Results from Kea V4.1 Performance Testing

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Never Stand Still | Faculty of Engineering | Australian Centre for Space Engineering Research (ACSER)

ACSER Australian Centre for Space Engineering Research

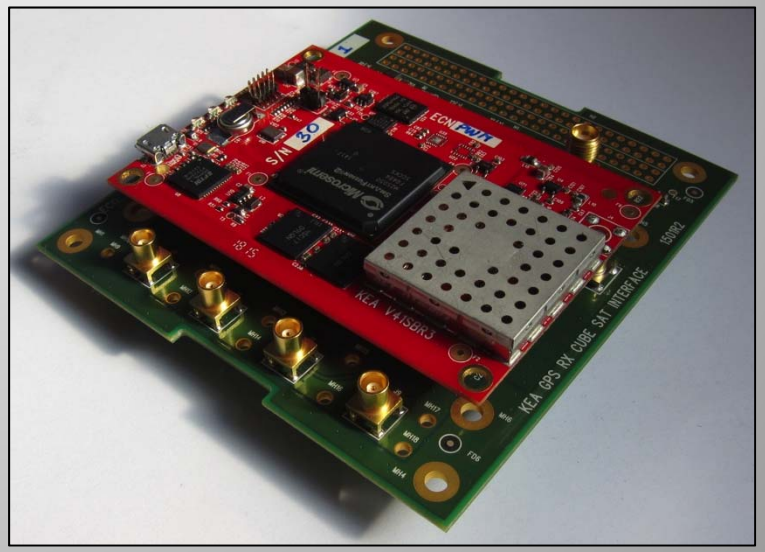
General Dynamics

Kea GNSS

SNAP Lab

Introduction

- Kea Origins?
- What does it do?
- What is it intended for?
- How does it perform?

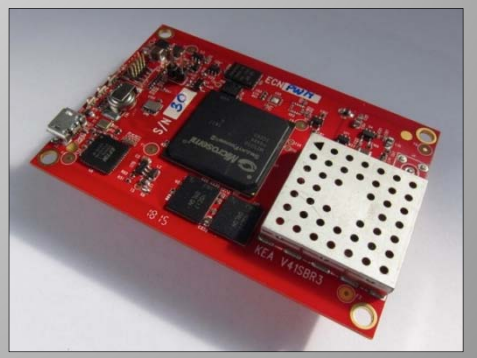


Namuru To Kea Evolution

- Kea V4.1SBR3 is the commercialization of Namuru
- Runs a derivative of the Aquarius firmware created for the Namuru V32R3
- Takes advantage of new parts
  - SmartFusion2 System-On-Chip (SOC) FPGA/Processor
  - BL2627, GD1030 & GD1040 RF ASIC front ends
- More features and improved performance
- Applications, instead of research focus
  - GPS for CubeSat missions is a main application
  - Accommodates a standard CalPoly CubeSat, which differs from Namuru V3.2 that is for Boeing Colony II

