ANEXOS

Anexo 1.1

MTC, Parte del Plan Nacional de Asignación de Frecuencias.

MHz
2 900 – 5 000

REGION 2	PERU	
	ATRIBUCION	NOTAS Y OBSERVACIONES
2 900 – 3 100 RADIONAVEGACION RADIOLOCALIZACIÓN	**2 900 – 3 100** RADIONAVEGACION RADIOLOCALIZACIÓN	P70, P71, P72
3 100 – 3 300 RADIOLOCALIZACION	**3 100 – 3 300** RADIOLOCALIZACION	
3 300 – 3 400 RADIOLOCALIZACION Aficionados Fijo Móvil	**3 300 – 3 400** RADIOLOCALIZACION Radioaficionados Fijo Móvil	
3 400 – 3 500 FIJO FIJO POR SATELITE (espacio-Tierra) Aficionados Móvil Radiolocalización	**3 400 – 3 500** FIJO FIJO POR SATELITE (espacio-Tierra) Radioaficionados Móvil Radiolocalización	P47, P73
3 500 - 3 700 FIJO FIJO POR SATELITE (espacio-Tierra) MOVIL salvo móvil aeronáutico Radiolocalización	**3 500 - 3 700** FIJO Fijo Por Satélite (espacio-Tierra) Móvil salvo móvil aeronáutico Radiolocalización	P73
3 700 – 4 200 FIJO FIJO POR SATELITE (espacio-Tierra) Móvil salvo móvil aeronáutico	**3 700 – 4 200** FIJO FIJO POR SATELITE (espacio-Tierra) Móvil salvo móvil aeronáutico	
4 200 – 4 400 RADIONAVEGACION AERONAUTICA	**4 200 – 4 400** RADIONAVEGACION AERONAUTICA	P74
4 400 – 4 500 FIJO MOVIL	**4 400 – 4 500** FIJO MOVIL	P92
4 500 – 4 800 FIJO FIJO POR SATELITE (espacio-Tierra) MOVIL	**4 500 – 4 800** FIJO FIJO POR SATELITE (espacio-Tierra) MOVIL	P75, P92
4 800 – 4 990 FIJO MOVIL Radioastronomía	**4 800 – 4 990** FIJO MOVIL Radioastronomía	P76, P92
4 990 – 5 000 FIJO MOVIL salvo móvil aeronáutico RADIOASTRONOMIA Investigación espacial(pasivo)	**4 990 – 5 000** FIJO MOVIL salvo móvil aeronáutico RADIOASTRONOMIA Investigación espacial(pasivo)	P92

MHz
5 000 – 5 570

REGION 2	PERU	
	ATRIBUCION	NOTAS Y OBSERVACIONES
5 000 – 5 010 RADIONAVEGACION AERONAUTICA RADIONAVEGACIÓN POR SATÉLITE (Tierra-espacio)	**5 000 – 5 010** RADIONAVEGACION AERONAUTICA RADIONAVEGACIÓN POR SATÉLITE (Tierra-espacio)	
5 010 – 5 030 RADIONAVEGACION AERONAUTICA RADIONAVEGACIÓN POR SATÉLITE (Tierra-espacio) (espacio-espacio)	**5 010 – 5 030** RADIONAVEGACION AERONAUTICA RADIONAVEGACIÓN POR SATÉLITE (Tierra-espacio) (espacio-espacio)	P77, P79
5 030 – 5 150 RADIONAVEGACION AERONAUTICA	**5 030 – 5 150** RADIONAVEGACION AERONAUTICA	P78, P79, P80
5 150 – 5 250 RADIONAVEGACION AERONAUTICA FIJO POR SATELITE (Tierra-espacio) MÓVIL salvo móvil aeronáutico	**5 150 – 5 250** RADIONAVEGACION AERONAUTICA FIJO POR SATELITE (Tierra-espacio) Móvil salvo móvil aeronáutico	P78, P81, P82
5 250 – 5 255 EXPLORACIÓN DE LA TIERRA POR SATÉLITE (activo) RADIOLOCALIZACION INVESTIGACIÓN ESPACIAL MÓVIL salvo móvil aeronáutico	**5 250 – 5 255** EXPLORACIÓN DE LA TIERRA POR SATÉLITE (activo) RADIOLOCALIZACION INVESTIGACIÓN ESPACIAL Móvil salvo móvil aeronáutico	P83, P84
5 255 – 5 350 EXPLORACIÓN DE LA TIERRA POR SATÉLITE (activo) RADIOLOCALIZACION INVESTIGACIÓN ESPACIAL (activo) MÓVIL salvo móvil aeronáutico	**5 255 – 5 350** EXPLORACIÓN DE LA TIERRA POR SATÉLITE (activo) RADIOLOCALIZACION INVESTIGACIÓN ESPACIAL (activo) Móvil salvo móvil aeronáutico	P83, P84
5 350 – 5 460 EXPLORACIÓN DE LA TIERRA POR SATÉLITE (activo) INVESTIGACIÓN ESPACIAL (activo) RADIONAVEGACION AERONAUTICA RADIOLOCALIZACIÓN	**5 350 – 5 460** EXPLORACIÓN DE LA TIERRA POR SATÉLITE (activo) INVESTIGACIÓN ESPACIAL (activo) RADIONAVEGACION AERONAUTICA RADIOLOCALIZACIÓN	P85, P86, P87, P88
5 460 – 5 470 RADIONAVEGACION EXPLORACIÓN DE LA TIERRA POR SATÉLITE (activo) INVESTIGACIÓN ESPACIAL (activo) RADIOLOCALIZACIÓN	**5 460 – 5 470** RADIONAVEGACION EXPLORACIÓN DE LA TIERRA POR SATÉLITE (activo) INVESTIGACIÓN ESPACIAL (activo) RADIOLOCALIZACIÓN	P85, P86, P88
5 470 – 5 570 RADIONAVEGACION MARITIMA MÓVIL salvo móvil aeronáutico EXPLORACIÓN DE LA TIERRA POR SATÉLITE (activo) INVESTIGACIÓN ESPACIAL (activo) RADIOLOCALIZACIÓN	**5 470 – 5 570** RADIONAVEGACION MARITIMA MÓVIL salvo móvil aeronáutico EXPLORACIÓN DE LA TIERRA POR SATÉLITE (activo) INVESTIGACIÓN ESPACIAL (activo) RADIOLOCALIZACIÓN	P83, P88, P90

