

Rai – OB engineering – TV Production Department

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Rai - Experience on ENG and TVOB spectrum usage

08/03/2006

Rai fleet - OB/SNG spectrum usage

Programs & Contributions Transport to Production center(s) -1

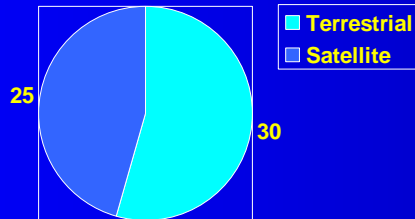
Large sized Production OBVAN	14		14--18	2	7 GHz
Medium sized Production OBVAN	7		5	2	7 GHz
High Eirp Satellite Mobile Station (72 DbW)	7		2-3 *	2 (ASI MUX.)	14-14.5 Ghz
SNG VAN (Regional OB)	14		2-3	1	14-14.5 GHz
Terrestrial Microwave Link VAN	5			2	7 GHz
Flyaway		4		1	14-14.5 GHz
Giro d'Italia VAN (Italian Cycling Tour)	4			4	7 GHz
Giro d'Italia RF System (Italian Cycling Tour)			8		

* Studio contributions

Rai fleet - OB/SNG spectrum usage

Programs & Contributions Transport to Production center(s) -2

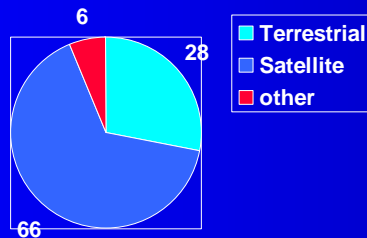
Subdivision of OB & SNG Van operating in Satellite or Terrestrial segments



The terrestrial segment

- The terrestrial segment mainly is based on 7 GHz band
- The 7 GHz band has been assigned by Administration for temporary point to point links
- The 7 GHz band is becoming more populated
- Actually using 7 GHz band requires more coordination actions
- The terrestrial spectrum segment is used mainly for OBTV operations
- Rarely used for ENG purposes
- Not yet used for digital links (some test done)
- On-Air up to 4 hour or more.

Subdivision % of link operations made in year 2005 (tot.6400) by segment



The satellite segment

- 62-65 dBW Eirp
- Mpeg2 4:2:2
- Two ASI channels can be tied together in a single stream TX
- Choice of different bit-rates for meet content quality requirements
- Mainly used for the delivery of ENG content and News contribution
- Studio program contribution
- Quick access to Rai transponder channels
- 8 x 6.6 Mbit/s maximum SNG channels available at same time on a 36 MHz bandwidth Satellite channel.
- Maximum allowable bitrate :26,66 Mbit/s (high quality contribution)
- On-Air up to ½ hour or more depending on the event

