



Modular Sensor System building blocks to support real world requirements for Military and HLS applications

Alan Varco

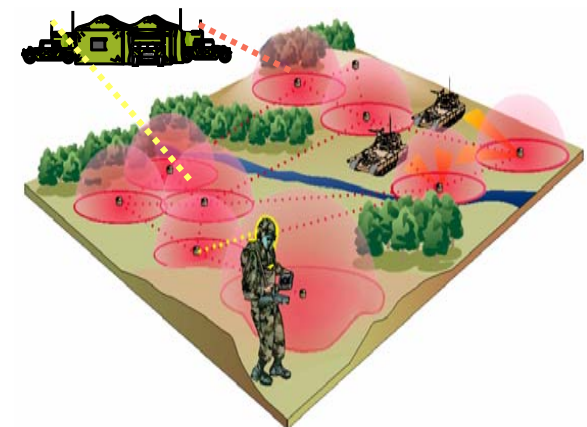
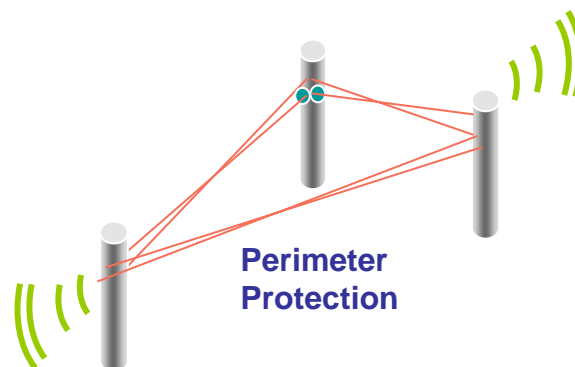
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- **Military and HLS requirements for Wireless Sensor Networks**
- **Application of COTS WSN technologies**
- **Rationale for SELEX WSN development**
- **Overview of CISP hardware**
- **Overview of the application software interface**
- **Conclusions**

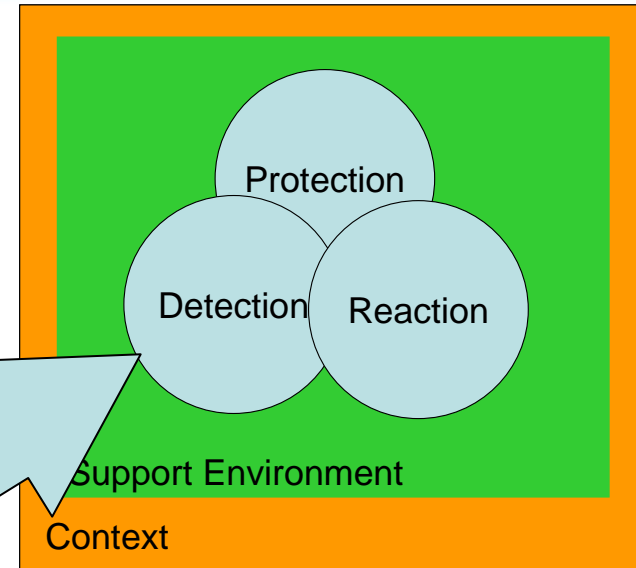
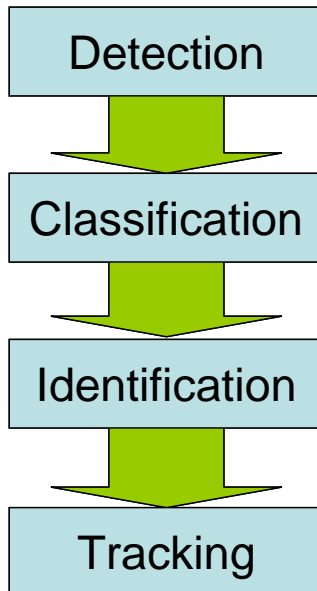
- **Provision of enhanced situational awareness for Home Land Security & Defense applications**
 - Reconnaissance - Area, Zone or Route
 - Perimeter Protection - Area or Linear
 - Critical asset protection
 - Tactical C2 intercept
 - Fire location (Artillery, Rockets, Mortar, Small Arms)
 - Communication relay in difficult Urban environments
 - Augments human senses, particularly where persistence / endurance and fatigue may be an issue
- **Potential linkage of the tactical level awareness picture to the larger information grid, (i.e. compliments / supplements other existing ISTAR assets)**



