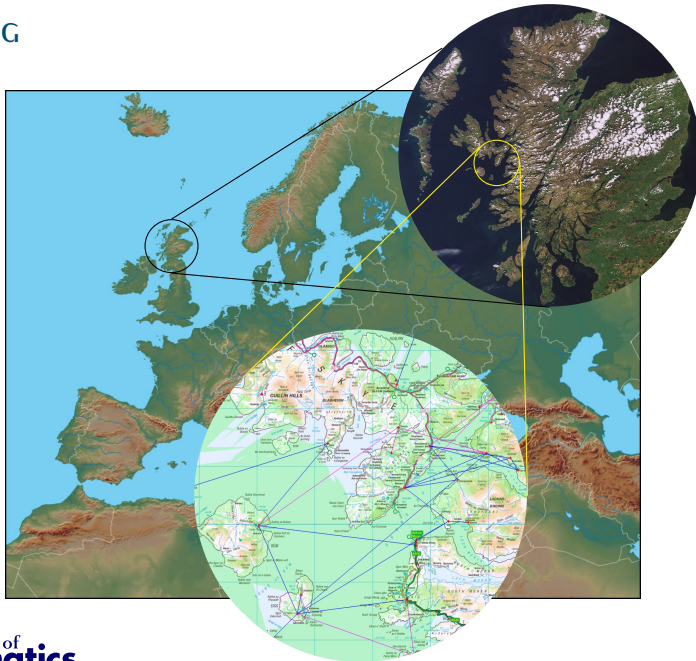
SETTING



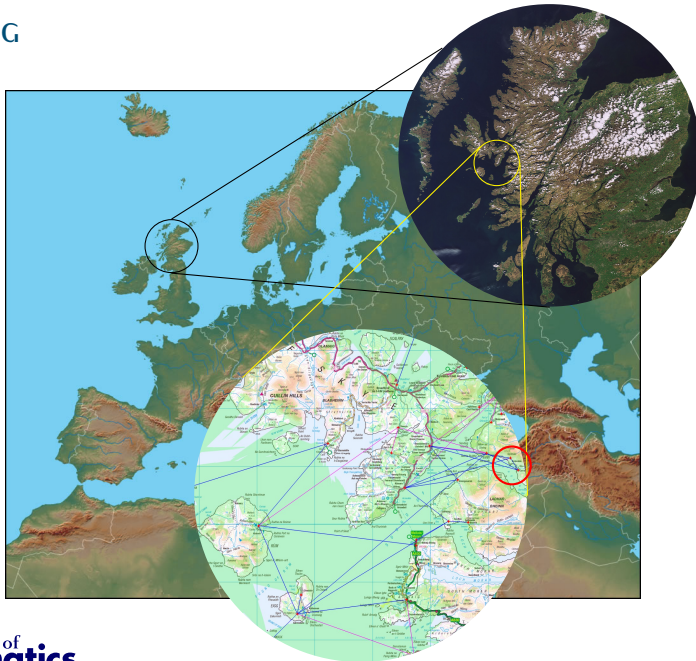
SETTING



SETTING



SETTING





Corran

Arnisdale

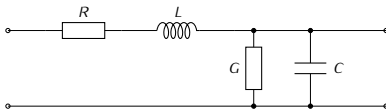
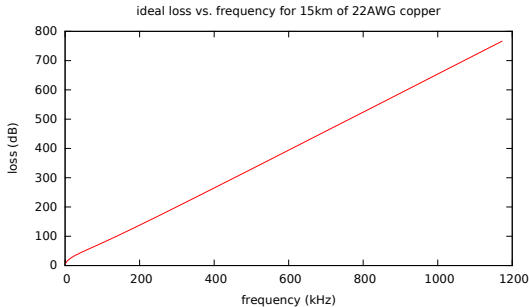
ARNISDALE



- ▶ 9 miles = 15km from the telephone exchange at Glenelg
- ▶ Copper wire barely good enough for 2400 baud
... Nevermind *DSL
- ▶ Anyways, Glenelg only has maybe a couple of E1s
- ▶ Ladhar Bheinn blocks satellites (& slow & expensive)
- ▶ Residents wrote many letters to BT, politicians
... to no avail
- ▶ Eventually decided to build a network themselves



9 miles = 15km from the telephone exchange at Glenelg



TEGOLA¹

- ▶ Tegola – Loch Hourn from 2008.
- ▶ Trial link from Corran 15km to Isleornsay sharing 512kbps ADSL.
- ▶ Expanded to a ring of six masts
- ▶ Gateworkx, OpenWRT, Quagga, OSPF, 802.11a
- ▶ Giacomo Bernardi, Peter Buneman, Mahesh Marina (UoE)
- ▶ Upstream bandwidth from UHI Sabhal Mòr Ostaig



¹An Italian word meaning *tile*, this name is in honour of the effect of wet roof tiles on 2.4GHz RF propagation which beset some early experiments.

