

# **DELTA SPE**

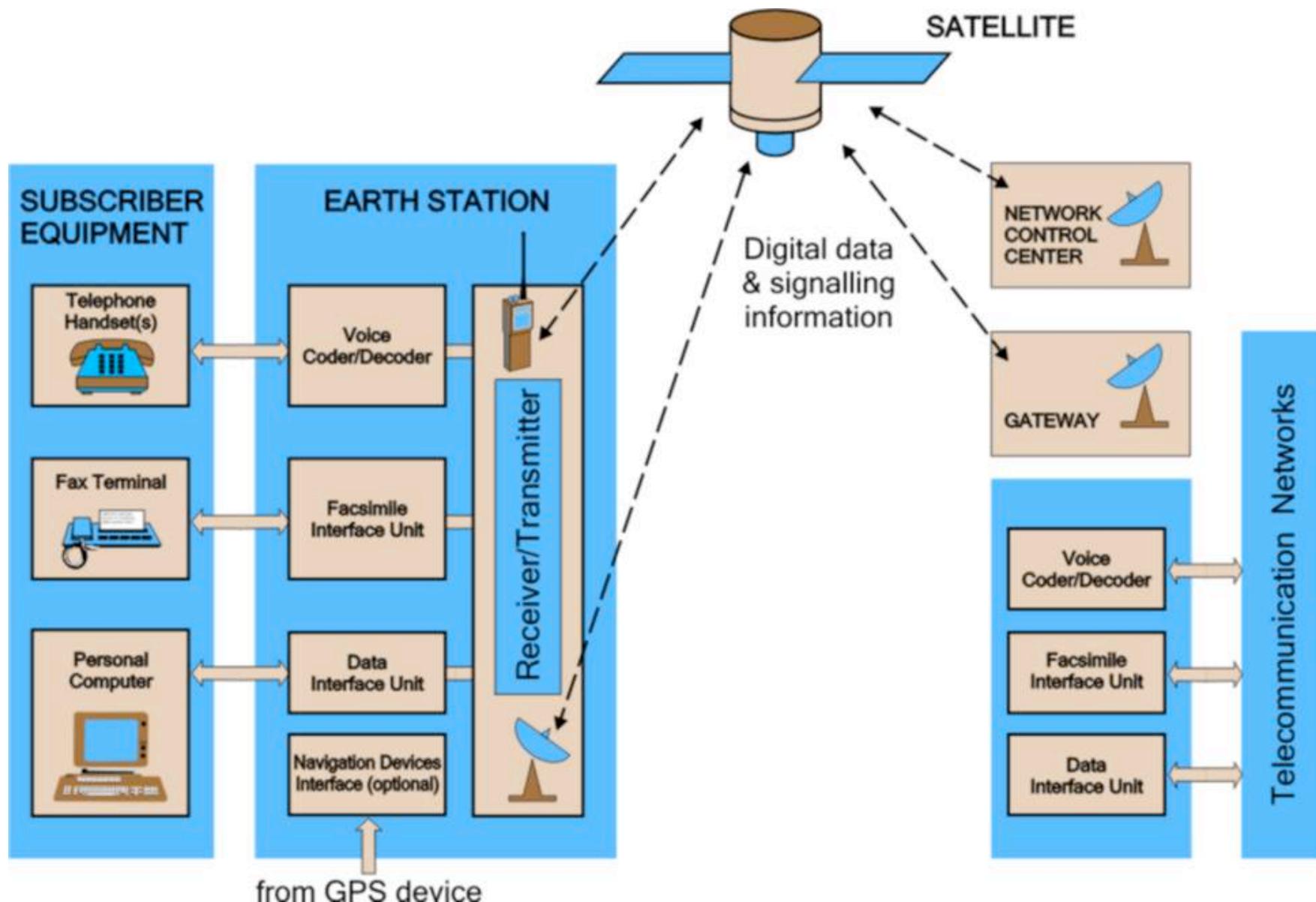
## **Scientific & Production Enterprise**

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### **The Challenge of Packet Data Collection from Satellite Communications Space Segment and Effective Solutions**

The provisioning of intelligence collection and processing of satellite communications (Inmarsat, Thuraya, VSAT etc) is one of the emerging challenges of today. This session will give an overview of original solutions for the collection and processing of packet data satellite services (Internet, VoIP, FoIP) at all layers of the Open System Interconnection model.

