CREATIVE ELECTRONIC SYSTEMS

Video Processing Technologies and Challenges for Mil/Aero Applications

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Introduction

Name **Alan Simmonds, Engineering Director**

Working with embedded video systems since the dawn of time…

Company **Creative Electronic Systems CAL, Inc., Morgan Hill, CA, USA**

US subsidiary of CES S.A., Geneva

Over 100 employees worldwide

Founded in 1981

Supplier of systems, single board computers and peripherals for aerospace, defense, physics and telecom markets

Consumer Semiconductor Video Technology for Mil/Areo

The Good

- Strong market driven by high volumes of HDTVs, Set-Top-Boxes, DVD/Blu-Ray Players
- Low prices
- High levels of integration

The Bad

- Product cycles can be as short as 6 to 12 months
- Regular updates and in the field bug fixes – less focus on right first time
- Programmed obsolescence
- Tools and technologies constantly evolving
  - New generations of Standards approved every few years
  - Proprietary formats created (imposed…) by market leaders as de-facto standards
  - Not every technology lasts

Consumer Semiconductor Video Technology for Mil/Areo

The Ugly

- Manufacturers have the perception of high support burden
  - Diverse video format support can require complex configuration
  - Noise sensitive mixed analog/digital requires careful power and PCB design
  - Complex compression/decompression often need complex low level control
- The Challenge of obtaining manufacturer support commitment
  - Purchase high volumes (usually not an option)
  - Good previous design history with the FAE networks
  - Experience with previous generations of parts and software

Video and Graphics needs for Mil/Aero applications

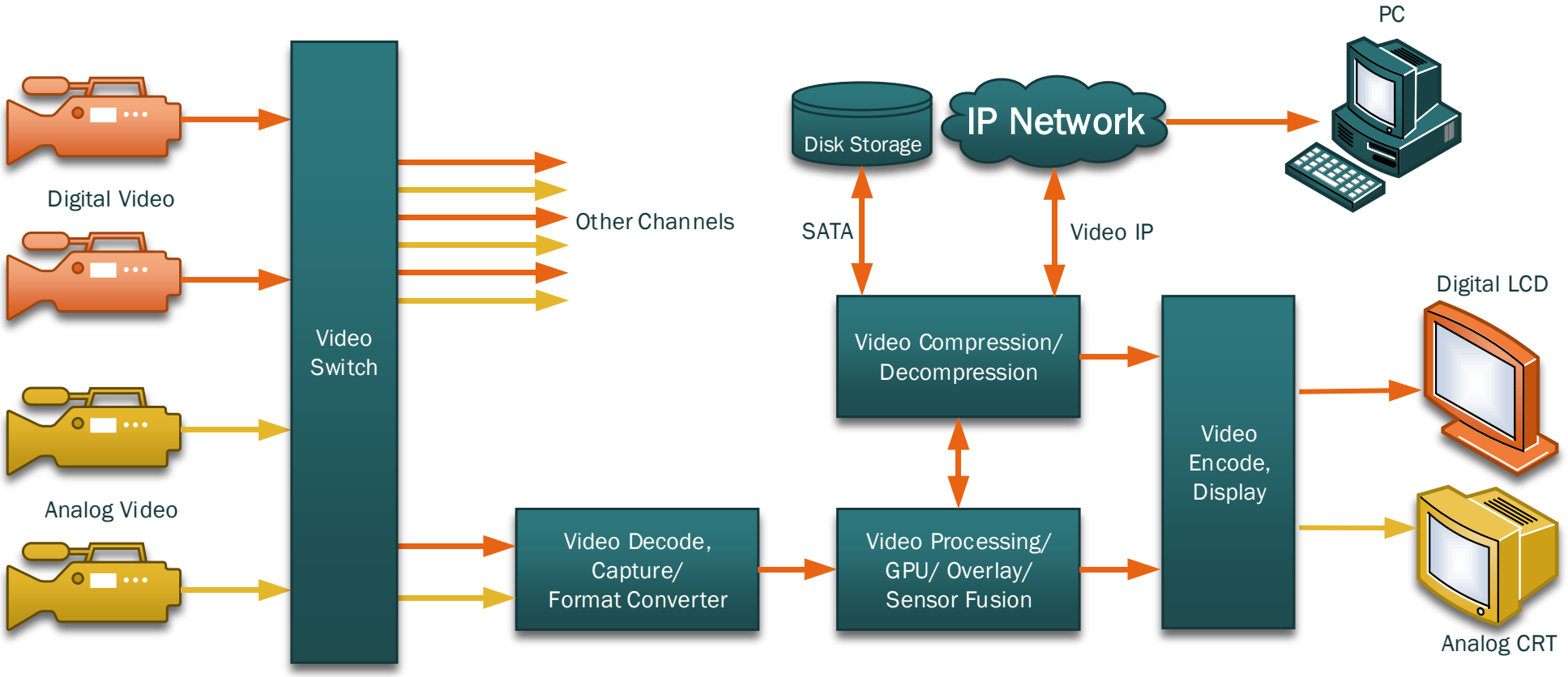
Video technology and the Mil/Aero market