Local WSN sub-network access

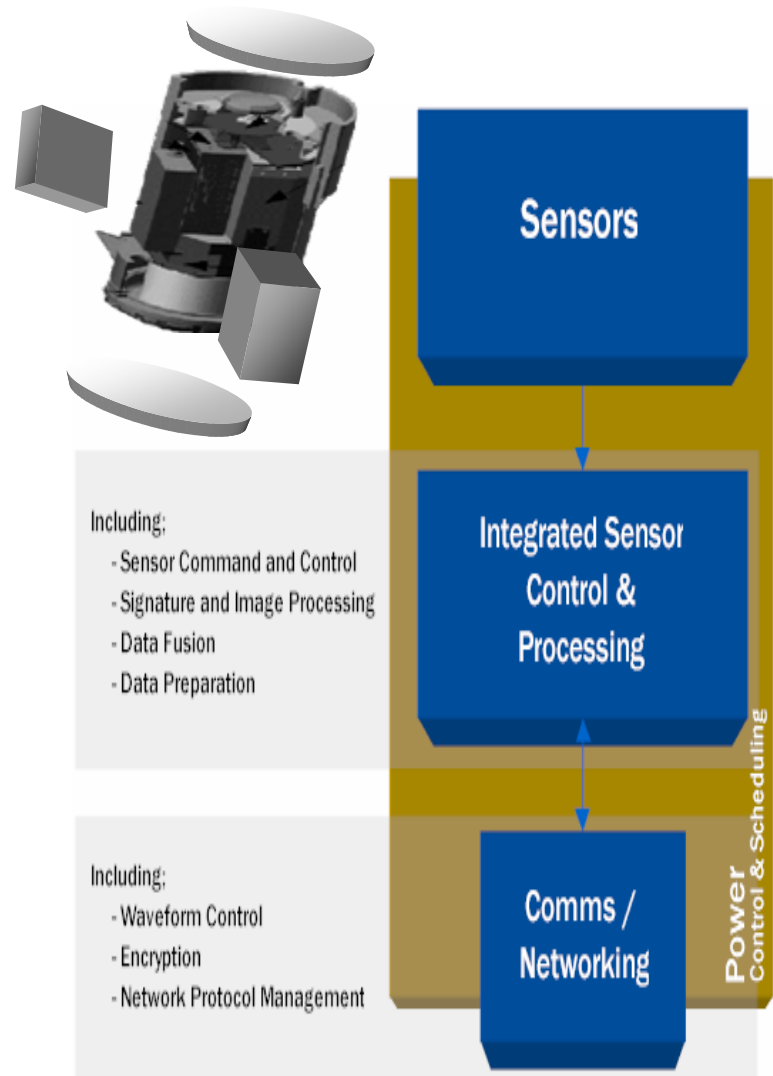


- **Effective security is a balance between**
 - Protection
 - Detection
 - Reaction
- **Support environment critical**
- **The interaction between these elements is defined in a Concept of Operation (CONOPS)**



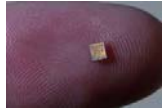
- **Effectivity of protection function and speed of intercept drives ranges**
- **Consequence of reaction function**
 - Positive target identification
 - Evidential quality of information received

- **Small, robust, light weight, low power expendable sensor package**
- **Sensor package includes integral processing for sensor control and data analysis**
- **Sensor package includes integral communications facilities with geo-location and Ad-hoc networking supporting local network access**
- **Sensor package architecture can be configured to interface with a variety of sensor types including: acoustic, seismic, magnetic CBRNE, RF & Imaging including colour and TI cameras.**
- **Configurable Gateway node provides wired Ethernet LAN or GPRS interface to Man Machine Interface, Back Haul Communications & C3I systems.**



