Satellite Telemetry and Command Applications

Flexible Processing and Network Transport for Distributed Ground Systems
The Built-In Flexibility to Evolve and Scale with Your Satellite Ground System

softFEP Apps provide the functionality and configurability needed for today’s modern architectures. Fully embracing a software-defined, application-centric model, the softFEP systems we deliver to customers reflect their requirements and system design. softFEP Apps have the added feature of easily evolving with our customer’s needs without a costly technology refresh.

softFEP Apps offer:

- Data rates from 1 kbps to 10 Gbps
- Full support for nearly any COMSEC device
- Serial and networked interfaces
- Standards compliance (CCSDS, MTS, AFSCN, GMSEC)
- Compatible with Command and Control Systems

“The product is very flexible in both customization and integration.”
softFEP Systems Handle Some of Our Nation’s Most Critical Space Data

- The Intelligence Community trusts softFEP systems in multiple control centers to securely process space data links before and after encryption/decryption. High rate mission data is moved between locations for dissemination and processing.
- Commercial companies such as DigitalGlobe rely on softFEP systems to capture, record, and transmit the image data received from their Worldview satellites.
- Many military space programs have deployed softFEP systems in support of the command and control of their spacecraft.
- The International Space Station’s voice, video, and data links flow through softFEP systems at multiple NASA ground location. Future manned space systems such as CST-100 are following suit.
Ground System Architecture

Key Functions

Network Transport:
- TCP, UDP, Multicast
- WAN Low-Latency Error Correction
- Serial to Network Translation
- Space Link Extension (SLE)
- ADCCP (AFSCN)
- GMSEC

Front End Processing:
- Command Formatting and Encryption
- Telemetry Decryption and Synchronization
- COMSEC Interfaces
- Time Processing
- CCSDS

Payload Processing:
- High Rate Data Ingest
- Decoding and Error Detection
- Recording and Rate Buffering
- COMSEC Interfaces
- CCSDS

Data Recording/Playback:
- RAID5 Storage
- Encrypted Data at Rest
- Standalone Recording
- Integrated with Apps
**Supported COMSEC Devices**

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**Supported COMSEC Algorithms**

- Caribou
- CARDHOLDER
- Carousel
- Pegasus
- Belshazaar
- INY
- INSCOE
- AES
- GRYPHON GCM ECB CTR CFB
- Sanballat
- GFP

**Proven Expertise**

AMERGINT has helped customers integrate and operate with nearly every space COMSEC device in use.

softFEP systems support the formatting and protocol matching for the various traffic interfaces, allowing the satellites encrypted and unencrypted data streams to flow through the COMSEC units. Our hardware edge devices accommodate the various physical and electrical interfaces. softFEP systems also provide for COMSEC device monitoring and control.
An Ultra-Modern Product Architecture Underlies each softFEP App

The flexibility and configurability that softFEP Apps are known for derives from AMERGINT’s SOFTLINK Product Architecture. SOFTLINK combines thin hardware-edge devices with interconnected software devices arrayed into processing chains. Let’s explain.

The ground processing of satellite telemetry, payload, and command data flows through a sequence of processing steps. For example, satellite commands require formatting per the encryption system and are then encrypted. Further formatting of the command stream is required to transport this encrypted uplink data across a wide area network with deterministic timing. At the antenna site, the insertion of barker codes and idle sequences may be needed prior to the uplink modem’s modulation. Many times, the ground system architecture drives both the processing steps themselves and the location where they are performed. The data may have to convert between software constructs and specific hardware interfaces multiple times.

SOFTLINK relates the expression of customer requirements directly into the actual software implementation. System requirements describe a pipeline of data processing with discrete transformations at each step. SOFTLINK devices implement these transformations allowing a nearly one-to-one correspondence between requirements and software devices. With a library of over 1,000 software devices, the ability to configure softFEP systems per customer requirements is nearly endless.

The power of this architecture extends well beyond the initial delivery and deployment. In the same way they are initially designed, softFEP systems easily evolve and extend to meet new requirements as a satellite program changes over time.

“The softFEP product is cutting edge.”
softFEP Apps are built on a proven library of more than 1,000 software devices.

This allows each softFEP App to be tailored to the requirements specific to your ground system.

Processing chains configured via Python scripts move satellite downlink data from Earth receipt to your processing and uplink data from your processing to the radiating site.

ICDs and application diagrams are auto generated and used for integration and support.
Virtual and Cloud Deployments

Deploying softFEP on multiple VMs or within the cloud, is inherent in the product architecture. Virtualized softFEP deployments support a wide range of ground system architectures while taking advantage of cloud-computing benefits.

When Apps are deployed in VMs, they can be hosted locally or run remotely in a cloud, and interoperate across network connections. Customers have deployed their softFEP Apps as independent network gateways, black front end processors, red front end processors, and data recorders; flowing data between the VMs as a satellite contact is processed.

Customers have also configured Apps specific to a family of spacecraft, accounting for the variations across satellite programs with long operating lives and multiple generations of satellites. Prior to a specific contact, the VM/App with that satellite’s unique processing chains and configuration is started, handles the contact, and is shutdown when the pass is over. Multiple instances of these environments can exist simultaneously in various locations to provide resilient, fail-safe solutions.

