Technologies for Compact Radio EW Sensors
SCOPE OF PRESENTATION

- Company Profile
- Compact EW Sensor Products
- Key Technologies
- Demo
PERALEX: COMPANY PROFILE

- Company background
- Core Competencies
- Products and Services
Company Background

• Founded in 1987
• Approximately 50 employees
• Based in Cape Town
• Strong and lasting relationship with Grintek Ewation
• **Mission Statement:** To provide the most cost-effective, technologically-advanced and value-added solutions to our clients, through expertise, partnership and commitment.
Core Competencies

• System
  • Product and system level design and integration

• Hardware
  • Mixed signal board level design
  • Complex, high speed PCB design
  • Complex FPGA programming
  • Mechanical design

• Software
  • Device drivers
  • High performance software
  • Signal processing algorithm development and implementation (DSP, CPU, GPU)
  • Man machine interfaces
Products and Services

• **Products**
  • Data acquisition boards
  • Data processing boards
  • Monitoring receivers
  • Wideband direction finders

• **Services**
  • Hardware development
  • Software development
  • Algorithm development
  • Technology research

• **Projects**
  • Numerous projects with Grintek Ewation
  • RADAR data acquisition
  • SONAR work for local and international companies
  • Research in conjunction with UCT & CSIR

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COMPACT RADIO EW PRODUCTS

- Skylark7050C
- Sky-i7000
- MRD7
Skylark7050C: Key Features

- Frequency range 1MHz–3.6GHz (6GHz extension)
- 20 MHz instantaneous DF bandwidth
- 2ppb frequency accuracy (with GPS lock)
- High Dynamic Range (80dB typical)
- Integrated DF and monitoring
- Correlative Interferometric DF algorithm
- Rugged, compact and low power consumption
- Signal monitoring and DF modes for:
  - GSM
  - TETRA
  - AIS
- Band and memory channel scanning
- Display of DF results in GoogleEarth Maps
- Integrated GPS and Compass
- Multi-level BITE
- Reference transmitter DB
- Audio and IF Recording
Skylark7050C: Applications

- Spectrum monitoring for Telecommunication Regulation Agencies (ITU)
- Illegal Transmitter Tracking
- Interference Monitoring
- Coastal, anti-poaching & anti-drug trafficking agency support
- Rapid semi-mobile deployment
Sky-i7000: Key Features

- Frequency range 1MHz– 3.6GHz (9GHz extension)
- 20 MHz instantaneous bandwidth
- 2ppb frequency accuracy (with GPS lock)
- High Dynamic Range (80dB typical)
- Rugged
  - IP67 rated
  - -10 to +55 °C operational temperature
- Portable
- Low power
- Signal monitoring modes for:
  - GSM
  - TETRA
  - AIS
- Band and memory channel scanning
- Multi-level BITE
- Audio and IF Recording
- Versatile
- Remote control interfaces
Sky-i7000: Applications

- Versatile desktop receiver
- Test and measurement receiver
- Remote monitoring receiver
  - Direct pole mount with USB modem for connectivity
  - Integration with SkyMon-CC <CVD: Not sure anyone will know what this is?>
- Portable last-mile transmitter location
- TDOA
MRD7: Key Features

- Frequency range 1MHz– 6GHz
- 40 MHz instantaneous DF bandwidth
- Man portable
- DF on the move
- Hot swappable battery packs
- 2ppb frequency accuracy (with GPS lock)
- Low power (<50W)
- Wide operating temperature range (-20 to +55°C)
- Integrated DF and monitoring
- Signal monitoring and DF modes for:
  - GSM
  - TETRA
- Integrated GPS and Compass
- Multi-level BITE
KEY TECHNOLOGIES

• Digital receiver overview
• ADCs
• FPGAs
• GPPs
• GPS Disciplined Oscillators
• Mechanical enclosures
• Remote sensors
Digital Receiver Overview

Key specifications for comms EW receivers:

- Spectrum coverage (frequency range, IBW, scan speed)
- Dynamic range
- Linearity
- Sensitivity

Key Drivers for Compact Receivers

- Size (portability, ease of installation, versatility)
- Power
- Cost Price (deploy in larger numbers)

How do we reduce size, power and price without sacrificing these key specifications?
High Speed, High Resolution Data Acquisition