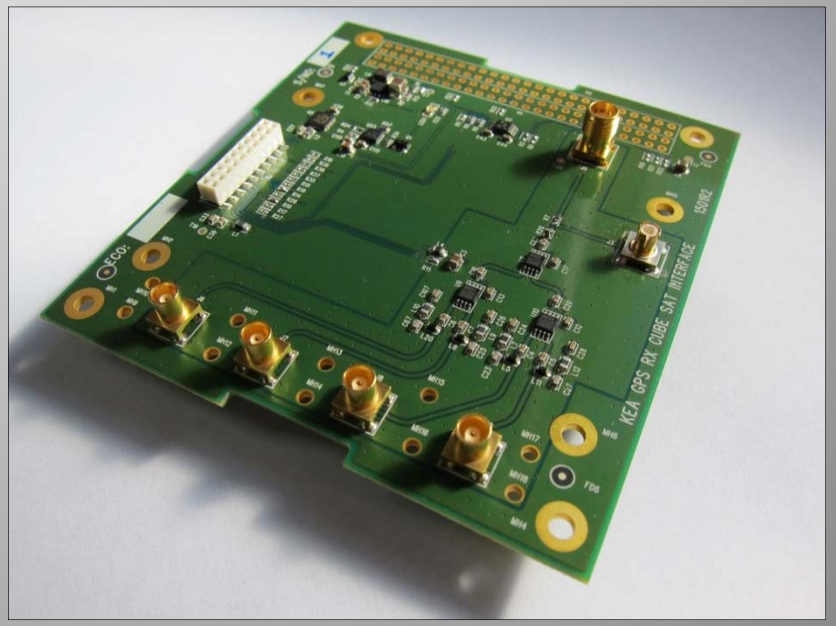
Kea V4.1SB Receiver Module

- Credit card sized
- SmartFusion2 SOC
  - Large flash based FPGA with 50k or 80k logic elements and enhanced SEU immunity
  - Powerful 166 MHz ARM Cortex M3 processor
- 512 Mb of SECDED LPDDR SDRAM
- 8 MB of serial Flash
- 8 kB of FRAM (ferromagnetic RAM)
- CMOS RF ASIC capable of L1/E1 operation
- Super-capacitor powered RTC
- Support for disciplined VC-TCXO and reference frequency output
- USB2 interface for debugging and data-capture