Rai TVOB - spectrum usage Microwave bands

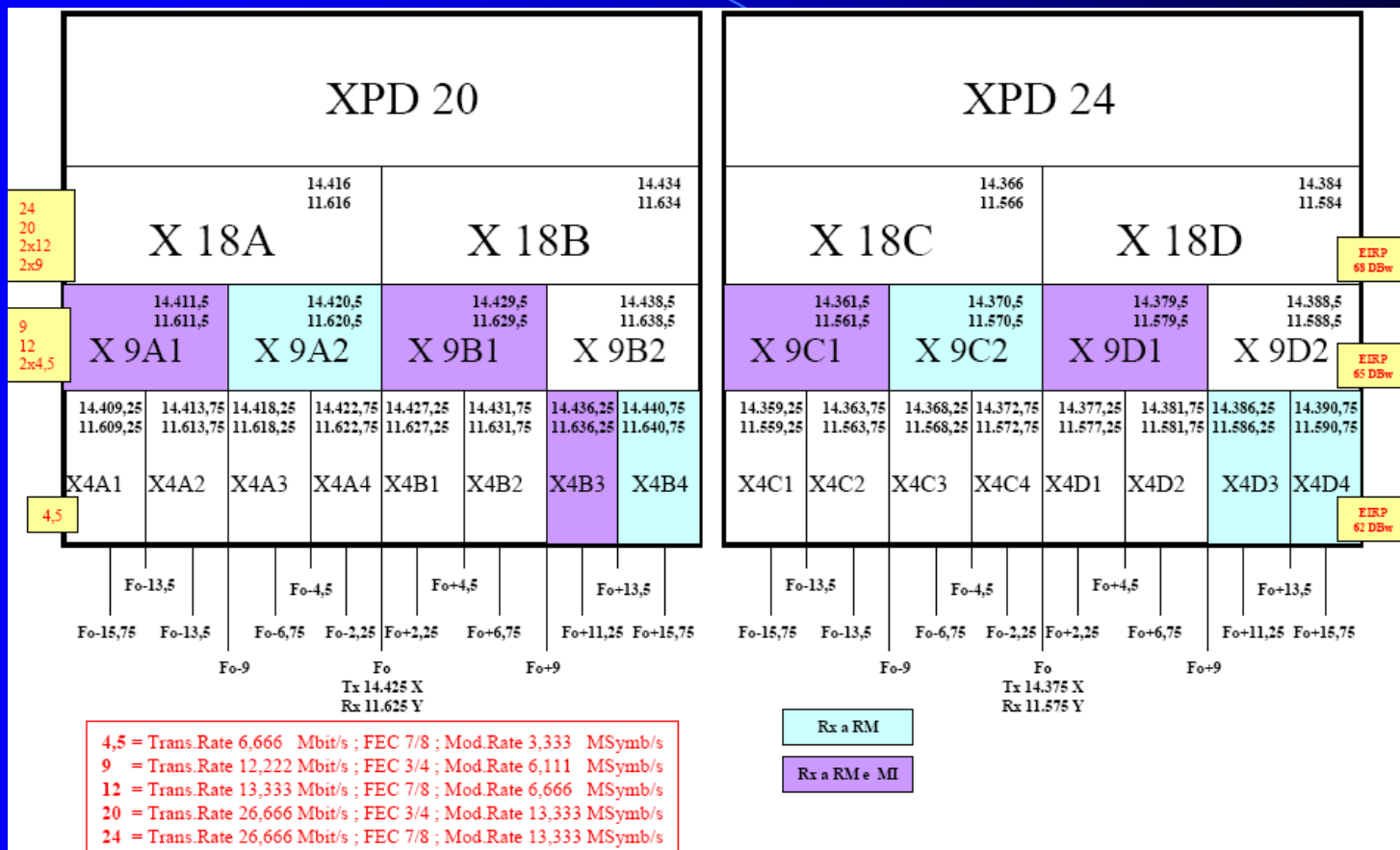
Frequencies (MHz)	Systems	Use
6428 – 7128 10380 - 10688 11771 – 12513 21200 - 21788	microwave radio links	Outdoor

Systems	Modulation	Channel spacing (MHz)	Tx output power [dBm]	Peak deviation (MHz)
Analog microwave radio systems (Antenna Gain 30 dB)	FM	28	26	8

- The 7 & 10 & 11 & 21 GHz band assigned by Administration for temporary links
- These bands are used involving the Administration
- The 10 & 11 GHz band cannot be used because of massive interferences
- The 21 GHz Band is very rarely used
- 6 Audio channels are coded PCM, companded, multiplexed and transported using a 7.2 MHz 4PSK modulated subcarrier.