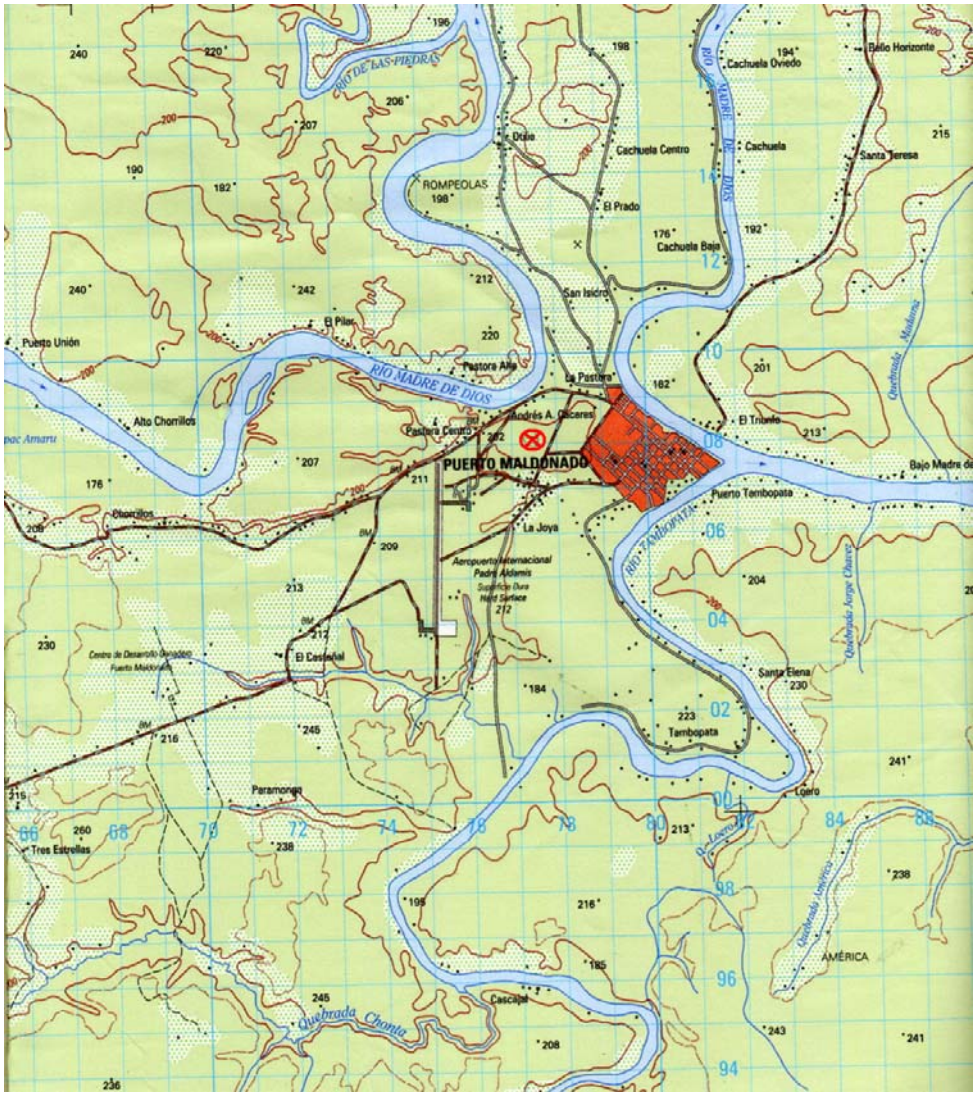
MHz
5 570 – 7 250

REGION 2	PERU	
	ATRIBUCION	NOTAS Y OBSERVACIONES
5 570 – 5 650 RADIONAVEGACION MARITIMA MÓVIL salvo móvil aeronáutico RADIOLOCALIZACIÓN	**5 570 – 5 650** RADIONAVEGACION MARITIMA MÓVIL salvo móvil aeronáutico RADIOLOCALIZACIÓN	P83, P89, P90
5 650 – 5 725 RADIOLOCALIZACION MÓVIL salvo móvil aeronáutico Aficionados Investigación espacial(espacio lejano)	**5 650 – 5 725** RADIOLOCALIZACION MÓVIL salvo móvil aeronáutico Radioaficionados Investigación espacial (espacio lejano)	P47, P83
5 725 – 5 830 RADIOLOCALIZACION Aficionados	**5 725 – 5 830** RADIOLOCALIZACION Radioaficionados	P23
5 830 – 5 850 RADIOLOCALIZACION Aficionados Aficionados por satélite (espacio-Tierra)	**5 830 – 5 850** RADIOLOCALIZACION Radioaficionados Radioaficionados por satélite (espacio-Tierra)	P23
5 850 – 5 925 FIJO FIJO POR SATELITE (Tierra-espacio) MOVIL Aficionados Radiolocalización	**5 850 – 5 925** FIJO FIJO POR SATELITE (Tierra-espacio) MOVIL Radioaficionados Radiolocalización	P23
5 925 – 6 700 FIJO FIJO POR SATELITE (Tierra-espacio) MOVIL	**5 925 – 6 700** FIJO FIJO POR SATELITE (Tierra-espacio) MOVIL	P92
6 700 – 7 075 FIJO FIJO POR SATELITE (Tierra-espacio)(espacio-Tierra) MOVIL	**6 700 – 7 075** FIJO FIJO POR SATELITE (Tierra-espacio)(espacio-Tierra) MOVIL	P75, P78, P92
7 075- 7 145 FIJO MOVIL	**7 075- 7 145** FIJO MOVIL	P91, P92
7 145 – 7 235 FIJO MOVIL INVESTIGACIÓN ESPACIAL (Tierra-espacio)	**7 145 – 7 235** FIJO MOVIL INVESTIGACIÓN ESPACIAL (Tierra-espacio)	P91, P92
7 235 – 7 250 FIJO MOVIL	**7 235 – 7 250** FIJO MOVIL	P91, P92

