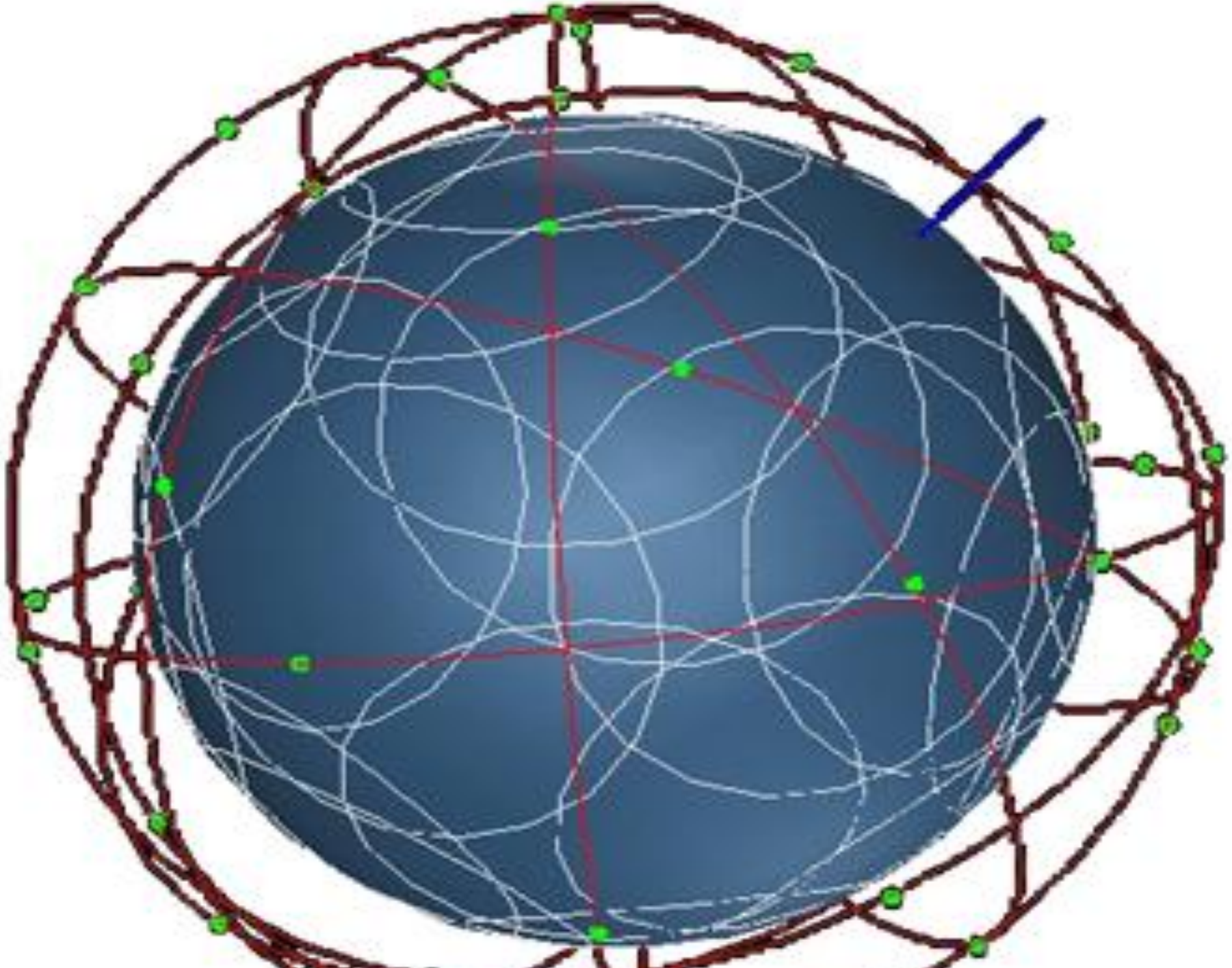


Vsat Maintenance Audit

- Maintenance actions schedule
- Troubleshooting and debugging
  - Hardware swap
  - Local configurations
- Incident reporting
- ETA and ETTR control
- Spare management
- Escalation proccedures
- Periodic maintenance action control
- SLA and SLM concepts

Maintenance actions schedule

- Being one action with purpose to extend the equipments useful life , shall be strategically defined as possible to be done internally, externally (also known by outsourcing) or in hybrid way, perhaps the best one because balance the in-house knowledges and competences with the external skills, avoiding time consumming tasks.
- Can be assumed the following alternatives:
  - Preventive
  - Corrective
  - Controlled

Objectives

S – Simples and (specific)

M – Measurables

A – Reachable

R – Realistics and (responsable)

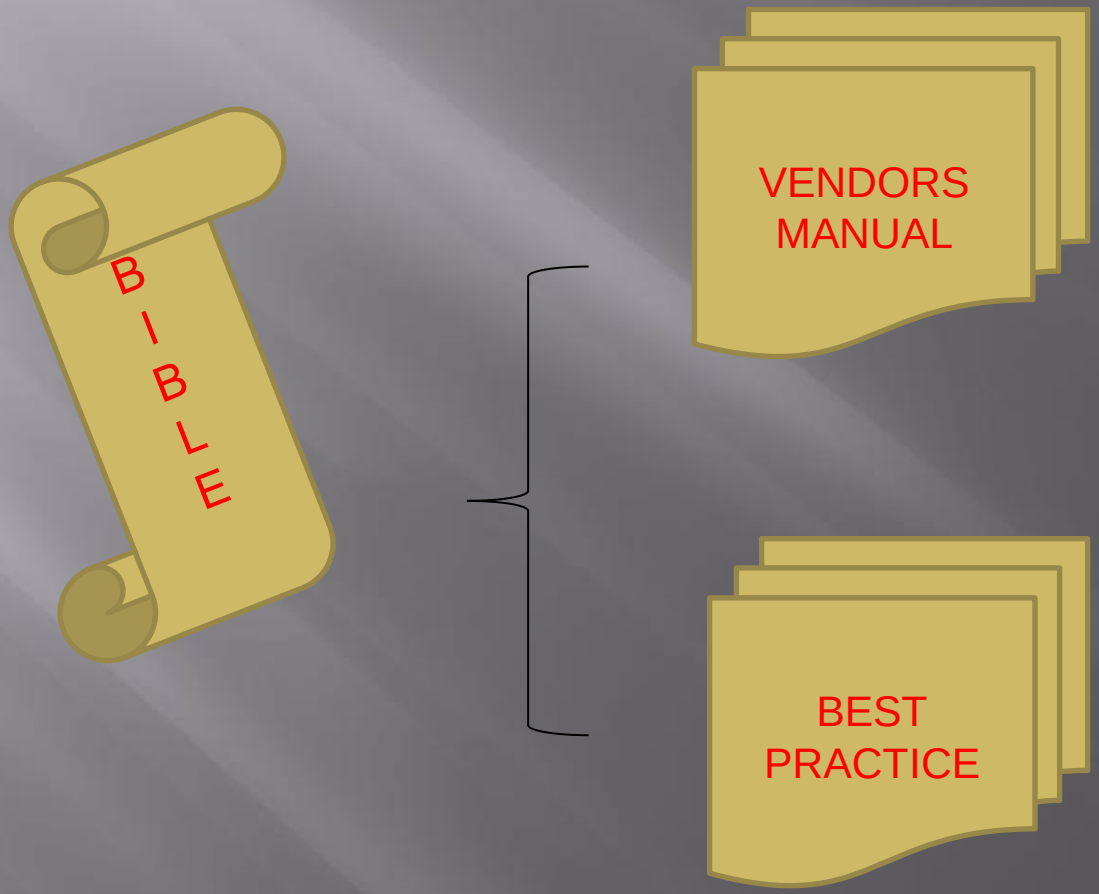
T - Tangible

Maintenance

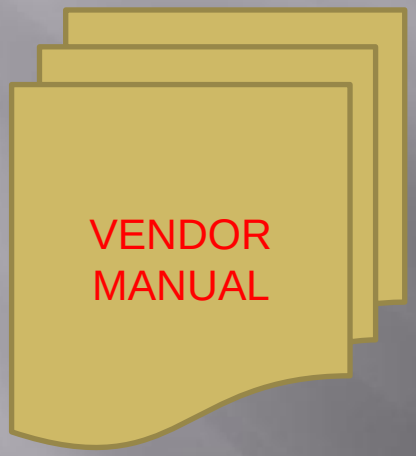
Macro Organization ex.

Sistem	Equipament	Model	Manutenance period
Antenna	ACU	Electrospace 93C23F	Monthly
	Beacon Receiver	Electrospace	Monthly
Transmission	*Modulador (9)*	*Radyne DMD 4500 e 4000*	Weekly
	Modulador (8)	*EFDATA SDM 8000*	Weekly
	U/C (4)	ETS 6000	Weekly
	U/C (2)	ETS 6207	Weekly
	TWT (3)	CPI VARIAN VJW2740	Monthly
	KPA (3)	VARIAN KPA 2725G	Monthly
	Switch Modulador	*EFDATA SMS – 658 A*	semiannual
	Switch Modulador (2)	*RADYNE RCU780*	semiannual
	Switch U/C	ETS 6000	semiannual
	Switch Branching	MITEC M254	semiannual
	Switch HPAs	CPI VARIAN	Monthly
Reception	LNA (3)	MAXTECH	Weekly
	D/C (4)	ETS 4000	Weekly
	Desmodulador (9)	*Radyne DMD 4500 e 4000*	Weekly
	Desmodulador (4)	*EF-Data SDM 8000*	Weekly

Troubleshooting 1



Troubleshooting 2



HW *swap* – O*n site* equipments exchange

SW *reset / up*date – Release update

Recommended *spare* list

- Power supply
- Fan
- RF, connectors & cables
- LAN connectors & cables
- Up / Down converter
- SSPA
- ….

