An Introduction to Ground Station as a Service

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What is Ground Station as a Service

- Ground Network Memberships: Cost-effective solutions are offered to smallsat users through commercial, government, and private networks. This presentation focusses on the commercial GSaaS providers.

- GSaaS provides users with a global, fully-managed ground station network as a part of a subscription.
  - *The global nature of GSaaS services ensures access anywhere with an internet connection*

- User maintenance includes scheduling contacts for uplink and data collection, all operation is covered by the GSaaS operator.

- GSaaS providers may have access to highly specialized data conditioning services which may then be integrated with user networks

Capabilities

- GSaaS providers maintain worldwide networks of ground terminals, including locations which maximize coverage for every orbital regime
- GSaaS providers cover all of the allocated satellite uplink and downlink bands commonly used today
  - *For uplinks; UHF, S/Ku/Ka-bands are most commonly available.*
  - *For downlinks; UHF, S/X/Ku/Ka-bands are most commonly available.*
- GSaaS providers have multiple apertures at each site, with the RF front ends necessary to handle the different combinations of bands
- GSaaS providers have maintenance personnel either on-site or on-call to remedy any ground anomalies
- GSaaS providers offer automated schedule deconfliction to maximize aperture use across their systems
  - *For users with "premium" service contracts, you will be scheduled more often*
  - *RF interference is significantly reduced among users of a given GSaaS services when coordinated to prevent conflicts.*
- Laser communications in GSaaS not yet widely available from multiple vendors.

Security

- Cybersecurity is a primary concern for GSaaS users
  - *It is best practice to at a minimum protect all smallsat command uplinks with encryption compliant with Level 1 of the Federal Information Process Standard (FIPS) 140-2. Encryption should also be placed on all telemetry, tracking, and command communications.*
- GSaaS providers may offer a full suite of security services and considerations including
  - *Virtual Private Network (VPN) access*
  - *Encryption services via Application Programming Interfaces (APIs)*
  - *Advanced Identity Access Management (IdAM) with multifactor authentication.*

Payment and Subscription Structure

- Pay-As-You-Go
  - *Must subscribe to the service*
  - *Provides access to cloud resources and antenna scheduling*
  - *Cost is calculated based off minutes used to receive data from the satellite pass or time to transmit*
  - *Generally includes transportation and storage of data*
  - *Data processing services may be available*
  - *Allows the user to control the collection and ingestion of data*
  - *Allows the user to send commands to the satellite*
- Unlimited Use
  - *Provides all of the functionality of Pay-As-You-Go on a highly available schedule*
  - *May include exclusive concierge services and priority scheduling*

Future Directions

- Future evolution of GSaaS are enhancements to the following elements:
  - *More ground terminals in more locations, more supported frequency bands, more automation and data processing, more cybersecurity & crypto*
- These enhancements are enabled by maturation of new technologies; hardware and software
- Long term goal is an "always on" CONOPs, where a smallsat could downlink any time over it's orbit
  - *The oceans will prevent a 100% solution, but proliferated ground terminals are the goal*
- As more GSaaS operators come online, market may saturate driving down pricing
  - *This depends heavily on if smallsats maintain current hegemony over inexpensive access to space*
- Several private constellations such as Planet, Spire, SpaceX One Web, etc. have their own networks. Many but not all of these antennas are co-located with some of the GSaaS sites mentioned. Avoiding interference with them, if using common frequencies, and co-location are important considerations, especially as this issue will continue to increase as all parties build more ground stations.

GSaaS Providers

The following is a not exhaustive list of current and future GSaaS providers.

Company	Website
RBC Signals	https://rbcsignals.com/
ATLAS Space Operations	https://atlasground.com/
Viasat	https://www.viasat.com
Swedish Space Corporation	https://sscspace.com/
KSAT	https://www.ksat.no/
Amazon Web Services	https://aws.amazon.com/
Azure Orbital	https://azure.microsoft.com/
Infostellar	https://infostellar.net/

Key Takeaways

- Most Government satellite systems have developed and maintained purpose-built ground systems in the past. In many cases the ground systems were acquired as part of the satellite acquisition.

- With the rise of smallsats, given their low cost and short timelines, the proposition of developing a ground system along with it loses appeal. This has given the opportunity for commercial entities to offer Ground Stations as a Service.

- This option can provide a tailored ground system solution given the requirements of a smallsat.

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