Capability

- CISP on a chip – pervasive intelligence very high density sensing



CISP

- CISP developed for multiple sensing modalities, video handling and data fusion / manipulation at the node, flexibility in networking topology and management



- Current COTS WSN Components optimised for network experimentation, mono-modal sensing

Telos



Mica



Dot



Rene



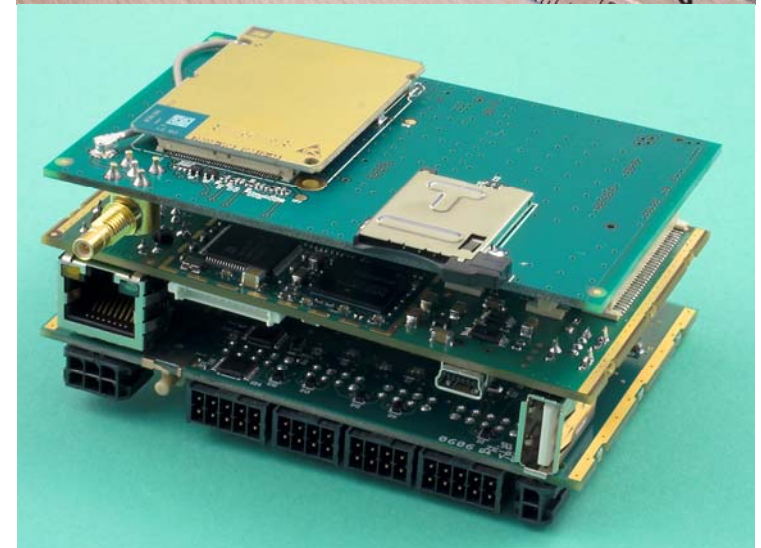
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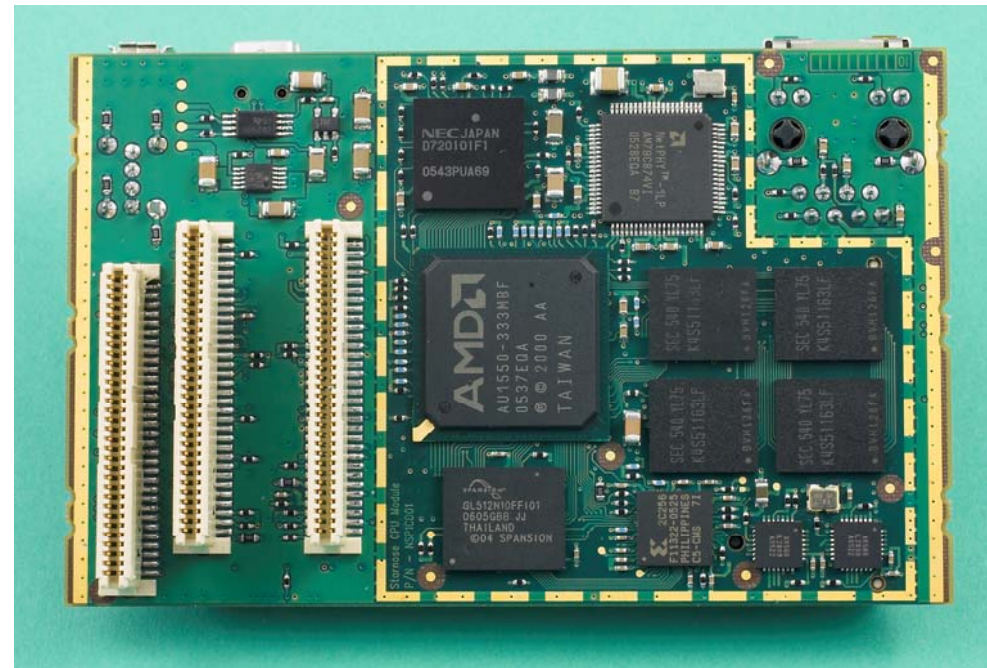
Time