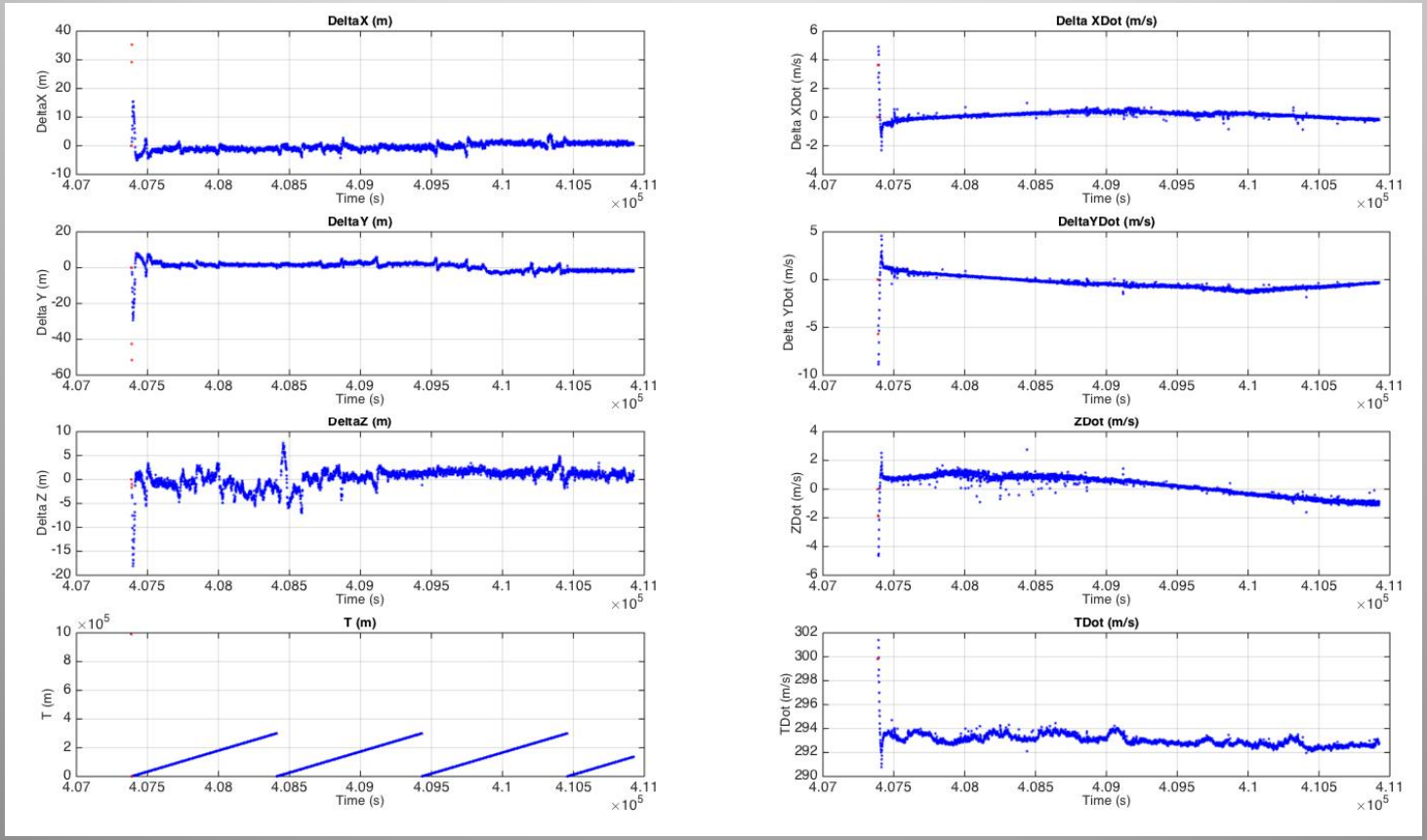
CalPoly CubeSat Interface Board

- Convert credit-card sized Kea to CalPoly form-factor
- Different interface boards for different customers
- Support includes:
  - GPS antenna switching
  - PC104 bus interface
  - USB UART serial port interface



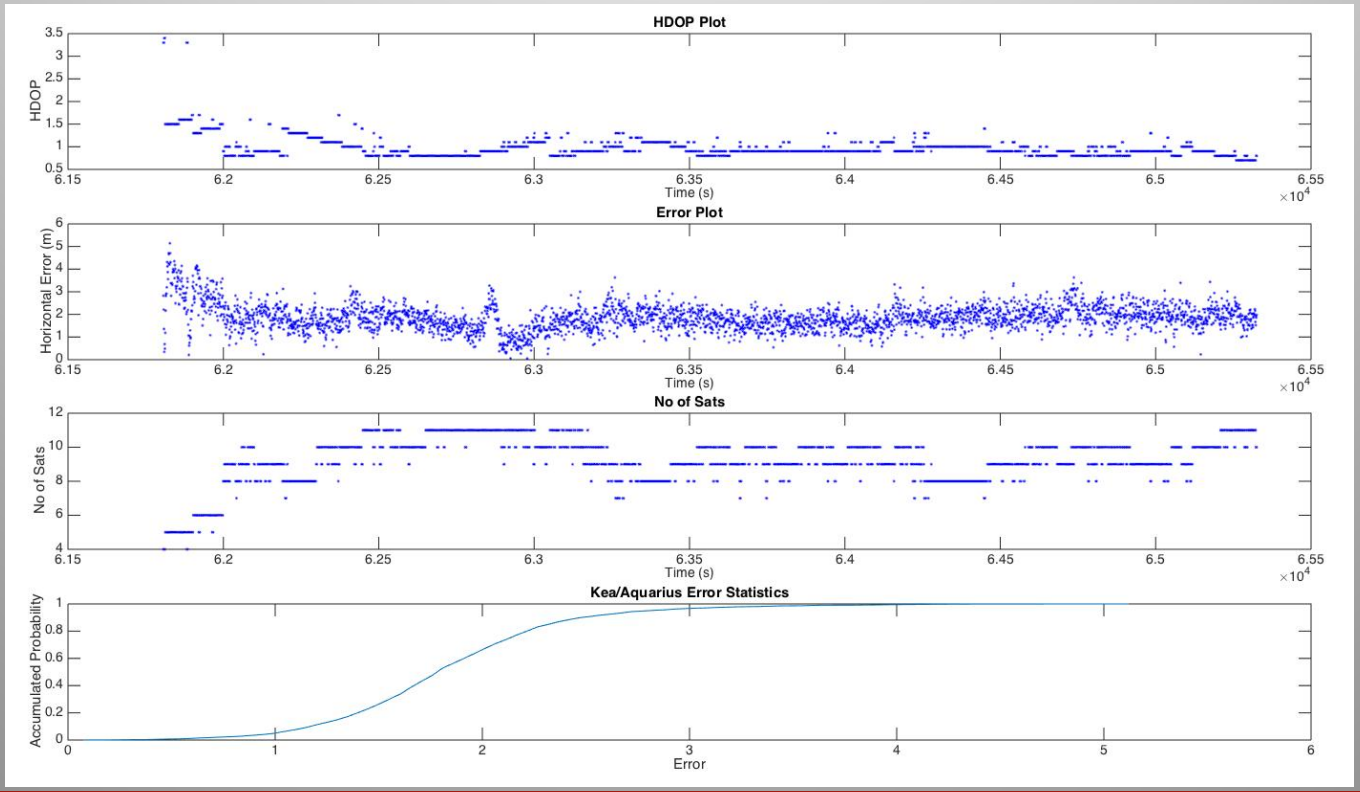
Low Earth Orbit (LEO) Accuracy 1

- Accuracy of low earth orbit test with Spirent GPS simulator (no ionospheric errors)



