Defense

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White Paper

Earth Observation (EO), Imaging, and Enabling the Warfighter at the Tactical Edge

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The space industry is entering its most dynamic period in decades. The onslaught of SmallSat Low Earth Orbit (LEO) satellite constellations has focused attention as never before on the **Earth Observation (EO)** and Imaging Market. In government and defense, imaging is used for surveillance, compliance, environmental stewardship, and resource management. Utilizing artificial intelligence (AI), analytics, and automation, governments and businesses alike are applying these tools to imaging data which generates real-time, actionable information and benefits the warfighter, saves lives and money, improves infrastructure, and creates business efficiencies.

Types of Earth Observations Satellites

Earth observation satellites are categorized based on their orbits, each with distinct advantages and applications. Here's a brief overview of the types of orbits and their uses:

- **Low Earth Orbit (LEO):** Satellites in LEO are typically placed at altitudes between 160 to 2,000 km. They are used for communication, remote sensing, and the ISS.
- **Medium Earth Orbit (MEO):** MEO satellites are placed at altitudes between 2,000 to 35,500 km. They are commonly used for navigation systems, including GPS.
- **Geostationary Orbit (GEO):** GEO satellites are placed at an altitude of 35,786 km, matching the Earth's rotation. They are used for telecommunications and Earth observation.
- **Polar Orbit:** Satellites in polar orbit are inclined nearly 90 degrees to the equatorial plane and travel from pole to pole. They are used for reconnaissance, weather tracking, and long-term Earth observation.
- **Sun-Synchronous Orbit (SSO):** SSO satellites are placed in polar orbit and pass over the same spot on Earth at the same local solar time every day. They are used for environmental monitoring and disaster response.

These orbits enable satellites to provide global coverage, track environmental changes, and support various applications in telecommunications, navigation, and Earth observation.

Besides the different orbits used, there are a range of different sensors serving different uses and applications:

Optical Sensors

Optical satellite sensors detect energy in the visible and near-infrared portions of the electromagnetic spectrum, enabling them to capture detailed images of the Earth’s surface.

Figure 1: Optical Sensor Image of San Francisco; credit: Planet Labs PBC

Thermal Infrared Sensors

Thermal infrared sensors measure the heat energy naturally emitted by the Earth's surface, detecting wavelengths that are invisible to the human eye but highly informative for environmental monitoring. day and night.

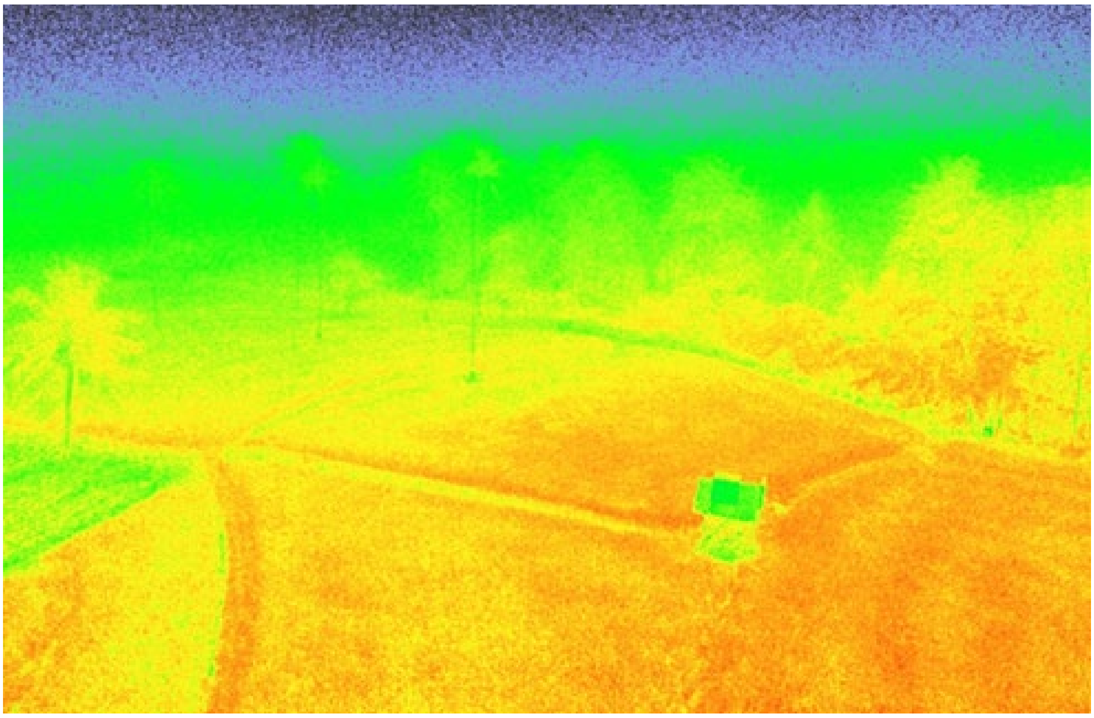

Figure 2: Thermal Infrared Sensor Image; credit: Shutterstock

Light Detection and Ranging (LiDAR) Sensors

LiDAR sensors use pulses of laser light to measure the distance between the sensor and the Earth's surface, enabling the construction of highly accurate three-dimensional models of terrain and objects.

