REPORT 1237*

SATELLITE NEWS GATHERING

(Study Programme 13H/CMTT) (1990)

1. Satellite news gathering requirements and specifications

1.1 *Definition of SNG*

Satellite news gathering (SNG) operating in the fixed-satellite service (FSS) is used exclusively for broadcasting applications. The following definition for satellite news gathering (SNG) for international application is suggested for the system(s) considered in the work of the CCIR in order to differentiate such systems from the domestic SNG systems currently operating in the fixed-satellite service (FSS) in many countries. The proposed definition is:

> "Highly-portable news-gathering satellite uplink system operating in the fixed-satellite service (FSS), capable of compliance with fixed-satellite service antenna side-lobe specifications, and of such small size and weight that it is capable of being transported in a scheduled airline, helicopter, automobile, or even being hand-carried to the site of a breaking event."
>
> The proposed definition of the equipment is that it should be capable of uplinking the video programme with its associated sound**, or sound radio signals, and capable of providing two-way coordination (communication) circuits, and may provide for data transmission as well. Further, the equipment should be capable of being set up and operated by a crew of no more than two (2) people within a reasonably short time (for example, one hour).

Transportable earth stations (as described in Report 1090) are also applicable for meeting the SNG requirements when logistics dictate use of such systems and those systems meet the basic functional characteristics of the SNG systems.

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* This Report should be brought to the attention of Study Groups 4, 8, 10 and 11.

** SNG (sound) may also be operated in the mobile-satellite service.

1.2 *Requirements*

1.2.1 *Functional description*

The main features of SNG systems are essentially defined by the uplink characteristics. Operations with the SNG uplink terminal assumes that the receiving side is appropriately dimensioned. To ensure system compatibility and efficient operation, it is necessary to standardize equipment characteristics and operating procedures.

Functions of the SNG system are to:

- transmit with a minimum of impairments, a video signal, regardless of the television standard;

- transmit with minimal distortions, the associated audio signals;

- provide limited receiving capability to point the antenna and to monitor the transmitted signals, where possible;

- provide two-way communication channels for operation and control, as described in §1.2.5.

1.2.2 *Frequency bands appropriate for SNG*

All frequency bands allocated to uplinks for the FSS may be used by SNG systems. However, since an SNG terminal requires a small antenna to provide high portability, the operating frequency band is extremely important. Experience has shown that the most appropriate frequency bands are either 14 GHz or 30 GHz, although SNG has been accomplished using frequency bands below 14 GHz.

1.2.3 *Link performance*

1.2.3.1 *Video transmission*

In general, video transmission characteristics for SNG shall comply with Recommendation 567 except for the signal-to-noise ratio. The signal-to-noise performance for SNG may be relaxed if acceptable to the user.

1.2.3.2 *Sound transmission*

The number of associated sound channels for an SNG system is suggested to be two. All audio signals associated with the video signal shall be transmitted using the vision carrier. Possible solutions include subcarriers and sound-in-sync (SIS) techniques. Transmission performance of audio signals shall comply with Recommendation 505, except for the noise objectives.

1.2.3.3 *RF performance*

Since the SNG terminal operates mainly in the FSS, RF parameters shall comply with the Radio Regulations, the applicable local radio regulations and be consistent with any coordination agreements which apply to a specific satellite being used. Major items to be considered are as follows:

(a) Off-axis e.i.r.p. density

According to Recommendation 524-2 (MOD I), the off-axis e.i.r.p. density in any direction within 3 degrees of the geostationary satellite orbit should not exceed the following values:

Angle off-axis (deg)	**Maximum e.i.r.p.** (dB(W/40 kHz))
$2.5 < \phi < 7$	$(39 - 25 \log \phi)$
$7 < \phi < 9.2$	18
$9.2 < \phi < 48$	$(42 - 25 \log \phi)$
$48 < \phi < 180$	0

However, satellite system operators may have more stringent requirements.

(b) Polarization discrimination

Some satellites use overlapping channels with orthogonal polarization discrimination (frequency reuse). The cross-polarization discrimination should be +35 dB within 1 dB off the main axis of the beam and +30 dB elsewhere. However, SNG terminals generally operate with low e.i.r.p. so a corresponding reduction in cross-polar performance may be accepted by the satellite system operator.

(c) E.i.r.p.

The necessary e.i.r.p. of the SNG terminal depends on the required uplink carrier-to-noise ratio (C/N) and satellite G/T. However e.i.r.p. is often limited by the off-axis e.i.r.p. density limits as indicated in *(a)*.

For example, with an uplink e.i.r.p. of 70 dBW, the off-axis e.i.r.p. density limit can be met for an SNG antenna of about 1.8 m (G = 46 dBi) with the two possible following sets of parameters (i.e. antenna radiation patterns and energy dispersal):

$29 - 25 \log \phi$ and 1 MHz or

$32 - 25 \log \phi$ and 2 MHz.

It has been demonstrated that there is no difficulty for an SNG terminal to comply with CCIR Recommendation 524.

1.2.3.4 *Energy dispersal*

The use of analogue television requires the addition of energy dispersal to reduce interference. Recommendation 446 and Report 384 are relevant.

1.2.3.5 ***Necessary RF bandwidth***

The necessary RF bandwidth for SNG can be determined by taking into account the signal format, the required signal-to-noise ratio, the e.i.r.p., the number of associated carriers for auxiliary circuits and the available bandwidth of the transponder.

1.2.3.6 *Communication requirements for supervision and coordination*

SNG uplink signals are often originated from remote areas. In these cases, communication using the public switched telephone network (PSTN) is difficult or impossible. The SNG terminal should therefore be equipped to provide all of its own communications through the satellite to both the satellite operator's communication control centre and the broadcaster's premises, with the following facilities:

- Between SNG terminals and the satellite operator's communication control centre: a minimum of one two-way narrow band, voice/data communication circuit. This should be available at all times and not be restricted to the transponder booked times. It is desirable that these circuits are provided in the same transponder as the programme vision and sound.

- Between the SNG terminal and the broadcaster's premises: four (4) two-way, narrow band, voice/data communication circuits. These circuits should be available for a short time before and after as well as during the transponder booked times. It is essential that these communications are provided in the same transponder as the programme vision and sound.

