



**INTERNATIONAL CIVIL AVIATION ORGANIZATION
SOUTH AMERICAN OFFICE**

**Fourth Meeting of the Central Atlantic FIR Satellite Network (CAFSAT)
Management Committee (CNMC/4)
Buenos Aires, Argentina 04 - 05 August 2014**

Agenda Item 6: *CAFSAT modernization and re-engineering*

Carriers, bit rates and modulation.

(Presented by Portugal)

Summary

This working paper presents topics for future CAFSAT stations upgrade.

1 Background

By end of first half of 2015 all stations will complete the upgrade of Phase 1 – Step 3 of document “Technical Study for CAFSAT UPGRADE – February 2012”.

This paper presents topics for discussion for future developments of the network.



CAFSAT modernization and re-engineering

Carriers, bit rates and modulation

1. Network Design

- Initially the network was designed to use QPSK and the FEC sequential 1/2:
- $E_b/N_0=6.5$ dB for $BER=10^{-7}$
- Availability of 99.99%
- Giving a required EIRP of 52.5 dBW (5 W) for a carrier of 64 Kbps on a global beam or a carrier of 128 Kbps on a hemispheric beam

2. Current status

- Operating carriers of 192 Kbps in a global beam on IS-901
 - LPA with 53.5 dBW
 - DKR with 52.6 dBW
 - JHN with 54.1 dBW
- Some states concerned about bandwidth increase due to change of ATS/DS to ATS N5 signaling.

3. Maximum rates

- With the current modulation and FEC, QPSK + Sequential 1/2
- The maximum of the stations is 55 dBW (3.7 m + 10 W)
- Depends of gain of the satellite for each position, but computed and checked with Intelsat for LPA
- 256 Kbps



4. Upgrade of modulation schemes (3)

- The next step in CAFSAT modernization is to change the modulation scheme
- With QPSK TPC $\frac{3}{4}$ -> 320 Kbps
- If QPSK TPC $\frac{7}{8}$ also 320 Kbps can be achieved but with a very limited margin
- Although some cases have little difference in the required EIRP, the difference in the allocated bandwidth can be significant.

5. Upgrade of modulation schemes (2)

- 320 Kbps of QPSK TPC $\frac{3}{4}$ requires around 315 KHz
- 320 Kbps of QPSK TPC $\frac{7}{8}$ requires around 270 KHz
- Currently a carrier of 192 Kbps with QPSK SEQ $\frac{1}{2}$ requires around 270 kHz
- Calculations have been also made with 8PSK but with the increase on the E_b/N_0 threshold greater rate cannot be achieved
- Although the limit in this case can be interesting in allocated bandwidth: 192 Kbps of 8PSK TPC $\frac{3}{4}$ requires around 135 KHz, the half.

6. Upgrade of modulation schemes (3)

- With QPSK LDPC $\frac{3}{4}$ -> 448 Kbps
- Given the maturity and the extension in the modem market, the Turbo Product codec is recommended.
 - With TPC $\frac{3}{4}$ carriers of 320 Kbps can be achieved without requiring more station power

7. Review of modems architecture (1)

- Another point to consider is the architecture
- Currently exists point to multipoint topology, requiring one demodulator for each collateral
- Additionally nowadays a full availability of 100% is reserved in the carrier's size.
- Other option is to save costs in the required bandwidth though other type of network like TDMA network



8. Review of modems architecture (2)

- In this type of networks, instead of multiple carriers, there are fewer carriers although greater but shared
- For example now the sum of the carriers is 1280 Kbps
- Then a rate of simultaneity is assumed, for example a maximum of 70%
-> 896 Kbps

9. Review of modems architecture (3)

- Then in this example 3 carrier of 320 Kbps would be used (to keep stations power)
- Each site would only need a single modem, although two configured as masters.
- The problem with this type of network would be:
 - Break with original requirement that circuits were not established under demand
 - Consensus is required for master stations and also a mechanism for the payment of the shared carriers.

3 Suggested actions

Meeting is invited to note and discuss the information of this WP.

----- End -----

(4 pages)