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FOCUS: "It's more than just the satellite..."

Small satellites (TacSats, microsattellites, nano-satellites, pico-satellites — whatever the nomenclature) potentially offer many positive benefits when compared to traditional satellite programs. Lower costs, shorter development and acquisition timelines, increased operational responsiveness, and an ability to augment on-orbit capabilities highlight a few examples of positive benefits. To fully realize their potential, these assets will require responsive ground systems that are flexible, expandable, capable of supporting multiple platforms, and responsive to technological advances.

In a 2007 report to Congress, the "*Plan for Operationally Responsive Space (ORS)*," the *Department of Defense (DoD)* outlined an implementation concept that stated "...the Commander, United States Strategic Command (CDRUSSTRATCOM) has expressed three desires: first, to rapidly exploit and infuse space technological or operational innovations; second, to rapidly adapt or augment existing space capabilities when needed to expand operational capability; and third, to rapidly reconstitute or replenish critical space capabilities to preserve operational capability. These desires have led to a multi-dimensional concept to implement ORS to improve the responsiveness of existing space capabilities (e.g. space segment, launch segment, ground segment) and to develop complementary, more affordable, small satellite/launch vehicle combinations and associated ground systems that can be deployed in operationally relevant timeframes."

For those of us in the satellite ground system and network management business, this is a significant statement because it documents and elevates the importance of the ground segment to the same level as the space and launch segments in achieving operational responsiveness.

In short, the report challenged the classical ground segment approach on two fronts. First, can we still afford to acquire satellite programs requiring their own mission-unique "stovepipe" control system characterized by limited focus and functionality in terms of flexibility and expandability (i.e., improve the responsiveness of existing space capabilities). *Figure 1* depicts a typical ground system providing functionality for *Telemetry, Tracking, and Command (TT&C)*, Earth station *Monitoring and Control (M&C)*, and network operations.