- **Network enabler for sensor products**
- **Low power consumption (battery powered)**
- **Self forming Self Healing ad hoc network**
- **Low cost**
- **Automatic Geo-location**
- **Video capture and streaming**
- **Small size and weight, hand deployable**
- **Localised Sensor processing / data handling**

- **Core Processor Card**
- **PSU & IO Card**
- **Personality Modules**
 - GPRS
 - Video Capture
 - Multiple Channel Analogue Interface
 - COTS Personality Cards

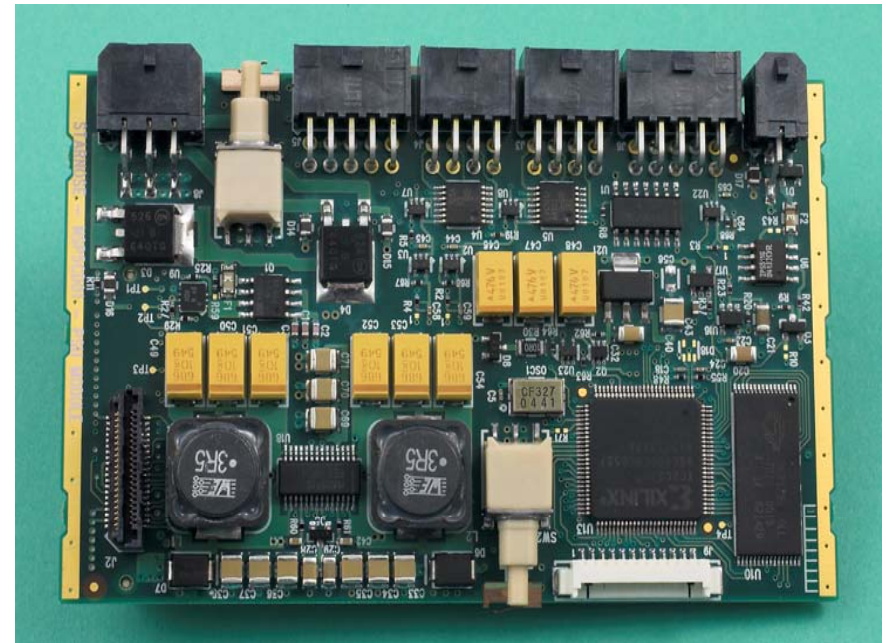


- **Win CE 5.0 Operating System**
- **MIPS Processor (333MHz)**
- **Networking**
 - 10/100M Ethernet Wired LAN
 - 802.11a/b/g Wireless LAN
- **Internal Interfaces**
 - 5 off internal discrettes
 - 32 bit 33MHz PCI via
 - Type III mini PCI
 - PCI mezzanine
- **Physical**
 - 102mm(W) x 63mm(H) x 66mm(D)
- **Environmental**
 - -25°C to +65°C Operational



Large memory capacity allows sensor data to be retained during long periods when communication may be compromised, in general COTS does not support this

- 3 Independent input power sources
- Wide input operation range (9V to 17V DC)
- Hot Swap battery change supported
- Anti-Tamper protected memory
- Power supply conditioning
- Input voltage measurement
- External Interfaces
 - RS 422
 - USB 2.0 and 1.1 ports
 - 4 off General purpose discrete I/O
 - SMBus
 - PTZ Controller



Intelligent Sensor Power Management

- Provides video capture and compression capability
- JPEG2000 CODEC
- Composite or S-Video Input
- Configurable frame rate
- Configurable compression ratio
- Capability to store locally high quality images and stream highly compressed images
- PZT Control