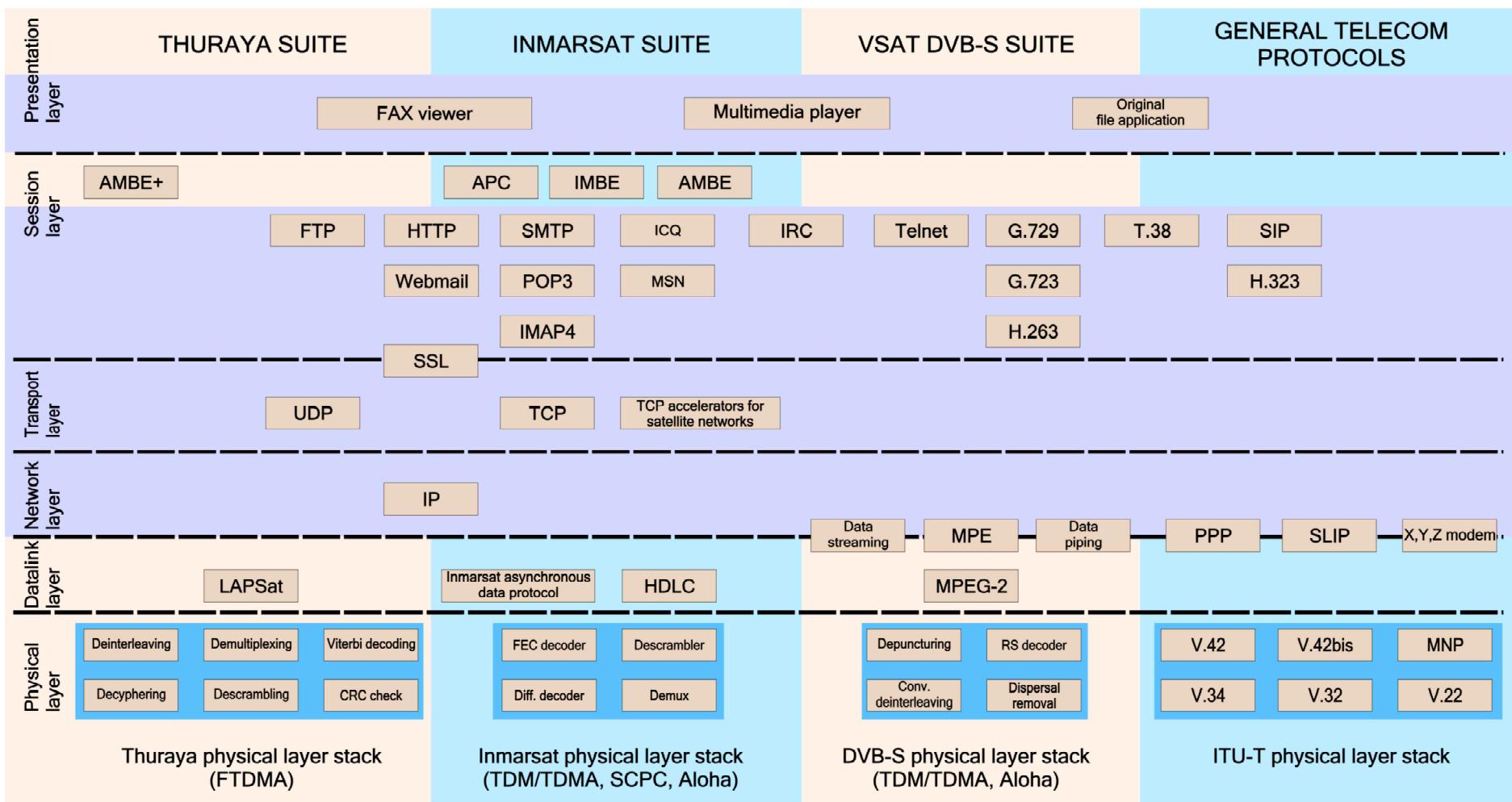
# SATELLITE COMMUNICATIONS - GENERAL STRUCTURE