- Strong requirement for COTS modules and products
- Cost sensitivity, low power, and smaller products driving requirements

Rapidly growing number of video tasks suited to Mil/Aero applications

- Capture and Acquisition (Surveillance)
- Sensor data Pre-processing and noise filtering (Sensors)
- Image processing and analysis
- Compression (Storage / Transmission)
- Streaming and recording (Broadcast, both local and global)
- Graphics Synthesis and display
- Indexing and metadata (Telemetry, Records)
- Context-awareness (Intelligent systems)

Typical Mil/Aero Video Processing System



Technology for Input and Output in Mil/Aero

Video capture and display (Commercial Chips)

- Demand for state of the art digital HD and Ultra HD resolution imagery
  - HDMI (commercial transmitters and receivers widely available)
  - HD-SDI, ARINC 818 (primarily via FPGA cores)
- Legacy support for analog formats (SD, CVBS, RGB, YP_BP_R) still needed
  - Component portfolio condensing into fewer more integrated choices
- Support for 16 bit monochrome – not generally available

Video switching complexity

- Heterogeneous systems mixing analog and digital formats
  - Different color spaces and data formats
  - Mismatched aspect ratios and frame rates

Video output enhancements (often implemented in FPGAs)

- Demand for PIP, mixing and fusion for surveillance and HUDs
- Synthetic overlays (reticles, etc.)

Technology for Video Compression

Many generations of video coding technology to support

- JPEG, MPEG2, MPEG4 ASP, MPEG4 AVC/H.264, VP9?, HEVC/H.265?
- Often multiple used simultaneously, e.g. JPEG 2000 and H.264

New tech. brings lower bit rates, higher resolutions for HD streaming

- HEVC adopted by Netflix for “House of Cards” at 4K UHDTV, but encoding is very processor intensive

SOCs, ASIC / FPGA, GPGPU or CPU ?

- Custom ASIC – easiest way to obtain IP, but high volumes needed
- Commercial ASIC chip – surprisingly few available
- SOCs – very high integration used in cell phones, security cameras
  - Dependent on software support, which can be limited and very difficult to adapt
- FPGA – very high gate counts/power needed for advanced compression
- GPU and CPU – similar issues to FPGA

Technology for Processing and Analysis in Mil/Aero

GPUs, FPGAs or many-core/CPUs are capable of many DSP and pipelined video algorithms

- New approaches to optimizing for hardware possible
  - University research (CES uses EPFL)
- Algorithms for tracking and metadata extraction
- Complex analysis in real time
- Watermarking
- Can be used to fill in where commercial silicon fails to deliver

Video Storage and Transmission

File formats and multimedia containers

- Long term storage of video data for surveillance
- Several muxing and container formats available – for multiple feeds
- Proving authenticity of the images/video
  - Content protection, Checksums, Digital signatures, Watermarks
- Encryption

Transmission challenges

- Different packetization and transport protocols
  - Varying levels of error checking and correction capability
  - Varying metadata options
- High latency can be problematic

Video Technology Evolution

Constant Technology Monitoring/Direction Required

- Video technology moves at a very rapid rate. Keep ahead with:
  - Standardization Committee technology monitoring
  - In-depth understanding of innovative features and tools
  - Stay active with sponsorship of high-end research and original thinking
- Small Form Factor development important
  - There's a certain expectation for video systems to be small
  - VITA 74 SFF - CES is a sponsor and co-architect
  - 3U VPX – becoming extremely popular, good I/O options
  - XMC

Video and Graphics Technology Revisited

The Mil/Aero application domain is founded on much stronger requirements

- Focus on technologies and components with established adoption
- Assessment of reliability and feature sets at all levels, HW, SW, FW
- Careful benchmarking of visual quality and performance
  - Quick recovery from errors, especially with compressed video streams
  - A good old encoder can still be better quality than a new approximate one
- Screening often necessary for environmental requirements
- Management of obsolescence adds constraints on components and their life cycle
- Long term support of legacy systems as well as state of the art technologies is always a challenge

Conclusion

Significant Investment is Needed to Support the Mil/Aero Market

- The Mil/Aero Video Market has a wide diversity of characteristics:
  - Capture, Image Processing, Compression, Synthesis, Packetization
  - Video formats – Encoding types, physical interface and resolutions/timing
  - File formats and IP transmission packetization
  - Compression
  - Legacy and Leading Edge technologies
- Commercial chips offer rich technology but need careful management
  - ASIC, GPU, FPGA, Multi-Core CPU, SOC technologies
  - Feature customization, reliability, obsolescence, support
- Form Factor needs (VITA standards are very suited)
- Rapid Technology/Standards Evolution – tough challenges for longevity
- System level knowledge, including SFFs and VITA is important

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With you all the way…