

MilCIS 2014

# Rethinking Satellite Ground Station Architecture

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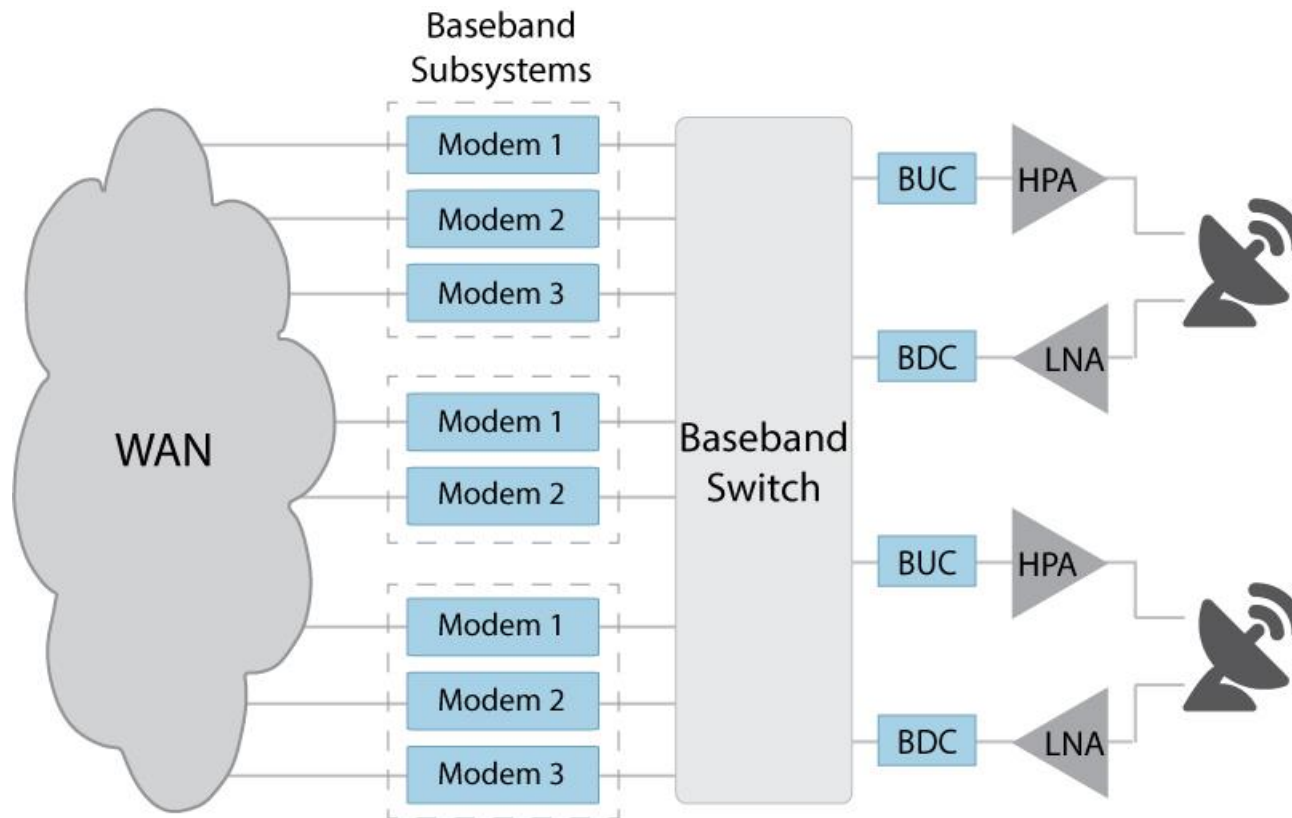
## The New Ground Station Architecture

### Overview

- A typical modem application
  - Software running on HPC
  - RF provided as IP stream
  - Signal processing done on GPU's
  - Transmission as IP stream
  - Baseband network interface as usual

## Current Ground Station Architecture

### Overview



## Current Ground Station Architecture

### Shortcomings

- Supportability
  - Vendor specific spares
  - Subsystem specialist knowledge
  - Logistics for repair of failed spares

