

# “WindFi” Lower Power Renewable Basestation

S. Weiss<sup>1</sup>, C. McGuire<sup>1,2</sup>, M. Brew<sup>1</sup>, R. Elliott<sup>1,2</sup>, M. Enderwitz<sup>1,2</sup>

<sup>1</sup> Dept. of EEE, University of Strathclyde, Glasgow, Scotland

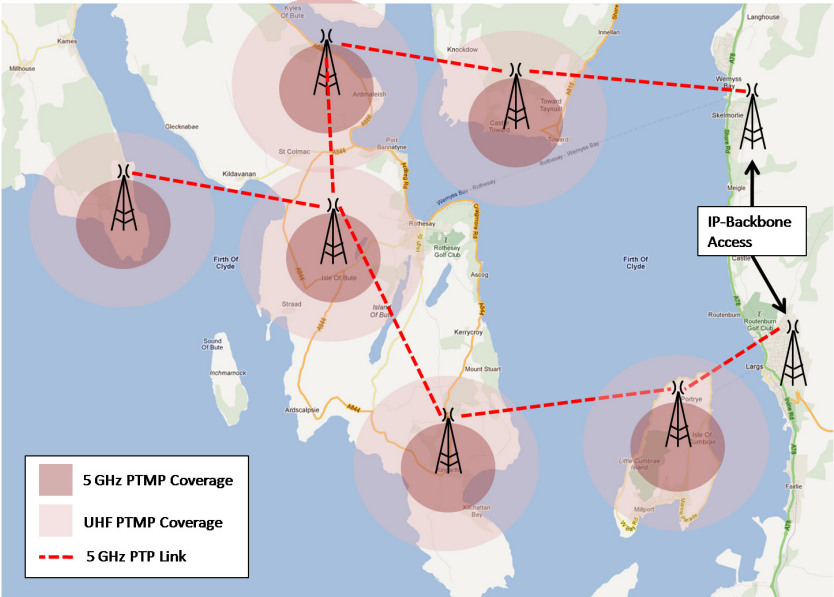
<sup>2</sup> MathWorks, Glasgow, Scotland

TVWS Event, May 14, 2015

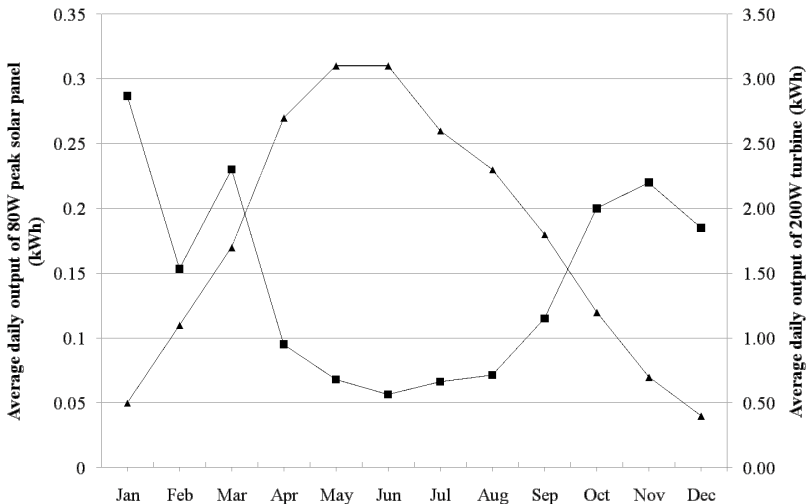
This work is/was supported by the Scottish Funding Council, the Technology Strategy Board, and the Engineering and Physical Sciences Research Council via industrial CASE awards.



# Example Basestation Network

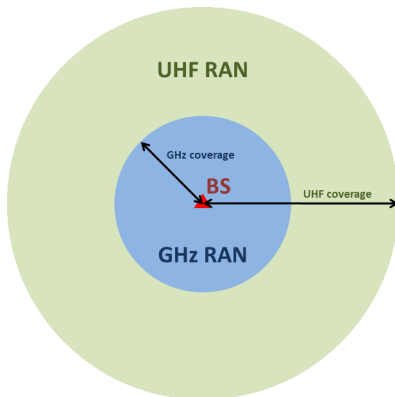
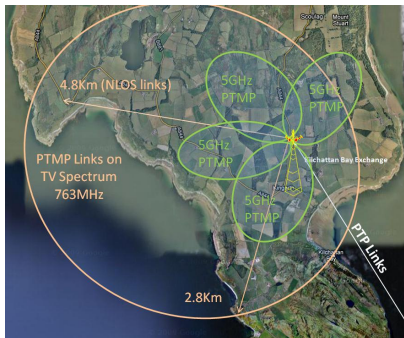


- ▶ Wind and solar outputs measured on Tiree:



# Heterogenous Networks

- ▶ How to optimise power in a system with both 5GHz and TVWS links?