Anexo 4.1

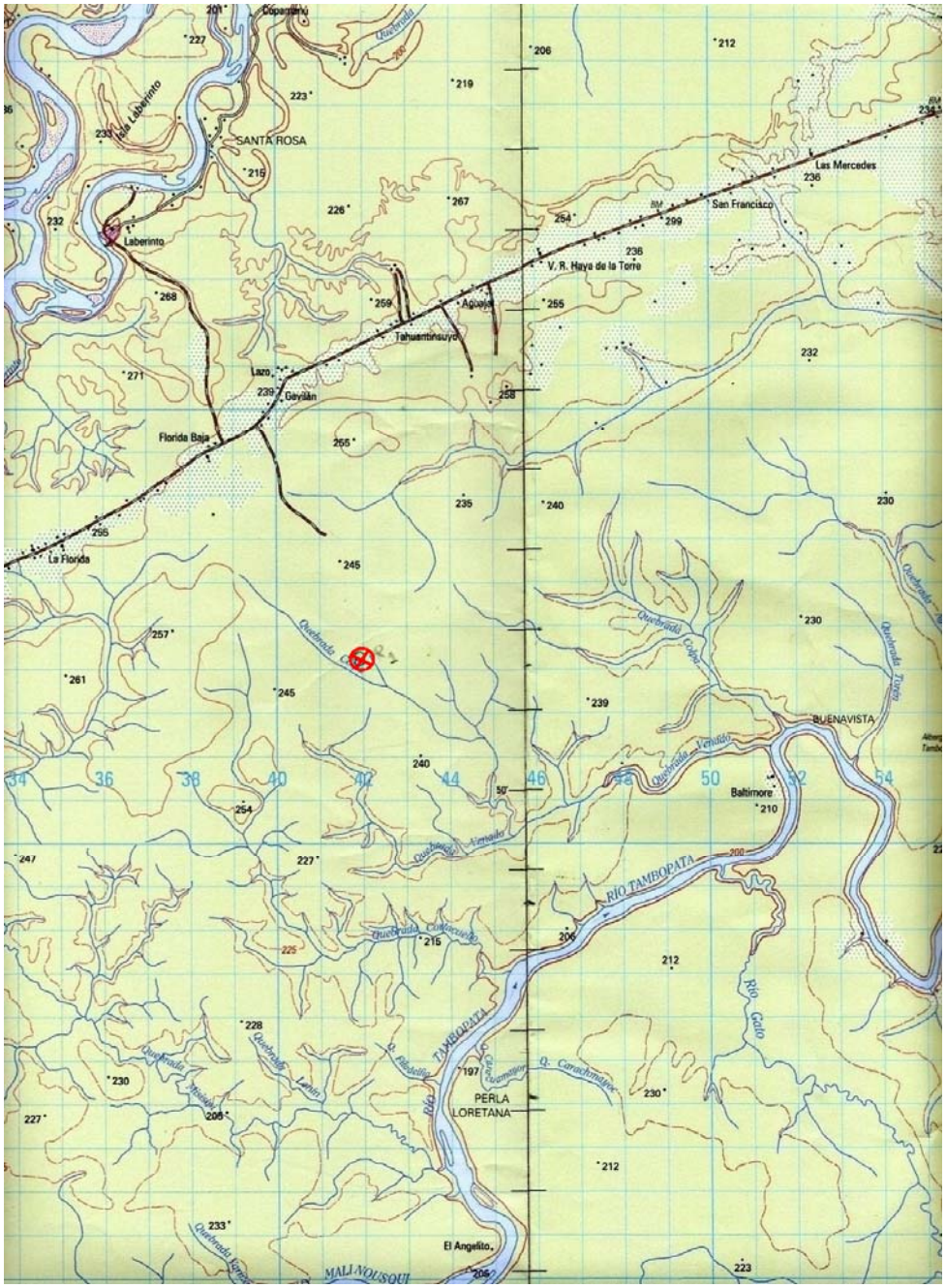
Ubicación geográfica de las Estaciones

ESTACIÓN - PUERTO MALDONADO

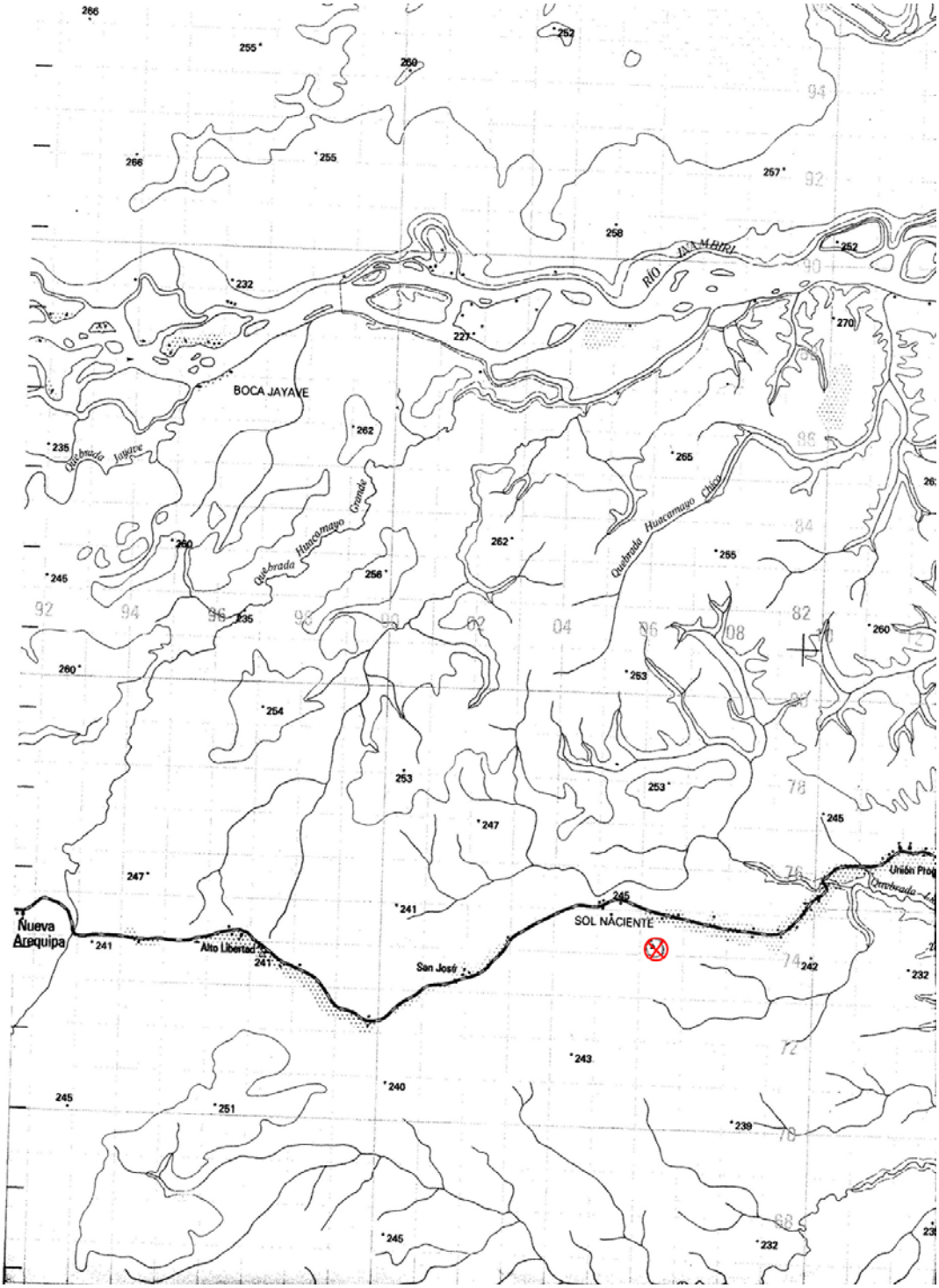


ESTACIÓN – INTEROCEANICA

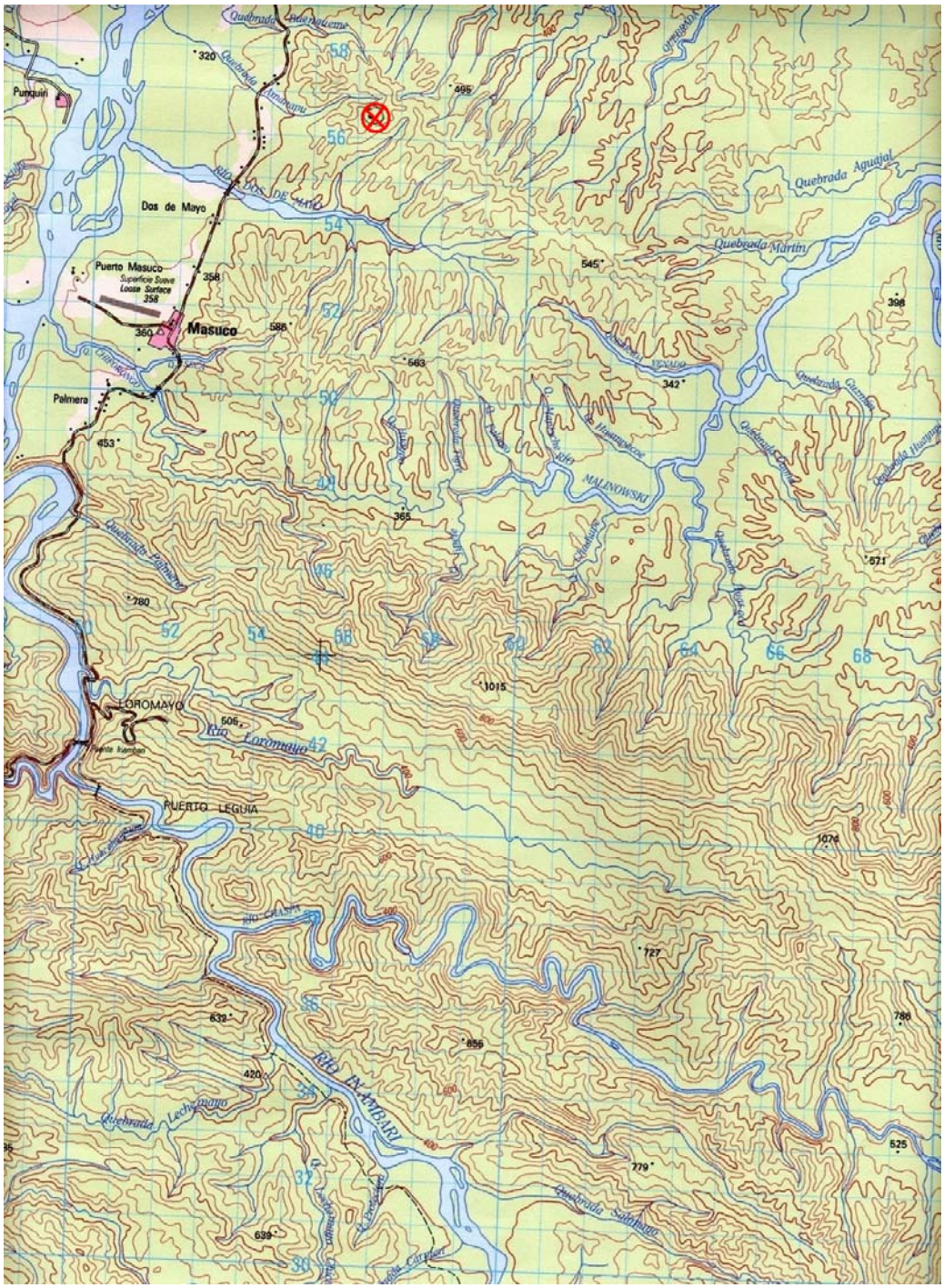
ESTACIÓN – QUEBRADA COLPA



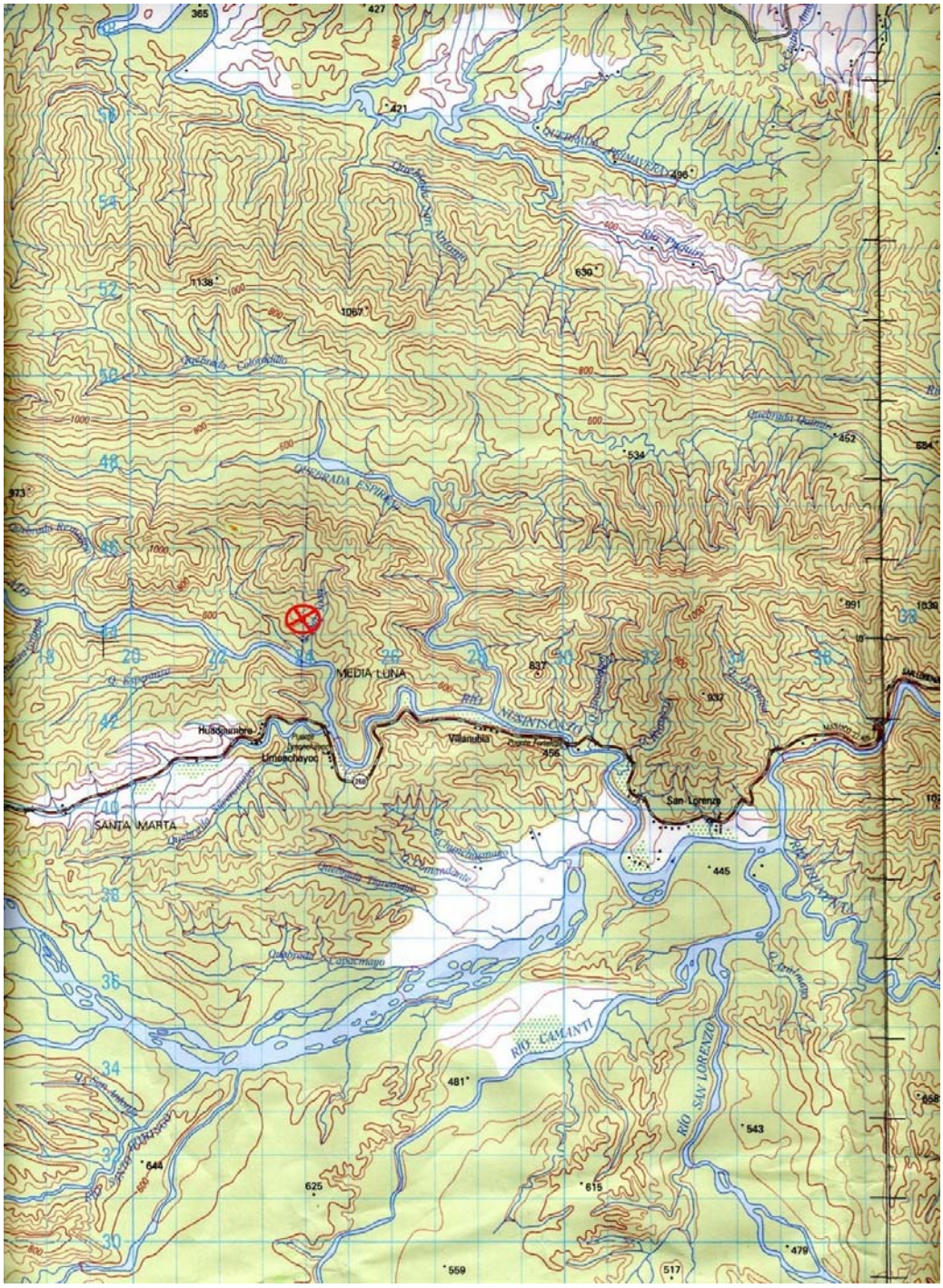
ESTACIÓN – SOL NACIENTE



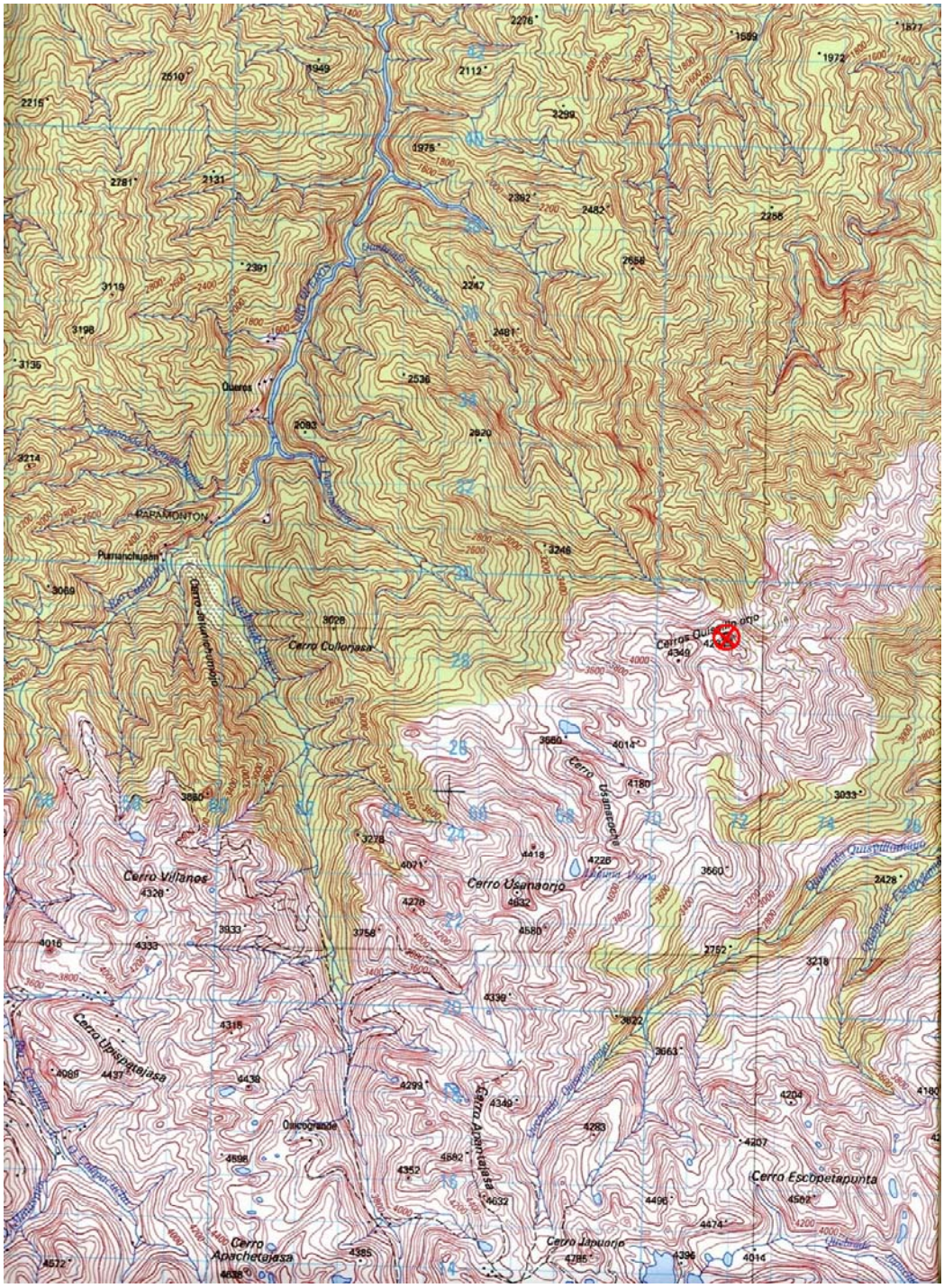
ESTACIÓN – MASUCO



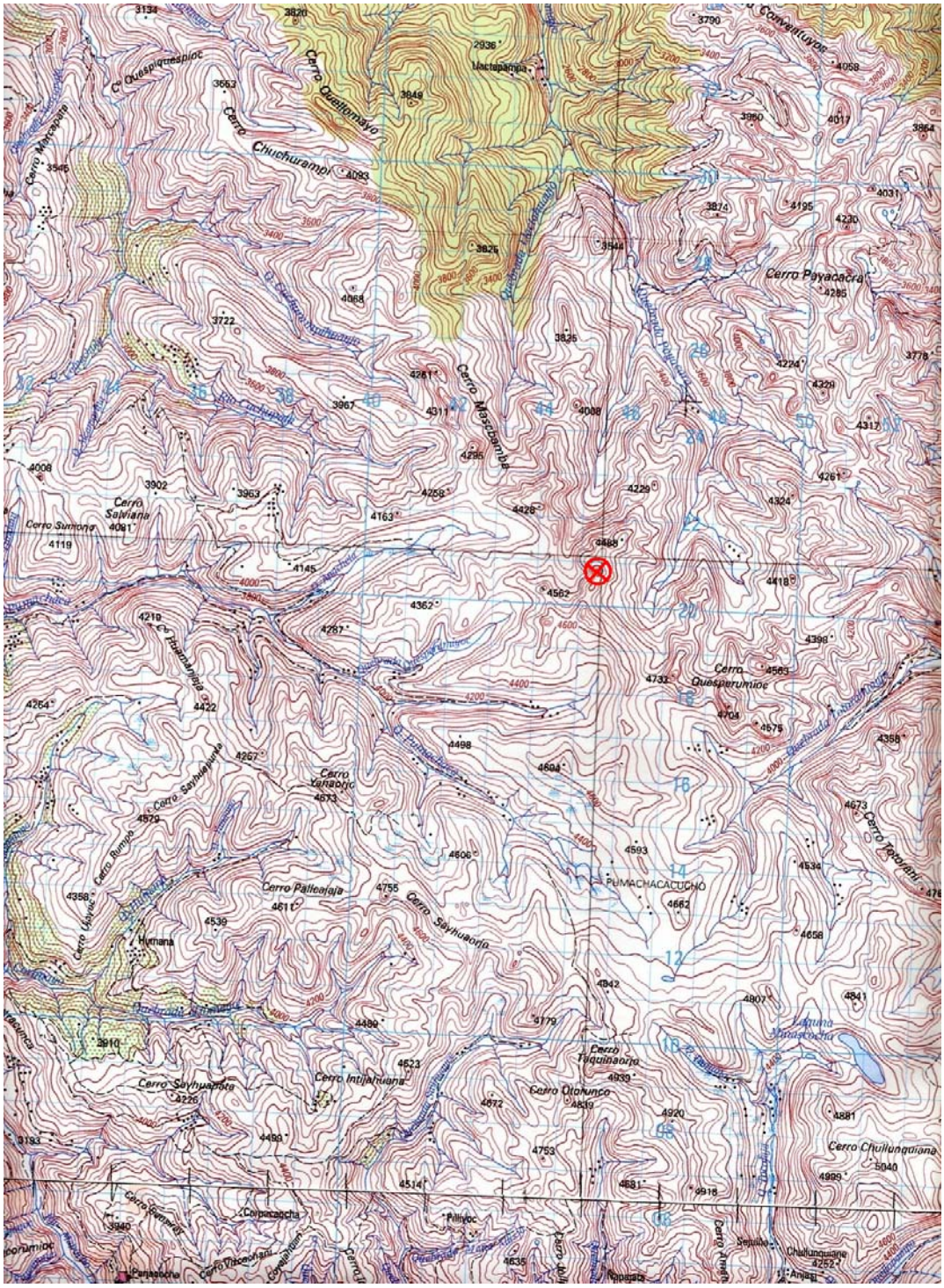
ESTACIÓN – CERRO QUISPILLO ORJO



ESTACIÓN – CERRO QUISPILLO ORJO

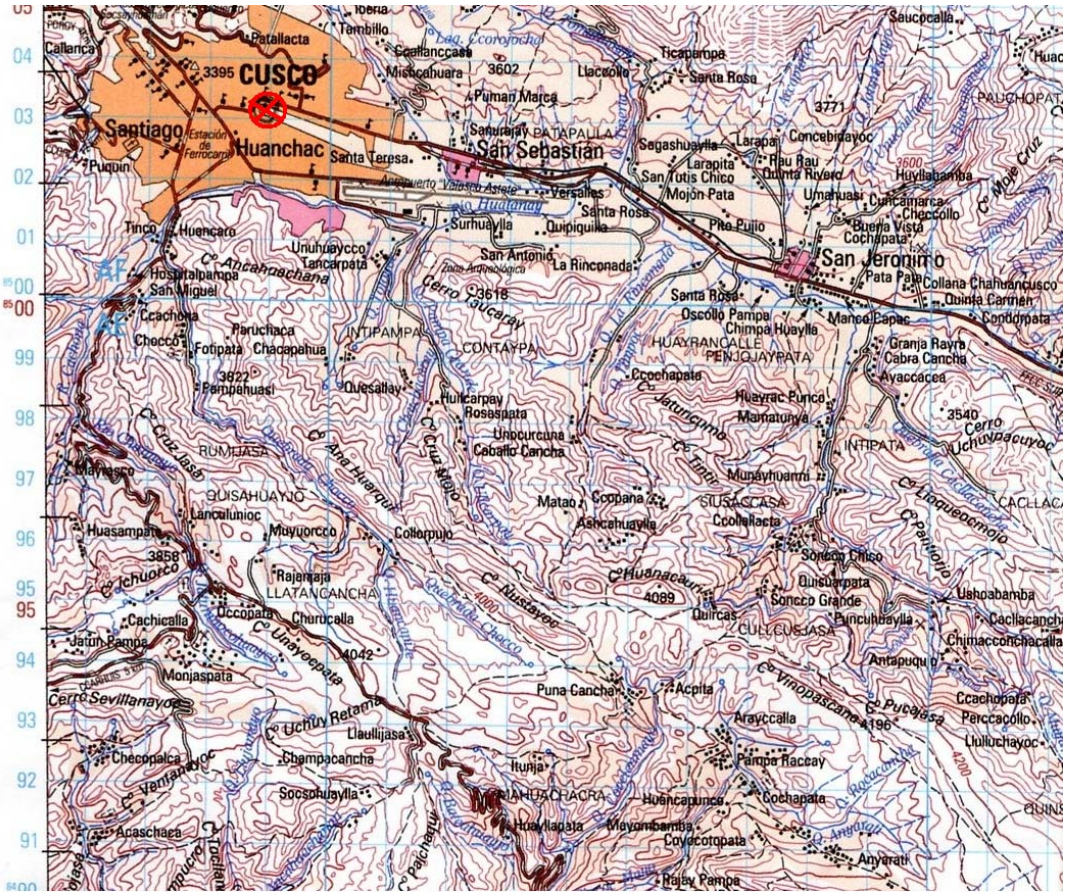


ESTACIÓN – CERRO QUESPERUMIOC



ESTACIÓN – CERRO PACHATUSAN

ESTACIÓN - CUZCO



Anexo 4.2

Cálculo de radio propagación y confiabilidad el enlace

	NUMERO DE SALTO		1	2	3	4	5	6	7	8	9
	ESTACION TX		PUERTO MALDONADO	INTEROCEÁNICA	QUEBRADA COLLPA	SOL NACIENTE	MASUCO	CAMANTI	CERRO QUISPILLO ORJO	CERRO QUESPERUMIOC	CERRO PACHATUSAN
	ESTACION RX		INTEROCEÁNICA	QUEBRADA COLLPA	SOL NACIENTE	MASUCO	CAMANTI	CERRO QUISPILLO ORJO	CERRO QUESPERUMIOC	CERRO PACHATUSAN	CUSCO
1	Freq. Operación	[GHz]	6	6	6	6	6	6	6	6	6
2	Freq. Central	[GHz]	6,175	6,175	6,175	6,175	6,175	6,175	6,175	6,175	6,175
3	Distancia del tramo	[Km]	15.21	27.78	36.34	52.55	35.63	54.39	28.93	49.25	18.44
4	Long. Alimentador 1	[m]	41	75	55	40	70	55	70	40	70
5	Long. Alimentador 2	[m]	41	75	55	40	70	55	80	40	70