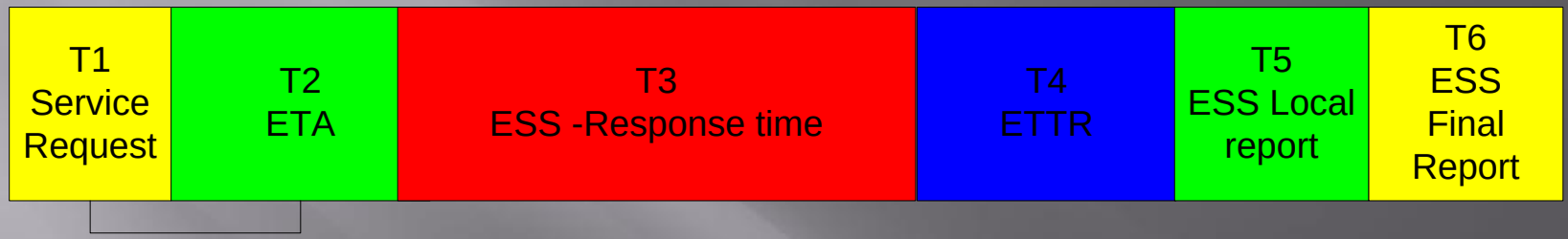
(Re)Configuration

- Pre-configuration
- Local configuration
- Remote configuration

Incident reporting

- Agreed schedule (montly, quarterly..)
- Date of creation and closure (open and close ticket)
- Severity associated to incident type
- TTR – *target time to repair,* forecast
- MTTR – *mean time to repair,* forecast
- Repair description
- SLA agreed has been accomplished?
- Failure description and causes, and - if applicable – exceeding SLA time justification

ETA / ETTR control



ESS – Global response time

ESS – Repair time

Spare Management

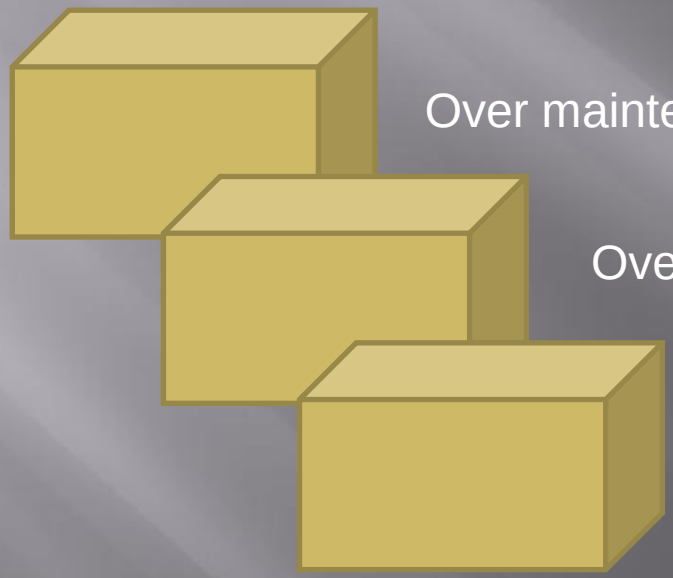
How define the *spare kit* to built ?

- In the absence of better information must be followed the proposal of the supplier of equipment or system
- There may be adjustments - reinforcements - in view of the, contracted SLA with the customers,(if there is a high % of interventions whatever **on-site** or **carry in** to the office) if the **MTBF is high** or if the **equipments contractor so requires**, (turn-around time of devices to be sent to service providers or vendors)
- Or costs associated with the clearance of the equipment is very high

Escalation

Level	Hierarchy	Name	Telephone	email
24x 7	NOC technician		+ 351 123456789	noc@service.com
N1 - 4h	Supervisory Manager	Bettencourt	+ 351 987654321	bettencourt@service.com
N2 - 8h	Earth Station Manager	David	+ 351 434556783	david@service.com
N3 - 12h	Network Operations Manager	Francisco	+351 345676544	francisco@service.com
N4 - 24h	Director	Clark	+351 234778999	clark@service.com

Periodic Maintenance Control



Over maintenance technical reports

Over SLA reports

Over SLM reports

SLA – Service Level Agreement

Guaranteed quality of service, parameters :

- Supplier side
  - KPI definition - limits, tolerances
  - Algorithm credit for failure
  - SLA parameters definition and measurement methods
  - Reports of occurences (type, availability, periodicity)
  - General conditions for the SLA applicability
- Clients side
  - Site downtime.
  - Compliance with technical / environmental site, requirements
  - Establishment of the scheduled time operation, site-by-site
  - Acceptance of maintenance windows
  - Bonus value for exceeding (better) KPI performance
  - Mode of action in certain anomalies

SLM – Service Level Management

Guaranteed quality of service, parameters by services supplier, namely:

- Interventions inside and outside the contract (SLA ok or nok)
- Justification of defaults
- Proposed improvements (ETA, ETTR, Spare, Processes….)

ITSO

FIRST RESPONDER'S GUIDE TO SATELLITE COMMUNICATIONS

SIA
SATELLITE INDUSTRY ASSOCIATION

Satellite Industry Association
1730 M. Street, NW Suite 600
Washington, DC 20036

t. 202.349.3650
www.sia.org

PROVIDERS

SATELLITES = UBIQUITY + RELIABILITY + OPERABILITY

SATELLITE SOLUTIONS PROVIDERS

inmarsat

Point of Contact: north_america@inmarsat.com
Telephone Number: (703) 647-4760
Website: www.inmarsat.com
Solutions: Mobile Satellite Services (MSS); Broadband Global Area Network (BGAN)

iridium

Point of Contact: John Schroeder
Telephone Number: (301) 571-6265
Website: www.iridium.com
Solutions: Mobile voice, data and tracking capabilities on an immediate basis.

HUGHES

Point of Contact: Amir Dehdashty
Telephone Number: (301) 601-2674
Website: www.hughes.com
Solutions: Broadband satellite networks, backup services, continuity of operations and other managed network services.

SES NEW SKIES

An SES GLOBAL Company

Point of Contact: Robert W. Turner
Telephone Number: (202) 478-7121
Website: www.ses-newskies.com
Solutions: Fixed Satellite Services to include voice, data, video and Internet connectivity.

eutelsat

communications via satellite

Point of Contact
info@eutelsatinc.com
Telephone Number: (202) 756-1460
Website: www.eutelsatinc.com
Solutions: Fixed satellite video applications, broadband IP connectivity, mobile data and telephony communications.

Intelsat

General Corporation

Point of Contact: Britt Lewis
Telephone Number: (301) 571-1210
Website: www.intelsatgeneral.com
Solutions: Ground infrastructure, mobile and fixed satellite systems, technical expertise, and secure communications network solutions.

Xtar

Point of Contact: Larry Haughey
Telephone Number: (301) 590-7402
Website: www.xtarllc.com
Solutions: Fixed and COTM X-band communications services.

MSV

Mobile Satellite Ventures

Point of Contact: info@msvlp.com
Telephone Number: (800)-216-6728
Website: www.msvlp.com
Solutions: Interoperable two-way radio, telephone, and mobile data solutions.

Globalstar

GO FURTHER. DO MORE.

Point of Contact: Len Corasaniti
Telephone Number: (301) 361-0091
Website: www.globalstarusa.com/en/
Solutions: High quality, cost effective satellite voice and data communications to over 120 countries

AMERICOM

GOVERNMENT SERVICES

Point of Contact: info.americom@americom-gs.com
Telephone Number: 703-610-0988
Website: www.americom-gs.com
Solutions: FSS fixed, deployable, and mobile Internet, voice and data broadband connectivity.

TerreStar

NETWORKS

Point of Contact: Jim Frolk
Telephone Number: (571) 921-4619
Website: www.terrestar.com
Solutions: Next generation mobile communications that seamlessly integrates cellular and satellite networks through customized IP-based applications.

STRATOS

Point of Contact: Jennifer Brooks
Telephone Number: (301) 968-1972
Website: www.stratosglobal.com
Solutions: Multiple VSAT/MSS solutions for emergency and contingency communications.