- ADC performance critical to wideband receiver performance (SFDR and SNR)
- ADCs moving closer to the antenna (direct RF/IF sampling, true SDR)
- Trend for higher sample rates: instantaneous bandwidth vs instantaneous energy compromise
Direct RF Sampling

- Eliminate IF stages from receivers to reduce cost, component variability and eliminates LO phase noise

- Technology enablers:
  - High speed, high dynamic range ADCs
  - Filter banks/tunable filters (limit frequency content/energy)
  - Digital down-conversion

- Balance between instantaneous bandwidth and dynamic range
FPGAs

Key Drivers:

• High speed interfaces
• Digital signal filtering and data reduction using DDCs
• Design tools and IP cores
• Embedded uC for intelligent logic and hard real-time SW
• Low latency high speed interface for companion processing
• Lower power consumption
FPGA Radio Signal Processing Cores

- Digital down-converters (WB, NB, channeliser)
- Digital up-converters (WB, NB, de-channeliser)
- Programmable polyphase windowing functions
- High-bandwidth multi-channel delays/buffers (sophisticated SDRAM-based buffering)
- FFTs
- Direction finding algorithms
- Signal correlators
- Spatial filters (super resolution DF beam forming)
FPGA Interfaces

- PCI 64-Bit, 66 MHz: 528 Mbytes/s (legacy)
- PCI-Express Gen 2.0 (1X - 8X): 2 Gbyte/s (in each direction)
- 1 Gigabit Ethernet (1GBASE-T PHY)
- 10 Gigabit Ethernet (10GBASE-CX4, SFP+ copper/optical external PHY)
- Custom 2.5 Gbps serial links: Xilinx multi-gigabit tranceivers with Xilinx “Aurora” light-weight protocol and Peralexlx packet protocols; scalable 1X-4X: 1 Gbyte/s
- DDR2/3 memory controllers
FPGA power optimisation

- Static power increase with decrease in transistor size
- Trend towards high speed serial rather than parallel interfaces
  - Lower pin count
- Optimal device selection for project
  - Code optimisation for size
- Reduce clock speed
  - Multiple clock domains
Xilinx 7 Series FPGAs

Xilinx 7-Series FPGAs will deliver:

• Unified architecture across series (cross-series portability)
• Lower power
• Higher performance
• Zynq-7000 platform: Independent dual ARM Cortex A9 with double precision FPU
• More, faster high-speed serial transceivers
• Unified AXI-4 core interfacing infrastructure

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General Purpose Processors

Key Drivers

• Cost effective
• High performance
• Parallel processing
• Sequential processing
• Rapid development of complex signal processing algorithms
• Soft real-time requirements
CPUs

- CPUs have surpassed DSPs for raw signal processing performance
- Adopted Intel x86, x64 architecture (Pentium, Core, Core2, Corei7)
- Standard interfaces and form factors (PCI, Ethernet; CompactPCI) are key facilitators to allow tracking of Intel’s rapidly advancing CPU performance, while mitigating obsolescence issues
- Intel Atom for power sensitive designs
- IPP libraries
- Intel 2nd Generation i7 “Sandy Bridge” succeeded by “Ivy Bridge”
- “Ivy Bridge” integrated GPU will support OpenCL
GP GPUs

- High performance to price ratio
- CUDA is likely to give way to OpenCL standard, that is supported by multiple vendors.
- Current AMD and future Intel processors will feature on-chip OpenCL-capable GPUs. This is likely to provide more options for ruggedised GPU acceleration in the embedded processing space.
- “Ivy Bridge” integrated GPU will support OpenCL
GPS Disciplined Oscillator

- Frequency and timing accuracy an important specification for certain applications
  - ITU market
  - TDOA
  - Commensal RADAR
- The internal stable reference oscillator can be disciplined to accuracies < 2ppb using information gleaned from the GPS satellite system
- Real-time clock (RTC) synchronised to GPS UTC time (nano-second accuracy)
- Holdover modes supported for failsafe operation
Mechanical Enclosure

- Conduction cooling
  - Noise reduction
  - Improved ruggedness
  - Fanless design provides improved MTBF
- Machining and casting (as appropriate)
- Rugged, IP rated designs
- Wide operating temperature range (-30 to +55°C)
- Heatpipe technology
Remote Sensors

- Key requirement for large deployment of RF sensors
- Flexibility to use available network infrastructure
- Alignment with commercial technologies and trends UMTS, LTE
- VPN provides secure tunnel over open networks
Thank You For Listening!