Current Ground  
Station Architecture

Shortcomings

- Surge Capability
  - Long lead time for new equipment
  - Outages required for upgrade

## Current Ground Station Architecture

### Shortcomings

- Redundancy
  - Vendor specific redundant equipment
  - Additive effect with multiple vendor subsystems

## Current Ground Station Architecture

### Shortcomings

- Obsolescence
  - Equipment LOT typically 18 years
  - New waveforms developed more frequently

## Innovations in the IT Industry

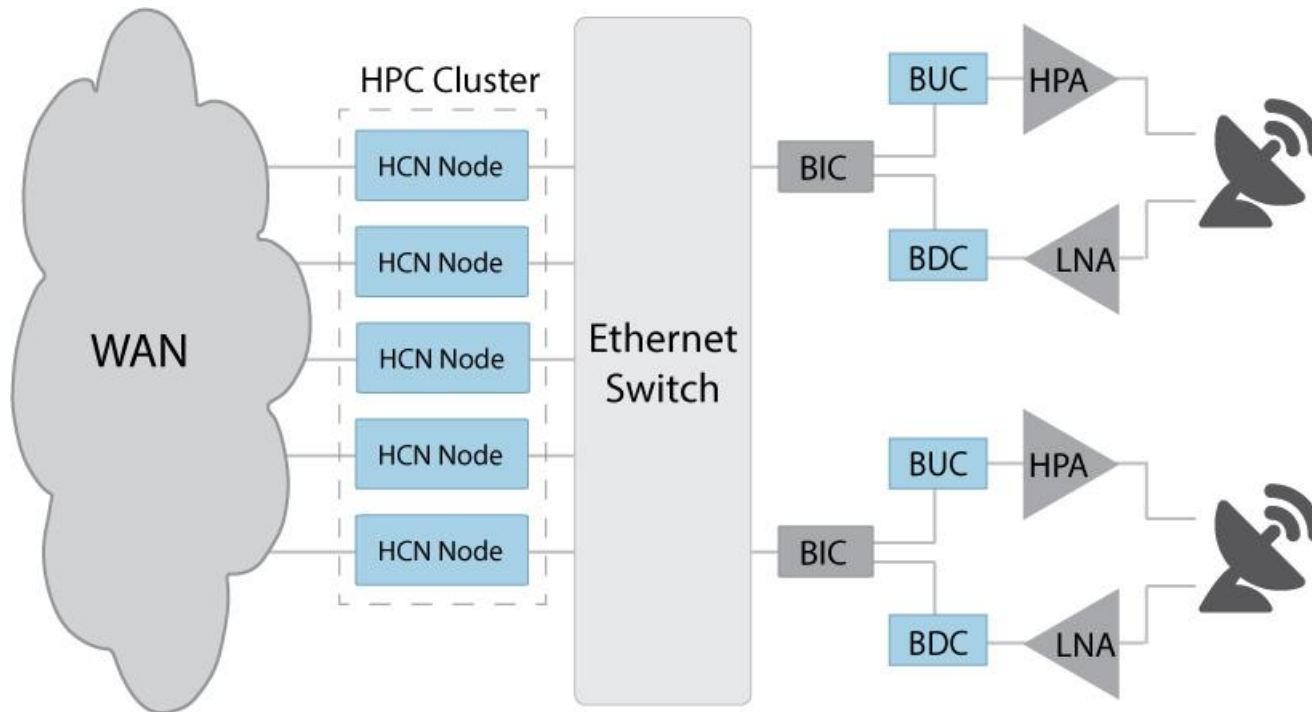
### Trends and Buzzwords

- Moore's Law
- 10/100 Gbps Ethernet networks
- SaaS
- Heterogeneous HPC
- Cloud Computing



## Rethinking the Design

### Overview



## Rethinking the Design

### Straight to Digital

- Digitise straight after down conversion
- Lossless distribution via IP networks
- Works the same in transmit direction
- Typical bitrate for 200MHz @ 16-bit:



# 6.4Gbps

## Rethinking the Design

### IP Switching

- Commodity Ethernet switches available
- Multiple vendor support
- COTS product available from Cisco, Lucent, HP, etc
- Short lead time hardware

## Rethinking the Design

### Commodity Computing

- Servers with GPU's provide cost-effective HPC capability
- COTS product available from Dell, HP, IBM, etc
- Short lead time hardware

## The New Ground Station Architecture

### Capabilities

- Implicit redundancy
- Hardware support from local vendors
- Surge capability
- No waveform obsolescence

## The New Ground Station Architecture

### The Need for Standards

- Digitisation API
  - Multiple vendors could provide digitisation hardware
  - API provides a standard interface for vendor interoperability

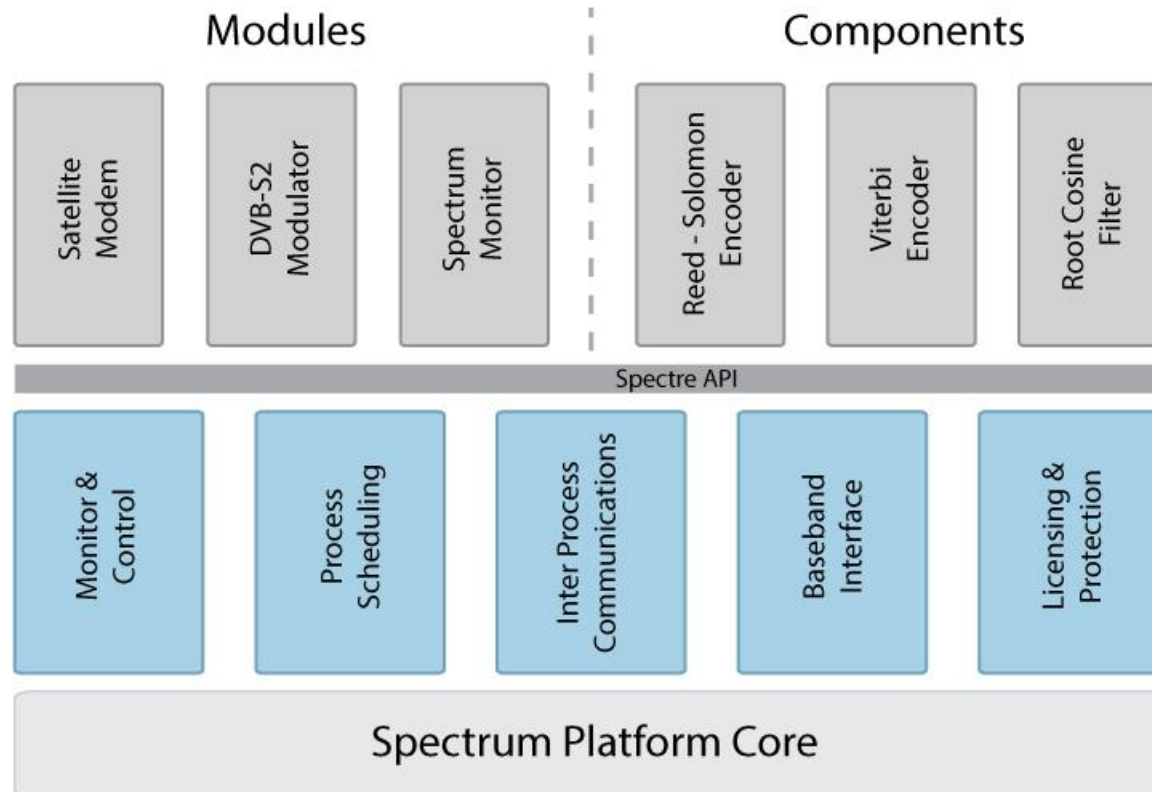
## The New Ground Station Architecture

### The Need for Standards

- Signal Processing API
  - An interface for vendors to develop software modems against
  - Controlled access to digitised satellite signals
  - Resource management for HPC cluster