1.2.4 *Equipment**

1.2.4.1 *General*

SNG terminals consist of the following main units:

- Antenna and feed system with polarization adjustment;

- Antenna mount with azimuth/elevation adjustment;

- High power amplifier (HPA) for vision/sound and auxiliary (voice/data) communication channels;

- Baseband/modulation equipment and IF to RF upconverter;

- Two-way voice/data communication equipment;

- System local/remote control panel;

- Video/audio/RF monitoring equipment;

- Optional power generator.

1.2.4.2 *Antenna and feed system*

The antenna should be small in diameter (less than 2 m), light weight, easy to assemble and easy to transport.

The antenna radiation patterns in the plane of the orbital arc at the earth station location shall comply with §1.2.3.3. The cross-polarization discrimination shall comply with §1.2.3.3.

Repeated assembly and disassembly of the antenna shall not affect the radiation and cross-polarization discrimination performance.

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*The figures cited are relevant to the 14 GHz band unless otherwise specified.

The feed system shall have transmit and receive ports and should be optimised for the uplink frequency band of 14.0 to 14.5 GHz and the corresponding downlink frequency band(s).

For operation with frequency reuse (dual linear polarization) satellites, polarization adjustment controls of adequate resolution must be provided to optimize the cross-polarization alignment.

1.2.4.3 *Antenna mount and azimuth/elevation adjustments*

A rugged antenna mount with azimuth and elevation controls and associated graduated scales should be provided.

The mount should be designed to accurately deploy the antenna and keep it pointed at the satellite even during high wind conditions.

1.2.4.4 *High power amplifier (HPA)*

The HPA for transmission of the vision/sound carrier should be rated at approximately 300 W. The resulting e.i.r.p. will then be of the order of 70 dBW when used with a 1.8 m antenna.

To keep the waveguide losses to a minimum, the HPA should be located as close to the antenna as possible. The HPA should therefore be designed and packaged to operate under wide environmental conditions.

To improve the availability of the uplink, or when higher power is needed, a second HPA can be provided. This HPA can be operated in a one-for-one redundant configuration or in a phase-combined configuration.

A separate solid state 14-GHz band power amplifier may be required for the auxiliary communication system unless the auxiliary communication hardware is combined at IF with the vision/sound.

1.2.4.5 *Baseband/modulating equipment and upconverter*

This unit shall include: a video low pass filter which can be bypassed, switchable pre-emphasis networks, selectable IF bandpass filters, one or more frequency agile sound subcarrier modulators, dispersal generator, IF power control, and a linear video FM modulator. The DC component of the video signal should be preserved to take advantage of the available bandwidth.

The upconverter should be frequency agile with a suitable frequency step size for the satellite system used. The phase noise and frequency stability should be adequate to allow upconversion of the auxiliary communication signals. To preclude accidental interference to other traffic on the same satellite, it is recommended that the up-converter be equipped to inhibit transmission in the event of off-frequency operation.

1.2.4.6 *System local/remote control panel*

All controls such as main carrier deviation, operating carrier frequency, subcarrier frequencies, subcarrier deviation, pre-emphasis, dispersal, power adjustment, etc., should be readily accessible.

It may be desirable to provide remote access to the power on/off and raise/lower controls from the satellite operator's communication control centre or from the broadcaster's premises.

1.2.4.7 *Video/audio/RF monitoring equipment*

To allow the SNG terminal operator to properly set up the terminal, monitoring equipment is essential.* To simulate the satellite transponder it is advantageous to provide a loop-test translator and video/audio receiver to verify the performance of the uplink equipment.

Due to the low G/T of the SNG antenna system and the particular operational configuration of the satellite system, it is normally not possible to monitor the transmitted video and audio signals at full quality. In such cases, narrower IF bandwidth monitoring of the satellite receive signal may provide limited monitoring capability.

1.2.4.8 *Size and weight objectives*

A complete, highly portable SNG terminal, designed specifically to be transported anywhere in the world, must be packaged in shock-resistent shipping cases in order to withstand rough handling. The total dimensions (length + width + height) should meet the International Airline Transportation Authority (IATA) regulations for carriage on scheduled airline flights as accompanied baggage.

The weight of each shipping case of the SNG terminal must enable the cases to be handled easily by a two-man crew (maximum weight of 45 kg per case including equipment is suggested as a good target).

1.2.5 *Auxiliary communications*

1.2.5.1 *Communication channels for supervision and coordination*

SNG terminals require two-way communication channels, in addition to the vision and associated sound, to provide for communications capability with the satellite operator's communications control centre and the broadcaster's facilities.

An example is shown in Figure 1 for the case of multiple SNG terminals accessing occasional use 36-MHz transponders.

The SNG terminals are assumed to be located in the downlink footprint.

If the SNG terminal is not in the downlink footprint other solutions, as described in §1.2.5.4, are required.

It should be noted that several domestic systems are presently in operation using various communication techniques including multiple analogue SCPCs within the same transponder as the video signal and/or narrow-band carriers in a separate transponder from the video in the same satellite and with the same polarization.

If an SNG terminal is accessing a leased transponder, wide-band digital carriers may be employed (e.g., 128 kbit/s, 256 kbit/s or 1.544 Mb/s).

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*Where monitoring of the satellite transmit signal is possible, a spectrum analyzer could be used to optimize the antenna pointing and polarization.

The configuration (see §1.2.5.2, §1.2.5.3 and Fig. 1) is proposed to efficiently provide an SNG operator with the minimum communication facilities in an occasional-use SNG environment (i.e., short notice, short duration, high traffic demand) on shared-use transponders.

1.2.5.2 *Channels between SNG terminal and satellite operator*

Liaison with the satellite operator's communications control centre should be available at all times and should not be restricted to the duration of the transponder booking. For this purpose it is desirable that coordination channels, in each direction, be provided preferably in the same transponder as the programme vision and sound. Single-channel-per-carrier (SCPC) techniques may be used to provide these channels. (These are shown in Figure 1 as Carriers 1 and 2.)

Carrier 1 (see Fig. 1) provides communication from the satellite operator's communications control centre to the SNG terminals. This carrier should always be present and may be used for the following purposes:

- Voice and data,*

- Satellite channel identification,*

- Alignment of SNG terminal,*

- Safety in the event of misalignment,*

- Verification of channel availability,

- Activation of SNG transmitter for control purposes,*

- Tracking down-converter reference signal for receiving SCPC carriers.

It may be desirable to supplement this carrier with a separate pilot carrier* to accommodate some of these functions, although it is considered preferable to use Carrier 1 for this purpose.