“The AMERGINT products have performed flawlessly.”
Virtualization

Our customers have deployed softFEP Apps in their architectures ranging from virtualized to physical, both centralized and highly distributed, and from single satellite to full constellations.

softFEP Apps can be delivered for nearly any satellite mission.

Information Assurance

Security hardening can optionally be applied per the appropriate Security Technical Implementation Guides (STIGs), making Information Assurance an integral part of the system. Customers can subscribe to periodic RHEL updates containing the latest security patches.
Hardware Edge Devices

- **MFDM**: The Multi-Function Digital Module is a full-height PCIe board that connects softFEP Apps to legacy devices that use serial interfaces. The hardware supports multiple channels of clocked binary and ternary data. IRIG inputs and outputs support timing references.

- **MFDM-2**: The MFDM-2 provides higher density I/O and on-board RAM for enhanced data buffering in a half-height PCIe form-factor. A full-height bezel is also available. Coupling the MFDM-2 with AMERGINT’s family of I/O Panels allows customers to connect a softFEP system to a large number of different serial interfaces and a variety of electrical signals such as TTL, RS-422, and LVDS.

- **Matrix Switch**: The AMERGINT Matrix Switch can support up to 64 x 64 RS-422 signals, able to route any input signal to one or more output lines. In addition, 16 monitor points are provided on the front panel allowing the user to sample any of the routable signals. The chassis is completely software controlled through a network-based connection, provided on the back of the chassis.
Hardware I/O Panels

AMERGINT’s suite of rack-mount Hardware I/O Panels are designed to interface with the equipment found in ground systems that continue to use serial data interfaces. These devices include serial switches, modems, network gateways, and COMSEC devices. Mounted at the back of an equipment rack, the panels connect on the backside to our MFDM-2 modules, and this adapts softFEP systems to our customer’s existing cabling infrastructure.

Panels can be easily customized and new panels developed for specific requirements not met by an existing panel.

“They have consistently gone above and beyond to make my program a success.”
Process 10 Gbps Data Streams

Sophisticated flight hardware operating on data streams up to 10 Gbps require test of their XAUI data interfaces. These high-rate systems are notoriously complex, making it vital to debug and diagnose compatibility issues between flight units.

Test and operational systems with high-rate downlinks require reliable data capture and transport.

AMERGINT has a suite of 10 Gbps capable softFEP products.

Test—10G XAUI Conversion Module

AMERGINT’s AT-10G XCM supports testing of flight systems that use the high-speed XGMII Attachment Unit Interface (XAUI) to transmit or receive data. The XCM supports bi-directional data flow and can be deployed multiple ways:

- **Interface Conversion:** Connect data streams between flight units using XAUI and test systems using 10GigE.
- **Data Capture:** Record data packets in-line between two flight units with in-line transfer to test systems.
- **Data Generation/Playback:** Send data to flight units from generated data streams or user-defined data from a file.
- **Offline Data Analysis:** Perform post-processing of recorded data in non-real time.

Coming Soon...

20+ Gbps and Faster
AMERGINT has a suite of 10 Gbps capable softFEP products for recording and reliable network transport. Our WAN Forward Error Correction (WANFEC) algorithms layer packet error detection and recovery on top of the IP/UDP protocol to reliably move continuous multi-Gbps data streams across wide area networks.

The WANFEC Network Gateway utilizes specialized network cards to handle high packet rates and graphics processing units (GPUs) for processing horsepower.

WANFEC Algorithms weave together three techniques to provide guaranteed data delivery:

- Interleaving the source data prior to encoding
- Generating check symbols that are transmitted with the data
- Adding meta-data to each packet

Running the WANFEC algorithms on the two sides of the network connection between downlink antenna site and payload data processing center allows the satellite downlink data to arrive in near real time and without costly transmission errors. WANFEC performs packet reordering and can even recover the data in lost packets.

The WANFEC capability can be directly embedded with other softFEP solutions where needed.
User Interface

Monitor and control of softFEP Apps is augmented with our User Interface. From a web browser, the user can manage the systems, run tests, view documentation, and troubleshoot issues. softFEP canvases are editable to allow users to create their own custom views.

Our UI is often used as an adjunct to a mission control center’s M&C and TT&C software.
softFEP and Customer Value

- **Proven Reliability:** softFEP delivers the high software reliability that is crucial in space applications. Our Code Generation technology and other tools drive significant maturity and testability into each SwD, and these reliability drivers flow directly into the softFEP Apps.

- **Extensible:** The configurability of softFEP Apps carries over to post-delivery extensions and modifications. Your softFEP Apps stay in lockstep as your requirements and architectures evolve.

- **Red Hat Enterprise Linux:** The RHEL operating system provides a robust, secure environment for the softFEP Applications.

- **Direct Support:** AMERGINT engineers provide direct support to you for any hardware, software, or operating system issues. We are happy to assist with setup, operations, and troubleshooting.

Contact AMERGINT to start configuring a softFEP system to your requirements.