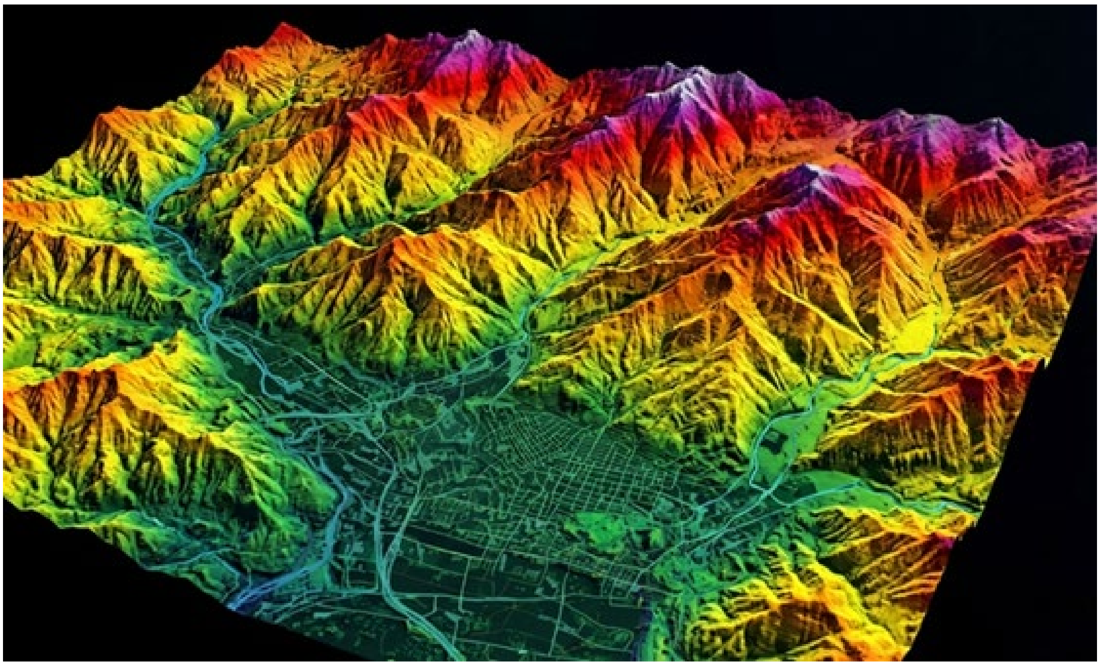

Figure 3: LiDAR Sensor Image

Synthetic Aperture Radar (SAR) Sensors

SAR sensors transmit microwave signals toward the Earth's surface and then measure both the strength (intensity) and timing/phase of the waves that bounce back.

Figure 4: Synthetic Aperture Radar (SAR) image

Enormous Data Requirements Lead to More Powerful Designs

In the Earth Observation market, satellites now generate more imagery than traditional downlinks can handle, especially in LEO. Increasingly, AI is used onboard to classify, filter, and prioritize data so that only mission-relevant products are sent to Earth. This shift reduces bandwidth pressure and enables faster, more actionable insights.

As lightweight, space-qualified machine-learning models advance, future EO constellations will function as autonomous sensor-analytics networks and not just cameras in space. Satellites will routinely perform tasks such as object detection, anomaly monitoring, and change analysis directly onboard, minimizing the need to transmit massive raw datasets.

Even with onboard AI, modern satellites are at least ten-fold more powerful and produce exponentially larger data volumes. Imaging systems drive this growth by generating enormous quantities of information that must be received and processed on the ground. At the same time, SATCOM technology has evolved to support these demands, including the adoption of optical communications capable of extremely high data rates.

Multi-orbit and multi-frequency SATCOM terminals are now standard, enabling faster deployment, smaller logistics footprints, better satellite utilization, and stronger resilience in contested environments. While today's constellations primarily use free-space optical links for inter-satellite connectivity, many are beginning to add space-to-ground optical links as well. As optical systems become core to next-generation architectures, deployable high-throughput and secure optical ground solutions will be essential.