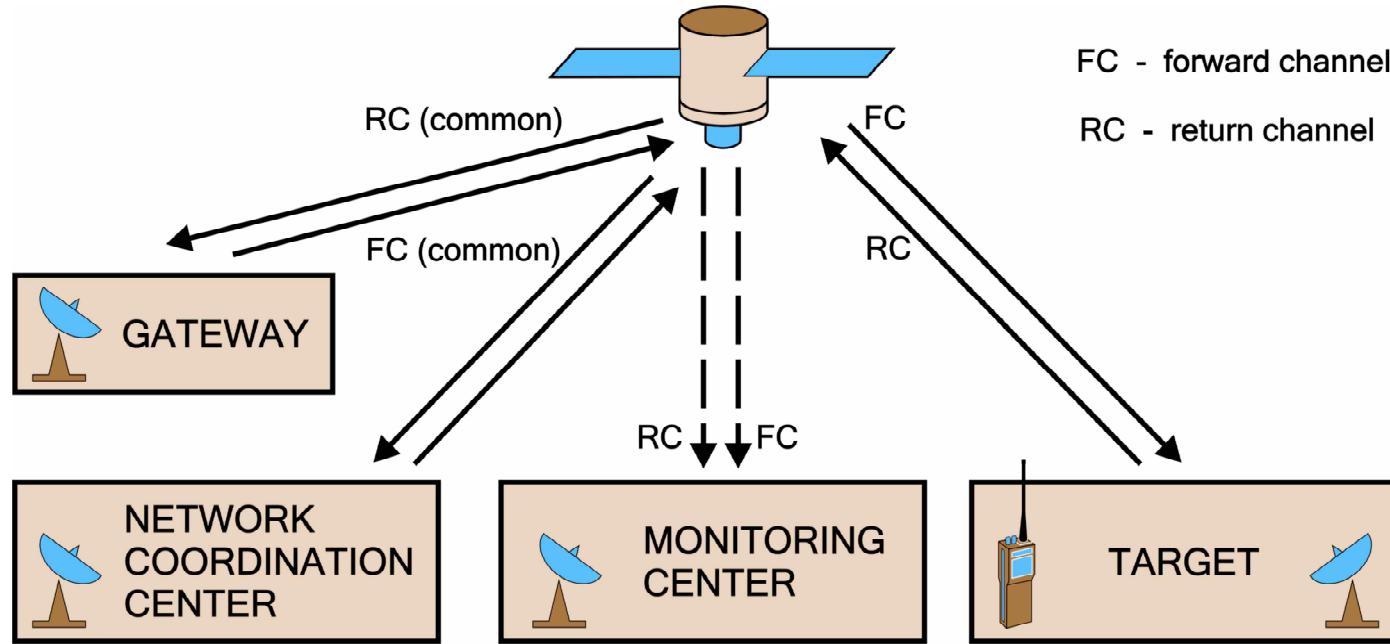
# OVERVIEW OF SATELLITE COMMUNICATION SYSTEMS

	INMARSAT FLEET 77	INMARSAT FLEET 55	INMARSAT FLEET 33/in Global Beam	INMARSAT FLEET 33/in Spot Beam	INMARSAT FLEET B-GAN "R-GBAN"	INMARSAT Mini-M	INMARSAT M - 4	Iridium+	Globalstar	ACeS	THURAYA	VSAT	MSV (formerly MSAT or AMSC)
<b>COVERAGE / ARCHITECTURE &amp; MARKET ACCESS</b>													
Global Coverage	YES	YES	YES	YES	NO	YES	YES	YES	Regional	Regional Only (ASIA)	ME/Europe/Africa/Centr.Asia/Indian	NO	North/Central America
Type of System	GEO	GEO	GEO	GEO	GEO	GEO	GEO	LEO	LEO	GEO/GSM	GEO	GEO	GEO
Satellite Constellation	9	9	9	9	1	9	9	66	48	1	1	10+	1(106.5°)
Network Gateway/Operators	Many	Many	Many	Many	1+	40	40	2	26	5	1	N/A	1
<b>SERVICES</b>													
Voice (Kbps)	(4.8 - 64)Kbps	TBD	4.8Kbps	4.8Kbps	NO	4.8Kbps	4.8Kbps	4.8Kbps	9.6Kbps	4.8Kbps	4.8Kbps	(4.8-16) Kbps	4.8Kbps
Fax/Data (Kbps)	G-III 2.4 Kbps/ G-4 64 Kbps	TBD	FAX NO/DATA 2.4Kbps	G-III FAX 9.6Kbps DATA 9.6 Kbps	NO	2.4Kbps	9.6Kbps	2.4 Kbps (07/2001)	9.6 Data	2.4Kbps	9.6Kbps	9.6Kbps	4.8Kbps
High Speed (Kbps)	56/64 Kbps	NO	NO	NO	NO	NO	64 Kbps	10 Kbps IP Solution	NO	NO	NO	(64-8000) Kbps	NO
Packet Data/MPDS	YES Up to 64Kbps	YES Up to 64Kbps	NO	YES Up to 64Kbps	YES Up to 144Kbps	NO	YES Up to 64Kbps	NO	9.6 Data	NO	NO	N/A	NO
Messaging	N/A	N/A	N/A	N/A	N/A	YES	YES	YES	120 Char	NO	YES	NO	Voice Mail
<b>SERVICES START DATE</b>													
Voice:	2002	TBD	2Qtr. 2003	2Qtr. 2003	N/A	1997	Oct. 1999	Apr. 2001	Apr. 2001	2000	May 2001	1985	1985
Data:	2002	TBD	2Qtr. 2003	2Qtr. 2003	Dec. 2002	1997	Oct. 1999	Jul. 2001	May 2001	2000	May 2001	1985	1985

