Enabling Affordable Internet Access with Dynamic Spectrum and Software Defined Radio

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It’s Year 8 of our TVWS Journey!

• Presentation Outline:
  – Centre for White Space Communications
  – An Engineering Look Back to some TVWS Projects
  – UK Govt Funded DSA Project
  – The Scotland Innovation Programme
A multi-disciplinary international centre working with industry, government and academic partners to undertake R&D on Dynamic Spectrum, TVWS and related areas

• Started in 2010 and led by the University of Strathclyde
• Builds on over 30 years of experience in mobile/wireless communications and signal processing
• Investigating technological and socio-economic aspects of Dynamic Spectrum Access
• Academically-led, Industry-focused, Govt Engaged
• Working very closely with business, social enterprise groups, Government Offices and industry
2010: Isle of Bute TVWS

2012: Isle of Tiree 5GHz/TVWS

2014: Ofcom Glasgow TVWS Pilot

2015: Orkney Islands ‘Nomadic’ TVWS

2016: MarTacNet (TVWS at sea)

2017 Q3: Scotland 5G Innovation Prog.

2017 Q2: UK Govt/DFID Engagement...

2017: Social Housing with DS/SDR
• Supported by UK Technology Strategy Board
• Successfully demonstrated the viability of using White Space for rural broadband connectivity
• Eleven premises connected – trialists & their families:
  – Video streaming (iPlayer, YouTube)
  – Facebook, Twitter, Videoconferencing
  – DEFRA, Internet Banking, VAT returns, ...
• Six collaborating partners:
2011: Isle of Bute Equipment Setup

Telephone Exchange

Trialists’ premises

BBC ... Test & Measurement
Problem: Getting electrical power where the wireless relay basestations are Wind and Solar powered with up to 100 watt base-load and 4 days of battery backup Running on Isle of Bute, and on Isle of Tiree (5GHz network).
2014: Glasgow Ofcom Pilot

- TVWS network installed on University of Strathclyde campus
- Supporting Ofcom to validate its proposed DSA
- Helping to assess new technologies, e.g: IEEE 802.11af
- Demonstrating higher-level benefits of using White Space spectrum
  - Outdoor Internet access;
  - Webcam backhaul
2015: Orkney Islands ‘Nomadic’ TVWS

• Connecting ferries and hard-to-reach rural premises
2015: Orkney Islands Nomadic TVWS
“BAE Systems will play a key role in the Royal Navy’s upcoming Unmanned Warrior exercise, the largest event of its kind ever undertaken……

….. Unmanned Warrior will showcase BAE Systems’ MarTacNet technology developed in collaboration with Cloudnet IT Solutions, 6Harmonics, Fairspectrum and Strathclyde University, which uses part of the UHF spectrum made redundant by the digital TV switchover to provide high bandwidth, long-range tactical communications.”
Rural Connectivity in Kenya

- 4 Afrika (Microsoft)
- Linking remote villages in rural Kenya
- Radio planning, basestation design
- Bucket-Fi (have a look YouTube)
- An Outstanding Success
- www.mawingunetworks.com
Mawingu Access Point – With a “Bucket-Fi”

Watch it on YouTube
• May 2017:

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• The UK Government via EPSRC (Engineering and Physical Science Research Council) will fund a **5 academic partner** project alongside input and support from a number of supporting and collaborating industry partners

• **Participating Countries:** Scotland (UK), Zambia, Ghana, Malawi, Kenya

* GCRF: *Global Challenges Research Funding*
2017: Enabling Affordable Internet ...

- **Dynamic Spectrum Access & Cloud Services Partners**
  - Microsoft
  - NOMINET

- **UK Test Network Partners**
  - BROADWAY PARTNERS
  - CloudNet

- **Enabling Technologies (Software and Hardware)**
  - XILINX
  - MathWorks

- **White Space / DSA Radio Hardware Vendors**
  - 6HARMONICS
  - ADAPTRUM

- **Project Lead**
  - University of Strathclyde, Glasgow

- **International Partners**
  - Strathmore University (Kenya)
  - MAWINGU (Malawi)
  - Copperbelt University (Zambia)
  - National Communication Authority (Ghana)

Enabling Affordable Internet Access with Dynamic Spectrum Management & Software Defined Radio

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• **Aim:** To investigate how the use of dynamic spectrum access (DSA) management and geo-location database technology, combined with software defined radio (SDR) implementations to enable effective and efficient wireless networks to be built at scale to support affordable Internet.

• Build upon previous work and know-how that has taken place in the five partner countries; to lead to improved routes towards digital inclusion.

• Create an open-project and set up relationships with similar projects (achieved at DSA!), engage new university partners, new countries, other industry partners.
• Project Dates: May 2017 to May 2020
• Funding: £1.2M:
  – 1 Project Manager (UoS)
  – 0.5 Research Director (UoS)
  – 2 Research Engineers (UoS)
  – 2 PhD Students in Scotland (UoS)
  – 4 x 1 Research Engineer in each international Academic Partner Malawi, Zambia, Ghana and Kenya
• Industry in-kind support and engagement, ~£0.5M
• A strong base to bid for further UK DFID and ODA funding
Established in June 2016, constituted in March 2017...

Scotland Innovation Programme (SIP) is an open collaborative framework to which companies or individuals can contribute, by creating or participating in innovative projects which support the Scottish Government's ambition for the availability of world class digital connectivity.
2017: SIP Objectives

• Implement innovative solutions to move towards achieving 100% coverage (indoor and outdoor) across Scotland, and build the foundation for the evolution to 5G in the future.

• Provide a platform for innovation to close the gap between the availability of new technologies in urban areas and their availability in remote and rural areas.

• Enhance the lives of local communities through innovation in communications technology.

• Collaborate with member partners and international partners to test and evolve towards 5G, with particular emphasis on rural and remote communities.
Founding Partners and Board Members:

- EE
- BT
- NOKIA
- CISCO
- facebook
- Strathclyde University

Start-up Members:

- Lime Microsystems
- Google
- University of the Highlands and Islands
- AWTG
- Parallel Wireless
Software Defined Radio

• Low cost SDR hardware
• SDR (and DSA projects and design) is almost core curriculum on EE courses
Software Defined Radio Dev Kit

Lime SDR
Couple of $100’s

USRP
Few $100’s

RTL-SDR
$15 (fifteen!)

• Powerful? Take a look at the Limenet LTE Basestation (in a wee PC box!) demo here at DSA
• PHY Layers...? MATLAB Simulation and Design for DSP, LTE, 802.11x... Near every tech University has access and licence for MW tools
• At Strathclyde – every students gets an SDR to take home
DSA: By Royal Appointment!
Thank you!
And please do visit us in Scotland
Converging skills: Programmable Networks

LIME SDR Hackathon

Call for entries: to apply visit: http://bit.ly/BTEESDRHack1
For full briefing email to infinitylab@bt.com
Partners: