Proposed TIGER-3 Radar Architecture

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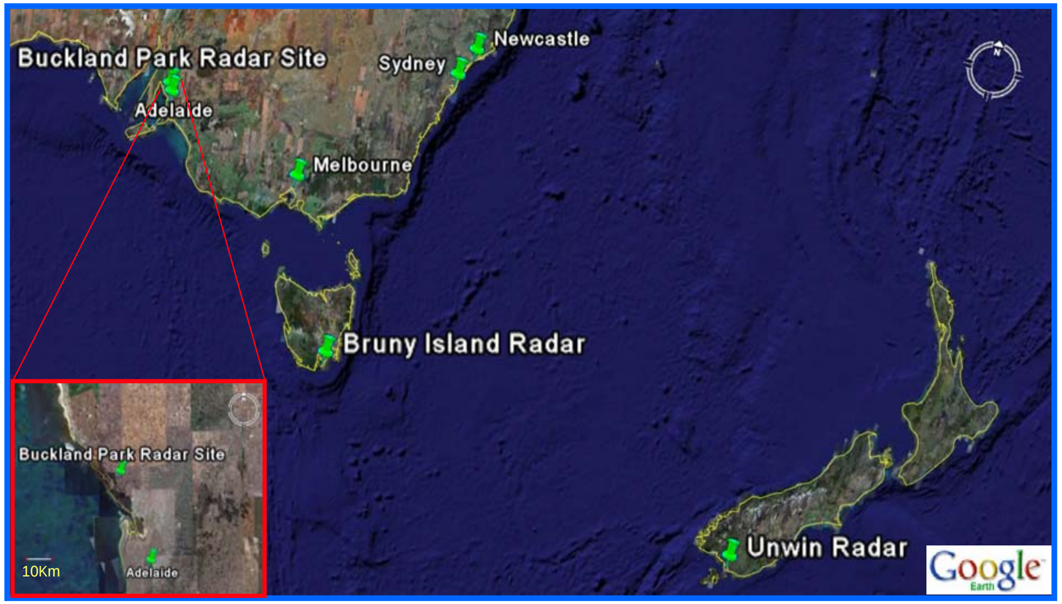
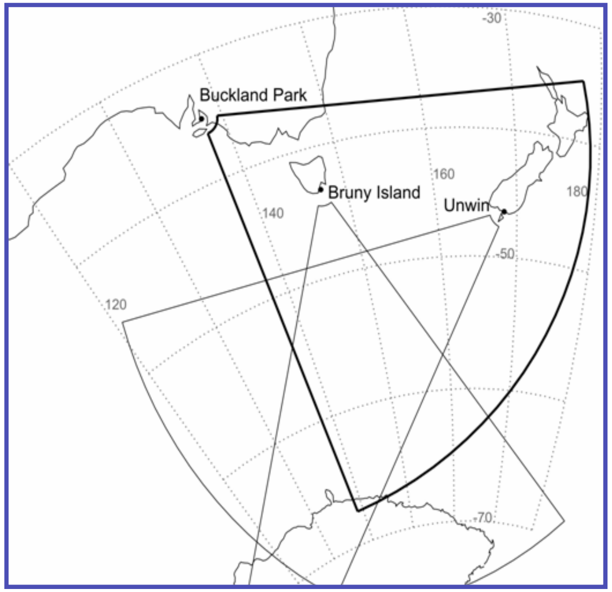
Introduction

La Trobe University, the University of Newcastle and the University of Adelaide are planning to build a new digital SuperDARN HF radar at Buckland Park, near Adelaide in South Australia. The new radar (TIGER-3) is the subject of a current grant application and, if funded, is expected to commence operations in 2011.





