Blow'n' to Bits

"As Cheap As Chips"

Malcolm Brew
Brew & Associates

Anthony McMahon
Steepest Ascent Ltd

Bob Stewart, Faisal Darbai, Stephan Weiss
University of Strathclyde,

steepest ascent

University of Strathclyde

BREW Your Own

Highland and Islands Broadband

- Broadband connectivity is “sparse” in H & I
- Broadband where available is often highly contended
- WiMax and special microwave access available in some places
- Avanti Satellite provides subsidised 0.5-2Mbit/s connection
- Voice and GPRS mobile is (in places) available…v. low data speed
- 3G is virtually not there, (and would be low speed/expensive)
- …and 3G LTE is a long (long) way from H&I deployment
- And we need **fixed broadband** before **mobile broadband**.

- **A Solution?** Build your own low power, co-op/ community based, renewable energy “4G” network, with 0.5Gbit/s wireless MESH backbone, high speed subscriber access over parts of H&I.

A (Brew) Broadband Case Study

- Kingarth and Kilchattan Bay on Isle of Bute
- 24 "ADSL" lines in the community
- A single 2Mbit/s connection to Rothesay
- So, it's actually one 2Mbit/s line shared with 24 people.
- 12 more *waiting* in the village for DSA
- People are paying….for broadband?
- New £16million School on Bute – 1Mbit/s for the school.
- Exchange upgrade plans? – no plans
  (Confirmed from BT CEOs office and confirmed to Scottish Government)

Recent Reports

- Telecoms Connectivity in the Highlands and Islands

Report, from Sept 2009, concluding remarks

Action 5: Investigate providing additional incentives and funding to extend NGA coverage

Digital Britain may not deliver universal NGA to the Highlands and Islands by 2017. Highlands and Islands Enterprise could investigate options to provide additional incentives and funding alongside central government funding to have more extensive NGA coverage. Key public sector stakeholders to engage with are: Department for Business, Innovation and Skills (BIS), Technology Strategy Board and Scottish Government. HIE could also be involved in facilitating technology trials and demonstrations of rural NGA roll-out.

Report by:

analysys mason

"Mind The Gap"

- £84M on fibre to the exchanges, how long?
- £434 M fiber to the door, only 40% of house holds, how long?
- Policy is yet unclear, 50p per land line tax

Figure 2: Broadband technology and take-up in the Highlands and Islands [Source: HIE, BT (2008), Analysys Mason]

3 There are some significant gaps in the current generation of telecoms connectivity

A consensus is emerging that to use a reasonably broad range of Internet-based services such as email, shopping, home working and streaming video, it is necessary to have access to a download connection of at least 2Mbit/s. Indeed, the UK Government's 'Digital Britain' recommends a 2Mbit/s universal service commitment (USC) for broadband by 2012. The USC will be delivered using a mix of technology solutions. We estimate that 28% of phone lines in the Highlands and Islands are unable to receive broadband services at a speed of 2Mbit/s or greater, compared to 11% of the UK. This is due to both the nature of the telecoms infrastructure in the Highlands and Islands, and to a lesser extent the use of Exchange Activate in some areas.

The WindFi Vision

- Wireless Backbone with Point to Point (P2P)
- Subscriber access with Point to Multipoint (P2MP)
- **Wind** Power + Wi**Fi** (802.11x) = **WindFi**
- Can it be done?

  If we can do it ***Uganda*** with solar power ….
  …. we can do it in ***Scotland*** with Wind power

- Low power basestation (less than a low wattage light bulb)
- The wireless 802.11x technology is all there ready to roll.
- The issues to solve to roll-out a network are all engineering ones. Its technology feasible, NOW.

Build Your Own: Where's the Bandwidth?

- OFCOM – 5GHz bands B & C open for use
- Regulation on-side: 'light licensing' regime in place
- We have healthy link budgets that go the (20km) distance
- Point to Point (**P2P**):
  EIRP 4 watt (5.7 to 5.8) 125 MHz spectrum
- Point to Multi-Point (**P2MP**)
  EIRP 1 watt (5.4 to 5.7) 300 MHz spectrum

Ofcom

UK Interface Requirement 2007

Fixed Broadband Services operating in the 5725-5850 MHz band

WindFi: 802.11n Wireless

It's here today and....tomorrow

- 802.11n, MIMO, SOC's latest 6th generation silicon
- COTS Dual Band 2.4/5.8 GHz sub $25 a 'POP'
- Latest OFDM, 64QAM modulation schemes = FAST
- Spectral Efficiency 5bits/Hz close to 'Shannon Limit'
- 30km+ LOS @ -74 dBm P2P 100+ Mbps in 20 MHz
- 4km CPE to Base Station links @ -86 dBm 40Mbps+
- Ultra Light, Ultra Small, Ultra Cheap
- Negligible power consumption, no heat = no cooling
- **HotHops** 2 **HotSpot** 5.8 Ghz to 2.4 Ghz
- TDMA to CSMA BackBone 2 Wi-Fi