# Signal Processing API

## Overview





- Product demonstrator built
  - 250Msps 14-bit IQ demodulator
  - 250Msps 16-bit IQ modulator
  - L-band up and down conversion
  - 10Gb Ethernet optical interface

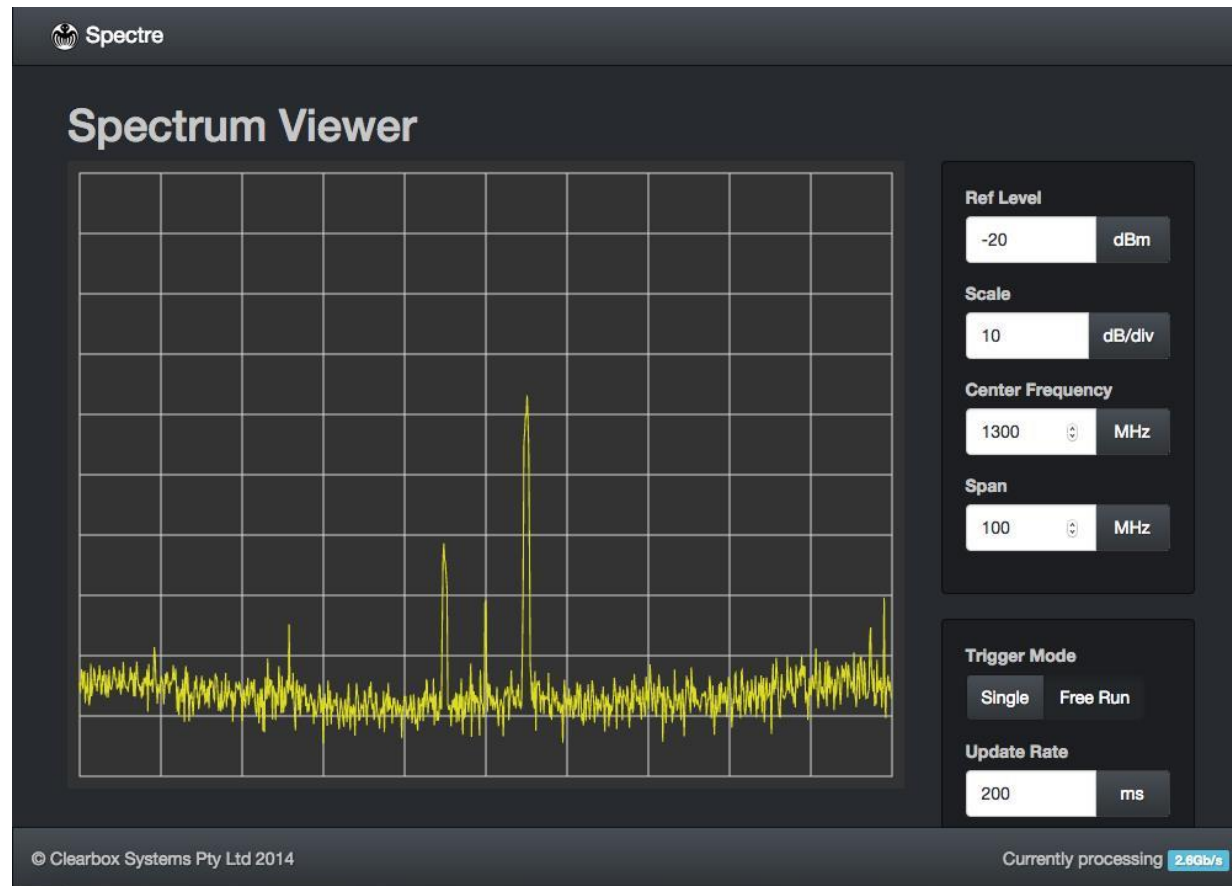
## Feasibility Study

## Digitisation Hardware



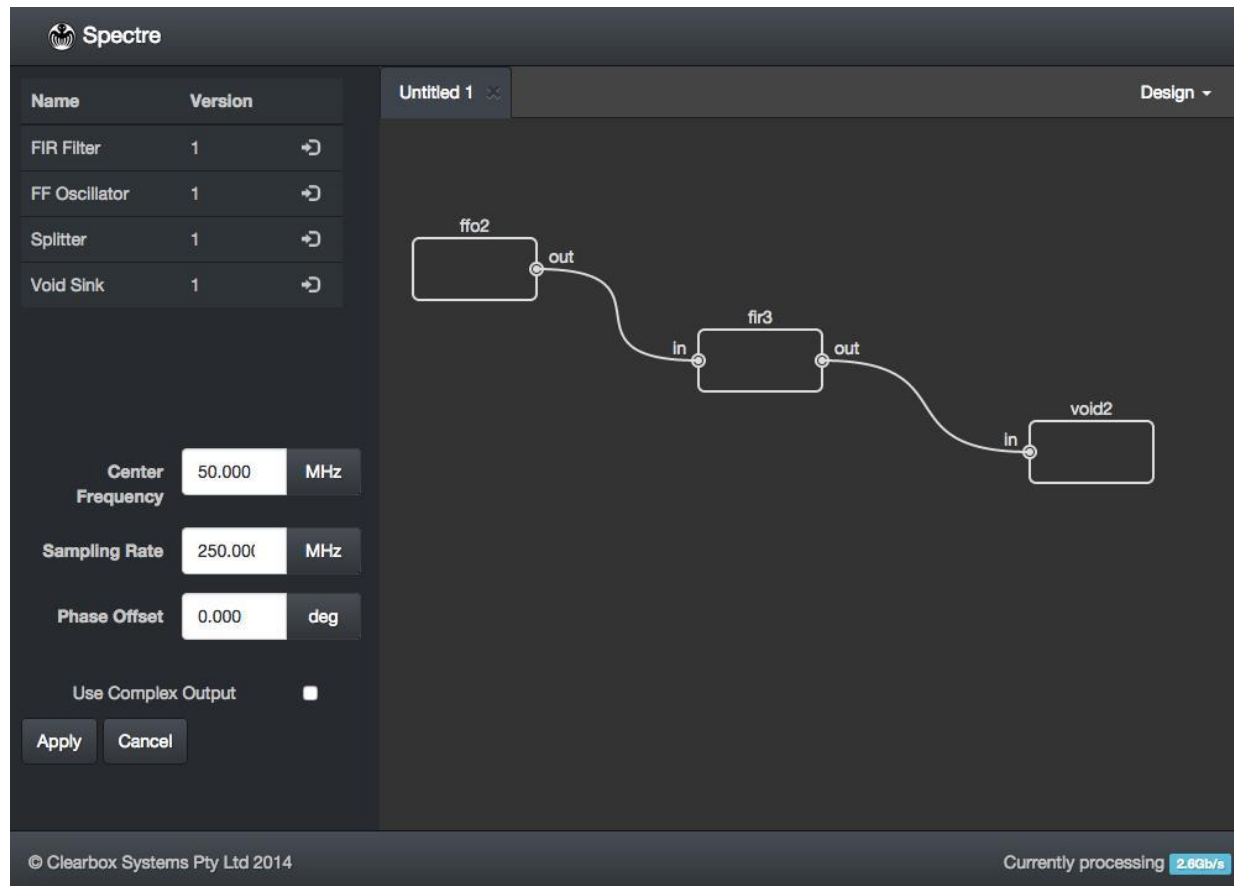
## Feasibility Study

## Signal Processing API



# Feasibility Study

## Signal Processing API



## Future Possibilities

- Centralised processing
- Commercial sites for military applications
- Multi-site signal processing algorithms

## Next Steps

- Seeking to engage industry and defence
- Standardise digitiser and signal processing API's
- Development of reference modem
- Deploy test site

Questions and  
Contact

# Any questions?

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