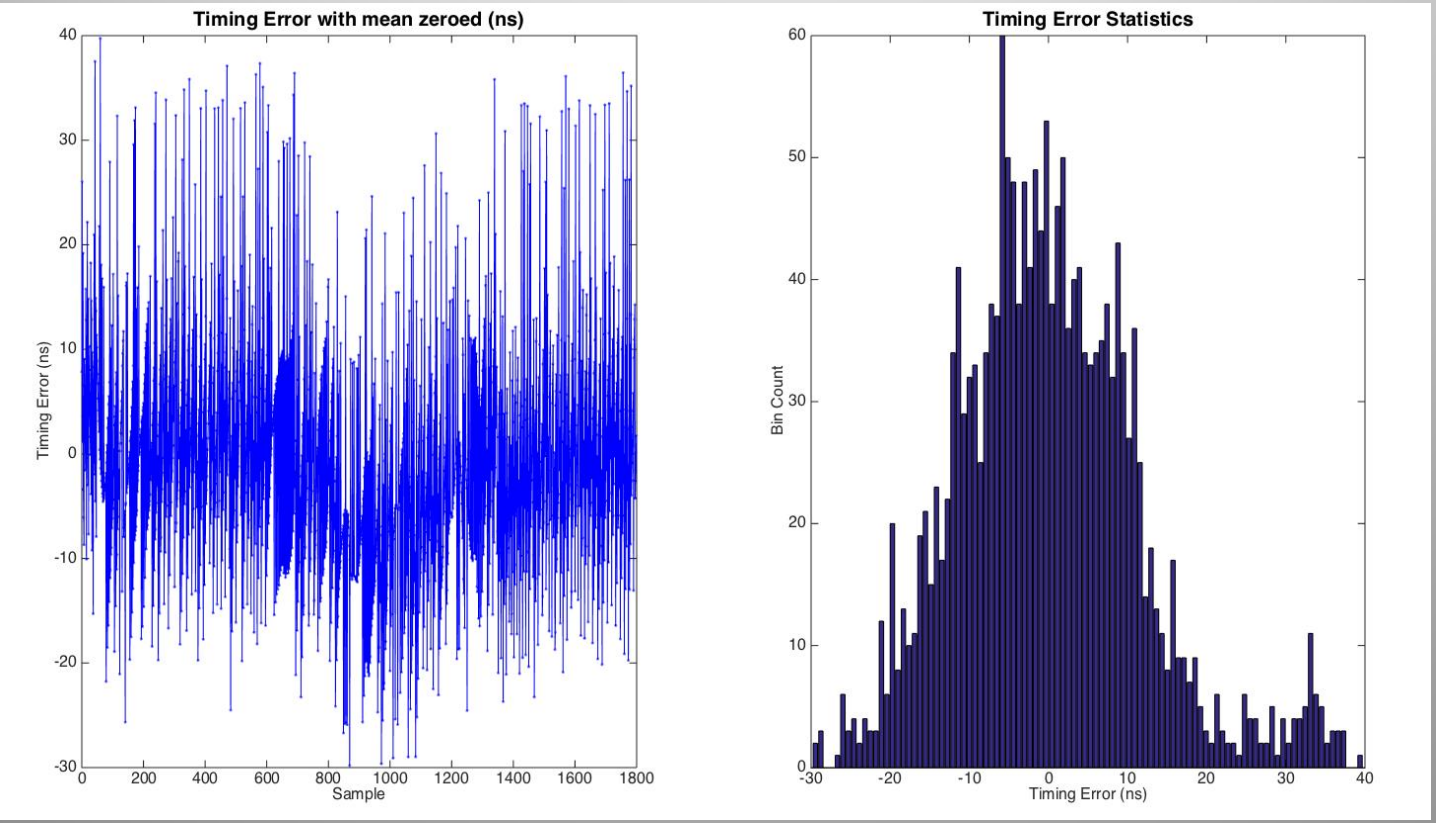
LEO Accuracy 2

- Kea V4.1SBR3 shows similar performance to Namuru V3.2R3
  - R98 = 3.285 m, 2DRMS = 3.875 m, CEP = 1.808 m



