Fazzt Forward Error Correction®

INTRODUCTION

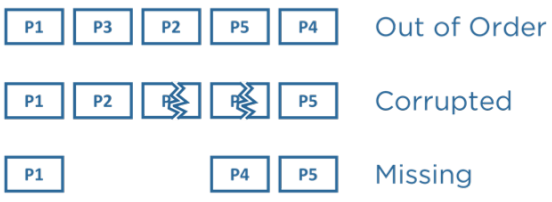
The need for large amounts of data to be moved from anywhere, to anywhere, on demand, is vast and growing. This demand is driven not only by social and commercial requirements (like collaborating on educational, medical, and business information) but also by the military.

However, the increasing market demand for live, streaming, video-quality data for mobile users is limited by terrestrial infrastructures and technologies. Large parts of the globe are left out of a global network because of the inability to afford or connect with the necessary terrestrial infrastructures. In addition, we expect low Earth orbit (LEO) and medium Earth orbit (MEO) satellite constellations to deliver broadband bandwidth to any place on the planet, comparable with consumer-grade landline speeds.

But no approach is without its disadvantages. The economic advantage of satellite networking is partly a result of its one-way nature, which keeps costs down by not requiring a return link. While terrestrial networks check for errors end-to-end and can request corrupted or missing data to be retransmitted, one-way networks can't interact with the sender. So, it is essential that data is transferred such that all recipients can autonomously recover from transmission errors. This is called Forward Error Correction.

TYPES OF ERRORS

The graphic below illustrates the three most common types of satellite transmission errors:



Satellite signals are vulnerable to noise. White noise is caused by thermal radiation from the Earth's surface, and can cause bit errors in data packets. Burst errors, caused by sunspots or rain clouds, are continuous – from msecs to seconds. Mobile receivers will experience gaps in line-of-sight visibility as they pass through tunnels, overpasses, or behind obstacles.

BENEFITS

- Fazzt FEC is a KenCast-proprietary set of methods for forward error correction, and is protected by multiple patents.
- The most efficient and economical way of assuring that transmissions are received in perfect condition the first time they are sent.
- Industry-leading low overhead of 3% to 5% is added to original file size.
- Avoids the cost of two-way satellite networks (e.g., VSAT) and multiple transmissions.
- Provides flawless digital delivery for file transfers and live streams, with minimal overhead or delay.
- Operators can select from multiple FEC modes – FECv2, Braided or Compound for files; FECv3 for live streams; and can extend protection across multiple channels or subchannels.

HOW IT WORKS

Fazzt FEC uses complex mathematics to analyze a given block of data packets, and generate a set of supplemental packets, 3% to 8% of the size of the original block. So long as the number of missing or corrupted packets doesn't exceed the number of supplemental packets, the receive side can perfectly recreate the original data block (e.g., file or stream segment) from any combination of valid packets.

Most satellite operators use a different form of FEC, called error detection and correction (EDAC). EDAC schemes generally operate at the bit level by adding enough redundant bits to the data to correct bit-level errors (e.g., Reed-Solomon, Viturbi). But these are not robust enough to correct the vast majority of packet-level errors addressed by Fazzt FEC.

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Packet- vs. Bit-level Correction
Outages due to rain clouds, solar activity, line-of-sight loss, and other conditions, can impact one or more packets, making bit-level correction insufficient.

Lowest Overhead in the Market
Fazzt FEC boasts the lowest ration of FEC packets required to reconstruct the original data. Starting as low as 3%, this avoids excessive bandwidth costs.

Support for AES Encryption
AES (Advanced Encryption Standard) encryption is applied to each packet of data. Fazzt FEC can apply this security to data already encrypted as well.

Validation
For an extra 1% in supplemental packets, Fazzt FEC uses its patented algorithms to validate that a file is absolutely identical to the original file transmitted.

Support for Streaming Content
By introducing a few seconds of delay, Fazzt FEC eliminates the freezing, jerkiness and garbling that is common with unprotected streams.

The Other FEC
You will be told that a vendor has FEC, but this not the same as Fazzt FEC. Built-in FEC heuristics address small, scattered errors, and don't correct longer outages.

VALIDATION

With traditional one-way FEC, it is not possible to ensure that a received file is identical to the transmitted file. In fact, it isn't even possible to validate received packets. However, using KenCast's patented validation algorithms, Fazzt can validate that a received and reconstructed file is absolutely identical to the file that was originally transmitted.

A NOTE ON ENCRYPTED DATA

The biggest problem with the one-way transmission of encrypted data is that the file must arrive fully intact, without a bit out of place. If there is any flaw in an encrypted stream or file, it cannot be decrypted and must be retransmitted. Without Fazzt FEC, incomplete or corrupted data will require manual intervention, or if too frequent, the addition of a back-channel, negating the cost benefit of satellite networking.

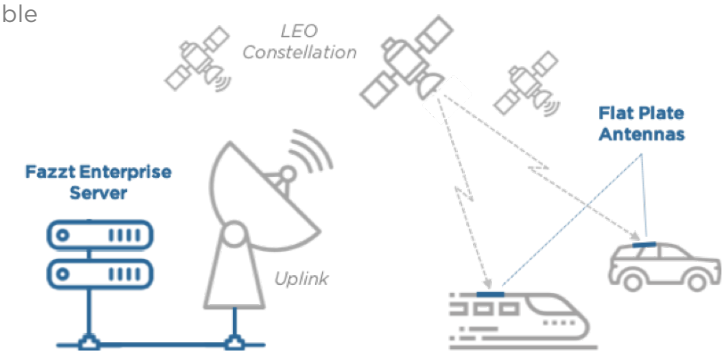
RELIABLE AND SECURE DELIVERY TO RECIPIENTS ON-THE-MOVE

Metamaterials-based antennas with electronic tuning (e.g., Flat Panel Antennas, Flat Plate Antennas, or FPAs), are being counted on to securely and reliably send large files, programs, and live streams at high speed to recipients on-the-move. These include FPAs that will soon be installed on autos, passenger trains, buses, ships and remote military posts.

Small, solid-state, low profile, wideband FPAs in Ku-band and Ka-band on moving vehicles promise a much lower cost and better technical solution than motorized antennas – provided these transfers can be made reliable and secure.

Several vendors are developing FPAs for the upcoming launches of LEO and MEO constellations, which will put thousands of satellites in orbit and provide high speed coverage to the entire Earth's surface. And at an expected price point of $300, FPAs with LEO/MEO satellites could make it possible to connect from literally anywhere, and has the potential to make many terrestrial approaches obsolete.

But early tests of FPAs indicate that this type of connectivity at high throughput cannot yet be done securely and reliably. But, adding Fazzt FEC to the equation could accelerate the mass-market readiness of FPAs by months or years.



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