Original Image

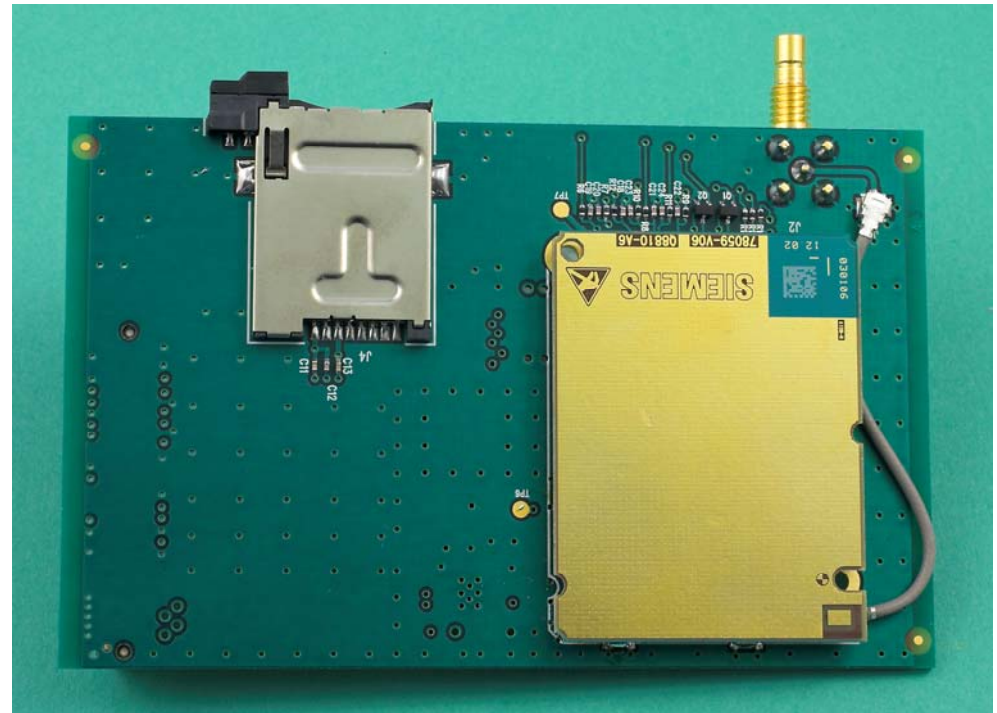


Compressed by a factor of 500



Most COTS video cards don't include drives for PZT and embedded compression

- Provides data communications over the GPRS / GSM networks
- Quad Band Operation
 - EGSM 850MHz
 - EGSM 900MHz
 - GSM 1800MHz
 - GSM 1900MHz
- Can be configured to support virtual private networks