Timing Precision Test in LEO

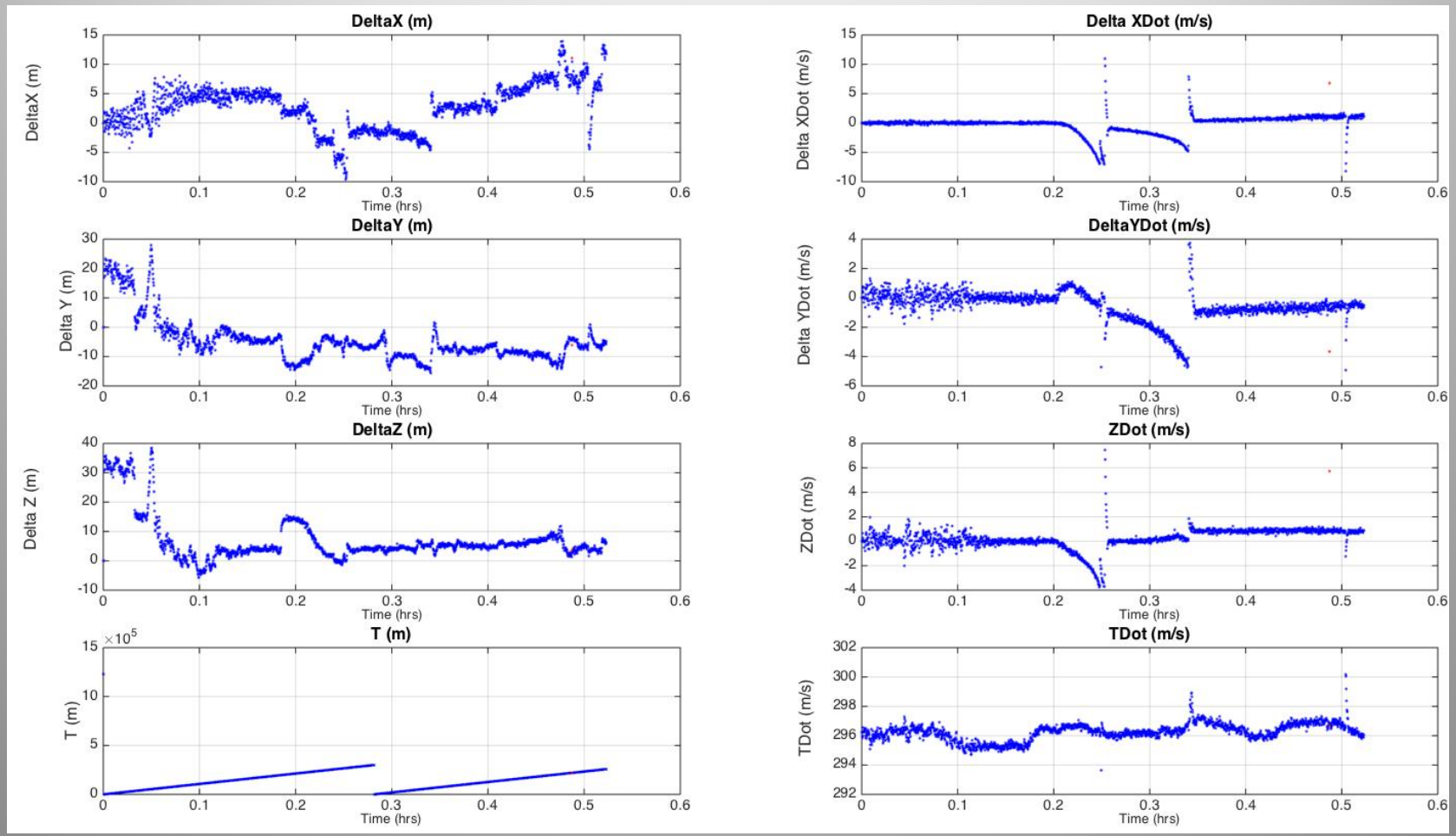
- 1PPS timing precision tested with Spirent simulator