Rai SNG – Digital channels bandwidth allocation example

EXPRESS 3A satellite (11°OVEST)



Rai ENG - spectrum usage Equipments used in the 2.5-2.7 GHz band -1

Frequencies (GHz)	Systems	Use
2,5 - 2,7	Wireless camera	Indoor-outdoor
	Portable video link Mobile video link	Outdoor

Systems	Modulation	Channel spacing (MHz)	Tx output power	Peak-Peak deviation (MHz)
Analog wireless camera	FM	28	100/200 mW	8
Analog portable video link	FM	28	2 W	8
Analog Mobile vehicular video link	FM	28	4 W	8
Digital 4 K COFDM wireless camera	64QAM	8	40 mW	
Digital 2K COFDM portable video link and Mobile vehicular video link	QPSK-16QAM 64QAM	8	100mW 1-5 W	

- A total of 90 of this type of wireless systems are used by Rai in different events
- 50 Analog Wireless Camera
- 30 Digital Wireless Camera
- 10 Digital Radio Link

Rai ENG - spectrum usage

Equipments used in the 2.5-2.7 GHz band -2

Class of equipments tested on field

- Digital 2K carriers COFDM wireless camera
- Digital 2K carriers COFDM portable video link
- Digital 2K carriers COFDM video link while the vehicle is moving (motorcycles - elycopters)

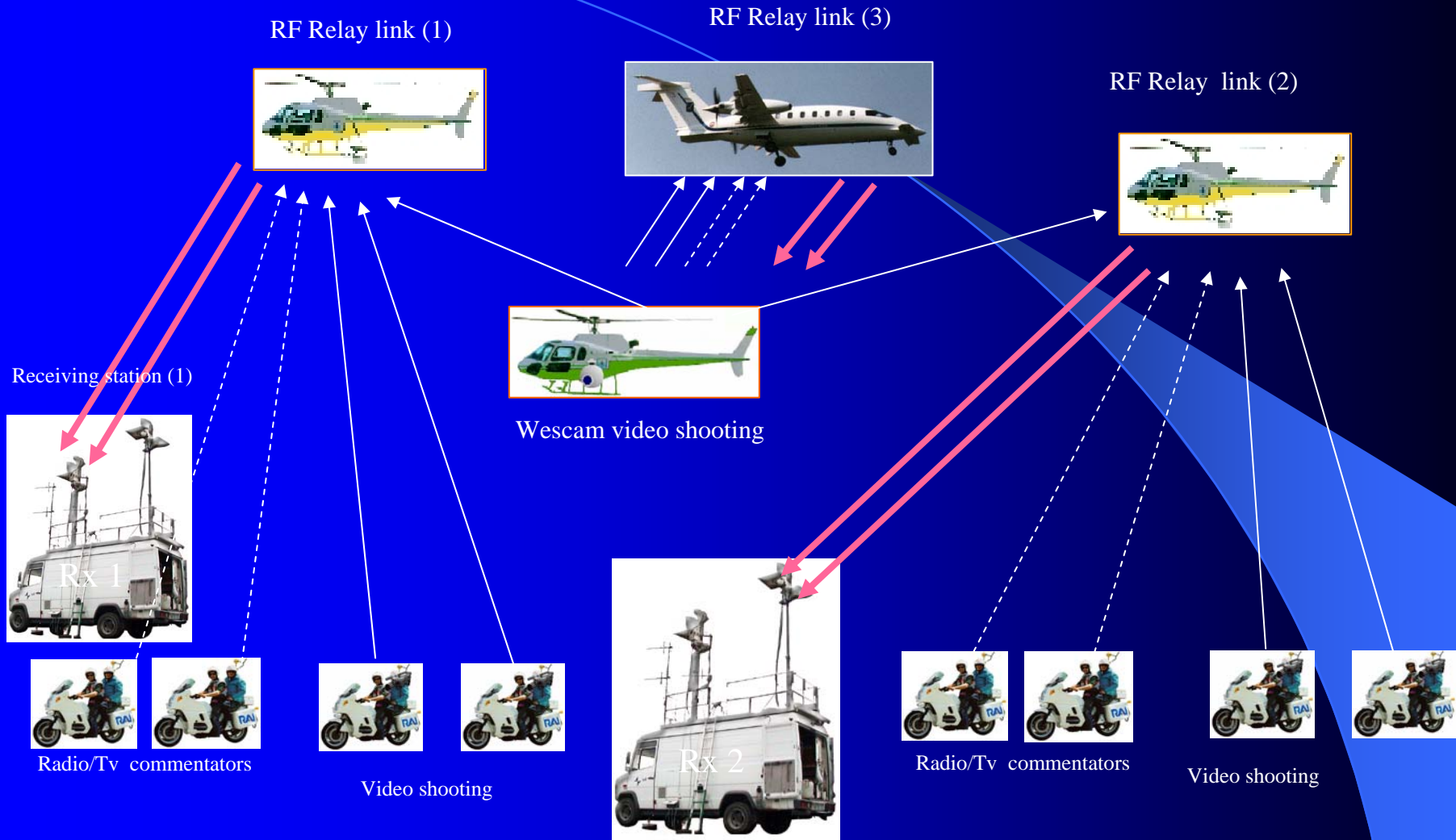
Events where the use of these type of wireless equipments are considered essential