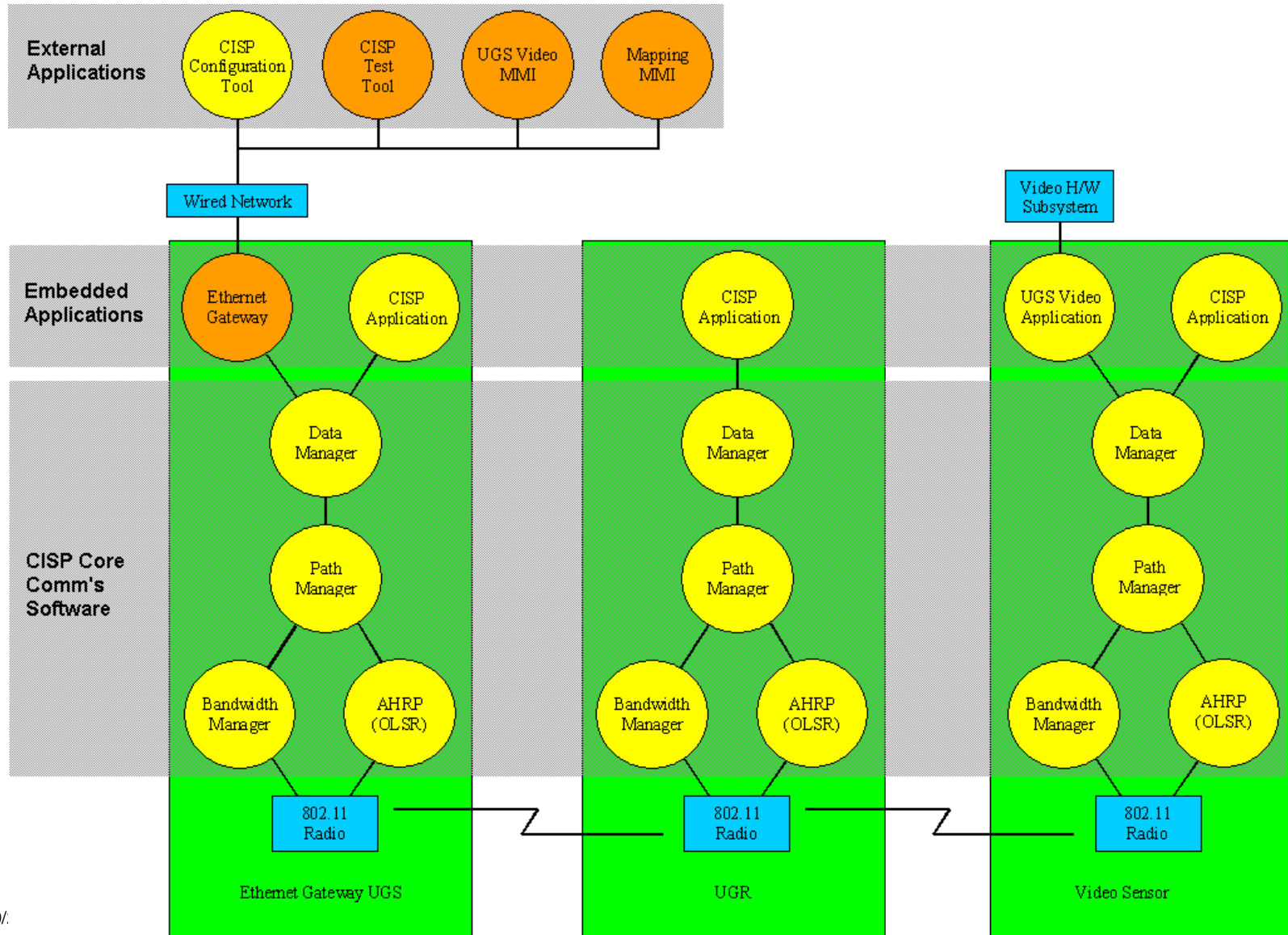
Provision of long range communications not generally supported in COTS cards

- **4 channel Analogue Interface, Network centric synchronous sampling**
- **Sample timing referenced to UTC via GPS 1pps**
- **Sample data DMA'ed to Processor each second**
- **24 bit ADC (113dB Dynamic Range above the noise floor)**
- **Sample Rate 30.08kHz**