# OSI MODEL OF SATELLITE SYSTEMS



# SATELLITE MONITORING SYSTEM

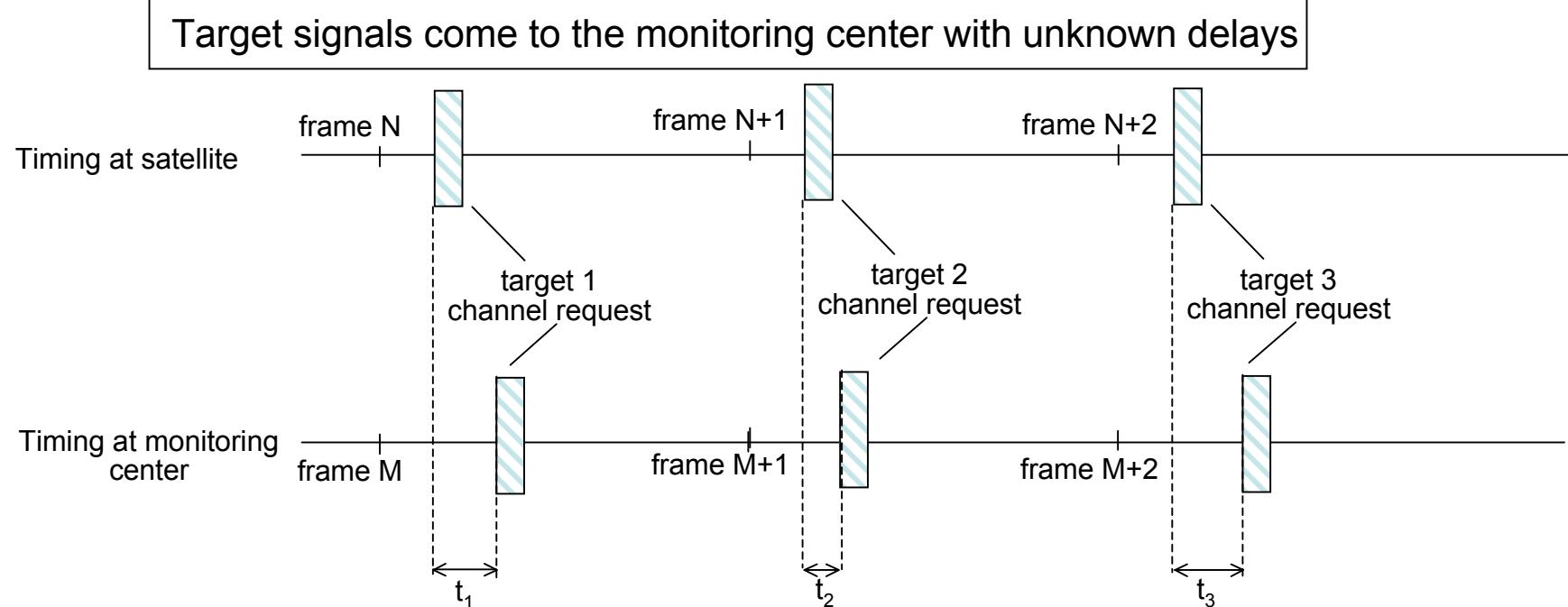


## MAIN CHALLENGES OF SATELLITE MONITORING

1. Absence of common synchronization source and system parameters
2. Possible absence of one satellite direction
3. Non-standard (not defined by interchange protocols) delay between channels when signals are recorded in different points
4. Presence of echo

## SYNCHRONIZATION PROBLEM

[The problem source:](#) All signals are synchronized at the satellite's aperture