TIGER-3 will have an extended azimuthal footprint east to New Zealand and South to just reach Antarctica. The radar will survey the region immediately equatorward of the existing TIGER radars, providing sufficient overlap to ensure continuity of the measurements in the sub-auroral region. Thus, TIGER-3 will be in a good position to map equatorward movements in ionospheric convection particularly during disturbed periods, when we have found the convection extending beyond the field of view of the current TIGER radars

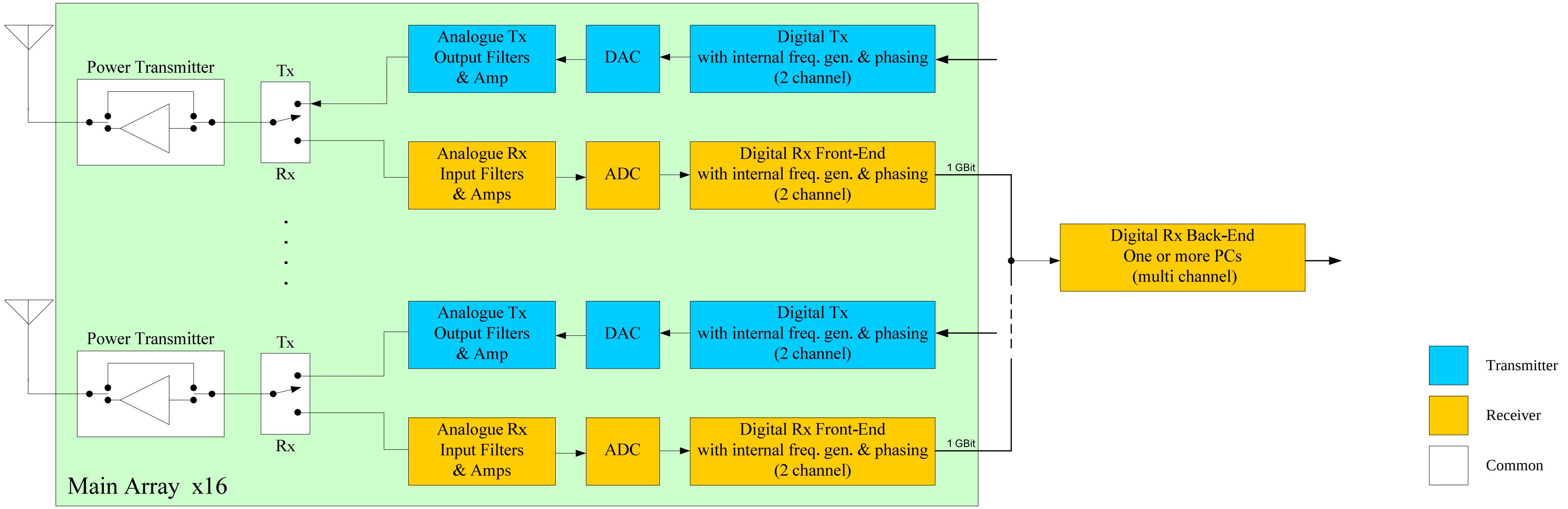
Buckland Park Site

The Buckland Park (BP) field station is a mature site managed by the University of Adelaide. It already houses a number of instruments developed by the University of Adelaide, and international partners.

Photo: Iain Reid, University of Adelaide

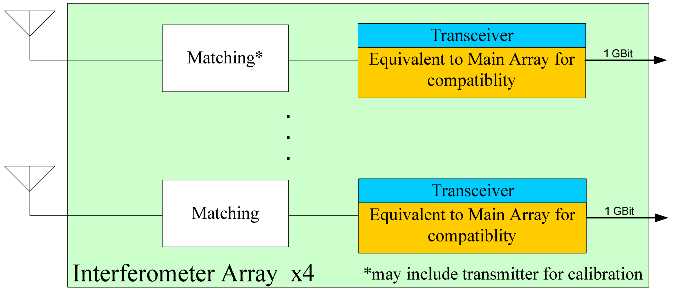
Digital Stereo

TIGER-3 will be a stereo radar with antennas chosen so that extended azimuthal sweeps can be accommodated. By placing fully digital transceivers at each antenna the operation of each channel can be completely de-coupled in all operating parameters, e.g. beam width and sweep rate, apart from the transmit pulse pattern. This will enable each channel to operate in completely different modes, for example, the hardware will be capable of supporting one channel operating in a mode giving high-resolution Doppler spectra of low velocity echoes, while the other provides un-aliased spectra of high-speed echoes.