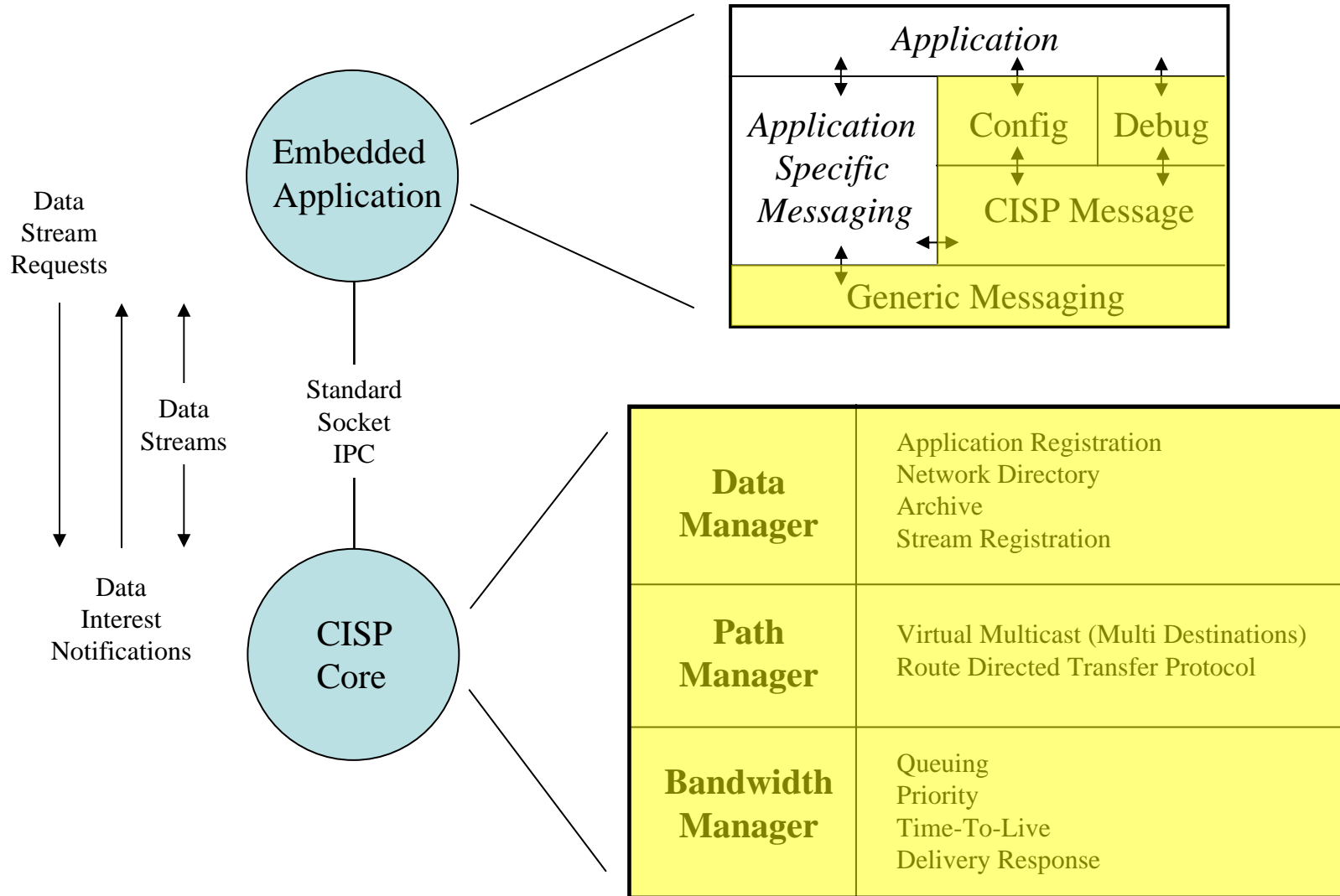


Most COTS solutions support single analogue channel with limited synchronisation capabilities and lower dynamic range