Carrier 2 (see Fig. 1) provides communication from the SNG terminals to the satellite operator's communications control centre. Since, at the same time, more than one SNG terminal may wish to communicate via this carrier, voice operated switching/"press to transmit" equipment should be used. This channel could also carry an SNG terminal identification code.

If it is necessary to provide these carriers elsewhere on the satellite, and linear polarization is being used, they should be provided on both polarizations to avoid the need for a dual polarization feed on SNG terminals.

1.2.5.3 *Channels between SNG terminal and broadcaster's premises*

For the purpose of communicating with the broadcaster's premises, typically up to four (4) two-way (duplex) voice/data channels are required per broadcaster. These channels generally operate for brief periods before and after transponder bookings and during actual programme transmissions.

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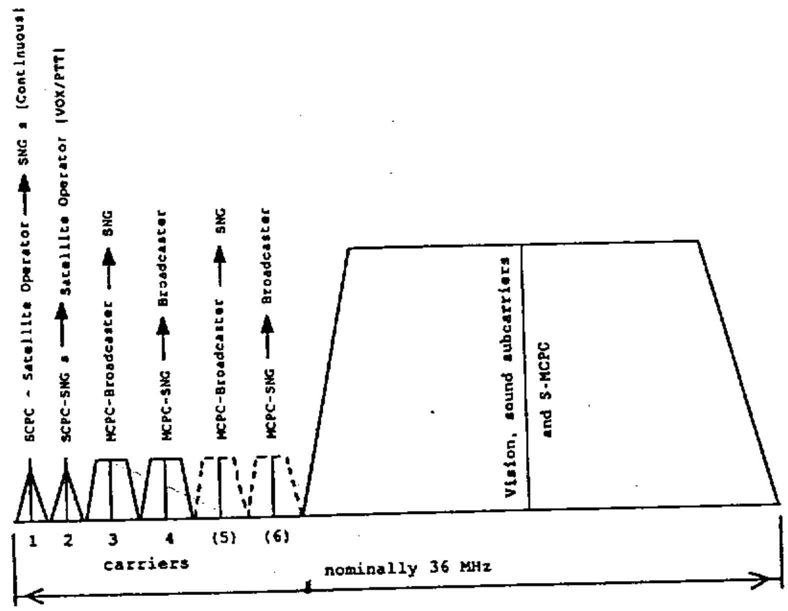
*See also §1.2.6.3 of this Report



Note 1: Not drawn to scale, nor in order.

Note 2: Carriers 1, 3 and 5 may be allocated in other satellite repeaters if appropriate coverage with the SNG terminal is located outside the downlink footprint.

Figure 1 - *Example of satellite carrier loading*

Two-way channels can be multiplexed onto a pair of multiple-channels-per-carrier (MCPC) carriers. (Carriers 3 and 4 (see Fig. 1) represent these MCPC carriers, one in each direction, between the SNG terminal and the broadcaster's premises.)

Carriers 5 and 6 (see Fig. 1) represent the MCPC carriers, one in each direction, between the "next" SNG terminal in the booking sequence and the broadcaster's premises. Carriers should only be used in these numbered pairs. While this represents the international operational practice, it does not preclude additional SCPC channels from being used in domestic or national circumstances.

These "two-way" channels between the SNG terminal and the broadcaster's premises could be used for:

- production coordination;
- engineering coordination;
- programme-related data transmission;
- more than one broadcaster;
- more than one language.

1.2.5.4 *Auxiliary communications when outside the downlink footprint*

When the uplink is in the 14 GHz band but outside the downlink footprint and/or PSTN connections are not available, a possible solution would be to use INMARSAT services or, alternatively, the 6/4 GHz band, either one way or two way.

1.2.5.5 *Technical considerations*

The technical parameters and other considerations that cannot be defined at this time and require further investigation are:

(a) SCPC/MCPC carrier levels;

(b) SCPC/MCPC/visual carrier frequency spacing;

(c) Modulation techniques (using analogue or digital techniques);

(d) Carrier combining configuration (e.g. pre-HPA or post-HPA);

(e) Technical consideration for transmission of communication channels in the case of a double-hop situation (e.g. IF repeat);

(f) Phase noise and frequency stability requirements to be consistent with any SCPC system to be utilized;

(g) Limitations to uplink operation while not in the downlink footprint;

(h) A possible solution to the problem in (g) could be SCPC/MCPC transmitted over a wide, or even a global, coverage area (14/11 GHz, 6/4 GHz, or other frequency bands);

(i) Possibility of using subcarriers (associated with the main TV carrier) to realize the channels from the SNG terminal to the broadcaster's premises;

(j) Costs, size and weight of equipment;

(k) Current equipment availability;

(l) Importance of consensus on the technical specification between all concerned.

1.2.5.6 *Communication channels for SNG (sound)*

For SNG sound broadcasting, many of the concepts contained in §1.2.5 apply.

The minimum requirements for an SNG (sound) terminal are as follows:

- One two-way voice communication channel between the SNG terminal and the satellite operator's communications control centre.

- Two two-way voice/data communication channels between the SNG terminal and the broadcaster's facilities.

1.2.6 *Installation and operational features*

1.2.6.1 *Antenna installation and alignment*

An approximate mechanical alignment of the antenna of the SNG terminal with the calculated azimuth, elevation and polarization will facilitate the acquisition of the satellite. Particularly when operating at low elevation angles, the satellite signal could be susceptible to rain fading which would degrade the transmission and could result in difficulties with the antenna alignment.

Frequency reuse satellites employ either linearly or circularly polarized antennas. Therefore, the antenna feed of the SNG terminal must be aligned to match the polarization of the satellite otherwise severe interference to other traffic in cross-polarized channels and severe signal degradation of the wanted signal may occur. Transmission shall only be initiated after antenna alignment to the correct satellite has been verified.

In most instances SNG terminals do not require any antenna repointing during programme transmissions. However, if the satellite has excessive drift in station keeping, some realignment of the antenna may be required. The extent of realignment will also depend on the size (beamwidth) of the SNG antenna.

All antenna adjustments, such as elevation, azimuth and polarization, should preferably be carried out from one convenient position, behind the antenna.

1.2.6.2 *Other design considerations*

The SNG terminal can be designed with all the equipment next to the antenna or with the HPA and LNA at the antenna and the other equipment located some distance (e.g. less than 50 m) away from the antenna. The latter option, which is operationally preferable, allows the SNG terminal to be operated and monitored from indoors after antenna alignment.
The HPA must be located as close as possible to the antenna to minimize the waveguide losses.

The system should be designed to accept redundant high power amplifiers.