6	Atenuación alimentador 1	[dB]	1.620	2.963	2.173	1.580	2.765	2.173	2.765	1.580	2.765
7	Atenuación alimentador 2	[dB]	1.620	2.963	2.173	1.580	2.765	2.173	3.160	1.580	2.765
8	Altura torre 1	[m]	36	72	72	54	66	66	66	78	66
9	Altura torre 2	[m]	72	72	54	66	66	66	78	66	66
10	Altura antena 1	[m]	31	65	45	30	60	45	60	30	60
11	Altura antena 2	[m]	31	65	45	30	60	45	70	30	60
12	Diámetro antena 1	[m]	1.8	2.4	2.4	3.7	2.4	3.7	1.8	2.4	1.8
13	Diámetro antena 2	[m]	1.8	2.4	2.4	3.7	2.4	3.7	1.8	2.4	1.8
14	Pérdidas Espacio Libre	[dB]	131.86	137.09	139.42	142.62	139.25	142.92	137.44	142.06	133.53
15	Pérdidas de alimentador	[dB]	3.239	5.925	4.345	3.160	5.530	4.345	5.925	3.160	5.530
16	Pérdida del circuito RF	[dB]	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
17	**PÉRDIDA TOTAL**	**[dB]**	**139.499**	**147.415**	**148.165**	**150.18**	**149.18**	**151.665**	**147.765**	**149.62**	**143.46**
18	Ganancia de Potencia del TX	[dBm]	30	32	30	30	30	30	30	30	30
19	Ganancia de la antena 1	[dBi]	38.8	41.3	41.3	44.8	41.3	44.8	38.8	41.3	38.8
20	Ganancia de la antena 2	[dBi]	38.8	41.3	41.3	44.8	41.3	44.8	38.8	41.3	38.8
21	Ganancia total de antenas	[dB]	77.6	82.6	82.6	89.6	82.6	89.6	77.6	82.6	77.6
22	**GANANCIA TOTAL**	**[dB]**	**107.6**	**114.6**	**112.6**	**119.6**	**112.6**	**119.6**	**107.6**	**112.6**	**107.6**