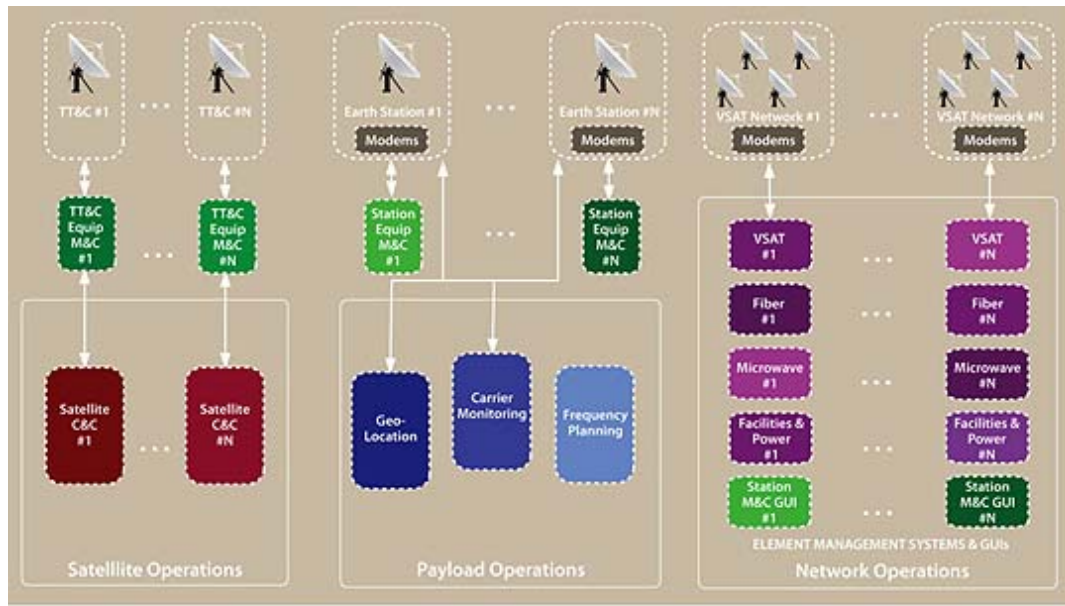


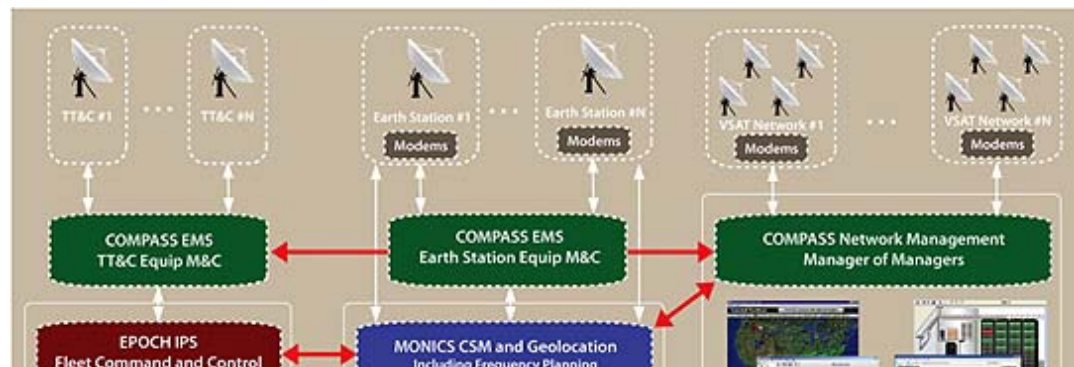
Figure 1. Traditional Stovepipe Satellite Ground System
Duplication functionality and limited interfaces for data sharing

This system is a collection of multiple stovepipe systems duplicating functionality — there are multiple *Command and Control (C&C)* systems (one for each satellite) and multiple Earth station M&C systems. In addition, the stovepipe systems do not interface with each other. For example, the C&C systems do not interface with each other (preventing fleet-based operations) or with other systems, thereby preventing a common control interface.

The second challenge — find a better way to identify and acquire capabilities that are designed from the outset to be flexible, scalable, and open systems that can readily, and cost effectively, grow or adapt to changing requirements. Fundamentally, this means we should develop complementary, more affordable, small satellite/launch vehicle combinations and associated ground systems that can be deployed in operationally relevant timeframes.

Integral Systems, Inc. (ISI) of Lanham, Maryland, has long understood the value in developing capabilities that are extensible and adaptable enough to accommodate advances in technology and dynamic requirements. Integral Systems and its subsidiaries, **Newpoint Technologies, Inc.**, and **SAT Corporation**, are market leaders in the areas of satellite command and control systems, network and equipment management, spectrum monitoring, and interference detection and characterization. We are well postured to meet these challenges and help define the future of satellite command and control.

ISI's **EPOCH T&C Server** provides complete off-the-shelf satellite telemetry and command processing for



operations and test environments. EPOCH delivers front-end data processing, distribution, and command formatting as part of an end-to-end command and control solution. **EPOCH IPS** (*Integrated Product Suite*) can manage a single satellite, multiple satellites from different manufacturers, or an entire constellation of satellites. Every operator using the EPOCH IPS has exactly the same core software, no matter what satellite types their fleet includes. Using extensible COTS as a system's core frees developers to concentrate on mission-unique components and not worry about developing basic command and control elements. In addition, EPOCH is based on an open architecture, so increasing the command and control system's capabilities without a major redevelopment of the entire platform allows operators to rapidly integrate and realize new capabilities. The ground system depicted in **Figure 2** depicts an integrated COTS system assembled with ISI's products. Contrast this with the stovepipe systems shown in **Figure 1**, and note the absence of multiple, duplicated systems and the addition of data sharing between satellite, payload, and network operations.

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Is it any wonder why ISI is the world's leading ground system supplier?



Newpoint Technologies expands on this approach to provide spacecraft operators with an integrated, end-to-end ground system M&C capability. Through our approach, a single user interface can manage a wide variety of legacy and new hardware and software subsystems. Historically, divergent interfaces made this extremely difficult, if not impossible. The development of network standards such as Simple Network Management Protocol (SNMP), attempted to overcome this problem, but even then, not all devices supported such standards and upgrading already fielded components introduced additional cost and risk to the operation.

Today, the application

of a multi-tiered **Manager of Managers (MoM)** architecture using components that can interface to a wide variety of standard and non-standard hardware, as well as existing equipment monitor and control systems enables operators to achieve a single solution for managing ground systems with divergent hardware and interfaces.

Newpoint's **Compass MoM** solution (**Figure 3**) provides satellite, terrestrial, and transmitter network operators a single solution for managing all the equipment comprising the transmission network. Compass accomplishes this by directly interfacing to the network equipment, or by interfacing with existing third-party M&C systems already in place, thereby providing operators with a single system for managing their entire network.

The implications of this technology are far reaching. Using the MoM approach, users can have complete situational awareness across the entire ground segment for any mission that needs to be brought online quickly by using the existing ground infrastructure already in place. Existing government and commercial M&C infrastructure can be kept in place and Compass software can interface into these existing systems quickly to provide overall situational awareness across these disparate systems. System maintenance and administration costs are greatly reduced through this consolidation. Training costs for operators are also reduced when training only needs to be provided for one operating platform.