System interconnections must be reduced to a minimum to allow quick and easy setup under all weather conditions; all external connectors must be waterproof.

It is desirable that the SNG terminal can accept a primary power input of 100-250 V/50-60 Hz, and power consumption not greater than 2.5 kVA.

The design of the shipping cases should allow the terminal to be operated in direct rain with the lids removed. The cases must provide a controlled environment for the electronics to allow proper operation during extremes of both high and low temperatures.

The SNG terminal must be designed to offer the maximum possible safety to the operator.

1.2.6.3 *SNG system enhancements*

To reduce the cost, enhance the reliability and safety, and simplify the operation of the SNG terminal, certain operational features may be implemented:

- Provision to uniquely identify the satellite and transponder by utilizing a pilot, modulated with a code, on the edge of the transponder.

- The pilot signal could be used for initial alignment of the antenna of the SNG terminal.

- Provision for remote enabling of the SNG uplink transmitter from the satellite operator's control centre through use of a "transmit enable code" on the pilot. This allows the satellite operator to share control over transmission.

- In the event of antenna mispointing, the enable code would not be received and the high power amplifier would be turned off.

- By using a tracking downconverter on the pilot signal the cost of the SCPC equipment may be reduced.

- By calibrating the power of the SNG equipment SCPC channels and calibrating the main carrier power during the SNG equipment approval process, the required uplink e.i.r.p. can be determined prior to enabling the main power amplifier.

- Provision to uniquely identify the SNG terminal by modulating an identification code on the calibrated SCPC channel. This code could, for example, define country of origin, organization, unit number, and certification number.

1.2.7 *Reliability/availability*

There are two aspects to be considered: mechanical reliability and operational availability.

1.2.7.1 *Mechanical reliability*

A high degree of mechanical reliability is achieved by designing the packaging of the various sub-systems of the SNG equipment to withstand rough handling in shipping and deployment in adverse weather conditions. The reliability of equipment is greatly improved by mounting all equipment on sub-frames which are supported by shock-absorbing mounts within the transport cases to protect from shocks and vibrations encountered during transportation. The shipping cases should be designed to provide weatherproofing.

If a segmented antenna is used, the individual segments should be capable of rigid assembly with captive lock pins. The segmented antenna system must be able to withstand stresses and wear resulting from the frequent assembly/disassembly process. It is important to maintain the physical shape of the reflector under frequent and continued usage conditions. The antenna system should be calibrated periodically to ensure that the side-lobe characteristics have not changed after continued field use.

Strong wind conditions affect the pointing accuracy of the antenna and may be controlled by placing weights on the antenna support or guying the antenna to some substantial structure or the ground. It is important to ensure that the antenna shape is not distorted by the use of any system of guys. At very high wind velocities, it may be advisable to stow the antenna.

It is desirable to design and package all equipment to operate under the following conditions: temperature -30°C to +50°C, relative humidity 0 to 100%, solar radiation 1100 W/m^2.

1.2.7.2 Operational availability

System performance availability should be measured under "clear sky" conditions. Because of the highly portable nature of the SNG terminal, it is sometimes not possible to provide for severe precipitation fade protection.

Precipitation fades in the 6 GHz band are relatively insignificant, whereas they can be of the order of 3 to 4 dB or more in the 14 GHz band, under adverse weather conditions. Fades in excess of 10 dB for several minutes can be expected in areas where heavy precipitation is not unusual. In the event of rain fades, transmissions may have to be repeated. In higher frequency bands such fades can be even greater.

1.2.8 *Radiation hazard*

The small physical size of the uplink system, and the likelihood of it being sited where it is readily accessible to the general public, require measures to be taken to ensure that exposure to excessive radiation is avoided.

Various countries specify differing maximum permissible radiation levels, therefore the values for the country in question should be used for determining the unsafe area. Safety standards generally distinguish limits for "public" and "occupational" exposure.

The unsafe area should be clearly defined by markers placed in accordance with the values for "public exposure" limits.

The equipment should be designed so that all adjustments can be done before the uplink power is applied, or are so placed that they can be done in safety with power applied.

All high power connections (waveguide, co-axial connectors, etc.) should be checked for integrity before switching on the high power amplifier. SNG terminals must be equipped with a calibrated radiation meter to check compliance with the safety standards around the antenna and components carrying high level radio frequency energy.

1.3 *Examples of link performance*

1.3.1 *Examples of the link performance for various satellite systems*

Table I shows typical link performance for 6 GHz (INSAT) and for 14 GHz (AUSSAT, EUTELSAT, JCSat/SCC) satellites.

1.3.2 *Examples of link performance for Intelsat satellites*

Tables II, III and IV show typical performance examples for 6/4 GHz, 14/11 GHz and cross-strapped transponders using Intelsat satellites.

1.3.2.1 *Performance results and modulation parameters*

To satisfy SNG transmission requirements, a minimum peak-to-peak luminance-to-weighted thermal noise ratio of 45 dB is assumed. Tables II, III and IV show examples for television transmission through Intelsat using System M (NTSC, 525/60) with 7.5 MHz peak video deviation, deemphasis in accordance with Rec. 405 and noise weighting in accordance with Rec. 421. The transmission bandwidth is assumed to be 17.5 MHz.

TABLE I - ***Examples of the link performance for various satellite systems***

PARAMETER		SYSTEM			
		JCSAT/SCC	**INSAT**	**AUSSAT**	**EUTELSAT**
Up-link					
Frequency	(GHz)	14.25	6.0	14.1	14.25
SNG e.i.r.p.	(dBW)	70.0	58.0	70.0	70.0
Antenna diameter	(m)	1.8	2.5	1.8	1.8
Transmitter power	(W)	300	100	300	300
Spreading loss	(dB)	162.7	162.0	162.7	162.7
Miscellaneous loss (1)	(dB)	6.0	0.0	0.2	0.3
P.f.d. at satellite	(dBW/m^2)	-98.7	-104.0	-92.9	-93.0
Satellite G/T (2)	($dB(K^{-1})$)	10.0	-4.5	0.5	3.5
Uplink C/N	(dB)	20.8	8.6	17.0	19.9
Down-link					
Frequency	(GHz)	12.5	4.0	12.35	11.3
Satellite e.i.r.p. per carrier	(dBW)	50.0	26.1	29.5	41.0
Spreading loss	(dB)	162.7	162.0	162.7	162.7
Miscellaneous loss (1)	(dB)	1.0	0.5	0.4	0.2
P.f.d. at receiving earth station	(dBW/m^2)	-113.7	-135.9	-133.6	-121.9
Receiving earth station G/T	($dB(K^{-1})$)	30.0	31.7	38.0	35.0
Downlink C/N	(dB)	27.0	16.0	15.2	24.5
Overall					
Overall C/N	(dB)	19.9	8.0	12.5	18.6
Video bandwidth	(MHz)	4.2	5.0	5.5	5.0
IF bandwidth	(MHz)	28.5	28.0	30.0	30.0
Frequency deviation	(MHz p-p)	21.0	24.0	22.3	19.0
Improvement factor (includes preemphasis and weighting)	(dB)	37.8	39.1	39.4	34.3
Overall weighted S/N	(dB)	57.6	47.0	51.9	52.9

(1) Miscellaneous loss includes atmospheric loss and/or the effect of rain attenuation, depending on the case.