MARSHALL COMMUNICATIONS

Point of Contact: Sonny Marshall
Telephone Number: (571) 223-2010
Website: www.marshallcomm.com
Solutions: Secure content delivery, mobile VSAT, and custom turnkey communications so

For more information and an electronic vers
of the guide, please visit **www.sia.org** and click o
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ITU

End morning 5th day

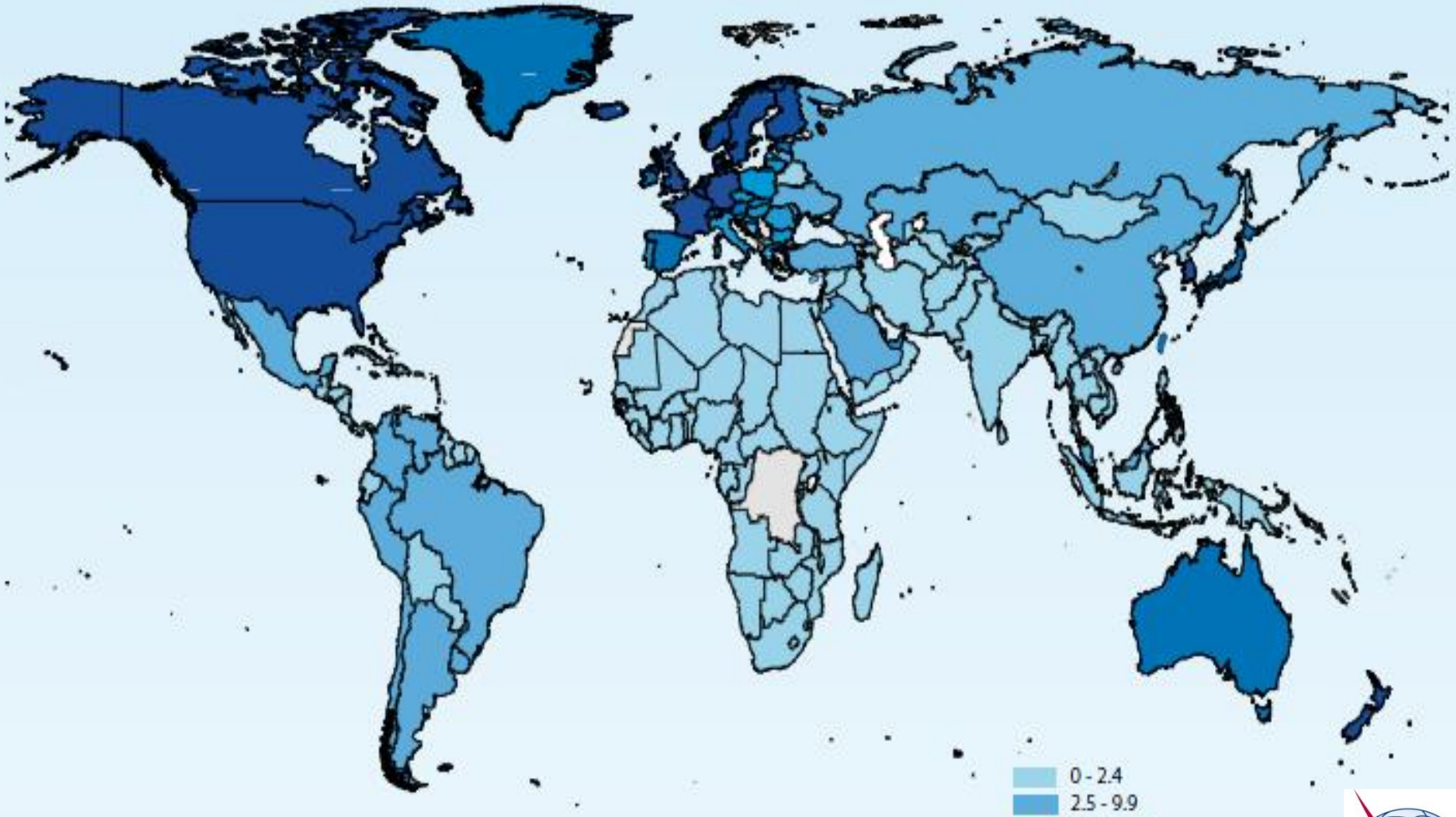
Almost there……

Regulatory Factors

- Licensing
- Frequency registration
- Orbital slot registration and ownership
- Intersystem coordination
- Earth Station and Vsat registration (best practices)
- Wimax
- Other terrestrial interference issues

The global broadband divide

Fixed broadband subscribers per 100 inhabitants, 2008



Denominations and classifications employed in these maps do not imply any opinion on the part of the ITU concerning the legal or other status of any territory or any endorsement or acceptance of any boundary.

Licensing

"We have now reached the stage when virtually anything we want to do is possible.
The constraints are no longer technical, but economic, legal or political"

Arthur C. Clarke

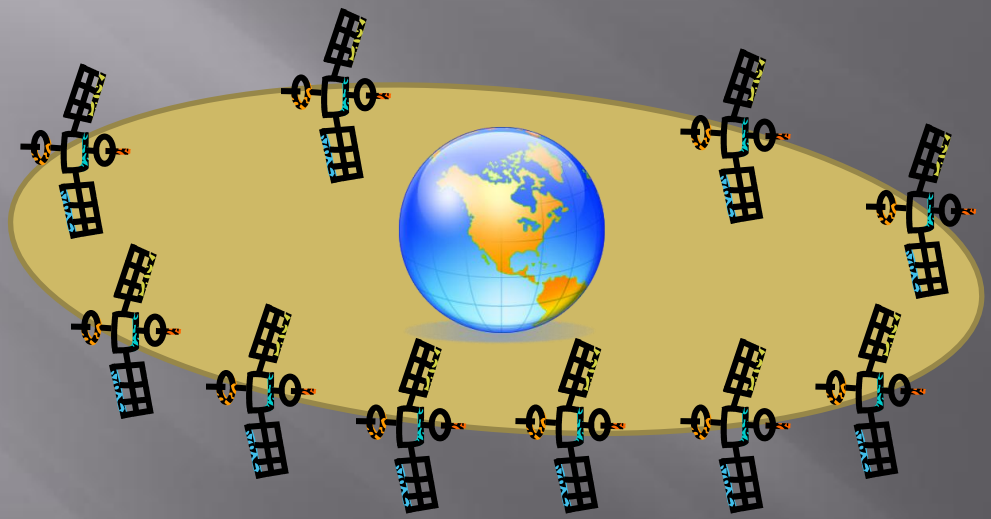
Why licensing

- Safeguarding the sharing of a common good, radio frequency spectrum for public and private entities.
  - Band defined by ITU-R, CEPT, IEEE, FCC
  - There are radio frequency bands shared between the satellite fixed services, terrestrial fixed services and more recently mobile. Should be protected the co-channel, cross-polar, adjacent channel interferences
- Imposes the standards of national regulatory agencies
- Determines the environmental, health (issues) and security objectives to people, safeguarded, bearing in mind the maximum PFD - *Power Flux-Density.*
- Prevents the cost balanced concern sale of the service

Frequency registration

- Following the licensing process and as a Network Operator or as a final user, should follow the provisions laid down by regulatory authorities, national or and international (within their jurisdictions of competence), taking into account:
  - Do not interfere with 3ºs service
  - Not to be interfered by 3ºs service
  - Safeguard increases in capacity

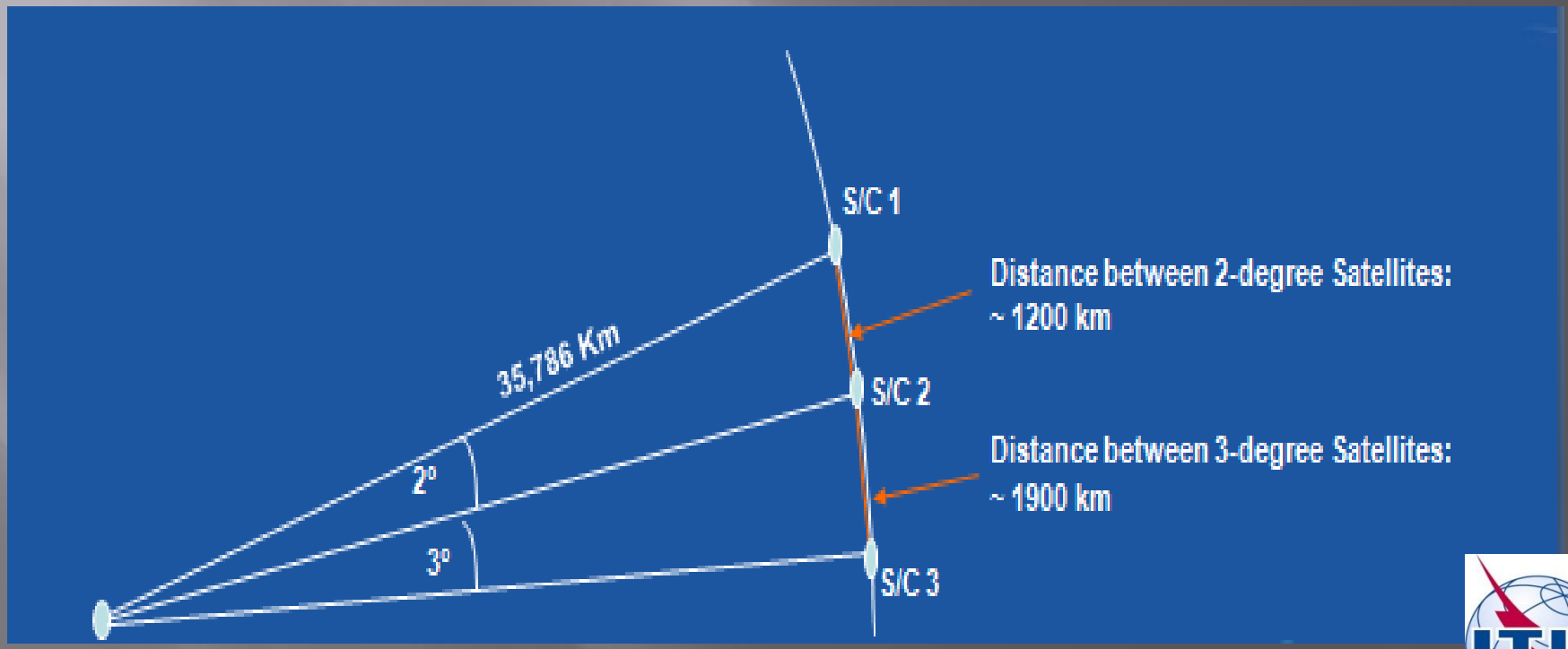
Orbit arc



The ITU regulates the portion of the arc geostationary orbits. This has 360º that is being imposed a separation between satellites 2º for no Interference, remainning therefore 180 parts to be occupied.
Each one can have two or more satellites simultaneously desired working at different frequencies