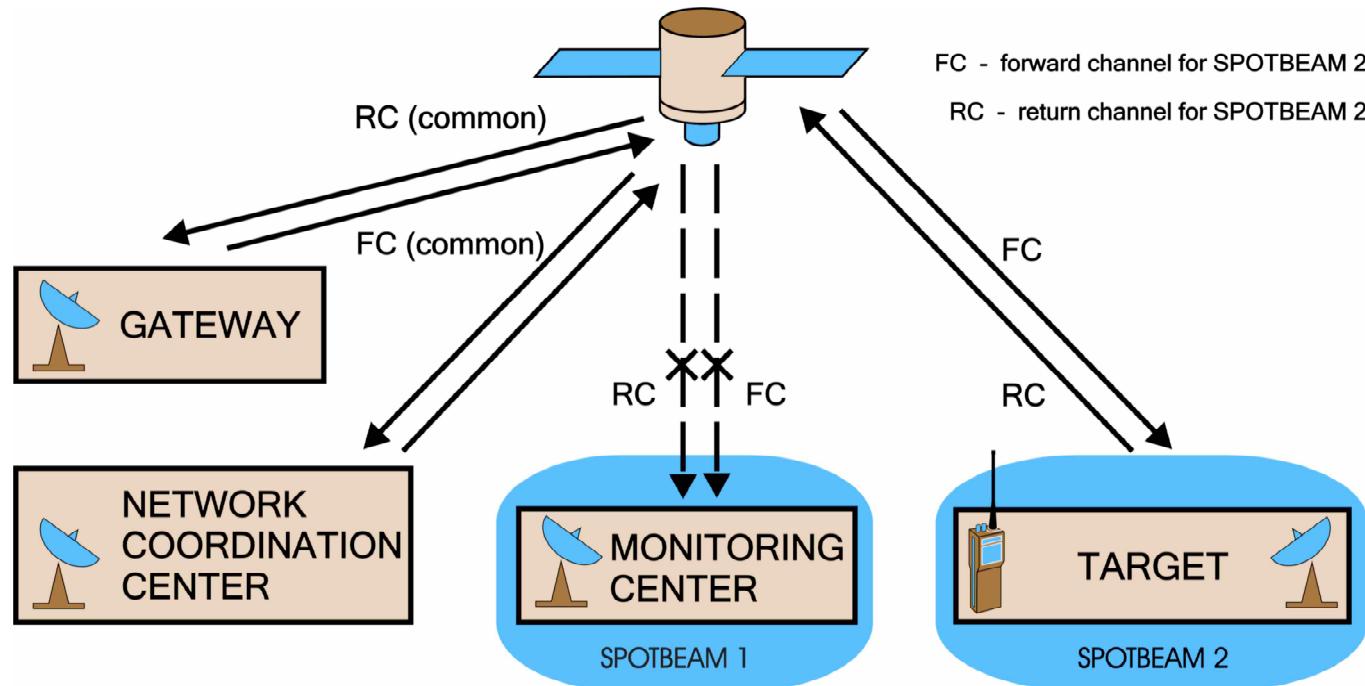


Maximum allowed distance divergence when synchronization in Thuraya network is provided: <127 km (GMR-1 04.008)

Proposed solution of synchronization does not depend on distance from target to monitoring center

**Distance divergence of more than 5000 km should be provided**

## FORWARD/RETURN CHANNEL ABSENCE PROBLEM IN SPOTBEAM SYSTEM



### The problem source 1:

Absence of forward channel

Absence of time/frame/message synchronization  
(FCCH, BCCH, AGCH in Thuraya network)  
(NCSS, NCSA in Inmarsat)

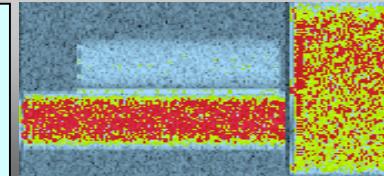
### The problem source 2:

Absence of return channel

Absence of channel request, positioning and  
ciphering messages  
(RACH, FACCH3 in Thuraya network)  
(MESRQ, SUB in Inmarsat)

## PROBLEM OF SIGNAL RESTORATION IN THE BACKGROUND WHEN SIDE ECHO IS ABSENT

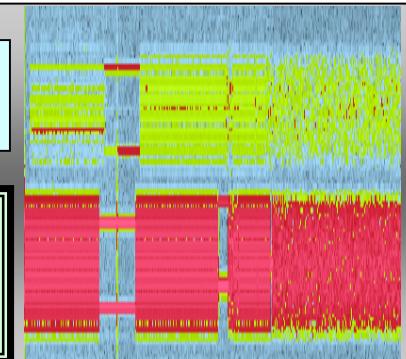
Echo signal is used to restore parameters for demodulation and decoding



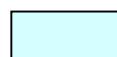
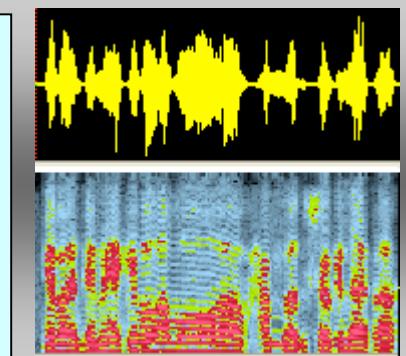
Unavailable parameters are restored by signal's intellectual analysis system