23	Nivel de Sensibilidad del RX	[dBm]	-72.4	-72.4	-72.4	-72.4	-72.4	-72.4	-72.4	-72.4	-72.4
24	Nivel de recepción	[dBm]	-31.90	-32.82	-35.57	-30.58	-36.58	-32.07	-40.17	-37.02	-35.86
25	Nivel de ruido KTBF	[dBm]	-155.6	-155.6	-155.6	-155.6	-155.6	-155.6	-155.6	-155.6	-155.6
26	C/N para BER 10^{-6}	[dB]	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3
27	Nível de señal para BER 10^{-6}	[dB]	-130.3	-130.3	-130.3	-130.3	-130.3	-130.3	-130.3	-130.3	-130.3
28	Margen sin Fading	[dB]	-57.20	-58.12	-60.87	-55.88	-61.88	-57.37	-65.47	-62.32	-61.16
29	Probabilidad de desvanecimiento Tipo Rayleigh		0.000206989	0.008284783	0.02267574	0.08449158	0.02067607	0.090871833	0.009548559	0.061466732	0.002061939
30	Desvanecimiento		44.55052626	48.15838323	50.4914369	51.4060064	45.7416821	49.41574684	43.06202607	47.6831821	38.39638042
31	Nivel de señal con desvanecimiento		-76.45	-80.97	-86.06	-81.99	-82.32	-81.48	-83.23	-84.70	-74.26
32	C/N con desvanecimiento		79.15047	74.62662	69.54356	73.61399	73.27832	74.11925	72.37297	70.89682	81.34362
33	Confiabilidad		99.9999835	9.9999439	99.9999333	99.9996249	9.9999827	99.9998256	99.9999967	99.9999661	99.9999980
34	**Nivel de recepción relativa [dB]**		**40.50**	**39.59**	**36.84**	**41.82**	**35.82**	**40.34**	**32.24**	**35.38**	**36.54**