SELEX S&AS Software Architecture

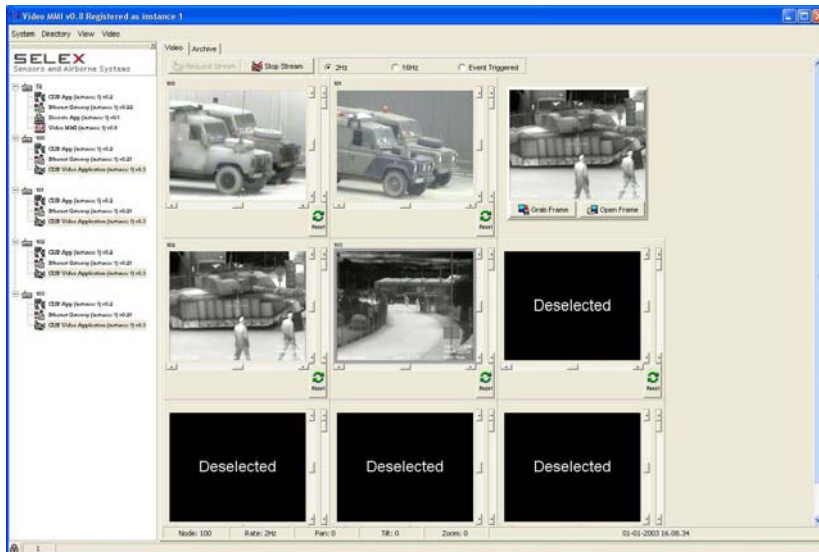


Application Architecture & Interface



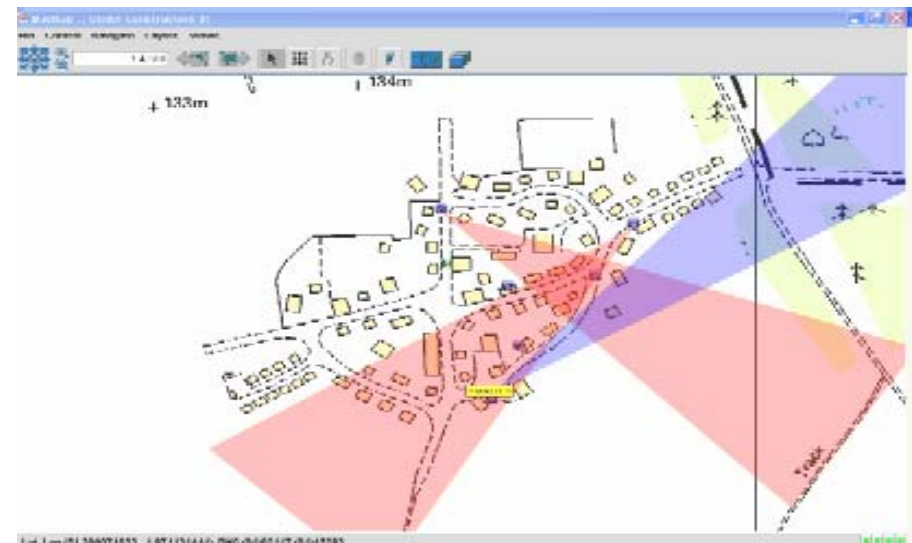
- **Embedded application communicate with the Core using a defined CISP message set**
 - CISP Message sets provides for:
 - Multiple destinations of single messages
 - Control of message Queuing, Priority, Time to live, archiving and delivery response request
- **Inter-Process Communications (Application to Core) implemented by a standard socket interface**
- **Core software provides serviced to the embedded applications**
 - Application registering for dissemination of node capabilities
 - Network Directory data provided to requesting application
 - Requests for data stream from local or remote applications
 - Data Interest Notification for setting up virtual multicast environment
 - Disruption Tolerant Data Transfer
 - Archive of recorded data

- **Rapid development of embedded applications is achieved by the use of templates for applications and Specific Messaging classes**
- **Templates also include:**
 - CISP Message class structure
 - Generic Messaging class structure
 - Live Node configuration and debug management classes
 - Persistent Node Configuration management class
- **Features included to host distributed networked applications**



- Video wall provides simultaneous views of all imaging sensors.
- Any targets of opportunity can be added to an integral threat data-base through single mouse click action.
- Sensor alerts displayed.
- Network access to configurable detection threshold adjustment

- Flexible mapping approach includes support for geo-referenced overhead imagery
- Geo-referenced sensor field of view overlays show surveillance coverage area
- Support for multi-standard co-ordinate systems including BNG and Lat/Long



- **SELEX Sensors and Airborne Systems Ltd undertook an extensive review of available WSN products and found gaps in capability for our chosen military/para-military application areas**
- **The CISP was developed to address these perceived gaps**
- **The development strategy was to use COTS open standards wherever possible**
- **Highly modular design approach**
- **Prototype applications have been used to develop/trial Concepts of Operation**
- **Product is now available for further exploitation**