- Large Sport events (Italian Cycling Tour, Formula 1 Race, ecc.)
- World event Live SNG (The coverage of Pope funeral event in Rome have been done using this type of equipments extensively)

Digital technologies

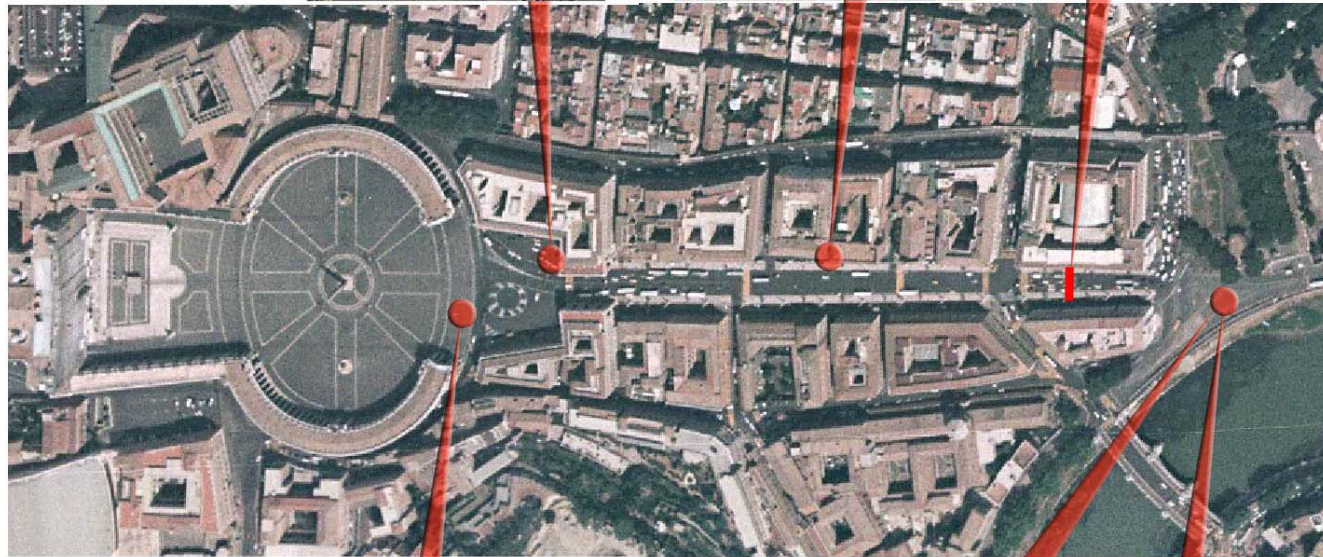
- COFDM modulation -> 8 MHz channel bandwidth -> better use of the spectrum for ENG
- Low delay coding
- 4:2:2 for video bit-rates ranging from 6.6 to 24 Mbit/s
- 4:2:0 when the link reliability is much more important than quality
- Short distance (up to 300 m.) may be covered with 100 mW.
- Small and lightweight R.F. equipments are actually available
- Extended service time with the same battery capacity used for Analog transmission.
- 1W booster for very unusual applications, when it is required to cover long distances or the robustness of signal is of primary importance (like Italian Cycling Tour)