Anexo 4.3

Datasheet de los equipos usados

Product Specifications

ANDREW
A CommScope Company

UHX8-59

2.4 m | 8 ft Ultra High Performance Parabolic Shielded Antenna, dual-polarized, 5.925–6.425 GHz

CHARACTERISTICS

General Specifications

Antenna Type	UHX - Ultra High Performance Parabolic Shielded Antenna, dual-polarized
Diameter, nominal	2.4 m | 8 ft
Polarization	Dual

Electrical Specifications

Beamwidth, Horizontal	1.4 °
Beamwidth, Vertical	1.4 °
Cross Polarization Discrimination (XPD)	33 dB
Electrical Compliance	ETSI Class 3 | US FCC Part 101A
Front-to-Back Ratio	77 dB
Gain, Low Band	40.9 dBi
Gain, Mid Band	41.3 dBi
Gain, Top Band	41.6 dBi
Operating Frequency Band	5.925 – 6.425 GHz
Radiation Pattern Envelope Reference (RPE)	1653J | 1654J
Return Loss	30.7 dB
VSWR	1.06

Mechanical Specifications

Fine Azimuth Adjustment	±5°
Fine Elevation Adjustment	±5°
Mounting Pipe Diameter	115 mm | 4.5 in
Net Weight	227 kg | 500 lb
Side Struts, Included	1 inboard | 1 outboard

Product Specifications

ANDREW
A CommScope Company

UHX6-59

1.8 m | 6 ft Ultra High Performance Parabolic Shielded Antenna, dual-polarized, 5.925–6.425 GHz

CHARACTERISTICS

General Specifications

Antenna Type	UHX - Ultra High Performance Parabolic Shielded Antenna, dual-polarized
Diameter, nominal	1.8 m | 6 ft
Polarization	Dual

Electrical Specifications

Beamwidth, Horizontal	1.8 °
Beamwidth, Vertical	1.8 °
Cross Polarization Discrimination (XPD)	33 dB
Electrical Compliance	ETSI Class 3 | US FCC Part 101A
Front-to-Back Ratio	75 dB
Gain, Low Band	38.4 dBi
Gain, Mid Band	38.8 dBi
Gain, Top Band	39.1 dBi
Operating Frequency Band	5.925 – 6.425 GHz
Radiation Pattern Envelope Reference (RPE)	1729K | 1730K
Return Loss	30.7 dB
VSWR	1.06

Mechanical Specifications

Fine Azimuth Adjustment	±5°
Fine Elevation Adjustment	±5°
Mounting Pipe Diameter	115 mm | 4.5 in
Net Weight	163 kg | 359 lb
Side Struts, Included	1 Inboard

Product Specifications

ANDREW
A CommScope Company

UHX12-59

3.7 m | 12 ft Ultra High Performance Parabolic Shielded Antenna, dual-polarized, 5.925–6.425 GHz

CHARACTERISTICS

General Specifications

Antenna Type	UHX - Ultra High Performance Parabolic Shielded Antenna, dual-polarized
Diameter, nominal	3.7 m | 12 ft
Polarization	Dual

Electrical Specifications

Beamwidth, Horizontal	0.9 °
Beamwidth, Vertical	0.9 °
Cross Polarization Discrimination (XPD)	35 dB
Electrical Compliance	ETSI Class 3 | US FCC Part 101A
Front-to-Back Ratio	80 dB
Gain, Low Band	44.4 dBi
Gain, Mid Band	44.8 dBi
Gain, Top Band	45.2 dBi
Operating Frequency Band	5.925 – 6.425 GHz
Radiation Pattern Envelope Reference (RPE)	1664J | 1665J
Return Loss	30.7 dB
VSWR	1.06

Mechanical Specifications

Fine Azimuth Adjustment	±5°
Fine Elevation Adjustment	±5°
Mounting Pipe Diameter	115 mm | 4.5 in
Net Weight	431 kg | 950 lb
Side Struts, Included	1 inboard | 1 outboard

Alcatel·Lucent

Alcatel-Lucent 1662 Synchronous Multiplexer Compact

RELEASE 2.7

The Alcatel-Lucent 1662 Synchronous Multiplexer Compact (SMC) is a compact, Synchronous Transport Mode 16 (STM-16) multiservice provisioning platform (MSPP). It serves as a building block for metropolitan networks, providing unmatched performance for its size and service-mix capabilities. Addressing metro-edge and metro-access applications, the Alcatel-Lucent 1662 SMC offers a transport platform with integrated packet functions, supporting revenues from multiple broadband services such as private-line and Ethernet business services, triple play and mobile aggregation.

The Alcatel-Lucent 1662 SMC is a metro-edge component of the Alcatel-Lucent Optical Multi-Service Node (OMSN) product family, a family that also includes the Alcatel-Lucent 1660 SM, an STM-64 MSPP, and the Alcatel-Lucent 1650 SMC, an STM-4 MSPP. For offering capital and operational efficiencies, the Alcatel-Lucent OMSN products share many common features and modules.

Features

- Fully non-blocking redundant Synchronous Digital Hierarchy (SDH) matrix with 96 x 96 or 64 x 64 high-order/low-order (HO/LO) STM-1 equivalent switching
- Up to six STM-16 interfaces for double 2.5 Gb/s ring interconnection
- Richly featured 10/100 Ethernet and Gigabit Ethernet (GE)
- E1, E3/DS3
- Multi-Protocol Label Switching (MPLS)-enabled Ethernet, packet ring and ATM switching
- Digital video switching
- Transport for IBM® Enterprise Systems Connection (ESCON®), IBM Fibre Connection (FICON®), fiber distributed data interface (FDDI) and Fibre Channel (FC)
- CWDM multiplexer/demultiplexer (MUX/DEMUX)
- Colored STM-16 for direct inter-working with Dense WDM (DWDM) systems
- Service extension over symmetric high-speed DSL (SHDSL) for E1 and 10/100 Ethernet
- ITU-T G.8032 v2 Ethernet Ring Protection (ERP)
- Synchronous Ethernet (SyncE) for Alcatel-Lucent Integrated Service Adapter Ethernet Switch (ISA-ES) blades linked to SDH Synchronization Status Message (SSM)

Benefits

- Supports high-capacity Plesiochronous Digital Hierarchy (PDH)/SDH metro-edge service support
- Aggregates broadband services:
  - ¬ Triple play
  - ¬ Business Ethernet: MEF (former Metro Ethernet Forum)-compliant virtual LAN (VLAN) and Virtual Private LAN Service (VPLS)
  - ¬ Extending service reach over copper loops
- Provides Third Generation (3G) mobile backhaul
- Functions as a terminal multiplexer, add-drop multiplexer (ADM) or mini cross-connect in spur, multiple-ring or mesh topologies
- Offers highly reliable and manageable TDM and data services
- Delivers feature transparency and operational savings with Alcatel-Lucent OMSN common components
- Supports ITU-T G.8032 v2 ERP for 100 percent increase in Ethernet over SDH (EoS) bandwidth for protected services
- Supports SyncE derived from SDH synchronization supply unit (SSU) quality

Technical specifications

Interfaces

- Network interfaces, compact ADM function with one of:
  - ¬ 2 x STM-1
  - ¬ 2 x STM-4
  - ¬ 1 x STM-16

  Each supports EPS 1+1
- Customer interfaces: up to eight slots available
  - ¬ 63 x 2 Mb/s: ISDN-PRA and retiming function
  - ¬ 3 x 34/45 Mb/s switchable
  - ¬ 4 x 140 Mb/s/STM-1 switchable
  - ¬ 4 x STM-1: electrical, S-1.1, L-1.1, L-1.2
  - ¬ 8 x STM-1 optical SFP: S-1.1, L-1.1, L-1.2, CWDM
  - ¬ 4 x OC-3 with administrative unit (AU) 3/tributary unit (TU) 3 conversion
  - ¬ 1 x STM-4: S-4.1, L-4.1, L-4.2
  - ¬ 2 x STM-4 optical SFP: S-4.1, L-4.1, L-4.2, CWDM
  - ¬ 1 x STM-16: I-16.1, S-16.1, L-16.1, L-16.2
  - ¬ 1 x STM-16 optical SFP: I-16.1, S-16.1, L-16.1, L-16.2, CWDM, DWDM
  - ¬ Integrated booster +10 dBi/ +15 dBi/+17 dB
  - ¬ 4 x any sub-lambda multiplexing function: four channels in 2.5G lambda: transparent Ethernet/FE, GE, STM-4, FC, ESCON, FICON, FDDI, digital video
  - ¬ Digital Video Broadcasting (DVB) ASI blade
  - ¬ Maximum 14 x Ethernet 10/100Base-T per ISA blade
  - ¬ Maximum 8 x Ethernet 100Base-FX per ISA blade
  - ¬ Maximum 4 x GE Base-SX/LX/ZX per ISA blade