The WindFi Green Basestation

- Sub 60 watt “basestation”
- 4 radios – 200Mbits/s trunk + 200Mbits access
- No cabling (electrical power not required; welcome if avaiable)
- Vertical axis wind turbine powered
- Base Station power budget, sub-50 watts
- NiCad battery pack 96+ Hrs standby/no wind
- Solar auxiliary backup, (great for Developing World!)
- Zero environmental impact
- Zero electrical installation regulations
- Zero Carbon opex footprint

“Building” your Network

- WindFi Mast: fully integrated, its all in the pole
- No excavation: free stand non penetrating masts
- No electrical or backhaul ‘plumbing’ to deal with
- Compliant : fit for ‘SSSI’ deployments, Totally Green
- Fast ‘n’ Easy: rapid base station rollout & installation
- Re-locatable: no site preparation = no site clean up
- No planning permission for 90 cm dishes or micro wind turbines
- **Network Planning Tools:** - SRTM (Shuttle Radar Topography Mission)
  - GoogleMaps
  - GIS coverage mapping

WindFi: H&I Digital Inclusion

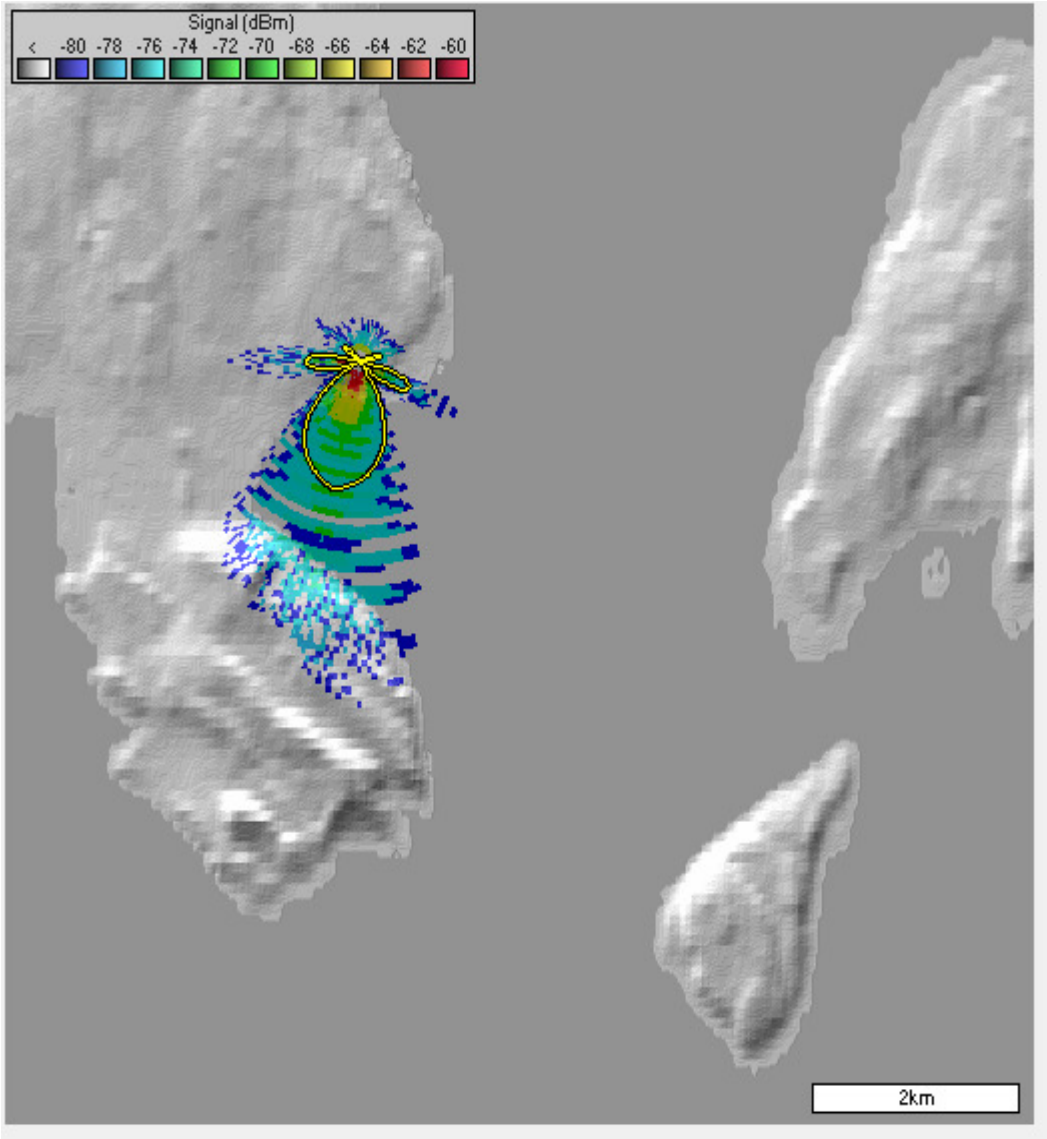
- Cooperative Network of Communities
- Public Access Wi-Fi available where it's needed
- Markets: Education, TeleHealth, Banks, Business
- **Hop Scotch** – Largs–Bute-Arran-Rhum-Eigg
- Download speeds of >>2Mbits/s available

