Esterline Control & Communication Systems

Crewstation-over-IP

Real-time mission-critical remote multi-desktops

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INTRODUCTION

Operational display systems involve multiple operators interacting via multiple displays with multiple computers. Commercial IT technology offers an array of solutions for flexible remote desktop capabilities using standard IP networks. However, mission-critical systems requiring real-time interaction and pixel-perfect imagery often utilize dedicated video and KVM switching equipment to achieve the necessary remote performance. These dedicated switching solutions place limitations on system flexibility, interoperability between systems, and technology insertion for advanced capabilities and sustainment.

10Gb Ethernet enables real-time interaction and pixel-perfect imagery between users and remote computers over standard IP networks. Using open-system networks for distributing computer video, USB devices, and audio brings several advantages for system flexibility, connectivity, and integration of new capabilities. Subsystems can be consolidated with reduced equipment and cabling, resulting in reduced total cost of ownership.

Esterline's Crewstation-over-IP solutions offer real-time interaction, lossless imagery, secure connections, and high system availability using standard 10Gb Ethernet networks. 10/40Gb Ethernet has become the baseline for data centers. Streaming uncompressed video over 10GbE provides a cost-effective means for achieving near-zero latency for real-time, interactive remote desktops.

BENEFITS OF
REMOTE HMIs
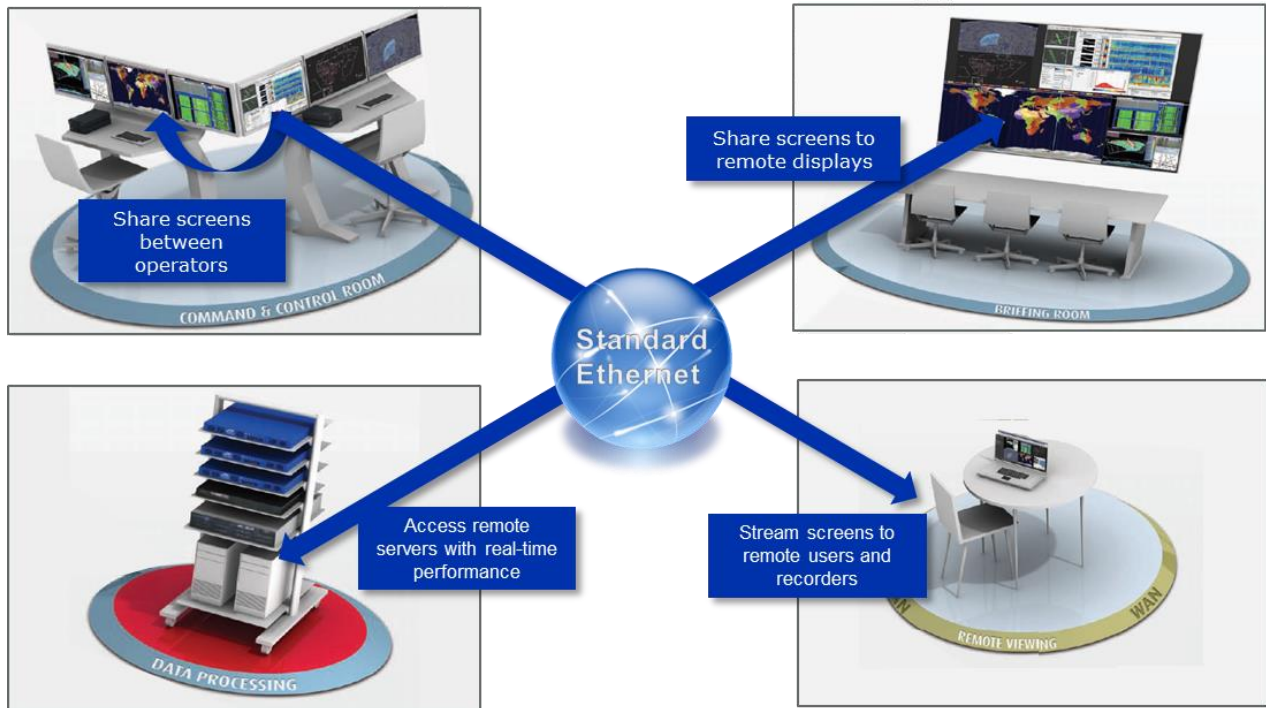
Real-time access to remote computers enables distributed operations.

For mission-critical systems, situation awareness is key for timely decision making. Tactical systems strive to provide the right information at the right time to the right people. A networked approach to connect multiple users, computers, and subsystems has become the norm. Ongoing performance advances now enable real-time operation over standard IP networks.

Real-time network communications allows computing equipment to be moved away from space-limited operator positions. This can serve to reduce the footprint of HMI equipment for size, weight, and power (SWaP) benefits or can free up space for advanced HMI displays and devices with improved ergonomics.