Connectivity

- 32 x 32 (HO/LO) or 96 x 96 (HO)/ 64 x 64 (LO) STM-1 equivalent full non-blocking SDH fabric in all configurations
- Unidirectional, bidirectional, drop-and-continue multicast, broadcast SDH connections
- Line and virtual container (VC) loopbacks
- Virtual concatenation (VCAT) and contiguous concatenation
- 1- or 2-channel CWDM optical add-drop multiplexer (OADM) function
- 8-channel CWDM MUX/DEMUX function
- Embedded ATM star, ring and mesh topologies
- Embedded Ethernet/MPLS star, ring and mesh topologies
- Embedded Ethernet multiple-ring topologies

Equipment protection

- Matrix, control and synchronization EPS 1+1
- ISA-ATM switch EPS 1+1
- ISA-ES16 EPS 1+1
- 63 x 2 Mb/s EPS n+1, 2 x maximum n = 3
- 3 x 34/45 Mb/s EPS n+1, maximum n = 7
- 4 x STM-1o EPS n+1, maximum n = 7

Network protection

Transport

- Linear single-/dual-ended 1+1 APS at STM-1/4/16
- Linear dual-ended n+1 APS at STM-1
- SNCP/I, SNCP/N
- SNCP drop-and-continue
- 2 x 2 fiber Multiplex Section – Shared Protection Ring (MS-SPRing) at STM-16
- Collapsed single-node ring interconnection
- Collapsed dual-node ring interconnection

Packet

- Dual attach: packet-ring interconnection
- ITU-T G.8032 v2 ERP

Monitoring

- Performance monitoring according to ITU-T G.784, G.826, G.821
- Path overhead monitoring (POM) on all VCs
- Supervisory unequipped trail (SUT)
- Tandem connection monitoring (TCM)
- Ethernet performance monitoring counters
  - ¬ Port/aggregate/flow
  - ¬ Incoming/outgoing

Synchronization

- Internal oscillator ±4.6 ppm
- Holdover drift ±0.37 ppm per day
- External sources: STM-n/2 Mb/s ports, one external 2 MHz/2 Mb/s output
- Priority and quality SSM synchronization algorithms
- SyncE for Alcatel-Lucent ISA-ES blades linked to SDH SSM

Data blades: ISA

ISA-ATM

- 600 Mb/s and 1.2 Gb/s cell switch with optional STM-1 access on board
- Equipment protection 1+1
- VPC/VCC switch/cross-connect
- Hard/soft PVC connections for PNNI
- Point-to-point/multipoint from E1 up to VC4-4c payloads
- Up to 252 ATM logical ports
- IMA support: maximum 126 groups/32 links
- Policing, shaping and congestion management
- CBR, UBR, UBR+, rt-VBR/nrt-VBR, GFR ATM traffic contracts
- ATM operations, administration, and maintenance (OA&M)

ISA-ES1

- 1 Gb/s throughput
- 155 Mb/s back-panel capacity
- 8 x Ethernet 10/100Base-T
- 8 x Ethernet 100Base-FX
- GFP-F/LAPS, VCAT, LCAS
- LACP
- VC-12/VC-3/VC-4 terminations
- VC groups: maximum 8 at 50/2/1
- Classification/forwarding
  - ¬ Per port
  - ¬ MAC DA IEEE 802.3
  - ¬ C-VLAN/S-VLAN
  - ¬ IEEE 802.1p
  - ¬ DSCP/ToS
  - ¬ Ethertype

- Ethernet multicast: IGMP
- Ethernet OA&M CFM
- Q-in-Q: IEEE 802.1Q/ad
- QoS: IEEE 802.1p
- CoS
  - ¬ Guaranteed
  - ¬ Regulated
  - ¬ Best effort
- Congestion avoidance
- STP/RSTP/MSTP/PVSTP: IEEE 802.1d/w/s
- ERP standard G.8032 v2
- Ethernet performance counters
  - ¬ Per port/aggregate/flow
  - ¬ Incoming/outgoing
  - ¬ Unicast
  - ¬ Multicast
  - ¬ Broadcast
- E-Line, E-LAN, Ethernet aggregation services in accordance with MEF

ISA-ES4

- 2.5 Gb/s throughput
- 622 Mb/s back-panel capacity
- 1 x GE SFPs, 8 x Ethernet 10/100Base-T
- GFP-F/LAPS, VCAT, LCAS
- LACP
- VC-12/VC-3/VC-4 terminations
- VC groups: maximum 16 at 63/12/4
- Classification/forwarding
  - ¬ Per port
  - ¬ MAC DA: IEEE 802.3
  - ¬ C-VLAN/S-VLAN
  - ¬ IEEE 802.1p
  - ¬ DSCP/ToS
  - ¬ Ethertype
- Ethernet multicast: IGMP
- Ethernet OA&M CFM
- Q-in-Q: IEEE 802.1Q/ad
- QoS: IEEE 802.1p
- CoS
  - ¬ Guaranteed
  - ¬ Regulated
  - ¬ Best-effort
- STP/RSTP/MSTP/PVSTP: IEEE 802.1d/w/s
- Congestion avoidance
- ITU-T G.8032 v2
- Ethernet performance counters
  - ¬ Per port/aggregate/flow
  - ¬ Incoming/outgoing
  - ¬ Unicast
  - ¬ Multicast
  - ¬ Broadcast
- E-Line, E-LAN, Ethernet aggregation services in accordance with MEF

ISA-ES16

- 4.5 Gb/s throughput
- 2.5 Gb/s back-panel capacity
- 4 x GE SFPs, 14 x Ethernet 10/100Base-T, 7 x 100Base-FX
- GFP-F/LAPS, VCAT, LCAS
- LACP
- VC-12/VC-3/VC-4 terminations
- VC groups: maximum 64 at 63/12/16
- Classification/forwarding
  - ¬ Per port
  - ¬ MAC DA: IEEE 802.3
  - ¬ C-VLAN/S-VLAN
  - ¬ IEEE 802.1p
  - ¬ DSCP/ToS
  - ¬ Ethertype
  - ¬ MPLS label switching (pseudowire/tunnel)
  - ¬ MPLS EXP bits
- Ethernet and MPLS multicast, IGMP
- Martini encapsulation
- Q-in-Q: IEEE 802.1Q/ad
- QoS: IEEE 802.1p, MPLS
- CoS
  - ¬ Guaranteed
  - ¬ Regulated
  - ¬ Best-effort up to eight CoS
- Policing dual-rate token bucket, metering, marking, CIR/CBS, EIR/EBS, dropping (COP)
- Scheduling HOL, weighted-deficit round robin
- Congestion-avoidance WRED per queue
- STP/RSTP/MSTP/PVSTP: IEEE 802.1d/w/s
- ITU-T G.8032 v2
- Ethernet and MPLS performance counters
  - ¬ Per port/aggregate/flow
  - ¬ Incoming/outgoing
  - ¬ Unicast
  - ¬ Multicast
  - ¬ Broadcast
- Ethernet OA&M CFM
- E-Line/VLL, E-LAN/VPLS, Ethernet aggregation services in according to MEF

DVB-ASI

Unidirectional transparent transport

- CBR MPEG-n transport stream (TS)
  - ¬ Single program TS (SPTS)
  - ¬ Multiple program TS (MPTS)
- TS rate: 1.5 Mb/s to maximum 100 Mb/s: with C-12 or C-3 granularity

ISA Broadband Copper Extender (BCE)-ET/ISA BCE-Ethernet

- Eight interfaces: up to eight remote NT devices can be connected
- Full NT management
- PM on VC-12 and SHDSL line
- Maintenance operation on NT: loopback and restart

Physical specifications

Power

- Station battery: -48-V DC to -60-V DC
- Power consumption: 200 W, typical

Dimensions

Subrack

- Height: 390 mm (15.4 in.)
- Width: 470 mm (18.5 in.)
- Depth: 250 mm (9.8 in.)

Rack

- Height: 2.2 m (7.22 ft)
- Width: 600 mm (23.6 in.)
- Depth: 300 mm (11.8 in.)