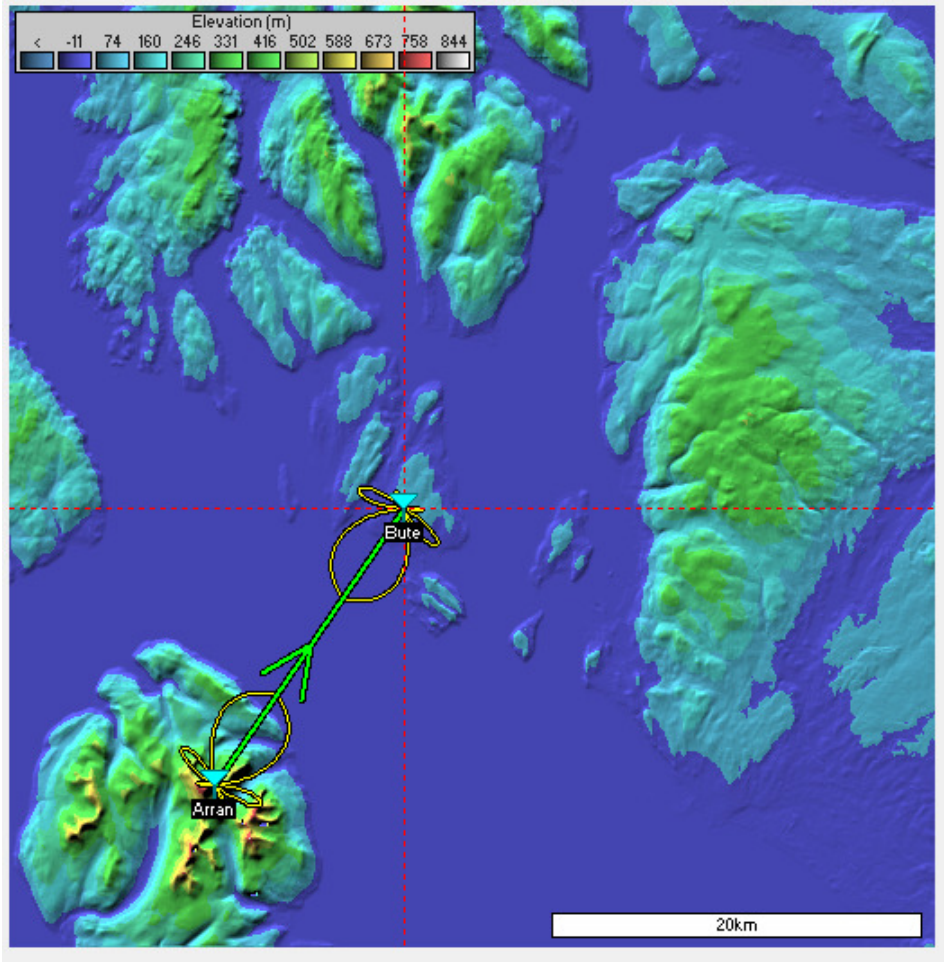
Conclusions and Forward

- Building first link prototypes
- 4km P2MP demo link already running
- WindFi prototype basestation for Q1 2010
- Aiming to attract level of Govt support
- Cooperative / Community Engagement
- Try to deliver on the 3G LTE data expectation… now