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These "zero client" crewstations also make it possible to connect to multiple remote systems for multi-function operation or redundancy from a common operator position. Utilizing common open standard equipment interfaces, such as DVI, USB, and analog audio, supports remote access and control of disparate subsystems from a common crewstation. This enables new and legacy subsystems to coexist without independent operator positions or costly integration and requalification efforts.

Separating the crewstation HMI from the processing equipment also enables the system's computing infrastructure to evolve following computing technology trends without impacting the crewstation equipment. Once the HMI interface is networked, there is no performance or functional difference if the computer remains with the operator, is removed to a remote location, or is integrated with other servers. Upgrades to legacy subsystems can then be planned when most effective and implemented when most practical.

Additionally, once operators and computers are networked, all displayed information and operator interaction can be made securely available to other subscribers and services on the network. Operator activity can be shared across the LAN or between facilities to increase collaboration and situation awareness. Streaming video, audio, and metadata can also be captured independently by standard networked video recorders for incident analysis or after-action review.

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CRITICAL NEEDS
FOR MISSION SYSTEMS

Mission-critical systems require real-time interaction and access to information, dependable operation, and seamless connectivity. Deployed equipment must provide critical performance, high availability, and interoperability in an open standard environment.

Performance requirements include real-time interaction with remote computers, low-latency video distribution, and pixel-perfect image quality. Remote interaction must have the same look-and-feel as local workstation connections.

Systems must provide mission-critical operation without interruption. Rugged packaging provides reliability in harsh environments while redundancy and failover modes ensure continuous operation. Secure access controls and health monitoring also provide confidence that the system is operating properly.

Interoperability between equipment is critical for sharing visual information, integrating various subsystems, and sustaining qualified systems. The use of open system interfaces is key to integrating equipment from multiple subsystems and suppliers into a common operational system.

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COMMERCIAL SOLUTIONS
FOR REMOTE DESKTOPS

Multiple approaches are used to provide remote desktop capabilities for commercial applications. These include integrated software, extenders, KVM switching systems, and IP encoders/decoders.

Integrated Software

Software solutions provide flexible connectivity over standard networks and are often tightly integrated into the operating environment.   Solutions can be vendor-specific and are normally limited to sharing desktops between platforms running the same environment. This approach supports advanced capabilities for thin client access to virtualized servers but does not provide real-time performance for dynamic visualization applications. Additionally, integrating new software solutions onto legacy computing equipment may not be possible.

Extenders

Simple hardware extenders can be used to increase the distance of standard video, USB, and audio connections. This is a low cost approach for small systems requiring only point-to-point connections between operators and computers, often over standard 10G fiber cabling. Connection protocols are normally proprietary.

KVM switching

KVM (keyboard, video, mouse) switching systems utilize central switch matrices for routing multiple video, keyboard/mouse, and audio connections between users and computers. 10G fiber cabling is often used with extender hardware for remote connections. Real-time lossless performance is achieved, but the system is normally designed around proprietary (and sometimes large) central switching equipment.

IP Encoders/Decoders

Hardware desktop encoders provide an add-on solution with higher performance than software-based IP solutions. Hardware acceleration is used to encode video, USB, and audio for transmission across standard cabling. Compression can be employed to utilize 1G (or lower) networks at the cost of latency, image fidelity, and/or determinism.
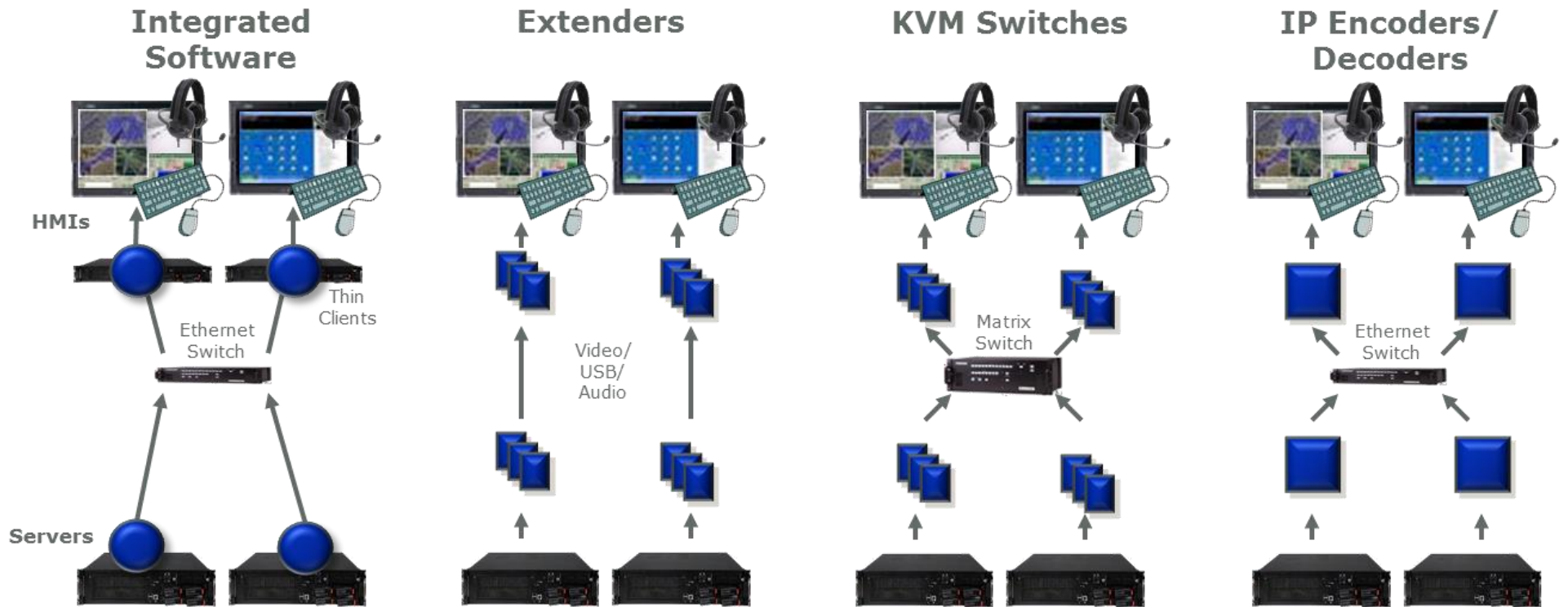
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Remote desktop implementation approaches