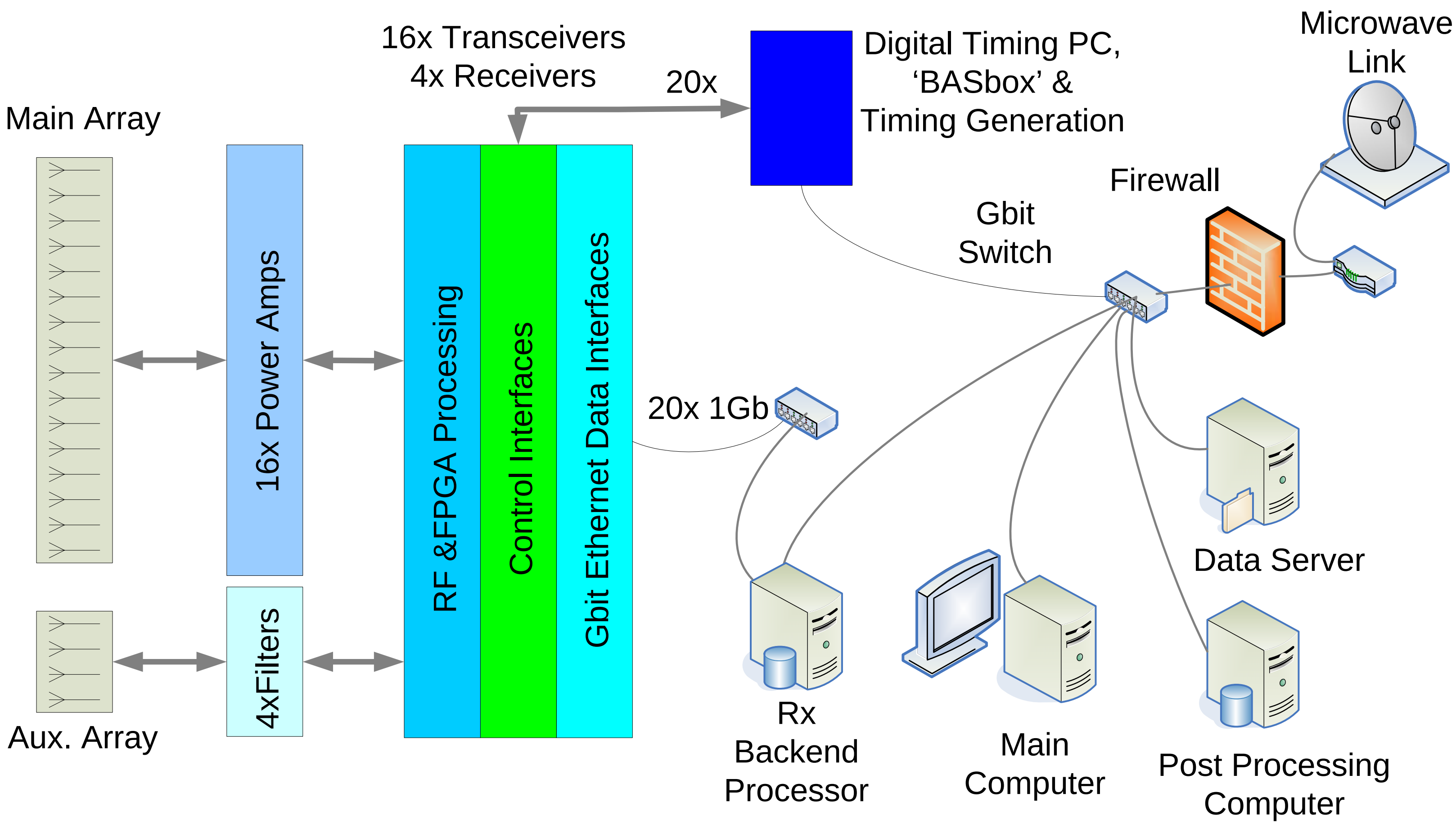
Performance & Flexibility

The receiver will be split between a high performance FPGA implementation for the front end and a highly flexible software PC implementation for the back-end, Communication via 1Gbit Ethernet.