Optical communications provide high-rate, low-latency, LPI/LPD, license-free connectivity with strong resistance to jamming and interception. When integrated with existing RF systems, optical links enhance gateway resilience and support real-time ISR and EO data delivery. These hybrid RF-optical architectures meet growing demands for continuous, high-speed communications.

Mission-Ready, Multi-Orbit, Full-Motion SATCOM Terminals for Earth Observation Operations

Modern government operations increasingly rely on tactical satellite communications that can be deployed rapidly, adapt to shifting mission requirements, and operate reliably in contested and austere environments. As missions grow more dynamic and satellite architectures diversify, ground systems must deliver flexibility and high performance without adding logistical burden or operational risk.

With more than thirty years of experience developing fixed and transportable ground systems, Gilat DataPath, a subsidiary of Gilat Satellite Networks, has built a proven portfolio of GEO and NGEO ready terminals engineered for these evolving demands. Our multi-band DKET3420/21 4.2 meter transportable terminal, widely used across U.S. DoD fixed and mobile enterprise environments, established the foundation for today's multi-orbit capabilities. Building on this legacy, the enhanced DKET3421 now supports GEO and MEO operation, while our newest 1.3, 2.6, and 3.4 meter DKET terminals introduce multi-frequency, full-motion operation across GEO, MEO, LEO, and HEO. These advancements position the product line to meet the accelerating performance needs of the Earth Observation market.

To align with the trajectory of next-generation constellations, Gilat DataPath is also advancing its transportable ground station solutions with integrated optical terminals. As a supplier agnostic integrator, we work with multiple optical SATCOM manufacturers to deliver both fixed and transportable Optical Communication Terminals capable of supporting emerging government systems equipped with optical links. This ensures that customers can transition smoothly as EO missions place greater emphasis on high-capacity optical downlinks.

Satellite constellations, communications frequencies, and technologies will continue to evolve over time, and ground systems, which often operate for more than twenty years, must be built for long-term adaptability. Gilat DataPath's family of portable and transportable terminals reflects this principle. Engineered for high throughput, ease of transport, and operational simplicity, they meet the demanding requirements of defense, government, and EO operators. Their rugged construction, certified to MIL-STD-810G, ensures reliable performance in extreme environments ranging from remote field operations to disaster response. All terminals in the portfolio are designed to support EO missions, and the product family scales in size, capability, and throughput to meet the full spectrum of EO use cases, from megabits per second to tens of gigabits per second and beyond.

The DataPath 1.3 and 2.6

The DataPath1.35m X/Y is a high-performance full motion antenna designed to track satellites in LEO, MEO and GEO orbits. It packs into 3 cases plus an RF/Integration case and can be assembled in 20 minutes or less. The DataPath 2.6m is designed for LEO, MEO and GEO applications with tracking and high-performance portability in a lightweight package. The terminal features a 9-piece segment carbon fiber composite reflector with an assembly time under 30 minutes. Rugged transport cases compliant to two-man lift requirements are provided to safely transport the terminal until deployment.

For both antennas, precision servo control, optional beacon receivers, and carbon-fiber reflectors optimized for Ka-band enable accurate tracking and high-performance links across GEO, MEO, and LEO environments. Modular RF kits allow rapid changes in frequency band and power level to support evolving mission needs.

Figure 5: DataPath 2.6m X/Y

Figure 6: DataPath 1.3m X/Y

The DataPath DKET 4341

The newest of our EO Capable terminals is the DKET 4341, our 3.4 Meter Full Motion, Transportable Antenna System. The DKET 4341 is a self-contained, autonomous, CE-Compliant, highly mobile (air and ground), transportable ground gateway communications system engineered and sized to deliver temporary or long-term multi-orbit ground gateway services globally. This solution addresses the user’s need for a robust, transportable gateway solution engineered to provide GEO, MEO, HEO, or LEO ground gateway services. It will support real-world, day-to-day requirements, global disaster response, government’s Continuity of Operations Plans (COOPS), temporary gateway site during construction of a permanent ground gateway system, site backup/recovery, and lastly, customer demonstration needs.

To meet the current market needs for transportable multi-orbit gateway terminals that are capable of being repeatably relocated, the 4341 is equipped with an X/Y positioner as a pallet-based, rapidly deployable antenna solution.

