Networked System for Inspection and Situational Awareness
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Preface

• The industry is moving toward smaller computer based cameras for current and future spacecraft imaging.

• With the emergence USB 3.0 with 5Gbps signaling, HD cameras using this standard are becoming more popular.

• Once the imagery is input into the computer, standard networking techniques (Wi-fi, Wi-Gig, hardware) can be used to distribute and store the imagery.

• NASA Johnson Space Center is developing ways to apply this technology to spacecraft inspection and situational awareness.
Sony MA130

Orion Video i5 Camera Controller Wi-Fi / Wi-Gig working Demonstration from May 2015
Networked Camera System Architecture

Take this concept…

… and now miniaturize it

Pixelink PL725

USB 3.0

Intel i5 computer

Wi-Fi

Processor / SBC

USB 3.0

Fully programmable Miniature Wireless Networkable Camera

Camera head

Illumination LED's

Power

Interface Board

Heater

USB 3.0
First construct an interface board to bring together the computer, camera, power, illumination, and heater.

Then build an enclosure (prototype shown).
Networked Camera System Architecture

Wireless Camera Prototype Internal components

Compulab Board with TI AM5728
- -40° to 85° C operation temp
- 50G / 20ms shock
- 20G / 0-600Hz vibe
- H.264 H/W compression
- 2.3” x 2.6” board size
- 2.5 – 6.5W depending on CPU load

CL-SOM-AM57x - TI AM5728 / AM5718 System-on-Module
ARM Cortex-A15 SoM
- Texas Instruments Sitara AM57x processors, 1.5GHz
- Up to 4GB DDR3 and 32GB on-board eMMC
- PowerVR SGX544 GPU, 1080p VPU and C66x DSP
- Dual-band 802.11a/b/g/n WiFi and Bluetooth 4.1 BLE
- 2x PCIe, 2x GbE, SATA, USB3, 3x USB2, 9x UART, 87x GPIO

PixeLink PL-D7715 camera
- Identical interface board to Orion wired cameras.
- Lightweight S-mount lens 15MP Imager

Interface board
- Power regulator with transient protection
- 5.5 – 16VDC operating range
- USB 3.0 camera interface
- Ethernet interface
- LED illuminator
Networked Camera System Architecture

Wireless Camera prototype

5.22GHz Wi-Fi
Full spec 802.11n

Wireless Camera/Controller
- Utilize built-in HW encoder to process HD video and frame rates.
- Process cmds
- Ingest raw HD via USB 3.0
- Store/playback/dnLoad files
- Compress with internal HW compression
- Stream
- Wi-Fi client

CMA/CM i5 Camera Controllers
- Wi-Fi access point
- Time stamping
- Ingest raw or compressed images
- De-Compress/Re-compress
- Store images

Wireless wi-fi Camera

HDMI Display
Orion Video complete Architecture with Alternate Camera

Wireless Camera/Controller
- Process cmds
- Time-stamping
- Ingest raw HD via USB 3.0
- Store/playback/dnLoad files
- Compress
- Stream
- Wi-Fi client

Solar Array Cameras
- 5.22GHz Wi-Fi
- Full spec 802.11n

OpNav Mono Camera
- CMA/CM i5 Camera Controllers
  - Wi-Fi access point
  - Process DEM cmds
  - Time stamping
  - Ingest raw or compressed images
  - De-Compress/Re-compress
  - Transfer via Wi-Gig
  - Store images

Int. faring Camera
- Heat shield Camera
- Extended faring Camera
- Internal faring Camera
- CAB Cam 1
- CAB Cam 2
- CAB Cam 3

Ground Computer
- 100BaseT Ethernet Hardline
- Vehicle Systems Emulator
- BW limited uplink/downlink

HDMI Display w/all cameras
**Spacecraft Video Distributed Architecture (without central controllers)**

- **Solar Array Cameras**
- **Wireless Camera 1:** 5.22GHz Wi-Fi Full spec 802.11n
- **Wireless Camera 2:**
- **Wireless Camera 3:**
- **Wireless Camera 4:**
- **Int. faring Camera**
- **OpNav Mono Camera**
- **Heat shield Camera**
- **External faring Camera**
- **Ground Computer**
- **Vehicle Systems Emulator**
- **BW limited uplink/downlink**
- **100BaseT Ethernet Hardline**
- **HDMI Display w/all cameras**
Networked Camera System Architecture – Spacesuit application

- Wired Helmet
- Camera with Dimmable Lights
- Small computer with video encoding
- Free-floating Battery-op Camera with Wi-Fi
Questions?