(2) All values refer to near beam centre, except for INSAT, which refers to the -3 dB contour.

Note: Effects of interference are not considered.

TABLE II - *14 GHZ-band cases*

Transponder Bandwidth	Earth Station Standard (1)	14 GHz Band (2)			
		Elliptical east spot up/ elliptical east spot down		Circular west spot up/ circular west spot down	
		C/N (dB)	S/N (dB)	C/N (dB)	S/N (dB)
36 MHz	C	17.9	49.3	21.4	52.8
36 MHz	E3	16.6	48.0	20.2	51.6
72 MHz	C	16.9	48.3	21.4	52.8
72 MHz	E3	15.2	46.6	20.2	51.6

(1) The receive earth stations used are:

C : Standard "C", G/T = 37 $dB(K)^{-1}$
E3 : Standard "E3", G/T = 34 $dB(K)^{-1}$.

(2) All calculations based on beam centre.

Note: Antenna diameter = 1.8 m, transmit e.i.r.p. = 70 dBW (300 W HPA)

TABLE III - *Cross-strap cases*

Transponder Bandwidth	Earth Station Standard (1)	14 GHz-band elliptical spot beam to			
		4 GHz-band zone cross strap (2)		4 GHz-band hemi cross strap (2)	
		C/N (dB)	S/N (dB)	C/N (dB)	S/N (dB)
36 MHz	A	16.8	48.2	16.8	48.2
36 MHz	A(R)	13.1	44.5	13.1	44.5
72 MHz	A	17.0	48.4	17.0	48.4
72 MHz	A(R)	13.5	44.9	13.5	44.9

(1) The receive earth stations used are:

A : Standard "A", G/T = 40.7 $dB(K)^{-1}$
A(R) : Revised Standard "A", G/T = 35 $dB(K)^{-1}$

(2) All calculations based on beam centre.

Note: Antenna diameter = 1.8 m, transmit e.i.r.p. = 70 dBW (300 W HPA)

TABLE IV - *4 GHz-band cases*

Transponder bandwidth	Earth Station Standard	Global 4 GHz-band (2)		Zone 4 GHz-band (2)		Hemi 4 GHz-band (2)	
		C/N (dB)	S/N (dB)	C/N (dB)	S/N (dB)	C/N (dB)	S/N (dB)
36 MHz	A	8.9	40.3	17.0	48.4	14.8	46.2
36 MHz	A(R)	7.3	38.7	13.5	44.9	11.9	43.3
72 MHz	A	8.3	39.7	14.7	46.1	13.5	44.9
72 MHz	A(R)	5.9	37.3	10.2	41.6	9.7	41.1

(1) The receive earth stations used are:

A : Standard "A", $G/T = 40.7\ dB(K)^{-1}$
A(R) : Revised Standard "A", $G/T = 35\ dB(K)^{-1}$

(2) All calculations based on beam centre.

Note: Antenna diameter = 3.0 m, transmit e.i.r.p. = 68.5 dBW (350 W HPA)

1.3.2.2 *14 GHz-band cases*

Performance examples for 14-GHz band transmission, assuming a transmitting antenna diameter of 1.8 m and an e.i.r.p. of 70 dBW are given in Table II.

1.3.2.3 *"Cross-strap" cases*

Performance examples for "cross-strapped" transmission, that is, 14-GHz band uplink, 4 GHz-band downlink, are shown in Table III, assuming a transmitting antenna diameter of 1.8 m and an e.i.r.p. of 70 dBW.

1.3.2.4 *4 GHz-band cases*

Performance examples for transmission from a relatively small 6 GHz band SNG terminal are shown in Table IV.

1.4 *Experimental and operational experience*

Operational experience is increasing rapidly with the use of SNG for coverage of world events such as Papal visits, summit conferences, national elections, natural disasters, and particular programme production needs. The experience is being gained on a world-wide basis as these events dictate.

While the equipment currently available is being used for the coverage of actual events, additional experimental work is being carried out in the field of:

- overall performance under difficult operating conditions;
- portability and operating convenience of the equipment;
- the communications requirements;
- the technical and operating standards and practices.

Plans are already in place to obtain more experimental experience in the coming months.

2. Uniform operating procedures required for temporary authorization for satellite news gathering

2.1 *Introduction*

SNG differs from most other forms of satellite transmissions in a number of ways. For example, the requirement for SNG typically is identified only days, possibly hours, before transmission. It lasts typically for no more than a few days, or at the most, weeks. Nevertheless, the SNG operator has to comply with the regulations of the host country and with a number of procedures which are designed to ensure the proper management and protection of the space segment and frequency spectrum.

The regulatory framework in which an SNG operation takes place has a dual effect on its operational effectiveness. In order to carry out its intended function, the SNG operator must have access to temporary agreements and/or authorizations in a timely and cost-effective manner. The operator's needs range from frequency authorization, to coordination with the space segment entity, to tariffs and administrative costs, to the necessary supporting lines of communication. This section describes the nature of the operational information that is required to assist the SNG capability.

Given that SNG requirements are occasional and/or temporary and that coverage for an unplanned fast-breaking news event is a valuable worldwide service, expeditious approval for activation of portable earth stations is essential.

The successful application of SNG technology requires uniform agreement on standard technical approaches and recognized operating procedures. (See § 5.4.) The frequency and number of programme sound channels as well as the number of auxiliary, data and coordination simplex and duplex channels should be uniformly adopted.