System Overview

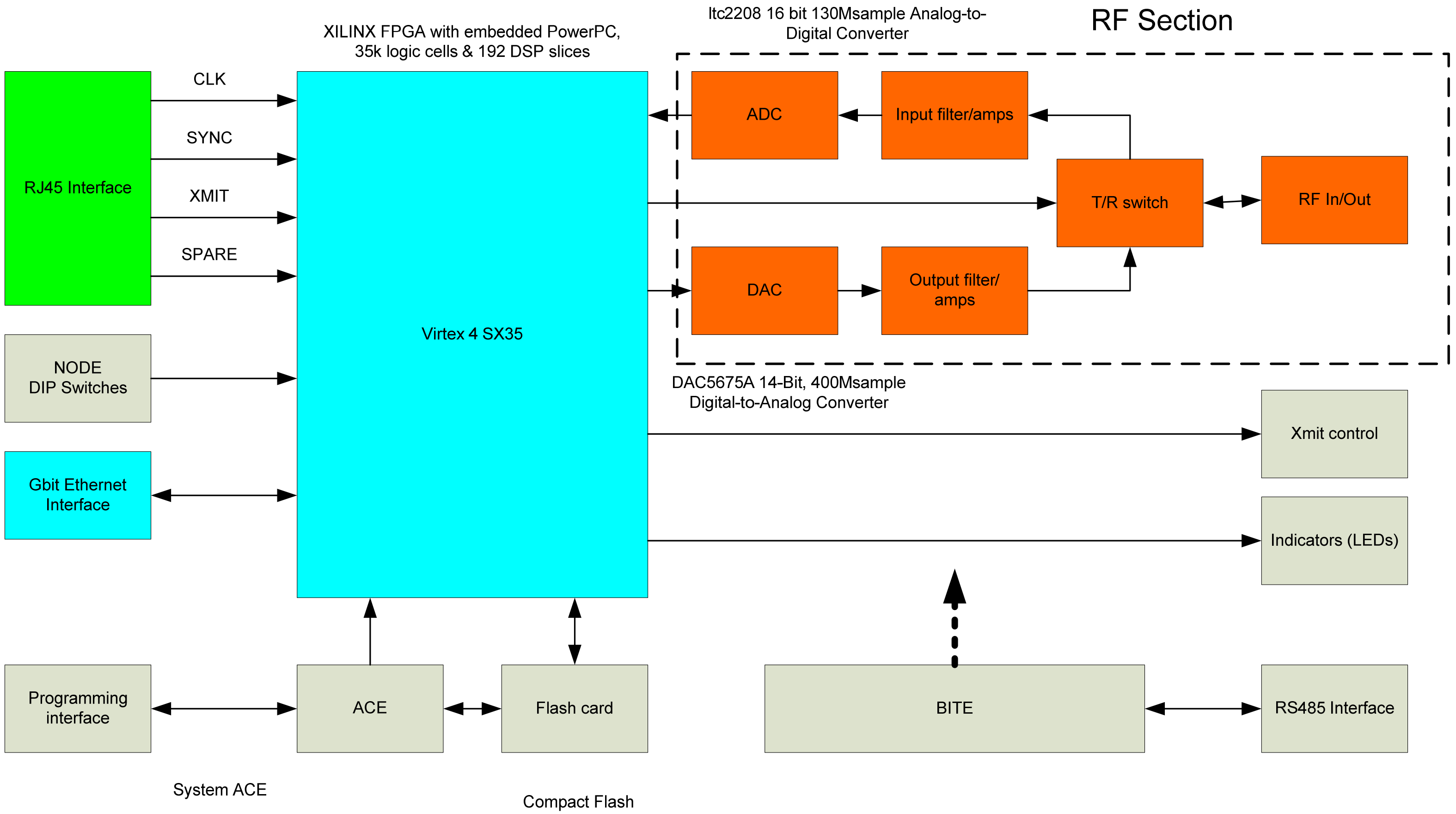
- Control & data transfer over 1Gbit Ethernet
- Timing computer integrated in embedded PowerPC in Digital BASbox
- Post Processing potentially available for special high rate/raw data recording
- Transceiver per antenna enables possibility of post campaign beamforming



Transceiver (20 required)