Orbit arcs

Prevents pointing errors
Avoids interference between satellites working in the same freq.



Monopoly end

Things always change, but never change ... ...

“Of all the objectives and interests of humanity none is as great as the desire of the competition”

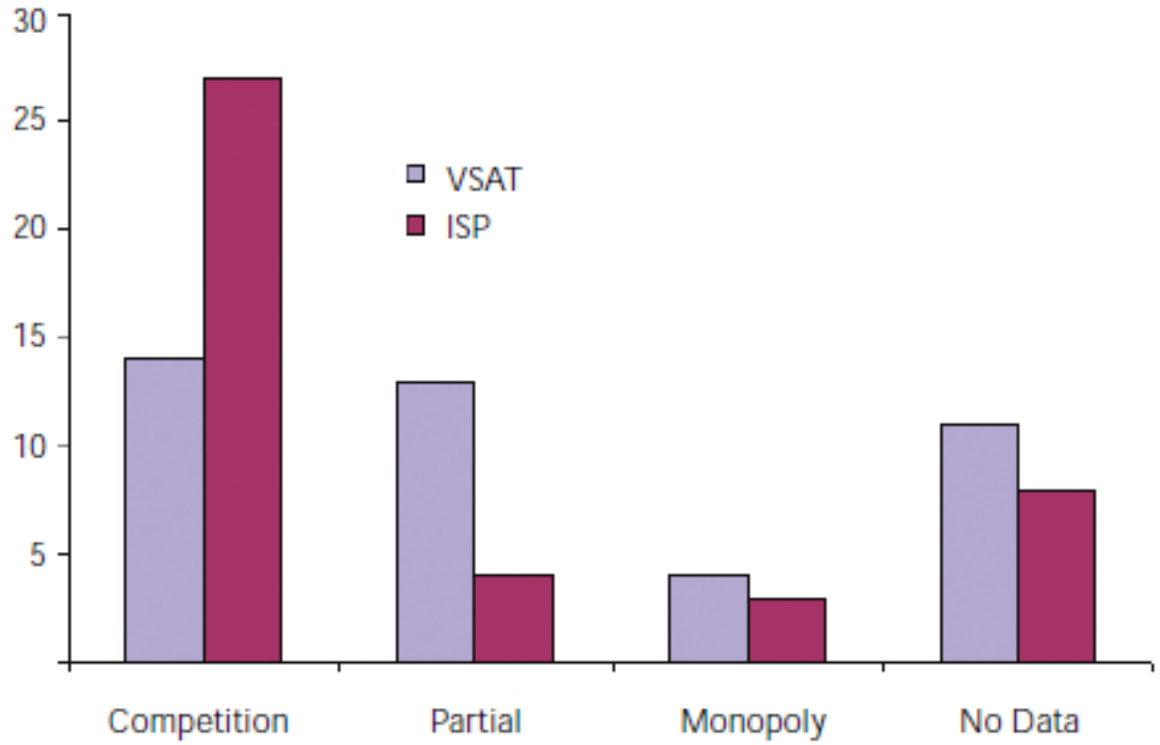
By the time when telecommunications were onthe state hands, things were easy for regulators.
Essentially it was the mega-tax income and imposed universal service it is therefore to recognize the pioneers of deregulation that liberalized their industries and introduced in their markets COMPETITION

Deregulation1

- Consequence of the breakup of ATT in 1984 that introduced and the monopoly;
- Need for openness to competition in the U.S. market long distance communications;
- As a natural consequence of free market open to competition, enabling new business challenges to traditional telephone operators (PTT);
- Originally unleashed in the U.S., the UK and Japan now and then to Europe, where traditional operators maintained reservations and opposition;
- From 1989 to pressure the markets in order to move towards a global market, has gradually forced to change the "changing telecommunications environment" being the current rule liberalization and privatization in the telecommunications markets

Deregulation 2

Chart 7: ISP & VSAT Liberalisation in Africa. Source: ITU 2002.



Deregulation 3

VSAT liberalisation allows some groups other than incumbent telco's to establish satellite services, but with persistent restrictions. This map shows where VSAT services are under monopoly, duopoly, or have been either partially or fully liberalised. Partially and fully liberalised does not reflect the expansion of an integrated national network as incumbents are not yet obliged to interconnect with new licensees.

"The licensing process is one of the most important regulatory factors that contribute to developing the telecommunications" (ITU 2004).

Administrations generally govern the procedure for access to an SO by Other terrestrial operator forgetting to match the right signal distribution enjoyed by the Satellite Operator.

Licensing usually involves:

Space Segment

- Distribution Rights signal (open sky)
- Spectrum management and licensing

Earth Segment

- Licensing Providers
- Service and Network Operators
- Licensing coverage (blanket)
- And general authorizations

Orbital window 1

The space is now given as an infinite resource. However, the "arc" of the area in which satellites operate - called Clark orbit - is itself a finite resource, with a number of orbital positions geostationary limited, making it as each increasingly essential to have a regulatory framework for the management segments of the orbital

Orbital window 2

Created in 1959 at the UN COPUOS - Committee on the Peaceful Uses of Outer Space (64 members present), have developed diverse international regulations on the space exploitation, namely, treaty

- Interstellar space
- Junk in space
- Promotion of international cooperation
- Nuclear power sources
- Communications, namely these:
  - Agreement on the INTELSAT (August 1971)
  - Convention liability for damage caused by space bodies (1972)
  - Convention Registration bodies thrown into space (1975)
  - Convention on the INMARSAT (1979)

Orbital window 3

With the increasing number of countries interested in launching their own satellites has become necessary to discipline its occupation and it was constituted the ITU-International Telecommunications Union (May 17, 1865), currently with over 189 member states and more than 500 organizations public and private, and targeted at:

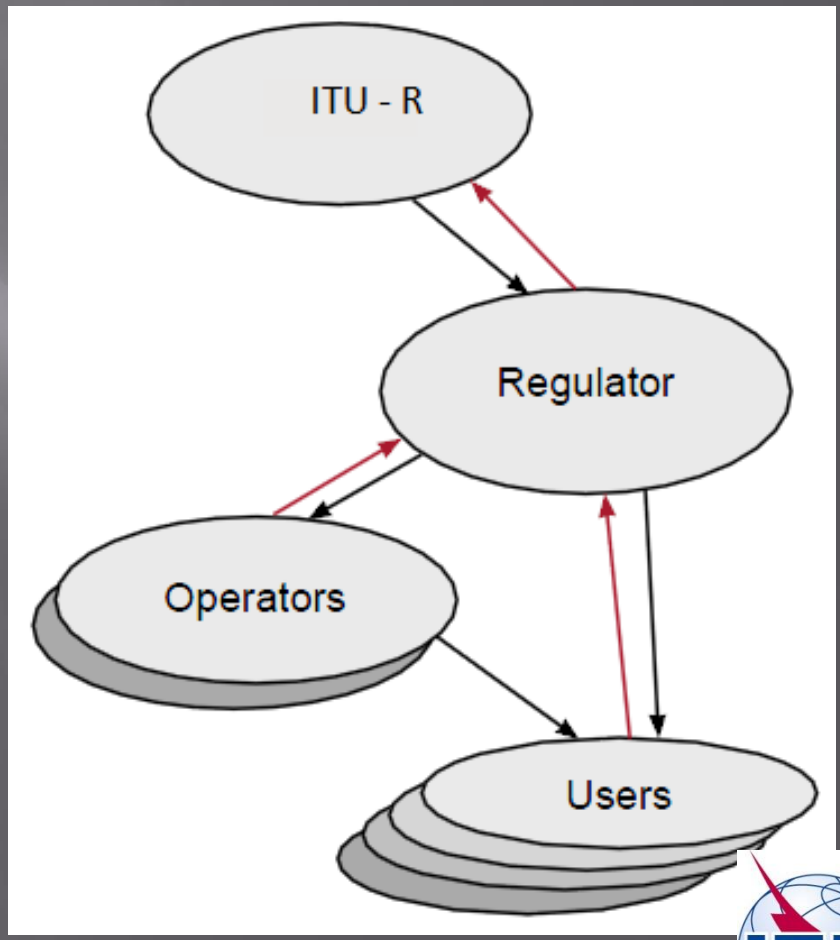
- ITU-T (former CCITT regulates telecommunications)
- ITU-R (former CCIR, regulate radiocommunications and allocate frequencies)
- ITU-D (assistance in developing countries technically)

Inter-systems coordination 1 (Satellite)

ITU - R coordinatse the international spectrum use, thus preventing the SO have interference problems in their systems.