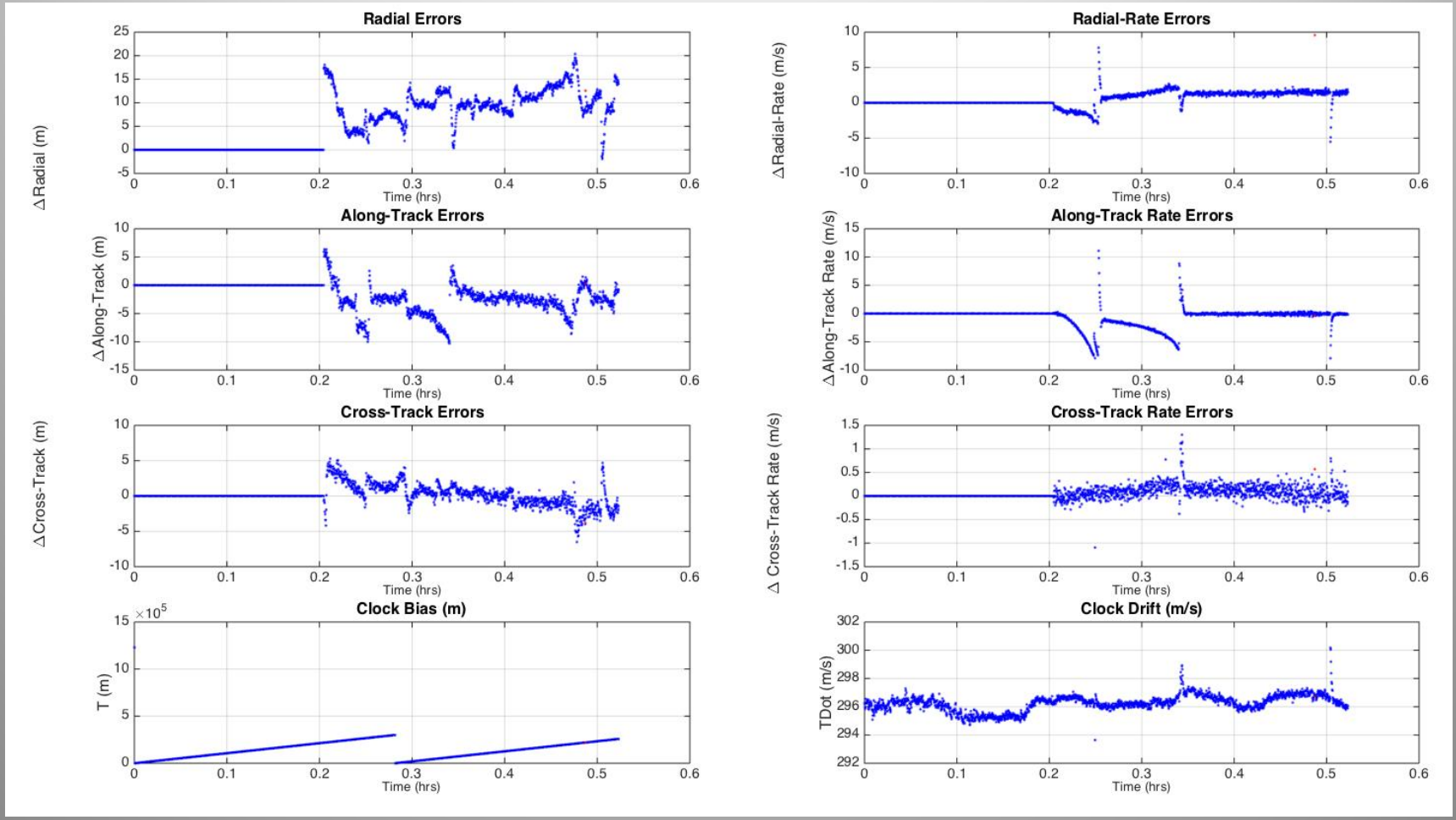
Rocket Launch Accuracy

- Spirent simulation covers launch to orbit, with multiple stages
- Dynamics
  - Up to 40 m/s/s of acceleration in this scenario (tracking loops expected to handle more than this)
  - Up to 7000 m/s speed
  - 1 Hz navigation solution update
  - Special ‘Rocket Mode’ must be switched on
- Accuracy in the ECEF and radial, along and cross-track dimensions shown in the following slides