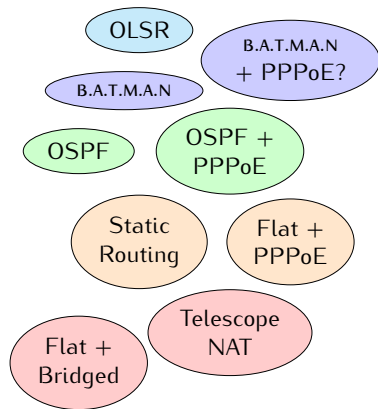
THE NEIGHBOURS



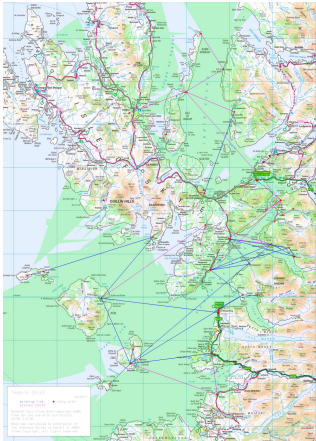
- ▶ Nearby islands **Eigg**, and **Rum** build networks on a similar model with advice from Tegola.
- ▶ **Knoydart** in the next Loch builds theirs with help from Eigg.
- ▶ Later, **Applecross** to the north joins in...
 - ... and **Locheil**
 - ... and northern **Mull**
 - ... and **Sleat**
- ▶ Farther afield **Laggan**, **Lothian** and others...

MANY ARCHITECTURES

- ▶ **Not** centrally managed
- ▶ Local networks built according to local skills – *very* important
- ▶ Aversion to dynamic routing
... but we **want** redundant paths
... more important for remote places – (MTTR, no mobile coverage)
- ▶ Vendor firmware is limited
- ▶ OpenWRT too high a barrier
- ▶ “serious” routers too expensive
... also too power hungry



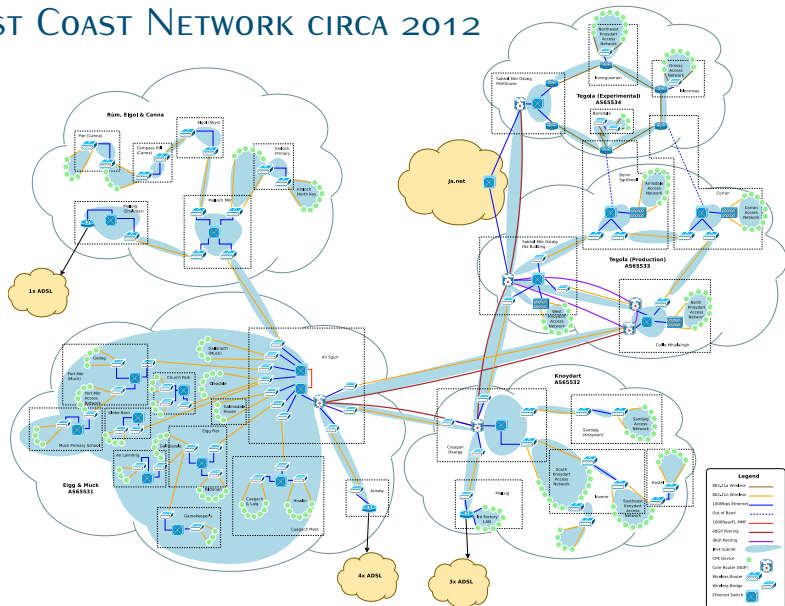
THE INTERNET IN MICROCOSM



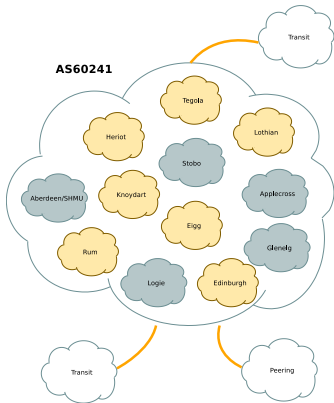
- ▶ Connect adjacent networks
- ▶ Inter-community backbone with BGP
- ▶ Cheap radios only as bridges
- ▶ FreeBSD + bird, or Mikrotik
- ▶ Let individual networks be
- ▶ Redundant paths are good
 - ▶ Fibre cut in Lochcarron takes out all BT services, our network stays up
 - ▶ Power cut takes out Sabhal Mòr Ostaig over the Christmas Holidays
 - ▶ Lightning strike melts phone lines, NHS uses community network