2.2 *Earth station approval*

Earth station approval is necessary to allow the responsible body to ensure compatibility of the SNG terminal with the space segment. To meet this requirement, administrations are requested to consider procedures to permit the SNG terminal to be brought into service as quickly as possible. Administrations are urged to investigate the possibility that an SNG terminal whose technical performance is approved by the space segment providers be accepted on a uniform basis and they are encouraged to complete administrative procedures in close cooperation with SNG operators as expeditiously as possible. A technical report demonstrating the measured performance characteristics should be prepared and be available to the administration. The following technical characteristics should be documented as a minimum:

- Transmit gain as a function of frequency;
- Transmit off-axis gain;
- Transmit main beam e.i.r.p.;
- Transmit beamwidth and polarization;
- Transmit main beam spectral density for the worst 4 kHz;
- Transmit off beam spectral density for the worst 4 kHz;
- Maximum energy dispersal;
- Receive G/T as a function of frequency;
- Cross polarization isolation;
- Receive and transmit frequency agility within the operating bands;
- Spurious emissions (in-band and out-of-band).
- Manufacturers' model numbers, modulation characteristics and frequency stability.

2.3 *Frequency assignment and coordination*

Frequency coordination procedures are derived from international and national regulations. In order to assess the acceptability of an SNG terminal in this respect, the responsible body may require the same information noted above, plus details of the geographical location of the SNG terminal and the anticipated transmission times.

The SNG operator requires in a timely manner radio regulatory authorization by the host administration for operation of the SNG terminal. Co-ordination between the proposed SNG terminal and existing terrestrial radio services is a necessary prerequisite to manage radio interference and allow authorization of the SNG terminal. Frequency coordination for SNG terminals is more difficult in the 6 GHz band, since this band is shared between fixed satellite and fixed terrestrial services and many fixed terrestrial links exist. For reasons of portability and ease of co-ordination, use of higher frequency bands (e.g. 14 GHz and 30 GHz) is beneficial. A portion of the 14 GHz band is not shared with fixed service using radio-relay systems making SNG coordination much easier. In some countries, however, the 14 GHz band is used for fixed and other terrestrial purposes and coordination is, therefore, necessary. The frequency band 29.5-30.0 GHz is assigned exclusively to the FSS (earth to space) on a primary basis. With respect to future technological improvements this band may become suitable for SNG applications. Where coordination is required between the SNG station and the terrestrial links of the host country, it may be different because of the temporary nature of SNG.

2.4 *Space segment booking*

The SNG operator needs to have a quick and clear understanding of what space segment will be available for his purpose in a timely manner (e.g. within less than 24 hours). This information needs to include:

- transponder characteristics, (satellite identifier);
- amount of bandwidth and power;
- earliest available time of access.

The SNG operator may require direct contact with the space segment provider on a continuous basis.

2.5 *Support communications*

In order to facilitate the effective operation of the SNG terminal, support communication channels may be required. Separate, independent transmission support channels are highly desirable. These additional facilities may include required point-to-point microwave, telephone communication systems, two-way simplex/duplex radio, wireless microphones and mobile satellite terminals for voice and data.

In the case of the radio-related services, temporary authorization may be needed to use frequencies at the desired location. This authorization needs to be obtained in a timely fashion, and to the extent possible, in advance of actual equipment deployment. Also, it is necessary to have information with respect to the technical acceptability of particular equipment which might be used.

In addition, it may be necessary typically to have a few or many telephone lines. These are critical to the proper functioning of the SNG. The SNG operator will require cost-effective (including a clear definition of tariffs and services) and reliable access to such telephone lines, and will need to have knowledge of the actual circuit availability involved.

2.6 *Radiation hazards*

It is essential to protect the public and personel from hazardous radiation. Many administrations have established standards for safe exposure to radio (non-ionizing) radiation which are a function of frequency, power level and duration of exposure.

SNG operators should comply with permitted radiation standards (health and safety) established by the host country. Where the host has not established its own standards the World Health Organization (WHO) standards should be used.*

Operators must carefully consider the siting and configuration of specific installations, and the access of both occupational personnel and the general public, when applying applicable maximum exposure cirteria.

A danger area around the SNG terminal shall be identified, checked and clearly marked.

2.7 *Importation and customs*

The SNG Operator should have a sufficient understanding of the importation and customs system of the host country. This is particularly important when there is frequent news gathering and where facilities in that country cannot be used.

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* WHO develops health criteria in conjunction with the International Non-Ionizing Radiation Committee of the International Radiation Protection Association.

2.8 *Contact point for information, guidance and approval*

Each administration or relevant organization should, if possible, establish a designated point of contact (DPC) for SNG, which should be available for 24 hours per day, seven days per week.

This contact point should be available for assistance to facilitate temporary authorization of SNG earth stations owned by foreign operators through intermediating exchange of information necessary for authorization procedures and frequency coordination and providing guidance for the administrative procedures of the host country.

It is considered necessary to exchange the information shown in Table V.

TABLE V

Information to be given to the Administration	*Information to be received from the Administration*
1. Service characteristics (e.g. TV standard, number and type of audio channels, number of telephone support circuits	1. Enquiry reference
2. Time and duration of service	2. Ordering entity
3. Uplink and downlink location	3. Other authorizing sections to be routed to
4. Intended space segment	4. Custom contact points
5. SNG earth terminal characteristics (e.g. existing application, identification code, frequency band, maximum e.i.r.p., antenna transmit pattern, modulation methods)	5. Tariff information
6. Transmission support (e.g. microwave, etc.)	6. Safety standards

3. Satellite parameters relevant to satellite news gathering (television)

3.1 *Introduction*

This section gives information on several characteristics of current and planned satellites relevant to the design and operation of SNG terminals for international connection and to the performance possible.

3.2 *Uplinks*

3.2.1 *Orbit spacing*

Satellite systems may use orbit spacings as low as 2°. For actual SNG operations the particular established satellite configurations in the orbital arc appropriate for the required circuit need to be taken into account.

Details of current satellites are available from the IFRB.

Some administrations require that a transmitting satellite earth station have an antenna radiation pattern designed to ensure that sidelobe peaks do not exceed $G = (29 - 25 \log \phi)$ dBi, at least in the direction of the geostationary orbit. Further information is given in §1.2.3.3.

3.2.2 *Frequency bands*

Frequency bands identified as operationally preferable for SNG uplinks are those above 10 GHz. Currently available satellites use the bands near 14 GHz and near 30 GHz. There is preference for use of the 14 GHz band for which the technology is sufficiently mature.

3.2.3 *Uplink service areas*

Uplink service areas fall into two general categories:

- national
- international.