Once implemented the policy of "open skies" for a country, so there will be no more additional licensing requirements for the SO, which is indeed strongly supported by the industry whose lack of definition sees as inefficiency.

Thus destructive interference is minimized and simultaneously optimizes the use of the orbital arc.



Inter-systems coordination 2 (Satellite)

Historically, the spectrum was distributed among the "incumbent" the military and public service providers (police, civil protection services or emergency services)

Once countries have been able to access foreign satellites (through policies of open sky) the licensing of spectrum has become an imperative in order to minimize interference and thereby better serve the public interest.

Today, under the coordination of ITU, there are bands allocated to services FSS, BSS and MSS, and also spepctral sub-segment assigned to different operators. Thus it is unnecessary to issue licenses to duplicate an international operator, or even separate license requirement, as there is no infrastructure installed or operated in the country

…./….

Inter-systems coordination 3 (Satellite)

…./…

Once bands being defined, the responsibility will pass to the regulators in each country to issue licenses for spectrum in accordance with the internal philosophy to it.

It is the responsibility of regulators, the allocation, but only to observe transparency and non discrimination of competitors.

It is important however that there is no discrimination against satellite operators, which can restrict the supply of market competition and free terminations (bidirectional and unidirectional). National policies that impact with spectrum licensing practices in other Countries, will only serve to discourage the desired policy of "open skies" and thus contribute to the access conditioning to the free market.

Inter-systems coordination 4 (Satellite)

Are listed below some regulation ITU-R related to VSAT and it believes should serve as *guidelines* for guidance of Countries (or operators) in planning for obtaining licenses:

Rec S725 - Technical specifications for VSAT.
Description VSAT network including the possibility of connection
to the PSTN

Rec S726 - Maximum level of spurious emissions for VSAT.
Description of requirements for protection the terrestrial and satellite link interference in licensing, expressed on spurious emissions limits

Rec S729 - Control and monitoring of VSAT
Suggests using a NCC-control center network, which can Inhibit the emission of the station is recorded whenever any change parameters without reason or fault finding.

Inter-systems coordination 5 (Satellite)

Rec S728 - Maximum level off-axis EIRP allowed for VSAT
Description of values in co-pol and cross-pol antenna Ku

ANGLE OFF-AXIS	MAXIMUM E.I.R.P. DENSITY PER 40 KHz
$2.5^\circ \leq \varphi \leq 7^\circ$	33-25 log φ (dBW/40 KHz)
$7^\circ < \varphi \leq 9.2^\circ$	12 (dBW/40 KHz)
$9.2^\circ < \varphi \leq 48^\circ$	36-25 log φ (dBW/40 KHz)
$> 48^\circ$	-6 (dBW/40 KHz)

ANGLE OFF-AXIS	MAXIMUM E.I.R.P. DENSITY PER 40 KHz
$2.5^\circ \leq \varphi \leq 7^\circ$	23-25 log φ (dBW/40 KHz)
$7^\circ < \varphi \leq 9.2^\circ$	2 (dBW/40 KHz)

E / S and VSAT registration 1

The process of station registration, is specific to each Satellite operator - Intelsat, Eutelsat, Hispasat, etc. – however containing common steps and that include:

1. Request for authorization to station registration
2. Delivery of the characteristics of the equipment to register
3. Obtaining the test plan to verify
4. Performing the tests (if applicable) in accordance with the plan and a monitoring station under the control
5. Verification of "compliance" test
6. Authorization granting to use the station to regist it and send the transmission plan suitable for the application user

E / S and VSAT registration 2 Intelsat case)

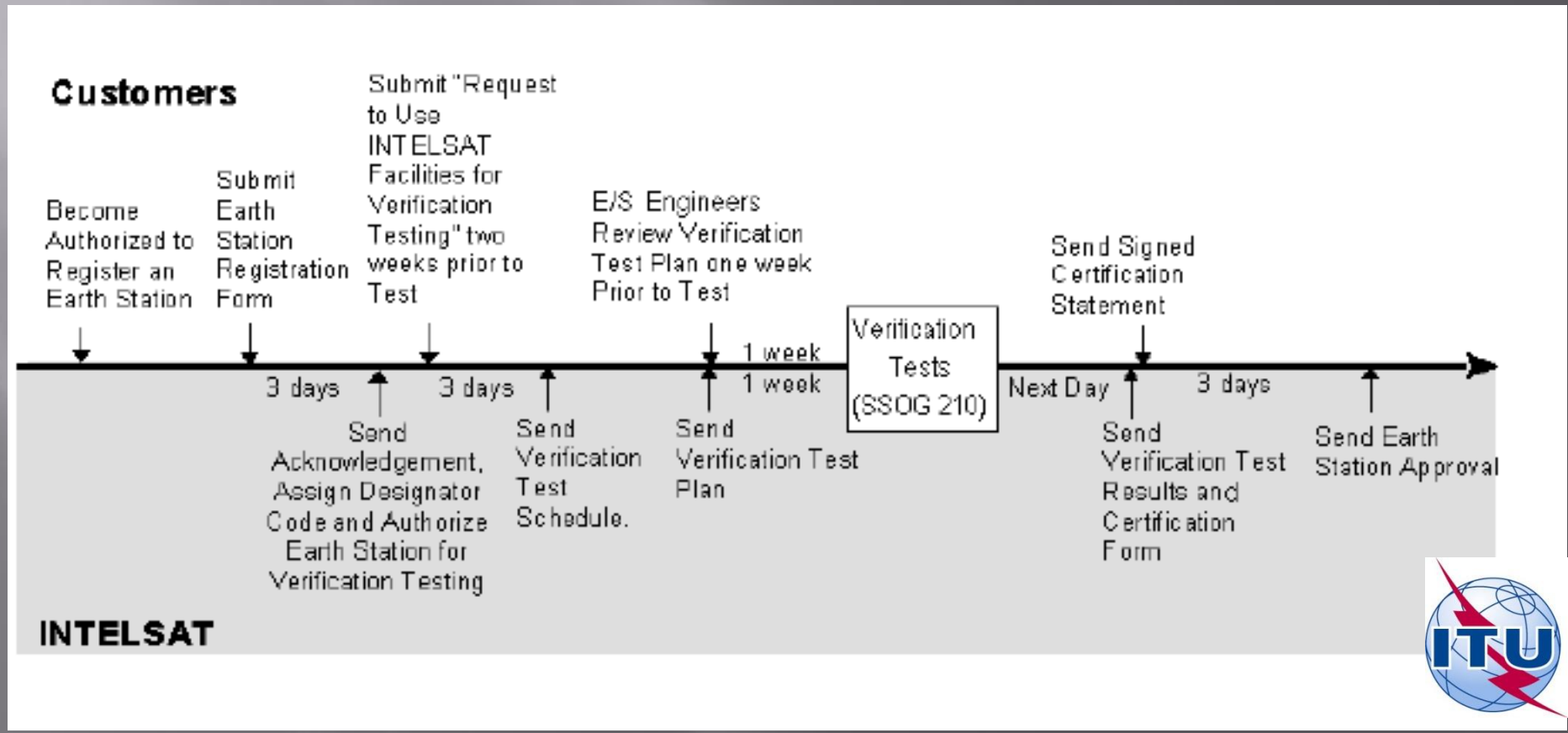
The approval to start service on the Intelsat system, requires the evaluation of the performance characteristics of the station, as mentioned previously, which necessarily involves verification tests that comply with the Standard Organization namely the IESS - Intelsat Earth Station Standard, through the SSOG-Satellite System Operation Guide. We address below the steps for licensing new stations::

STEP	DESCRIPTION
1	Obtain INTELSAT documentation
2	Notify INTELSAT of intention to construct a new Earth station.
3	Coordinate the RF bands.
4	Estimate traffic.
5	Submit Earth station application.
6	Verify the Earth station performance.
7	Certify Earth station performance.
8	Obtain approval to operate.
9	Submit a transmission plan (as applicable).
10	Perform SSOG line-up.
11	Commence operation.

..

E / S and VSAT registration 3 Intelsat case)

And the approval and registration



Verification tests

According SSOG 210, must be done the following tests

Presentation request for verification tests

Presentation of the actual situation due to the antenna verification testing of DILI, Timor Lorosae and the response of Intelsat

WiMax

The WiMax Forum was founded in 2001 by industrial clusters to promote conformity and interoperability of IEEE 802.16 Standard-2001 as BWA-Broadband Wireless Access.

Actually constituted as a Forum has> 200 members

Lead the process of harmonization of BWA and entitled as an authority

Promotes cooperation between SP's, PO's, system integrators, regulators etc.