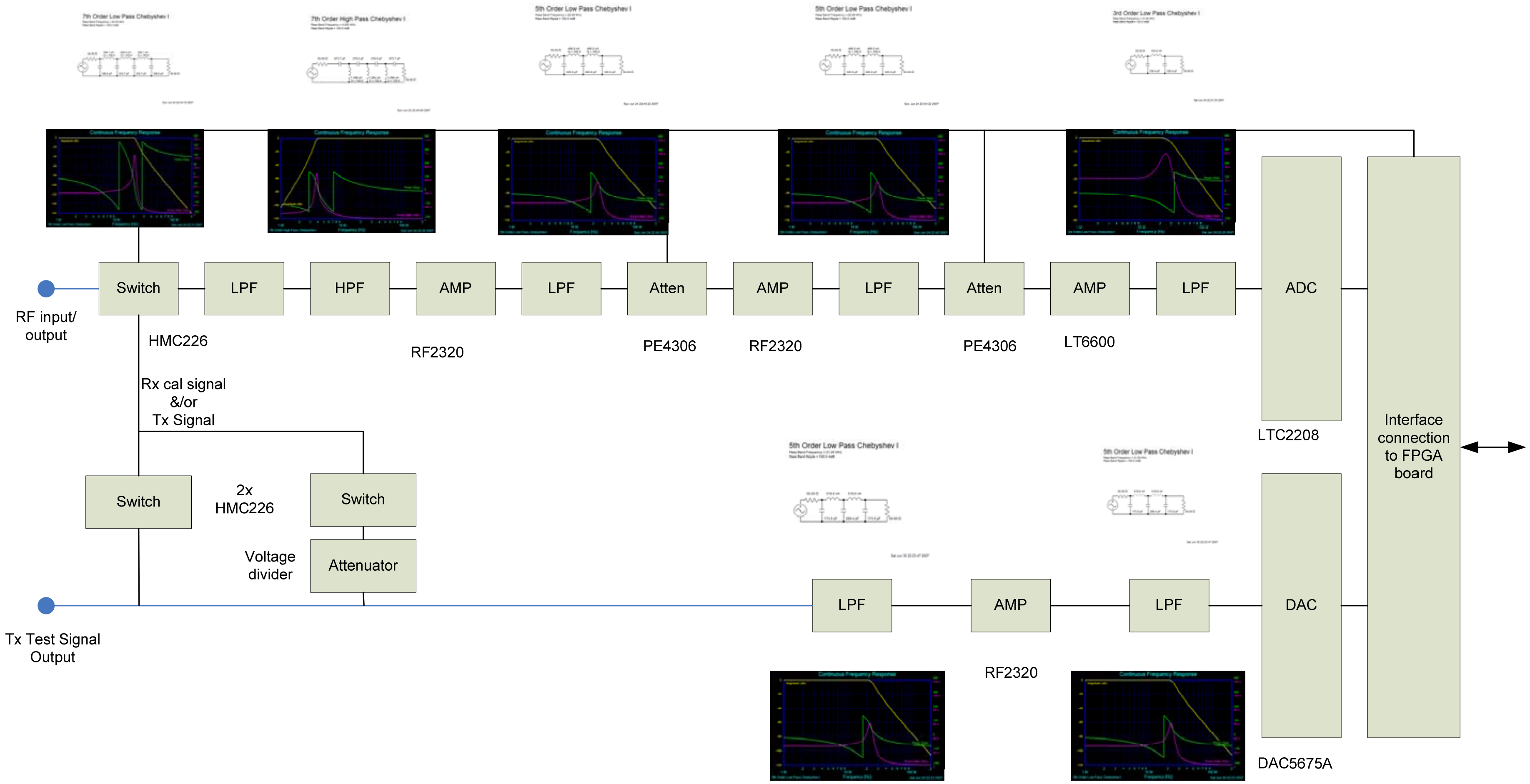
Currently undergoing PCB Layout the transceiver includes:

- Control interface,
- Gbit Ethernet interface,
- RF control and RF signal interfaces.
- Programming interface,
- Node ID switches,
- Indicators