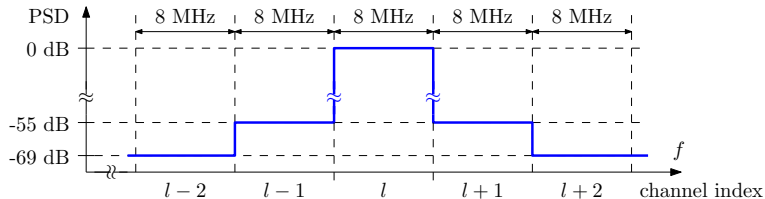
- ▶ Cell breathing: modify the boundary between both networks;
- ▶ counter-intuitively, it is best to assign users at the boundary to TVWS;
- ▶ it is most energy-efficient to switch off one network entirely.

# Future TVWS Radio Transceiver I

- ▶ UK TVWS spectrum (470-790 MHz) covers 40 channels, each 8 MHz wide;
- ▶ trials use fixed frequency assignment (e.g. 693 MHz on Bute)

Future transceiver characteristics:

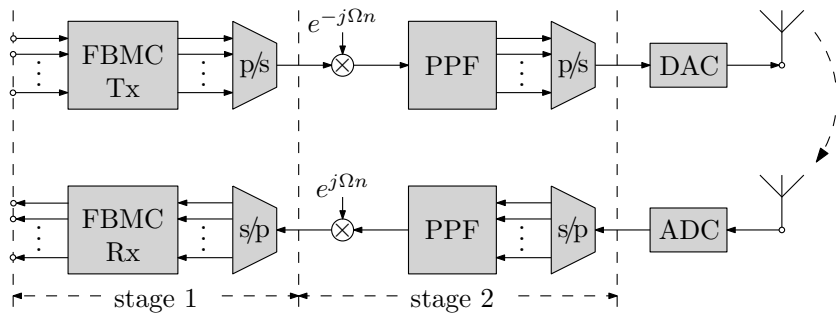
- ▶ stringent spectral mask requirements:



- ▶ frequency agility to accommodate different channel assignments;
- ▶ optional of channel bonding.

# Future TVWS Radio Transceiver II

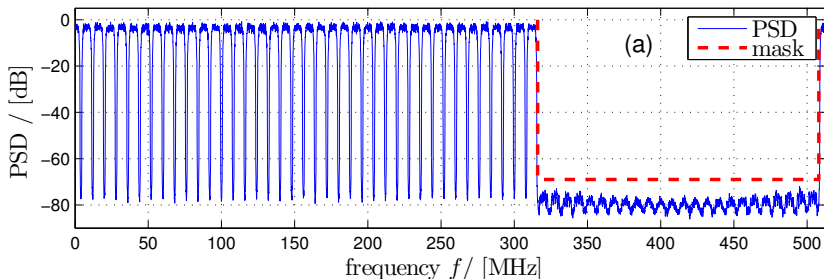
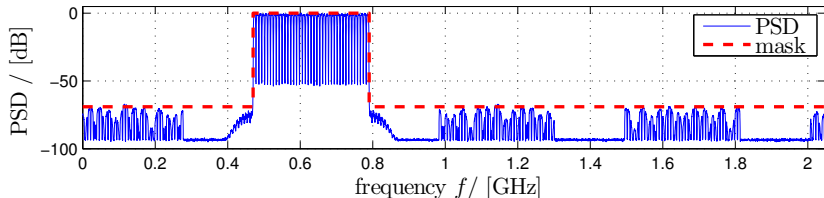
- ▶ Filter-bank based 320MHz transceiver;
- ▶ transmitter: 40 baseband channels are combined and modulated to UHF;



- ▶ receiver: sampling at RF (2GHz) and digital down-conversion;
- ▶ cost for 40 channels almost the same as for a single channel.

# Transceiver FPGA Implementation

- ▶ Transceiver fits easily onto a state-of-the-art FPGA;
- ▶ fixed point implementation still obeys the spectral mask:





- ▶ The use of renewables can be key to a rural basestation;
- ▶ independent of grid and planning permission, deployment is flexible;
- ▶ this requires the need for low power consumption;
- ▶ we have dimensioned the power supply to survive periods of no wind/solar;
- ▶ power can be further lowered by network optimisation and “breathing” radio access network cells;
- ▶ design and implementation of a low-cost, frequency agile transceiver.