A REAL-TIME
IP SOLUTION

Esterline's Crewstation-over-IP connects remote HMIs and computers with real-time lossless performance using standard IP protocols over 10G Ethernet.   A standard ethernet infrastructure is used with Rugged Network Adapters (RNA) for each endpoint. Standard network switches leverage commercial IT technology and readily support cost effective integration, reconfiguration, and future proof growth. Common standard cabling can be used for all endpoints and multiple devices and device types can connect via a single cable. Additional endpoints and new device types can be easily added, often without any changes to the network infrastructure.

The benefits of an IP-based approach include:
• **Remote access to multiple systems** – Add-on devices support simultaneous connection to new and legacy equipment, enabling operation of disparate subsystems from a single crewstation.
• **Minimal cabling** – A single, common copper/fiber cable carries all video, controls, and bi-directional audio between switches and endpoints.
• **Scalable, configurable, expandable** – Additional endpoints and channels are easily integrated using spare ports or additional standard network switches.
• **LAN/WAN distribution** – Hard real-time LAN performance are complemented by low-bandwidth compressed streaming suitable for wide area distribution.
• **Redundancy** – Dual network connections and switches, as well as automated fail-over modes, are supported for fail-safe operation.
• **Recording** – Multi-channel, synchronous recording of all compressed streams is possible using network attached stream recorders without any impact on system operation.
• **Evolution toward SOA** – Optional local connections between computers and HMI support the evolution from workstations to consolidated servers and/or service-oriented architectures using the same HMI equipment.

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Table 1 – Comparison of remote desktop approaches

	Integrated software	Extenders	DVI/KVM switching	IP Encoders/ Decoders	Crewstation-over-IP
Multiple displays	✓	✓	✓	✓	✓
Lossless video		✓	✓		✓
Near-zero latency		✓	✓		✓
Remote desktop control	✓	✓	✓	✓	✓
Real-time interaction		✓	✓	some	✓
USB devices	Keyboard, mouse, others	Keyboard, mouse, others	Keyboard, mouse, others	Keyboard, mouse, others	Keyboard, mouse, multitouch, hubs, others
Bi-directional Audio	✓	✓	✓	✓	✓
Equipment	Ethernet switch, thin client	Endpoint converters	Central matrix switch, endpoint converters	Ethernet switch, encoders/decoders	Ethernet switch, network adapters
Remote monitoring	✓		✓		✓
Video compositing	✓ Multiple windows		✓ N views per system		✓ N views per client
Multi-desktop control	✓ Multiple windows				✓
Local Computer-to-HMI by-pass	✓			✓	✓ Active local operation and fail-safe pass-thru
Wide area distribution	✓			✓	✓
Recording	integrated (some)		add-on	some	✓ Add-on via a network stream recorder
Redundancy	Double equipment	Double equipment	Double equipment	Double equipment	✓ Dual network ports for each endpoint

RNA HIGHLIGHTS FOR MISSION SYSTEMS

Esterline's Crewstation-over-IP solutions provide the following for mission-critical systems:

Performance

- **Lossless imagery** - Pixel perfect quality for text, graphics, HD video, radar, and sonar is achieved using uncompressed video distribution over 10GbE.
- **Near-zero latency** - Standard 10GbE supports video distribution and deterministic interaction with sub-frame latency.
- **Hybrid encoding** - In parallel, compression can be applied to any/all screen sources for low-bandwidth streaming.