Nations spanning large areas sometimes use large satellite antenna beamwidths which would be more appropriately categorised as "continental".

3.2.4 *Satellite G/T*

The predominant factor governing G/T performance is the size of the uplink service area. National beams generally have higher gain antennas, more suitable to the low e.i.r.p.s from SNG terminals.

The more common configuration is for large uplink service areas - national and international - resulting in G/T values of zero or in some cases negative at the edge of the beam.

To be as flexible as possible, the SNG terminals should be capable of working to satellite G/T values as low as -6 dB(K^{-1}), even if with lower performance. It is desirable for normal operation to take account of satellite values of 0 dB(K^{-1}).

3.2.5 *Satellite gain*

Satellites are often equipped with variable gain settings to achieve a higher e.i.r.p. Lower gain values have been shown to provide improved overall performance for SNG applications.

As it is not always possible to change satellite gain settings for short-term use, SNG terminals should be capable of operating with nominal satellite gain settings and the downlink receiver should be appropriately dimensioned.

3.2.6 *Bandwidth*

It may be possible to carry SNG on a shared basis with other television signals, and/or SCPC communication channels, depending on the transponder bandwidth available and its intermodulation characteristics.

3.2.7 *Channel plans for satellites*

Satellites often make use of overlapping channels with orthogonal polarization separation. Account needs to be taken of interference in relation to each specific satellite, in particular the polarization discrimination requirements.

3.2.8 *Future design possibilities*

Steerable antennas

Advantages of steerable satellite beams have been demonstrated by Intelsat. This allows a narrow beam antenna to be directed to the SNG earth station location to provide improved performance.

3.3 *Connectivity*

Satellites generally have some levels of connectivity (on-board switching) flexibility ranging from switching to spare components to variable interconnection of input amplifiers, output amplifiers and antenna beams. Use of variable connectivity depends on the satellite operator and may be related to the level of reliability and the inter-relationship of the satellite hardware affected by any change.

Where available, reconfiguration of connectivity may be useful in establishing the desired circuit. In some satellites it may be possible to connect 14 GHz band uplink capacity to, for example, 4 GHz band downlink circuits, however, two-way communication channels can sometimes be affected.

Improved flexibility in future satellites may be of benefit to SNG operations.

3.4 *Downlink*

3.4.1 *Downlink service area*

It is necessary that the downlink service area encompasses the intended receiving site. For ease of establishment, for communications and for monitoring, it is also highly desirable that the SNG terminal site be capable of reception of signals from the satellite.

4. Satellite news gathering for sound broadcasting

4.1 *Need for SNG (sound)*

Broadcasting organizations may need an application of SNG (sound) for the coverage of news and other events. Situations warranting such applications are:

- non-availability of normal terrestrial links having required baseband capacity (30 Hz-10 kHz), either due to remoteness of the location or due to disruption, as in the case of a natural disaster;

- news dispatches requiring high reliability, with minimum human intervention;

- requirement of instantaneous broadcast coverage of a news event.

4.2 *Available techniques*

The operational requirement for SNG (sound) can be realized by utilizing portable uplink terminals operating with dedicated or leased space segment capacity from any satellite system compatible with the technical characteristics of the SNG terminal.

In order to allow origination of carriers from different geographical locations, SNG (sound) may utilize an SCPC system operated in:

- dedicated transponder mode, where multiple carriers exist within the same transponder;

- edge of transponder operation, where narrow-band, low-level carriers may be added at the edge of a transponder band in addition to a TV signal.

A hand-carried personal communications device (PCD) would provide a baseband of 100 Hz-3 kHz (telephone quality). In this case, independent satellites such as the Inmarsat Standard A system and future systems utilizing amplitude companded single sideband (ACSSB), narrow-band frequency modulation (NBFM) and voice coder/decoder (vocoder) technology could be applicable.

4.3 *Quality objective*

For SNG applications, the performance objective for the sound programme signals at the receive earth station of the broadcaster shall be:

- S/N	:	50 dB (weighted), or higher if digital technique is used;
- Gain/frequency response:	}	as per Recommendation 504-2 (Geneva, 1982)
- Non-linear distortion:		

When received at the SNG terminal, the quality objective given above could be relaxed by the user.

4.4 *Appropriate frequency band*

Practically all the bands allocated to the FSS can be utilized for SNG (sound). In addition, this service can also be operated in the mobile-satellite service (MSS) bands, by employing a PCD (see §4.2).

SNG terminals as defined in this Report are feasible in the bands indicated below:

6/4 GHz or 6/2.6 GHz

These bands are being used extensively in existing satellite systems and provide intercontinental, continental or national coverage, however, the SNG terminals would be considered transportable.

14/11 GHz, 14/12 GHz or 30/20 GHz

The 14/11 GHz and higher frequency bands are suitable, even though these bands have the disadvantage of greater attenuation due to rain. In temperate climates, however, the use of these bands would allow a further reduction of the size of the antenna and can open the way to the ideal situation where just one reporter carrying a small suitcase could access a satellite from anywhere within the service area.

In the case of relaxed quality objectives (§4.3), the 1.6 GHz band could be used with a PCD.

4.5 *Technical characteristics*

In order to allow flexibility of operation, SNG terminals should be compatible to operate with a wide range of spacecraft parameters. However, for the nominal case, the typical satellite and operating parameters are given in Tables VI and VII, respectively.

TABLE VI - *Example of satellite characteristics for SNG (sound)*

Frequency up/down (GHz)	G/T (Edge of coverage area) (dB(K^{-1}))	Saturation power flux-density (single carrier) (dB(W/m^2))	E.i.r.p. (saturation) (Edge of coverage area) (dBW)
6/2.6	-5	-87	42
6/4	-5	-85	32
14/11	-3	-85	36
30/20	+0.5	-82	48

The antenna must be as small as possible. Since the terminal is required to receive downlink audio, the antenna size cannot be reduced arbitrarily by increasing the rating of the high-power amplifier (HPA). Furthermore, Rec. 524-2 (MOD I) specifies limits on the off-axis power spectral density (PSD) in the 6 and 14 GHz bands and this imposes constraints for the reduction of antenna size. Report 1001 also deals with the off-axis PSD for the frequency range 10-15 GHz.

In the case of a 6/4 GHz band SNG terminal, the above limitations can be satisfied by utilizing a 2.4 m antenna. This will yield a receive system G/T of the order of 19 dB(K^{-1}) at 4 GHz. Adaptive energy dispersal may be required with an FM-SCPC carrier. Use of a solid state power amplifier (SSPA) instead of a travelling wave tube amplifier (TWTA), wherever practicable, would make the SNG terminal more compact.