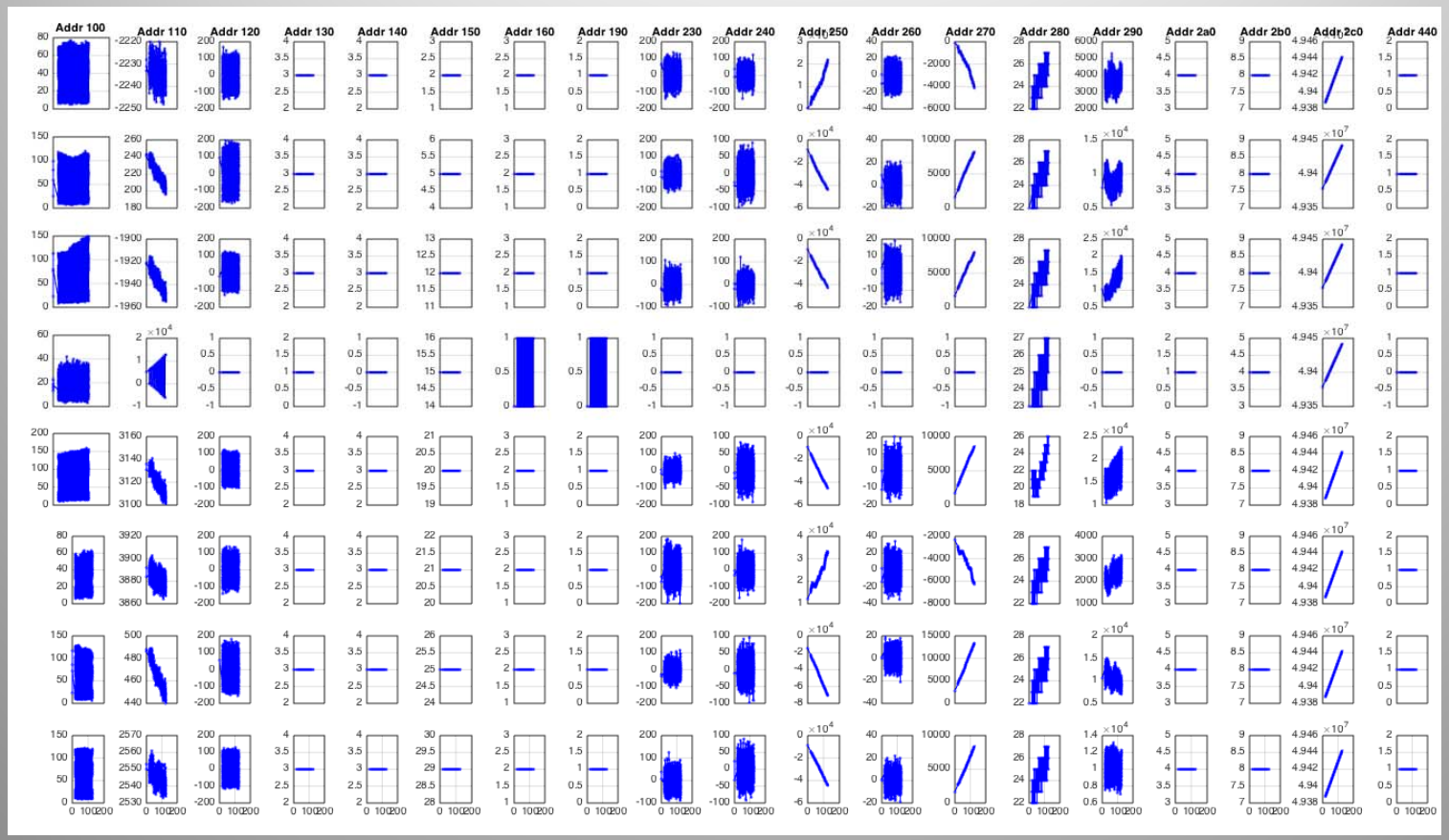
Rocket: ECEF Errors



Rocket: Radial/Along/Cross Track Errors



USB Debugging



Chan 0

Chan 1

Chan 2

Chan 07

Future Work

- Improving sensitivity
  - See my presentation on Thursday morning
- Improving the built-in Delay Doppler Map Accelerator
- Other general improvements to improve firmware portability

Projects

- UNSW ‘EC0’ QB50
- Sydney University iInspire2 QB50
- Defence Science & Technology (DST) Group
  - Buccaneer Risk Mitigation Mission
- SNAP Lab Research Platform

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