Restoration of absent transmission from echo signal (so that all information content is retrieved)

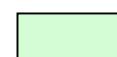
Application of special signal processing algorithms to restore echo signal in the background



Application of special speech processing algorithms allows (in some cases) the restoration of both sides by means of the echo signal



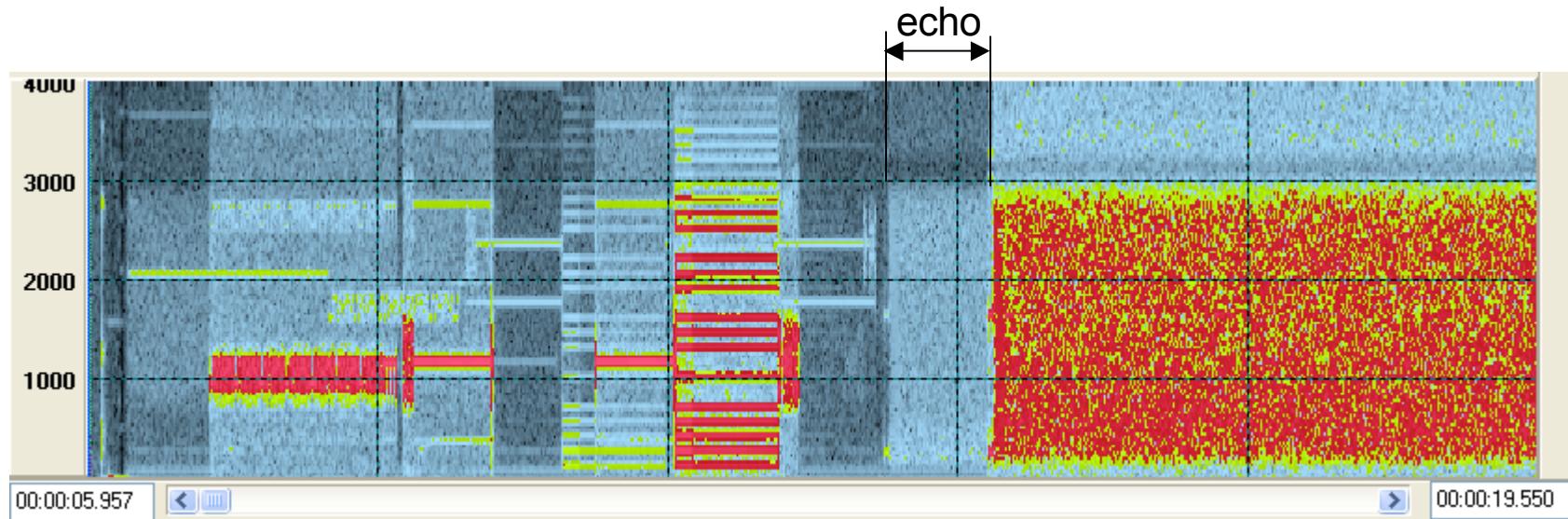
-Extract of information from echo



- Restoration of signal at echo background

# PROBLEM OF SIGNAL RESTORATION FROM ECHO SIGNAL

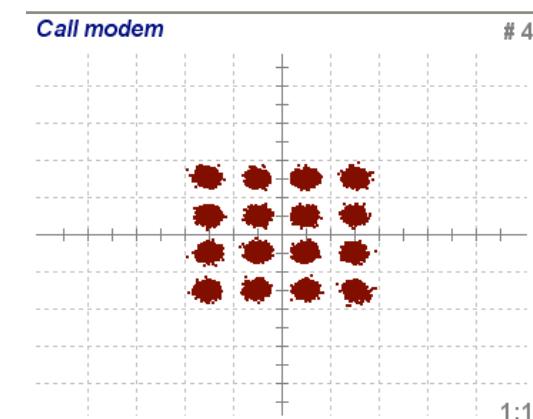
(modem session)