Labor savings can be realized by automating and integrating systems and responses previously requiring operator intervention. Human error is minimized, as automated scripts perform appropriate actions faster and in the correct order each time, all

the while testing to ensure the network is in the correct state before progressing to the next test. All information is now displayed on a single console. "Situational Awareness Dashboarding" of multiple systems' status is possible using the onboard report generation tools that eliminate the need to "pull" information from individual systems. Trouble ticketing is now centralized and can be automated as well. System faults may automatically generate a priority message to a technician or operator. Specific mission impacts can be forwarded to appropriate personnel, thereby encouraging proactive action.

In addition, the MoM solution delivers centralized management for equipment- and service-related faults and performance data. Alarm centralization and intelligent correlation gives operators the ability to quickly view the overall health of missions and rapidly respond to problems isolated to a device or

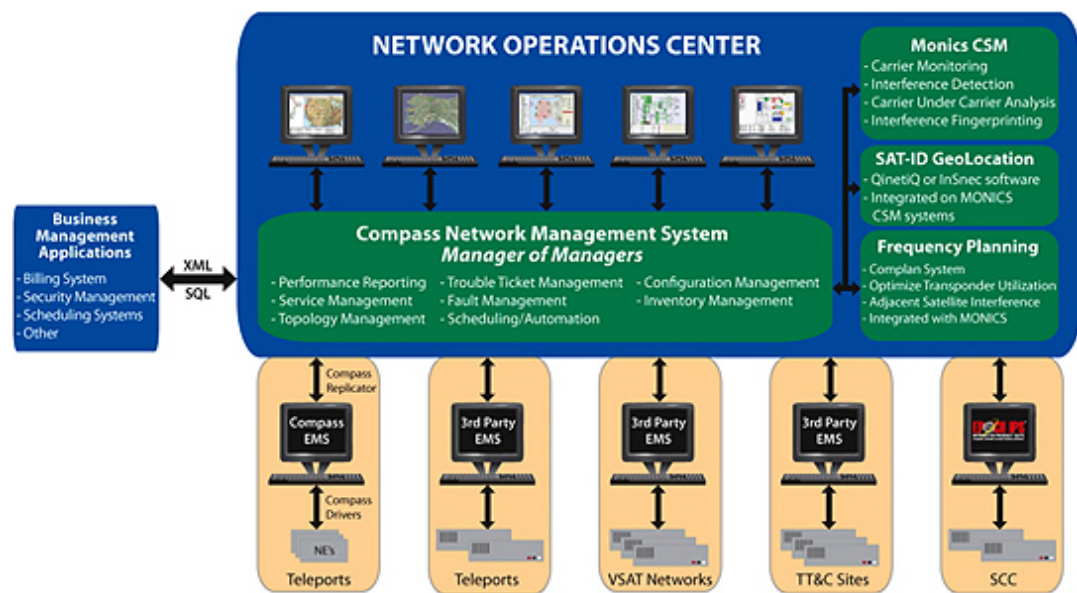


Figure 3. Newpoint Compass - Manager of Manager
Compass forms the hub to support multiple access points for receiving and distributing information

widespread across all network operations. Network operators can quickly respond to problems by having necessary information immediately available through a web-based Graphical User Interface such as that provided by Newpoint's *TrueNorth* product (**Figure 4**). This gives operators both the ability to prevent problems before they occur and troubleshoot in real-time before system performance degrades.

The previous examples highlight the MoM solution's ground segment network management functions and its ability to provide system-wide situational awareness. The final element making this



Figure 4. Newpoint's Compass /TrueNorth product can provide management of existing network management systems to create a single, fully integrated view and control of the entire ground network

approach unique is an ability to integrate, monitor, and manage third-party applications required by a specific platform being controlled, or in response to changing requirements or technological advances. You can add functionality without having to redesign your ground system.

For example, RF interference problems continue to worsen, especially in the current global climate. Satellite operators and data users will continue to contend with this interference and must be able to mitigate its impact. Tools such as SAT Corporation's *Monics Carrier Monitoring System* are used to identify and characterize interference, will remain in high demand. ISI's integrated system approach now provides operators with alarms and notifications from the same console used to control the satellite and monitor the ground system. This eliminates the need to correlate degradation with data from a standalone system, and enables a quick diagnosis and response to problems.

To quote a popular advertising phrase, "it's all about the network" seems especially relevant in terms of providing responsive satellite command and control capabilities. The role of small satellites in the DoD or commercial arenas is yet to be determined; however, companies such as Integral Systems that provide fully-networked, integrated, end-to-end command and control solutions clearly have a role to play with evolving space capabilities.

About the author

Scott Herrick is the Director of Government Business Development for Newpoint Technologies. Prior to joining Newpoint, he was a career US Air Force officer and served in numerous space operations and command and control assignments.