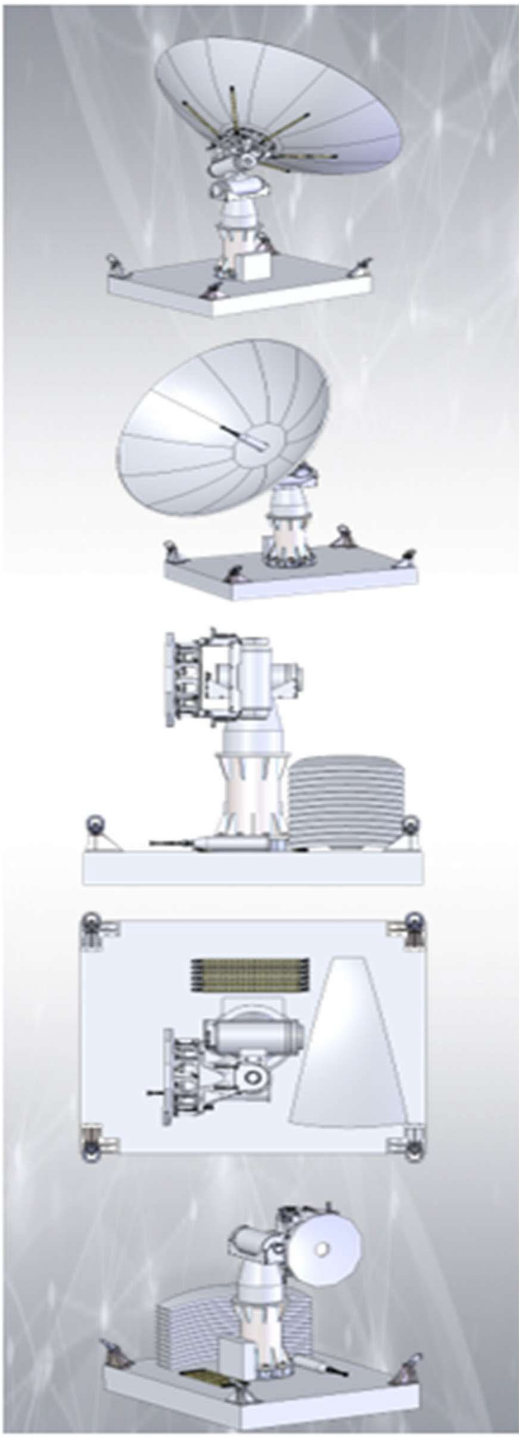

Figure 7: DataPath DKET 4341

Transportable Optical Gateway Station (T-OGS)

As optical satellite communications become part of next-generation military architectures, the Transportable Optical Gateway Station (T-OGS) provides a deployable solution for high-throughput, secure space-to-ground connectivity. Gilat DataPath has developed partnerships with multiple optical SATCOM terminal manufacturers to provide both fixed and Transportable Optical Communications Terminals. T-OGS integrates an optical communications terminal into Gilat DataPath's combat-proven transportable earth station platform, enabling optical SATCOM capability to be deployed using established field and logistics concepts.

Figure 8: TOGS Rendering (side view)

Figure 9: TOGS Rendering (rear view)

Built on a skid-based architecture meeting MIL-STD requirements, T-OGS delivers bidirectional optical connectivity at approximately 10 Gbps with a growth path to higher data rates as optical networks evolve. Laser communications provide inherent resistance to jamming, interception, and exploitation, while integration with existing RF gateway systems allows TOGS to complement traditional satellite links and enhance overall gateway resilience in tactical and operational environments. T-OGS is a first example of where Gilat DataPath integrates an optical communications terminal into our combat-proven transportable earth station platform.

A Complete Customized Transportable Earth Observation Solution

For mission-critical transportable, multi-orbit, ground station requirements, Gilat DataPath has developed a customizable solution which includes:

- The 3.4-meter DKET 4341 terminal, engineered on a 463L-compatible pallet
- Customized trailer with an integrated pallet forks and hydraulic lift for rapid deployment and recovery of the DKET 4341
- Gilat DataPath's customizable mobile data/command center using a twenty foot (20') CONNEX Shelter
- A Flat-bed Truck Chassis

This streamlined design enables quick, efficient on/offloading in any operational environment. The system provides a complete, ready-to-deploy solution for high-performance field communications at the tactical edge for the warfighter.

Conclusion

Gilat DataPath is a long-standing SATCOM solutions and services provider with a deep heritage in designing, delivering, and sustaining SATCOM ground terminals for defense, government, and coalition users. Gilat DataPath has easily evolved our business to parallel the Earth Observation market across our portfolio of terminals, enabling resilient, flexible connectivity across multiple orbits. Ground terminal designs emphasize field readiness: ruggedization for harsh environments, fast setup and teardown, maintainability in theater, and flexibility to operate on different frequency bands, orbits and networks where required. Whether it's RF, Optical, or Hybrid, Gilat DataPath's transportable or fixed SATCOM ground stations enable communicate with EO Satellites and our customizable solutions enable operators to match the terminal to the mission and include mobile data centers and command centers, allowing customers to obtain real time data at the network edge where critical decision-making occurs.