## Parameters restored by expert system

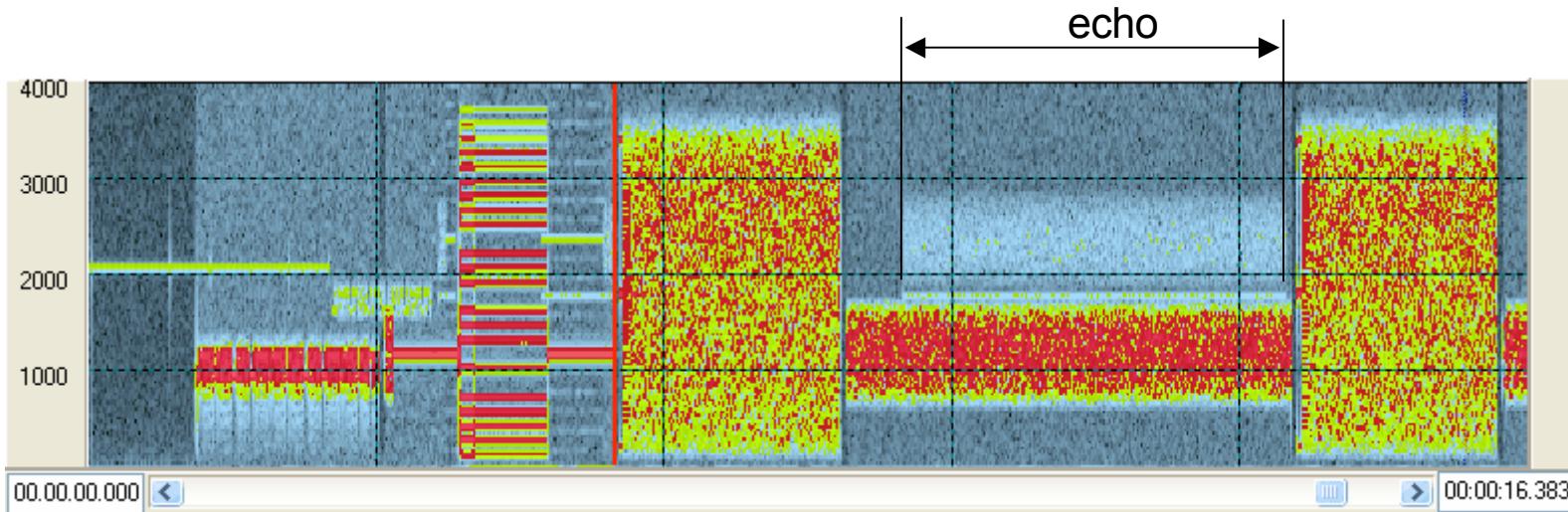
Protocol	V.34
Carrier frequency	1680.06 Hz
Symbol rate	2800.10 Hz
Number of trellis states	64
Non-linear coder parameter	0.3125
Type of constellation	'minimum'
Data rate	9600 bps
Pre-coder coefficients	[0 0 0]

## Restored signal constellation



# PROBLEM OF SIGNAL RESTORATION FROM ECHO SIGNAL

(fax session)



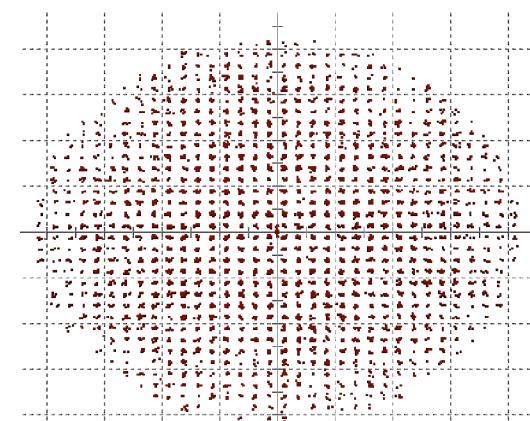
## Parameters restored by expert system

Protocol  
Carrier frequency  
Symbol rate  
Number of trellis states  
Non-linear coder parameter  
Type of constellation  
Data rate  
Pre-coder coefficients  
Mode of image coding