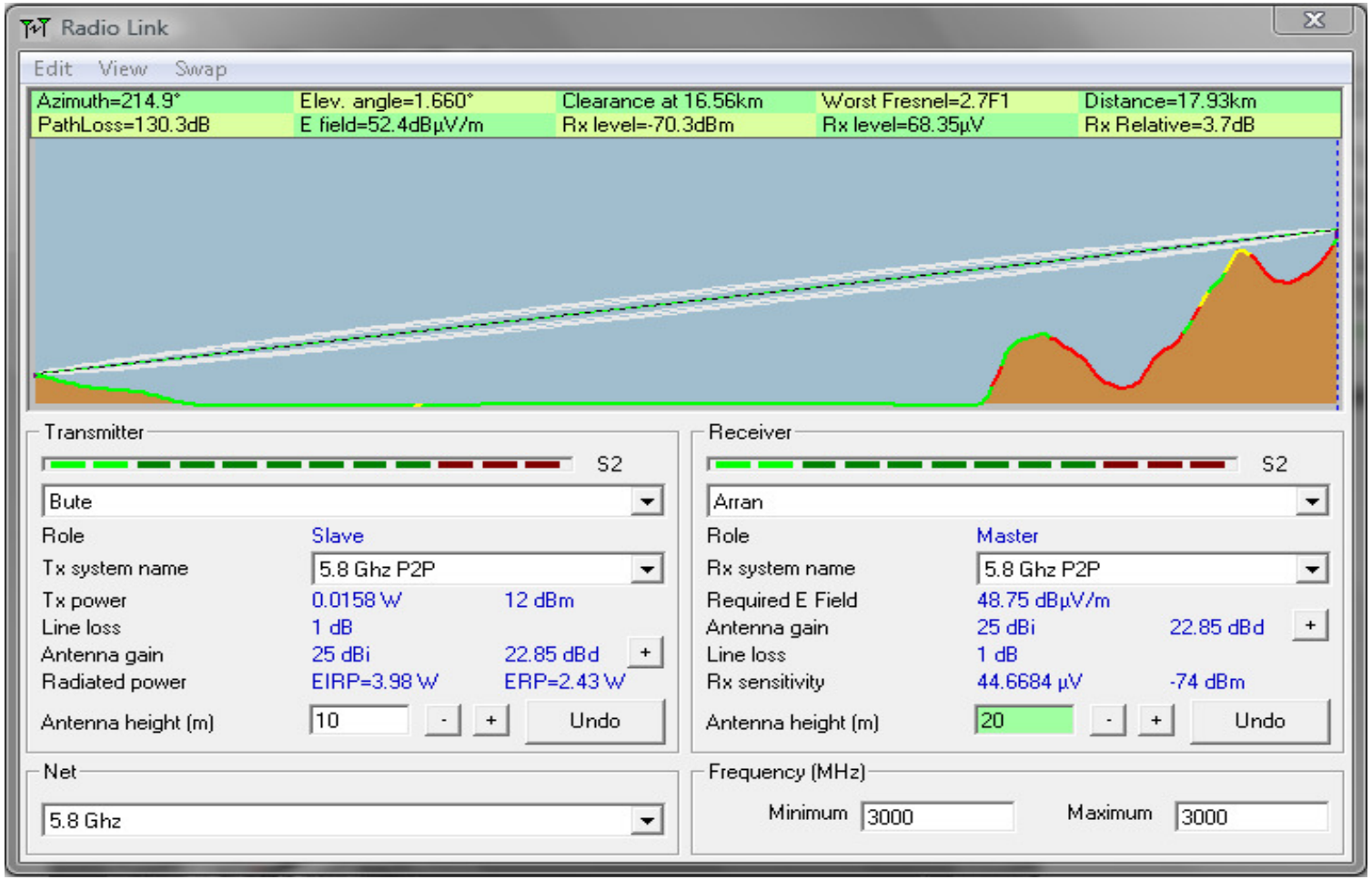
Coverage

- P2MP Base Station
- -86 dBm = 20 Mbps
- 4km CPE links
- TDMA to CDMA
- WiFi & UTP NICs
- Multiple SSIDs
- VPN support




Elevation (m)
< -11 74 160 246 331 416 502 588 673 758 844
Bute
Arran
20km

Current Test Link


Radio Link
Edit
View
Swap
Azimuth=214.9°
Elev. angle=1.660°
Clearance at 16.56km
Worst Fresnel=2.7F1
Distance=17.93km
PathLoss=130.3dB
E field=52.4dBµV/m
Rx level=-70.3dBm
Rx level=68.35µV
Rx Relative=3.7dB
Transmitter
S2
Bute
Role
Slave
Tx system name
5.8 Ghz P2P
Tx power
0.0158 W
12 dBm
Line loss
1 dB
Antenna gain
25 dBi
22.85 dBd
Radiated power
EIRP=3.98 W
ERP=2.43 W
Antenna height (m)
10
Undo
Receiver
S2
Arran
Role
Master
Rx system name
5.8 Ghz P2P
Required E Field
48.75 dBµV/m
Antenna gain
25 dBi
22.85 dBd
Line loss
1 dB
Rx sensitivity
44.6684 µV
-74 dBm
Antenna height (m)
20
Undo
Net
5.8 Ghz
Frequency (MHz)
Minimum
3000
Maximum
3000