Capabilities

- **Real-time remote desktops** - Any operator can monitor or control any computer source. Multiple remote desktop sources can be connected to a single operator. Servers can also be shared between multiple operators.
- **Collaboration** - The screen content from any crewstation can be shared with other operators for software independent collaboration. Screen content from multiple users can be shared simultaneously to remote/large area displays for collaboration.
- **Multi-head** - Multiple screens per crewstation can be supported with bi-directional audio and user input devices including keyboard, mouse, and multi-touch screens.
- **Recording** - Using compressed streams, all computer, sensor, and screen information can be recorded by networked services for training and after-action-review without any impact on real-time system performance.
- **Software clients** – Multicast compressed streams can be viewed simultaneously by multiple clients using standard media players on any computer or wireless device.
- **LAN/WAN distribution** - Compressed streams can be routed to 10/100/1000 Base-T networks for LAN distribution across the operational site or WAN

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distribution to remote facilities for live or recorded collaboration.

- **Media/System Management** – A device API is provided for integrating simplified system configuration and management with customer applications.

System Benefits

- **Scalability** - Small or large systems are readily supported using open standard components.
- **Agility** - Rapid system reconfiguration is supported by modular components under software control.
- **High availability** – Mission assurance can be achieved through redundant network connections and automated failover modes with little additional cost.
- **Security** – Information assurance is supported through secure access control and stateless clients.
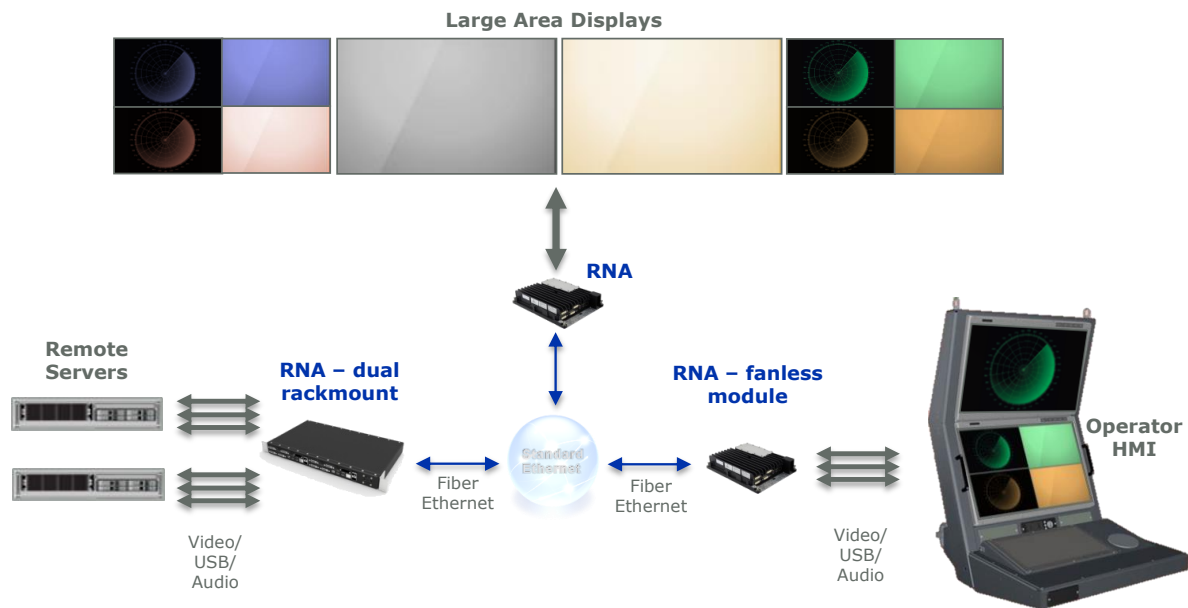
Rugged Network Adapters (RNA) provide an add-on solution for Crewstation-over-IP

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CONCLUSION

Esterline's Crewstation-over-IP solutions utilize RNA devices to connect operators and remote computers with mission-critical performance over standard 10G Ethernet. RNAs provide a seamless tech insertion upgrade for dedicated DVI, KVM, or other Audio/Visual (AV) switching systems. Existing DVI switching systems can be upgraded to a real-time IP system or new capabilities for desktop sharing and collaboration can be integrated into existing computing systems. Once integrated, computer technology insertion can evolve independently of the crewstation HMI.

Leveraging commercial IP networking and computing technology trends provides significant lifecycle cost and advanced capability benefits. Utilizing standard 10Gb Ethernet provides the near-zero latency and lossless image quality required for mission-critical real-time systems, along with the flexibility, interoperability, and future-proofing of open system IP networking.

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