Rai ENG - spectrum usage for sport Italian Cycling Tour example



7 GHz Analog Links
2,5 GHz Digital&Analog Links
UHF Audio Links

Rai ENG - spectrum usage The R.F. coverage of Pope funeral in Rome



Rai ENG - spectrum usage The 2.0-2.7 GHz band in Italy

Band (Mhz)	Services
2010-2025	UMTS
2040-2100	Fixed RF links
2110-2210	UMTS
2220-2290	Fixed RF links
2290-2460	Private Subjects
2460-2485	WI-FI
2485-2700	Free Access

Intensive spectrum utilization

- The 2485-2700 band is used by Rai for ENG
- The 2485-2700 band is intensively used by Rai for large Sports events (scheduled locations, scheduled locations on routes) ; often facing interference or channels still in use by other subjects
- During large sport events, many subjects, covering the same event, attempt to use the same band
- Could be useful to consider the use of 3.4-3.6 GHz band as an additional ENG band.
- ENG requires un-planned acces, two COFDM channels should be pre assigned for Public Services
- The experience done on field led us to be flexible in using this spectrum:, at least using some frequencies found to be free at that time, at that location!
- Frequency agility is becoming a must.

Rai wireless microphone and radiocommunication systems

Short distance coverage -1

Frequencies (MHz)	Systems	Use
174,000 - 223,000	High quality wireless microphones Unidirectional communication systems Bidirectional communication systems	Indoor-outdoor Program making and special events
470,000 - 854,000	High quality wireless microphones Unidirectional communication systems Bidirectional communication systems IEMs	

Systems	Modulation	Channel spacing (KHz)	Tx output power	AF Bandwidth (KHz)	Peak deviation (KHz)
Full duplex belt transceiver	FM	25	50mW	5	4.5
Full duplex Transmitter Module	FM	25	300mW	5	4.5
High quality Wireless microphone	FM	400	50mW	20	56
Unidirectional Transmitter Module	FM	25	300mW-2W	5	4.5
In Ear Monitor Transmitter	FM	400	100mW	15	50
Digital talk-back (DECT 1.9GHz)	QPSK		avr. 4mW; burst 250mW	7.1	

Rai wireless microphone and radiocommunication systems

Short distance coverage -2

- Rai has recently started using some digital talk-back systems using DECT technology in indoor environments; since it has been a positive experience, we are going to continue with it and test it also in outdoor environments.
- The next step will be the testing of digital reporter systems using 8PSK modulation and 250 KHz bandwidth in the upper UHF TV band (800-854 MHz), mainly for outdoor sport events coverage.
- Until now, considering indoor use, we didn't experience many interferences among the above mentioned systems and DTTB or DAB; some minor problems have been reported from outdoor use of wireless microphones, mainly in the VHF band.

Rai wireless microphone and radiocommunication systems Long distance coverage

Frequencies (MHz)	Systems	Use
459,325 - 459,925 469,325 - 469,925	- Bidirectional communication systems	Indoor-outdoor

Systems	Modulation	Channel spacing (KHz)	Tx output power	Peak deviation (KHz)
Bidirectional communication systems	FM	25	2-10W	3

A new regulation should be issued by Administration changing the channel spacing to half.
Rai is studying to move to digital systems

Rai ENG – Final considerations

- Rai, as well as other broadcasters, would like to increase the services number delivered using this band for ENG.
- Rai has got quite a lot of similar Analog R.F. equipments using this band.
- The renovation of the analog technology with the digital one will be possible only if such a band is available for these services.

Rai - Experience on ENG and TVOB spectrum usage

Thank you for your attention.