Transceiver RF Design

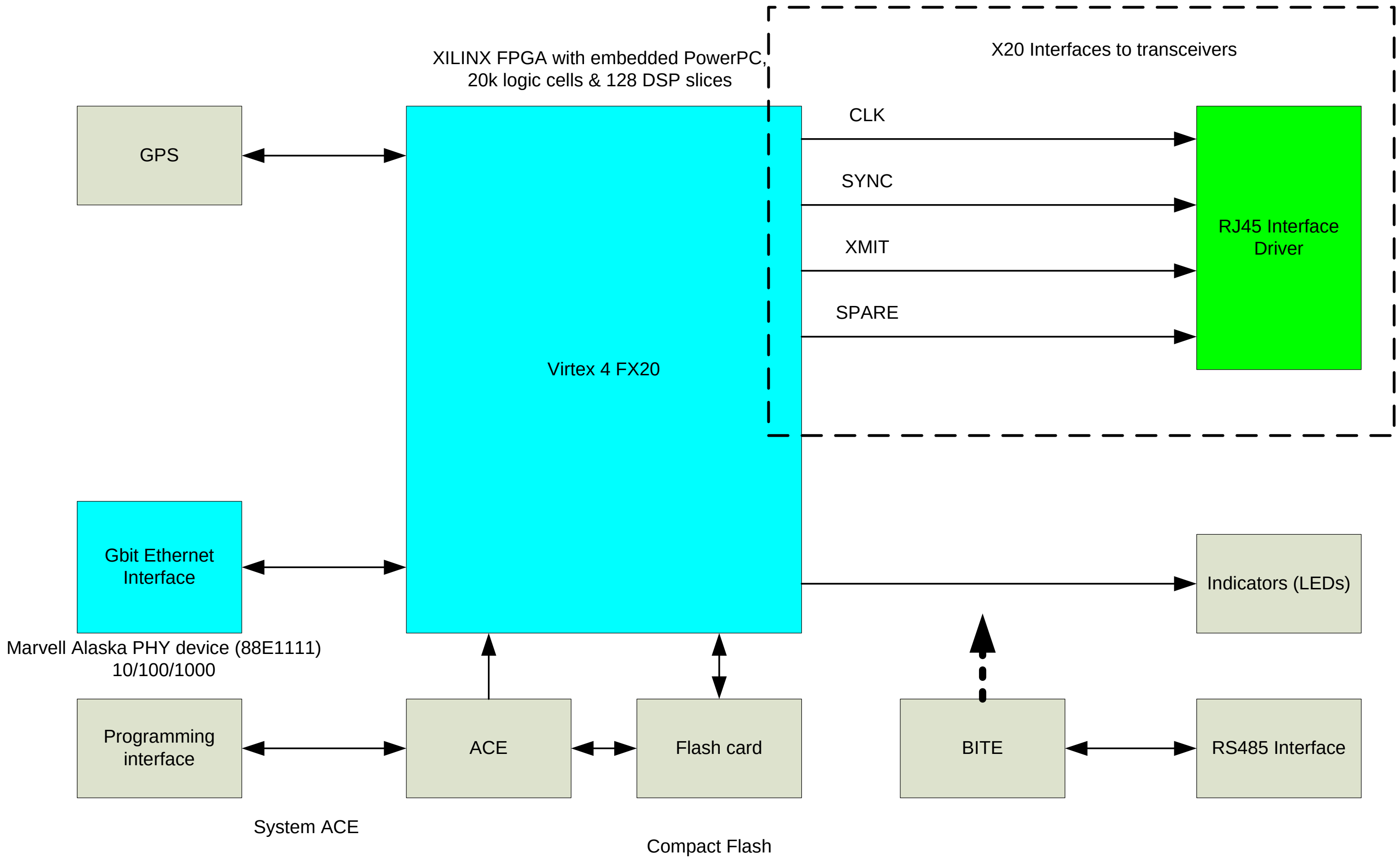
- Filters designed to produce minimal/matched phase shift at low frequencies (<20MHz)
- Cal signal path included for matching filters, if required



Timing Computer & BASbox Replacement

System uses an embedded Power PC in the FPGA running Neutrino RTOS from QNX to:

- interpret radar commands
- program the transceivers via an Ethernet interface
- Produce timing signals – 250MHz clock, Sync (1PPS from GPS), and Transmit pulses