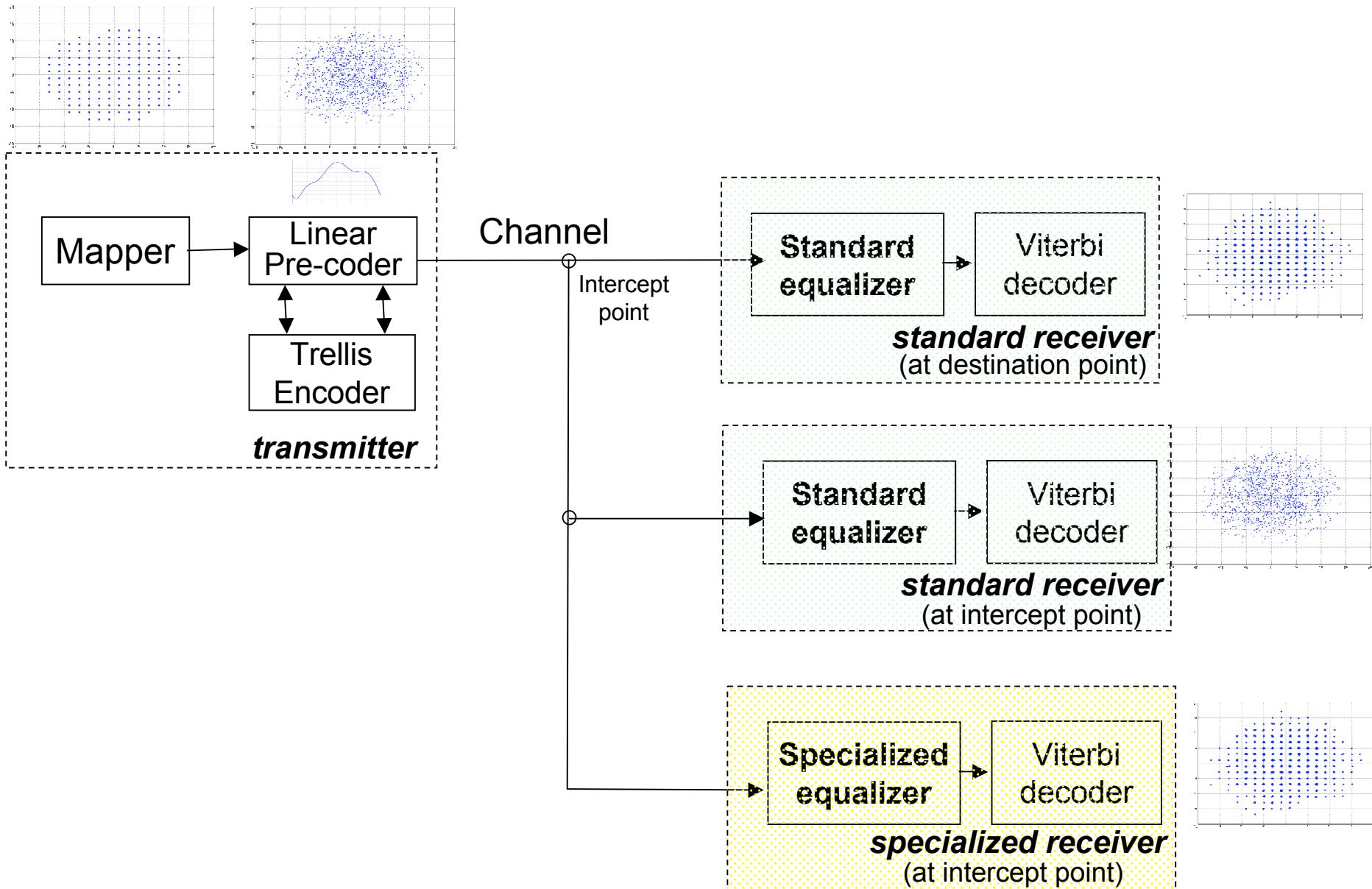
[2.4414e-4 6.1035e-5 6.1035e-5]  
JBIG

## Restored signal constellation

V.34 fax  
1828.52 Hz  
3200 Hz  
16  
0.3125  
'expanded'  
28800  
[2.4414e-4 6.1035e-5 6.1035e-5]  
JBIG



# PROBLEM OF PRE-CODED SIGNALS INTERCEPTION



## **Packet collection challenges at upper levels of OSI model**

1. Possible absence of one satellite direction – FC or RC
2. Impossibility to make a request for lost data
3. Violation of multimedia synchronization streams
4. Violation of synchronization commands when satellite directions are collected at different points
5. Possible absence of information of used protocols
6. Possible implementation of non-standard ports (SMTP, proxies for HTTP)
7. Problem of HTML page assembling. Absence of information on destination point for HTML page fragment.
8. Problem of HTML page fragment caching and tracking of cache changes
9. Problem of tracking HTML page fragments that have moved

# DELTA SPE Satellite Monitoring System provides solution of described challenges at all layers of OSI model

**Presentation layer**

Multimedia streams synchronization

Solution of HTML page assembling challenges

**Session layer**

Detection of non-standard ports implementation

Restoration of data in the absence of one side of the transmission

**Network Transport layer**

Packet requests tracking

Impossibility to request for lost data

**Datalink layer**

Determination of unknown protocol types

Fax constellation

Block 5

**Physical layer**

Provision of satellite channels synchronization independent from distance to target

Answer modem

DeFax