In the case of the 14/11, 14/12 and 30/20 GHz bands, even smaller antennas, up to 1.2 m, could be used. The receive system G/T of the SNG terminal in these bands is required to be of the order of 17 dB(K^{-1}).

The following features of the SNG terminal will add to its flexibility of operation:

- adjustable e.i.r.p. settings,
- ability to change the modulation deviation characteristic at the IF modulator stage,
- synthesizer-tuned upconverter,
- adjustable setting for polarization.

TABLE VII - *Example of SNG (sound) system characteristics*

Frequency up/down (GHz)	Antenna diameter (m)/ transmit gain (dBi)	Trans-mitter power (dBW)	Band-width (kHz)	C/N up (dB)	Receive sustem G/T ($dB(K^{-1})$)	C/N down (dB)	Post-detection S/N (dB) (weighted)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
6/2.5	2.4/41.5	12.5	200	24.76	(a) 9 (b) 17	7.5 15.5	44.5 52
6/4	2.4/41.5	14	200	26.26	(a) 18.6 (b) 29	4.4* 13.8	40.4 50.6
14/11	1.8/46.4	9.4	200	21.6	(a) 18.5 (b) 29	5.5* 15	41.4 51.1
14/11	2.5/50	20	(2 Mbit/s) ~2000	18	24	12	>70
30/20	1.2/49.5	9.8	200	21.6	(a) 16.8 (b) 29	4.6* 15.8	40.6 51.7

(1) G/T at (a) indicates the value for SNG terminal whereas (b) indicates the minimum value at the broadcaster's base station.

(2) Use of a threshold extension device has been assumed for demodulation at the SNG terminal.

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* predetection bandwidth: 52 dBHz.

4.6 *Modulation methods*

This report is based on FM-SCPC, since this type of modulation is quite effective in a power-limited environment. Nevertheless, other modulation methods such as PCM/PSK, delta-modulated PSK, etc., could be used if permitted by the system.

In the case of PCD, real-time transmission will be limited to a baseband of telephone quality. Additional processing such as that obtainable with a 2.4 kbit/s vocoder yields higher reliability at the cost of voice quality while still maintaining intelligence. More processing, such as store forward, to yield bandwidth compression would allow 4.8 kbit/s vocoder quality at the cost of longer transmissions. Inmarsat standard "A" provides telephone quality and the system uses a 1.2 m dish at 1.6 GHz.

4.7 *Communication requirements for supervision and coordination*

SNG uplink signals are often originated from remote areas. In these cases, communications using public switched telephone network (PSTN) is difficult or impossible. The SNG system should, therefore, include equipment to support independent, two-way voice/data communications between:

- the SNG terminal and the control centre of the satellite operator;
- the SNG terminal and the broadcaster's headquarters.

5. **Minimum requirements applicable to SNG (television) terminals**

5.1 *General functional requirements*

An SNG terminal must be able to: be rapidly deployed, transmit (with a minimum of impairments) video and associated audio signals, provide limited receiving capability to point the antenna and monitor (where possible) the transmitted signals, and provide two-way communications for operation and control.

5.2 *Transmission performance requirements*

5.2.1 *Video signal*

Shall be compliant with Recommendation 567-2, except possibly for signal-to-noise ratio.

5.2.2 *Audio signal*

Shall be compliant with Recommendation 505-3, except possibly for signal-to-noise ratio.

5.3 *Equipment requirements*

5.3.1 *Antenna*

5.3.1.1 *Off-axis e.i.r.p density*

Shall be compliant with Recommendation 524-2 (MOD I) or the satellite operator's requirements, whichever is more stringent.

5.3.1.2 *On-axis e.i.r.p. (14 GHz)*

When using a 1.8 m antenna and a 300-W HPA, the on-axis e.i.r.p. is nominally 70 dBW.

5.3.1.3 *Polarization discrimination requirements*

Polarization discrimination should be better than 35 dB within the -1 dB points of the main axis of the beam and 30 dB elsewhere. However, SNG earth stations generally operate with low e.i.r.p., so a corresponding reduction in polarization discrimination performance may be accepted by the satellite system operator.

5.3.2 *Video/audio exciter*

This unit should include:

- a video low pass filter and switchable pre-emphasis networks, dependent on the television standard;
- selectable IF bandpass filters, dependent on the transponder bandwidth;
- a minimum of two frequency agile sound subcarrier modulators, adjustable between 5.5 and 8.0 MHz;
- a dispersal generator, the deviation of which can be easily adjusted, if required, between 0.5 and 3.0 MHz p-p;
- power control, with a minimum range of 30 dB;
- a linear video FM modulator capable of deviating the IF carrier between 7.0 and 15.0 MHz peak and capable of preserving the DC component of the video signal to take advantage of the available bandwidth;
- a frequency agile upconverter (14.0 to 14.5 GHz) with a 250-kHz step size. The phase noise and frequency stability should be adequate to allow upconversion of the auxiliary communication signals.

5.3.3 *Communication equipment*

The minimum requirement for SNG communication equipment should be consistent with the technical considerations given in §1.2.5.5.

5.4 *Requirements for operational procedures*

When the SNG operator determines that there is a need to operate in another country he must comply with the operational procedures of the host country and the satellite system which he intends to use. The easiest way to accomplish this is to use an SNG operator's guide which would be available from the host Administration and from each satellite system.

The contents of these guides should be as harmonized as possible.

5.4.1 *Space segment guide*

The minimum information to be contained in a satellite space segment provider's guide for SNG users is:

- General description;
- Definition of terms used in the user's guide;
- Description of the approval procedures to access the appropriate satellite;
- Booking procedures to obtain the required space segment;
- Radio regulatory and frequency clearance matters relevent to the planned transmission;
- List of contact points in the individual countries;
- Pre-transmission preparatory tests;
- Satellite access procedures;

- Operations control coordination and communications procedures and requirements;
- Operating conditions.

5.4.2 *Administration guide*

The minimum information to be contained in an Administration's guide to SNG operators in that country is:

- General description of the specific situation and rules for SNG operations (e.g., radiation hazard);
- How to contact the designated point of contact (DPC);
- The procedure on how to obtain authorizations for SNG and related services;
- References to satellite operators' guides;
- Possible services that are available, e.g., for support communications;
- Tariff information.