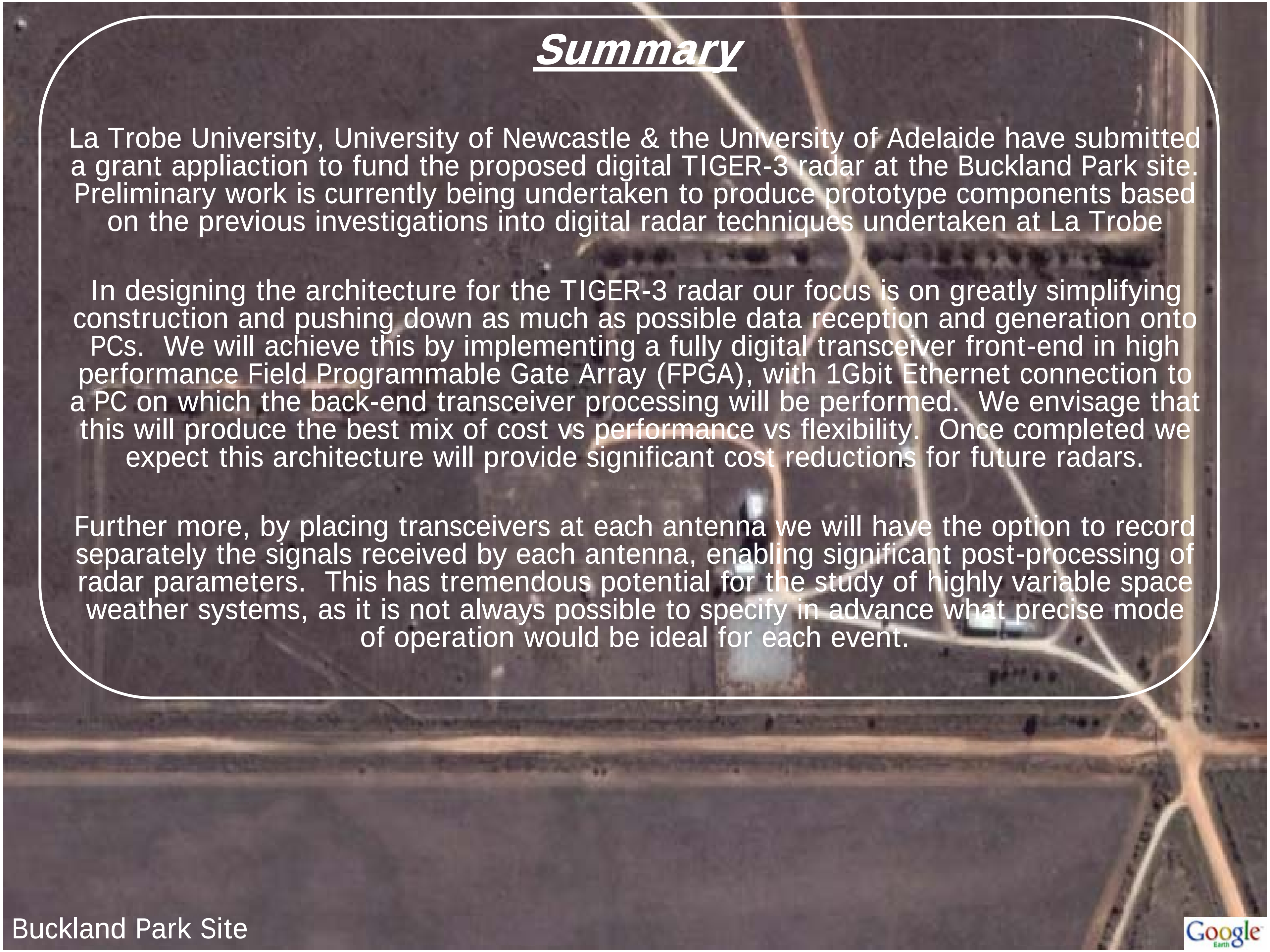


Summary

La Trobe University, University of Newcastle & the University of Adelaide have submitted a grant appliaction to fund the proposed digital TIGER-3 radar at the Buckland Park site. Preliminary work is currently being undertaken to produce prototype components based on the previous investigations into digital radar techniques undertaken at La Trobe

In designing the architecture for the TIGER-3 radar our focus is on greatly simplifying construction and pushing down as much as possible data reception and generation onto PCs. We will achieve this by implementing a fully digital transceiver front-end in high performance Field Programmable Gate Array (FPGA), with 1Gbit Ethernet connection to a PC on which the back-end transceiver processing will be performed. We envisage that this will produce the best mix of cost vs performance vs flexibility. Once completed we expect this architecture will provide significant cost reductions for future radars.

Further more, by placing transceivers at each antenna we will have the option to record separately the signals received by each antenna, enabling significant post-processing of radar parameters. This has tremendous potential for the study of highly variable space weather systems, as it is not always possible to specify in advance what precise mode of operation would be ideal for each event.



Buckland Park Site