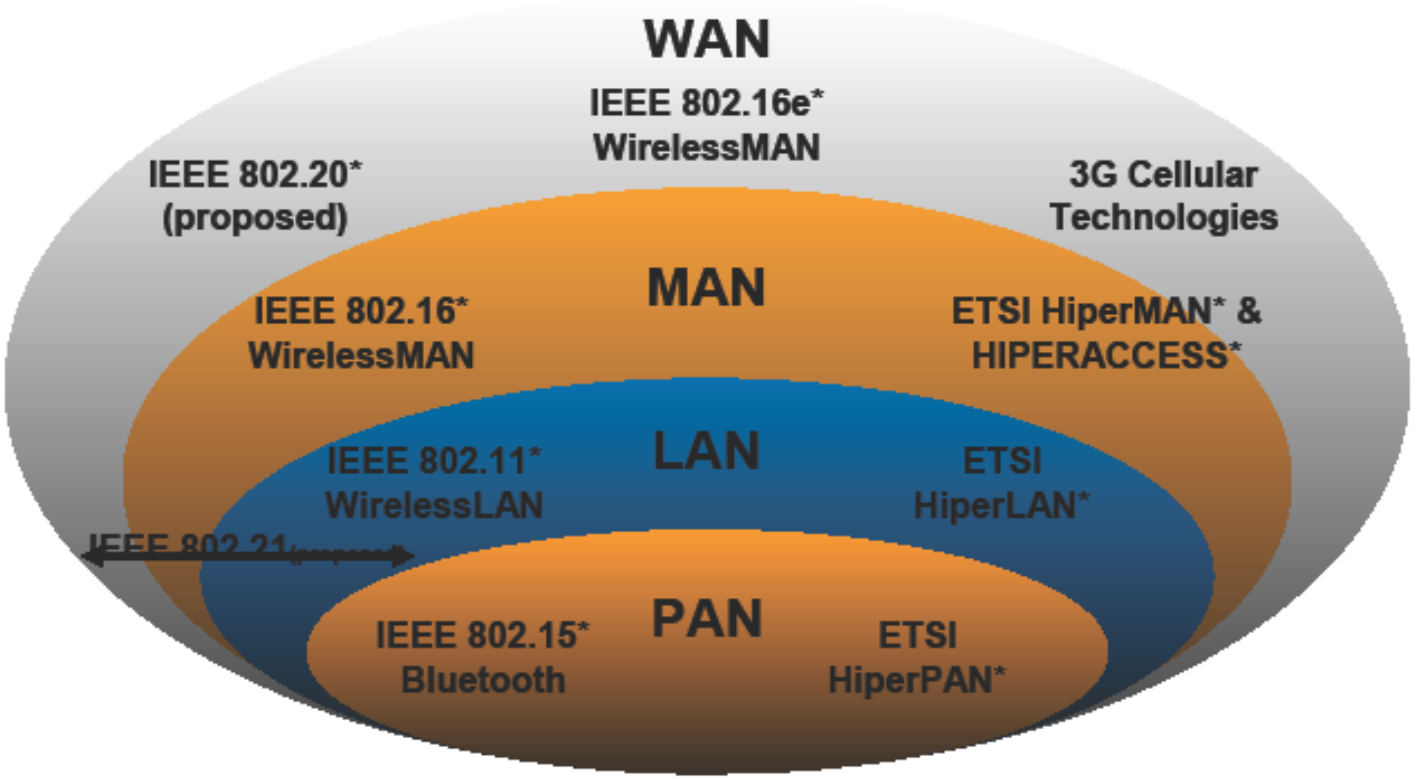
Promotes acceptance procedures WiMax products in all SP's

Develops procedures for compatibility and interoperability BWA products

Waht is WiMax

- The return on investments in the WiFi spot, given the coverage has not been exciting, so a development of standards that will ensure greater distances to cover, more or less the equivalent of wireless MAN, i.e WMAN. That Standard, 802.16 has already been considered by Intel as "the most important thing after the Internet“.
- The initial version worked in the range 10-66 GHz required line of sight (LOS) towers, but the 802.16a version, uses the frequency 2-11GHz, easing regulatory issues and therefore need not LOS. Has a range of about 50km versus 200 - 500m of WiFi, and 70 Mbps data rate.
- The 802.16e version uses abax frequency of 6GHz

Wireless Global Standards (Wimax)



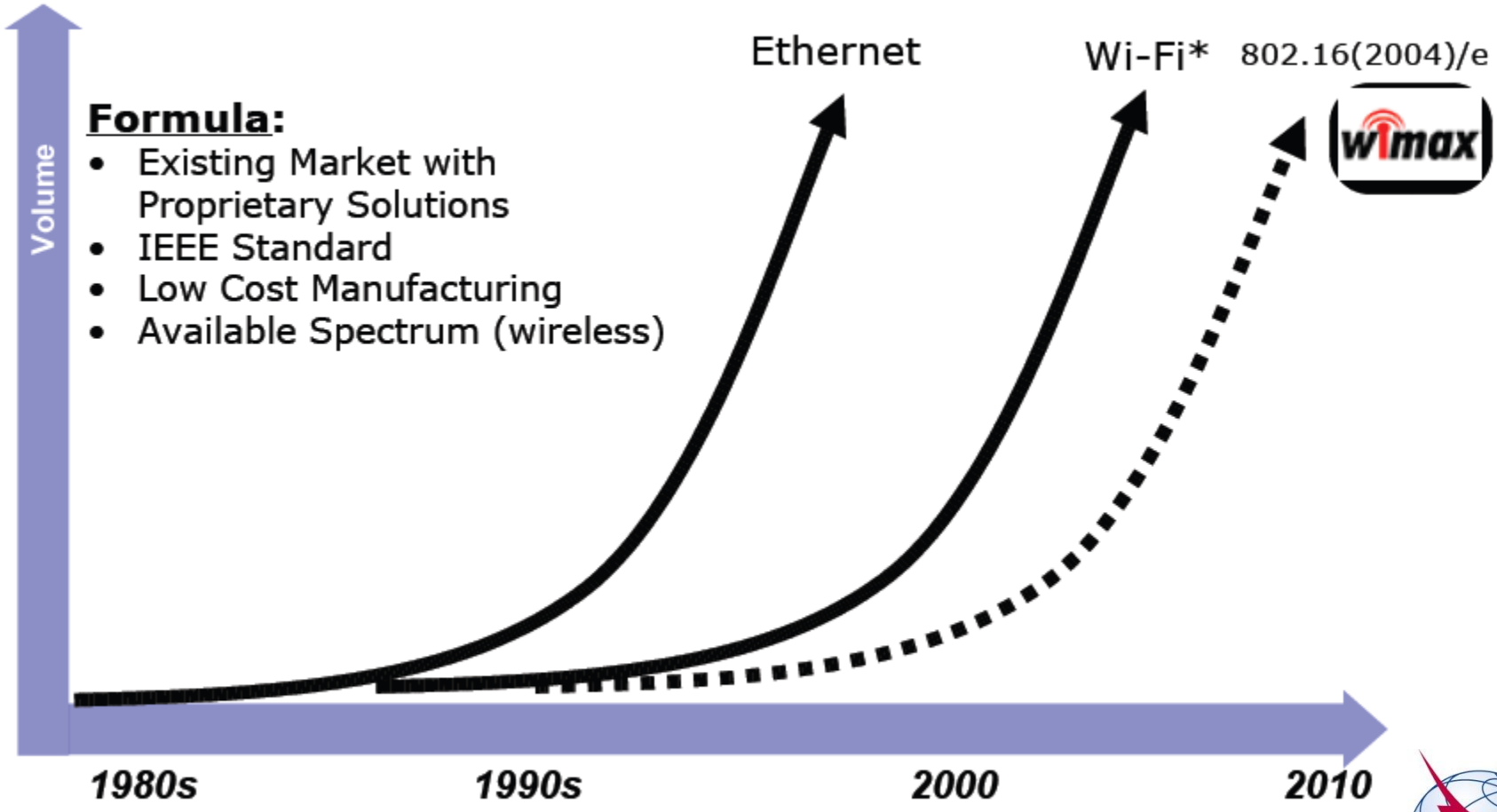
802.11 & 802.16 comparison

	802.11	802.16	Technical Explanation
Range	• Optimized for users within a 100 meter radius • Add access points or high gain antenna for greater coverage	• Optimized for typical cell size of 7-10 km • Up to 50 km range • No "hidden node" problem	• 802.16 PHY tolerates 10 more multi-path delay spread than 802.11
Coverage	• Optimized for indoor environments	• Optimized for outdoor environments (trees, buildings, users spread out over distance) • Standard support for advanced antenna techniques & mesh	• 802.16: 256 OFDM (vs. 64 OFDM) • Adaptive modulation
Scalability	• Channel bandwidth for 20 MHz is fixed	• Channel b/w is flexible from 1.5 MHz to 20 MHz for both licensed and license exempt bands • Frequency re-use • Enables cell planning for commercial service providers	• Only 3 non-overlapping 802.11b channels; 5 for 802.11a • 802.16: limited only by available spectrum
Bit rate	• 2.7 bps/Hz peak data rate; Up to 54 Mbps in 20 MHz channel	• 3.8 bps/Hz peak data rate; Up to 75 Mbps in a 20 MHz • 5 bps/Hz bit rate; 100 Mbps in 20 MHz channel	• 802.16: 256 OFDM (vs. 64 OFDM)
QoS	• No QoS support today -> 802.11e working to standardize	• QoS designed in for voice/ video, differentiated services	• 802.11: contention-based MAC (CSMA) • 802.16: grant request MAC