WEST COAST NETWORK CIRCA 2012



HUBS: FORMALISING THE MODEL



- ▶ Each community network encapsulated in an autonomous system
- ▶ Retain diverse internal structures according to what the operators are comfortable with
- ▶ Collective negotiation of transit, carrier services
- ▶ Seen by the outside world as a BGP confederation behind AS60241
- ▶ Currently two confederations, the West Coast and South Scotland



University of the
Highlands and Islands
Oiligh na Gàidhealtachd
agus nan Eilean



SABHAL
MÓR OSTAIG



UNIVERSITY OF
STIRLING



The European Union
The European Union
The European Union

FLUENCY



The diagram illustrates the network architecture for AS60241 - HUBS. It shows connections between various ISPs and data centers. The central cloud is labeled 'Internet'. Other clouds include 'Blair Logie', 'ja.net AS786', 'Tegola, Knoydart & Hebnet', 'Fluency AS56595', 'Public Peering IXScotland', 'Scolocate South Gyle', 'Stobo & Dawyck', 'Heriot', 'Edinburgh', and 'Lothian'. The diagram also shows connections to 'VPN Concentrator Encrypted tunnels across ja.net', 'Services, Measurement & Telemetry', 'Appleton Tower', 'TechCube Summerhall', and 'Lothian'. The diagram is color-coded: grey for 'Exists now (Nov 2014)' and pink for 'Planned for 2015/2016'.

Legend:

- Grey background: = Exists now (Nov 2014)
- Pink background: = Planned for 2015/2016

IMPACT



- ▶ Distance learning for adults (e.g. UHI)
- ▶ Distance learning for children (e.g. GLOW = Scottish schools national intranet)
 - Children on Eigg schooling even in bad weather.
- ▶ Local businesses no longer disadvantaged
 - ... have even seen *new* ones moving in!
- ▶ Telemedicine starts to be practised

...Symmetry is appreciated



LAYER ≤ 7

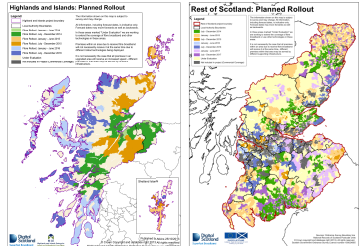
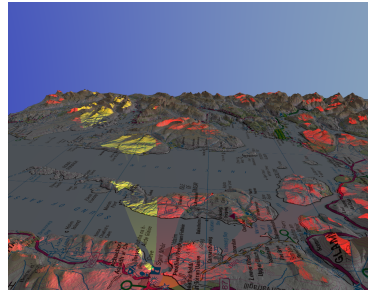


- ▶ Slow IPv6 adoption
- ▶ Variable equipment quality
- ▶ Outgrowing available capacity on the West Coast

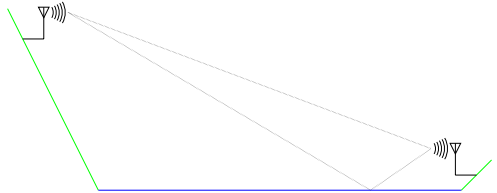
- ▶ Heavy use of NAT breaks picocells trying to do IPSec
- ▶ Heavy use of NAT can lead Google to accuse community networks of having worms ... Similar to anonymity networks like tor
- ▶ RFC1918 address collisions between UHI and the community networks cause pain
- ▶ Use of ADSL lines is *extremely* expensive (cf. BT WBC tariff) and providers notice

LAYER ≥ 8

- ▶ Step-Change, BDUK and ScotGov funding
 - ▶ Cumbersome process
 - ▶ State Aid & Double Funding
- ▶ BT's network build
 - ▶ Anæmic Open Access
 - ▶ Opaque process
 - ▶ Territorial “disputes”
- ▶ Education – not vendor courses, not “enterprise” courses, but “West Highland (Network) Engineering”
- ▶ **Summer School Next Year – Volunteers to visit & teach?**



PRACTICAL RESEARCH



- ▶ Tidal fading, periodic multipath reflections, off the water can be mitigated with appropriately spaced antennas on standard 802.11n hardware.
- ▶ 24GHz trials with a non-op license in Loch Hourn
- ▶ Free Space Optics trials in Edinburgh

Thank you

<http://www.tegola.org.uk/>
<http://www.hubs.net.uk/>