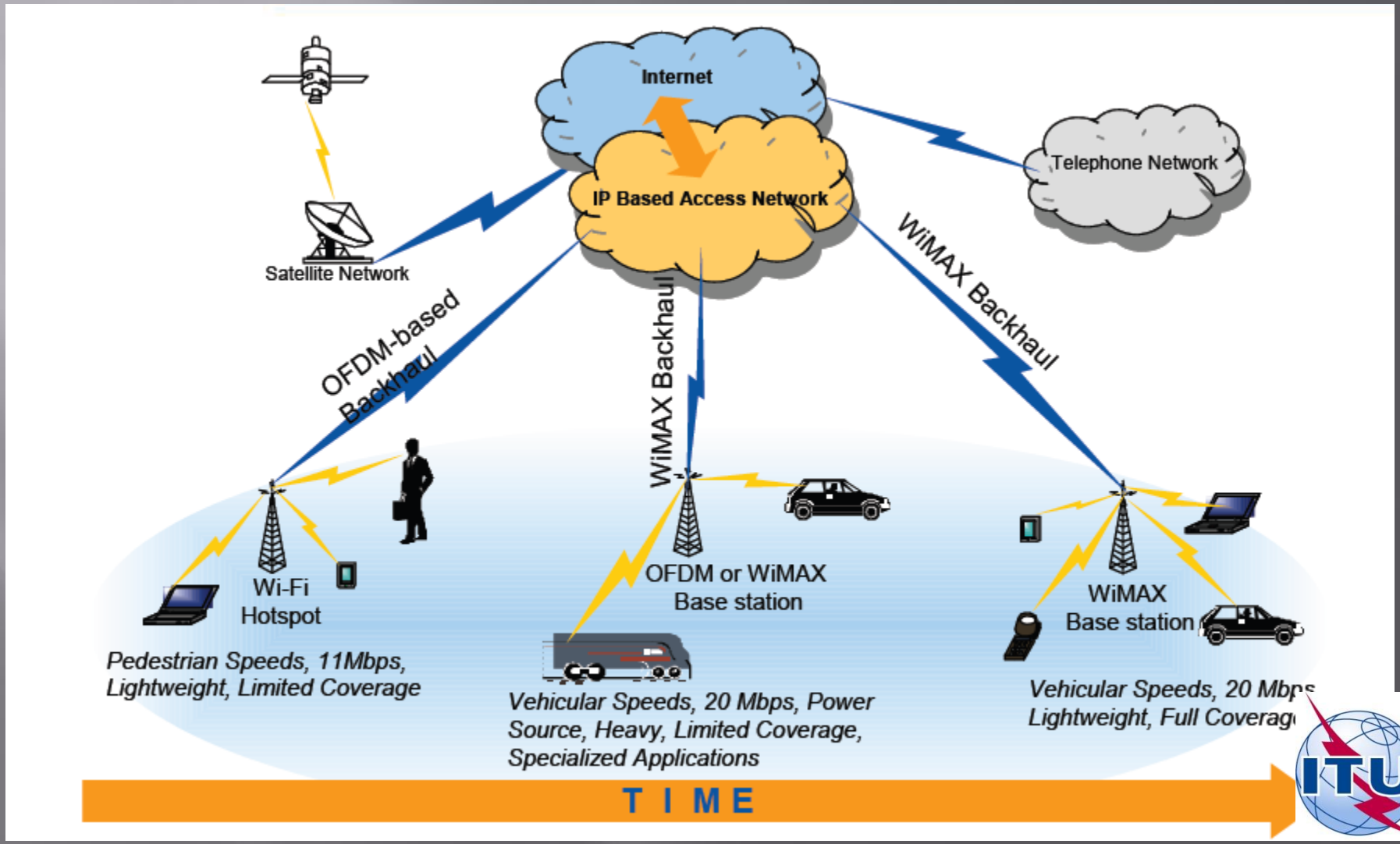
802.11,802.16,3G comparison

Broadband wireless services:	
	Service provider
802.16e	Evolving from fixed wireless ISPs
802.20	Start-up wireless operator or evolving cellular operator
3G	Cellular voice operator adding data support
	Technology
802.16e	Extension to 802.16a MAC and PHY
	Optimised to integrate with fixed stations
	Packet oriented
	Low latency
802.20	New PHY and MAC
	Optimised for packet data and smart antennas
	Optimised for full mobility at high speed
	Packet oriented
	Low latency
3G	W-CDMA or CDMA2000
	Evolution of voice-optimised GSM and CDMA
	Circuit oriented, though evolving to packets on the downlink
	High latency data architecture
	Spectrum
802.16e	Licensed bands between 2GHz and 6GHz
802.20	Licensed bands below 3.5GHz
3G	Licensed bands below 2.7GHz

Standards & interoperability



Future present vision



Other interference issues 1 (terrestrial)

C band and “extended” C band problems

- Many national regulators have attributed sub-bands in the 3.4-4.2 GHz band to terrestrial type BWA and future advanced IMT – International Mobile Telecommunications (post 3G and 4G). Once this band is already on the service of FSS services, radar and microwave links, it was foreseen they came in destructive interference in some cases.
- Being this band is particularly useful to countries undergoing development - equipment cheaper, easy to maintain and coverage will face quite alrargada Ku band - is however also used by developed countries, particularly in its component "extended" or 3.4 to 3.7 GHz (vice 3.7 to 4.2 GHz).

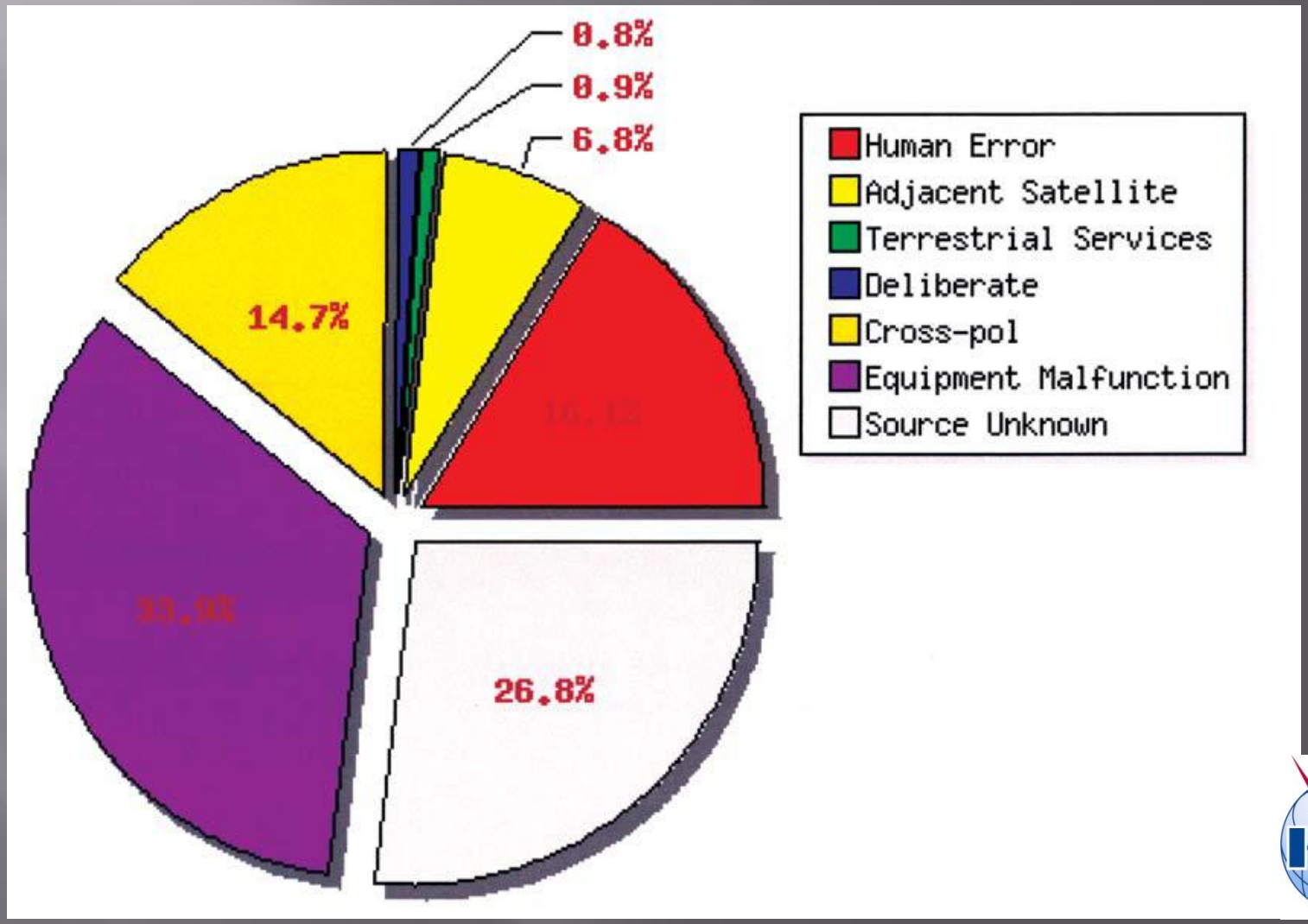
Other interference issues 2 (terrestrial)

- Indeed even the allocation of frequencies not overlapping, eliminated the problems and it is recognized that there is room for practical and rapid solutions being identified that BWA equipment working on different frequencies of the earth stations, at several KM away, still cause interference .
- Such problems were identified in Asia (Hong Kong Telecommunications Authority), South America (Bolivian Superintendencia de Comunicaciones), Asia Pacific Telecommunity. While the problem is not solved yet, studies shared in ITU show that a minimum distance of 35 - 75 km can avoid or minimize transmissões phenomena of interference between IMT and FSS receivers.

Other interference issues 3 (terrestrial)

- Because it is not near of being overcome, ITU, the Inventory Tool the GVF and the SUIRG - Satellite Users Interference Reduction Group, are active in their special monitoring, particularly in the case of GVF, which address the following themes:
  - Interference problems characterization
  - Precaution on the VSAT and SNG installation, to reduce interference
  - Search of remote sources of potential interference
  - Betting on Quality - *Vsat type aproved*
  - Use tools to minimize interference

Other interference issues 4 (terrestrial)

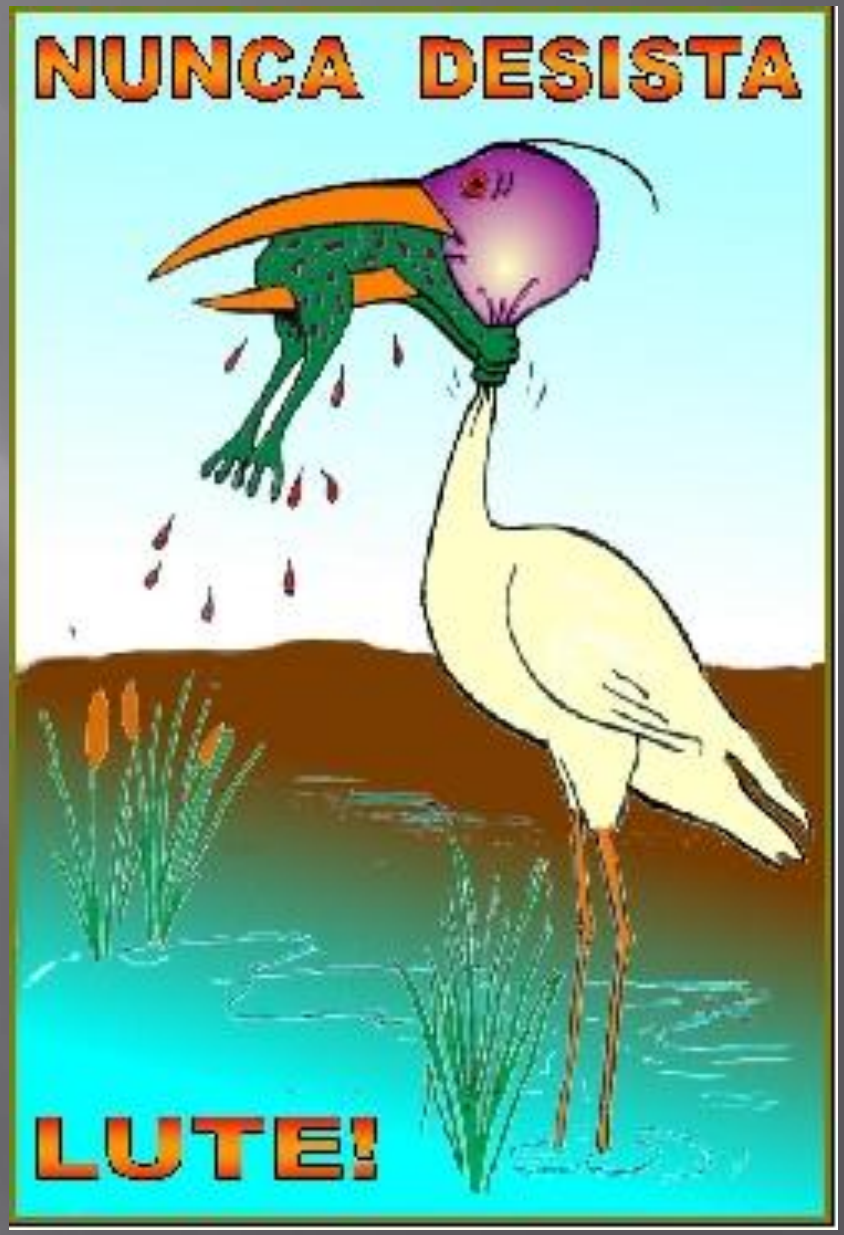


International Regulatory

In short, the authorities in satellite world are:

- UN General Assembly, take care and address general issues
- COPUOS, regulates space exploitation
- ITU - International Telecommunications Union, coordinate the operation on the telecommunications networks
- WRC-World Radio Communications, ensures the review of the radio regulations and the use of its spectrum and satellite orbits either stationary or non-stationary.

Go head to the goal



End 5th day

Prossecution of innocents

End of Workshop

Awards & honnours for underserving

Everything you need….

Annex

- Glossary
- References - bibliografy
- Footprint

Coaxial cable waveguide
RG Nomenclature (IFL ODU-IDU)

Tipo Cabo (RG/U)	Diametro ext (mm)	Dialectrico & Mat protec	Isolamento	Imped. Nominal (ohms)	aten 100MHz per 100m	aten 3GHz per 100m
6A	8,4	Polyethylene & PVC	Duplo	75	9,5	72,2
8	10,3	Idem	Simples	52	7,2	62,3
12A	12,1	Idem	Simples	75	7,2	62,3
34B	16	Idem	Simples	75	4,6	52,5
58	5	Idem	Simples	53,5	15,1	124,6
211	18,5	PTFE & Braid	Simples	50	3	24,6
212	8,4	Idem	Duplo	50	9,5	72,2
213	10,3	Idem	Simples	50	7,2	62,3
214	10,8	Idem	Duplo	50	7,2	62,3
…….	…….	…….	…….	…….	…….	……
225	10,9	PTFE & Braid	Duplo	50	6,9	45,9

Waveguide spacification

Nomenclatura WG	Banda	Gama frequência	Atenuação	Diamensões interno(mm)
IEC R 3 (EIA….)	400 MHz	320-490 MHz	0,001 dB/m	580x290
IEC R 14	L Band	1,14-1,70 GHz	0,01 dB/m	165x83
IEC R 22	W Band	1,72-2,60 GHz	0,019 dB/m	109x55
IEC R 32	S Band	2,60-3,95 GHz	0,037 dB/m	72x34
IEC R 48	C Band	3,95-5,85 GHz	0,07 dB/m	48x22
IEC R 70	6, 7 GHz	5,85-8,17 GHz	0,114 dB/m	35x16
IEC R 100	10, 11 GHz	8,20-12,40GHz	0,217 dB/m	22,9x10,2
IEC R 140	Ku Band (13,15 GHz)	12,4-18GHz	0,351 dB/m	15,8x7,9
IEC R 220	K Band (18 GHz)	18-26,5GHz	0,723 dB/m	10,7x4,3
IEC R 260	23, 26 GHz	22-33GHz	0,868 dB/m	8,6x4,3
IEC R 360	Ka band (38GHz)	26,5-40GHz	1,162 dB/m	7,1x3,6

Band allocation ITU-R

Banda	Local de app	Aplicação
1 GHz	Mundial	Móvel
2 GHz	Mundial	Móvel, DECT, PTP
3 GHz	Mundial	3,5 GHz Rural radio
4 GHz	Mundial	Elevada capacidade PTP (stm-1) Satélite
6 GHz	Mundial	Satélite
7-8 GHz	Mundial	Longa distância PTP (até 50 Km)
10 GHz	Mundial	Backbone BTS,PMP, WLL.
11 GHZ	Mundial	Media capacidade (E3,T3)
12,14 GHz	Satelites	Difusão satélite
13,15 GHZ	Mundial	Pequena e media distância PTP (25Km)
18,23,26 GHz	Mundial	Pequena distância (10-15 Km)
28 GHz	Mundial	PMP, APP. Multimédia
38 GHz	Mundial	Pequena distância (5-7 Km)
Acima 40 GHz	Mundial	Muito pequena distância (1-3 Km)

Band allocation ITU-R

banda	frequência
L	1-2
S	2-4
C	4-8
X	8-12
Ku	12-18
K	18-26,5
Ka	26,5-40
Q	30-50
U	40-60
V	50-75
E	60-90
W	75-110
F	90-140
D	110-170

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Now who is…

- Enthusiasm
- Apprehension
- Panic
- Search of the Guilt
- Persecution of the Innocent
- Awards & Honnors for the Underserving