Regulatory compliance

Environmental

- Operating conditions: ETS 300 019, Class 3.2
- Storage conditions: ETS 300 019, Class 1.2
- Transportation conditions: ETS 300 019, Class 2.2
- ESD/EMC: ETS 300 386 "Telecommunications Center"

Operational

- Alcatel-Lucent 1350 Optical Management System (OMS)
- CMISE craft terminal through TIA/EIA-232 at 38.4 kb/s
- Network management access through Q83 interface or Qecc G.784
- Local and remote software download
- Remote inventory
- Housekeeping: 12 inputs plus 2 outputs
- Auxiliary channels
  - ¬ EOW
  - ¬ 2 x 64 kb/s G.703
  - ¬ 2 x TIA/EIA-232
  - ¬ 2 x V.11
  - ¬ 1 x 2 Mb/s G.703

Standards

- In compliance with all the latest relevant ITU-T standards
  - ¬ ITU G.7041
  - ¬ ITU G.7042
  - ¬ ITU G.707
  - ¬ ITU-T G.8032 v2
- ATM Forum
- IETF
- IEEE
- MEF 9, MEF 14, MEF 21 certified for Ethernet application

Alcatel·Lucent

FLEXWELL® Elliptical Waveguide

Product Overview, Electrical

WVG. TYPE	OPER. FREQ. GHz	CUT OFF FREQ. GHz	MAX. VSWR/ RETURN LOSS, dB	ATTENUATION dB/100m (ft) IN THE OPERATING FREQUENCY BAND LOW BAND	MID BAND	HIGH BAND	AVG. POWER kW MID BAND	GROUP VELOCITY %c MID BAND	GROUP DELAY ns/100m (ft) MID BAND
E30	2.7 - 3.1	1.8	1.128/24.4	1.61 (0.49)	1.49 (0.45)	1.4 (0.43)	30.37	78.4	425.4 (129.7)
E38	3.6 - 4.2	2.4	1.15/23.1	2.37 (0.72)	2.20 (0.67)	2.08 (0.63)	16.27	78.8	423.2 (129.0)
EP38	3.6 - 4.2	2.4	1.083/28.0	2.37 (0.72)	2.20 (0.67)	2.08 (0.63)	16.27	78.8	423.2 (129.0)
E46	4.4 - 5.0	2.88	1.15/23.1	2.92 (0.89)	2.80 (0.85)	2.73 (0.83)	10.93	79.0	422.1 (128.7)
EP46	4.4 - 5.0	2.88	1.083/28.0	2.92 (0.89)	2.80 (0.85)	2.73 (0.83)	10.93	79.0	422.1 (128.7)
ES46	4.4 - 5.0	3.08	1.15/23.1	3.69 (1.12)	3.55 (1.08)	3.49 (1.06)	8.39	75.5	441.6 (134.6)
ESP46	4.4 - 5.0	3.08	1.073/29.1	3.69 (1.12)	3.55 (1.08)	3.49 (1.06)	8.39	75.5	441.6 (134.6)
EP58	4.4 - 6.2	3.56	1.083/28.0	5.10 (1.55)	3.96 (1.21)	3.60 (1.10)	6.54	74.1	450.3 (137.2)
E60	5.6 - 6.425	3.65	1.15/23.1	4.15 (1.27)	3.95 (1.20)	3.80 (1.16)	7.24	79.4	420.3 (128.1)
EP60	5.6 - 6.425	3.65	1.062/30.5	4.15 (1.27)	3.95 (1.20)	3.80 (1.16)	7.24	79.4	420.3 (128.1)
E65	5.9 - 7.125	4.01	1.15/23.1	4.9 (1.50)	4.5 (1.37)	4.25 (1.30)	5.26	78.7	423.8 (129.2)
EP65	5.9 - 7.125	4.01	1.062/30.5	4.9 (1.50)	4.5 (1.37)	4.25 (1.30)	5.26	78.7	423.8 (129.2)
EP70	6.4 - 7.75	4.34	1.062/30.5	5.5 (1.68)	5.0 (1.52)	4.8 (1.46)	4.65	79.1	421.5 (128.5)
E78	7.1 - 8.5	4.72	1.15/23.1	6.2 (1.89)	5.8 (1.77)	5.6 (1.71)	3.67	79.6	419.0 (127.7)
EP78	7.1 - 8.5	4.72	1.062/30.5	6.2 (1.89)	5.8 (1.77)	5.6 (1.71)	3.67	79.6	419.0 (127.7)
EP100	9.0 - 10.0	6.43	1.105/26.0	9.5 (2.90)	8.9 (2.71)	8.4 (2.56)	1.91	73.6	453.1 (138.1)
E105	10.0 - 11.7	6.49	1.15/23.1	9.6 (2.92)	9.2 (2.79)	8.9 (2.71)	1.77	79.9	417.3 (127.2)
EP105	10.0 - 11.7	6.49	1.062/30.5	9.6 (2.92)	9.2 (2.79)	8.9 (2.71)	1.77	79.9	417.3 (127.2)
E130	10.7 - 13.25	7.43	1.15/23.1	12.6 (3.84)	11.5 (3.52)	11.1 (3.39)	1.22	78.5	424.8 (129.5)
EP130	10.7 - 13.25	7.43	1.083/28.0	12.6 (3.84)	11.5 (3.52)	11.1 (3.39)	1.22	78.5	424.8 (129.5)
E150	13.4 - 15.35	8.64	1.15/23.1	14.6 (4.44)	14.0 (4.26)	13.7 (4.16)	0.88	79.7	418.6 (127.6)
EP150	13.4 - 15.35	8.64	1.083/28.0	14.6 (4.44)	14.0 (4.26)	13.7 (4.16)	0.88	79.7	418.6 (127.6)
E185	17.3 - 19.7	11.06	1.15/23.1	20.3 (6.17)	19.4 (5.92)	18.9 (5.75)	0.51	80.2	416.1 (126.8)
EP185	17.3 - 19.7	11.06	1.083/28.0	20.3 (6.17)	19.4 (5.92)	18.9 (5.75)	0.51	80.2	416.1 (126.8)
E220	21.2 - 23.6	13.36	1.105/26.0	28.8 (8.77)	28.3 (8.63)	28.1 (8.56)	0.31	80.3	415.6 (126.7)
E250	24.25 - 26.5	15.06	1.15/23.1	33.2 (10.1)	32.4 (9.88)	32.0 (9.75)	0.31	80.5	414.2 (126.3)
E300	27.5 - 33.4	19.05	1.15/23.1	50.0 (15.2)	46.0 (14.0)	44.4 (13.5)	0.14	78.1	427.1 (130.2)
E380	37.0 - 39.5	23.45	1.15/23.1	61.3 (18.7)	60.7 (18.5)	60.0 (18.3)	0.09	79.1	421.9 (128.6)

WVG. TYPE	OPER. FREQ. GHz	MAX. VSWR/ RETURN LOSS, dB	ATTENUATION dB/100m (ft) IN THE OPERATING FREQUENCY BAND LOW BAND	MID BAND	HIGH BAND	GROUP VELOCITY %c MID BAND	GROUP DELAY ns/100m (ft) MID BAND
EO11	10.7 - 11.7	1.073/29.1	3.95 (1.20)	4.10 (1.25)	4.25 (1.30)	93.2	358.0 (109.1)
EO15	12.7 - 15.35	1.083/28.0	5.80 (1.77)	6.09 (1.86)	6.93 (2.11)	92.6	360.4 (109.8)
EO19	17.7 - 19.7	1.083/28.0	9.24 (2.82)	9.52 (2.90)	9.97 (3.04)	92.5	360.5 (109.9)
EO22	21.2 - 23.6	1.105/26.0	12.5 (3.81)	13.0 (3.97)	13.7 (4.18)	93.4	357.2 (108.9)
EO38	37.0 - 39.5	1.15/23.1	24.5 (7.46)	24.7 (7.52)	25.0 (7.61)	93.1	358.4 (109.2)

NEC

5000S N+1 SERIES

4 - 11 GHz STM-1/OC-3 MICROWAVE RADIO SYSTEM

(64/128 QAM)

1+0 SYSTEM
1+1 TWIN PATH SYSTEM
1+1 HOT STANDBY SYSTEM
N+1 SYSTEM
N+0 SYSTEM

This document describes the current version of NEC standard equipment. If there is any conflict between this document and the System Description and/or the Compliance statement, the latter will supersede this document.

The specifications or configuration contained in this document are subject to change without notice due to NEC's continuing design improvement.

NEC Corporation

Sy014tc.doc

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ACCP	Adjacent Channel Co-Polarization frequency allocations
AGC	Automatic Gain Control
AIS	Alarm Indication Signal
ALC	Automatic Level Control
ALM	Alarm
ALS	Automatic Laser Shutdown
AMI	Alternate Mark Inversion
AMP	Amplifier
APC	Automatic Phase Control
APS	Automatic Protection Switching
ATDE	Adaptive Time Domain Equalizer
ATPC	Automatic Transmit Power Control
AU	Administrative Unit
B8ZS	Bipolar with 8 Zero Substitution
BB	Base Band
BBE	Background Block Error
BEF	Band Elimination Filter
BER	Bit Error Rate
BIP	Bit Interleaved Parity
BPF	Band Pass Filter
BR	Branching
CDDP	Co-Channel Dual Polarized Transmission with XPIC
CENELEC	European Committee for Electrotechnical Standardization
ch	Channel
CISPR	International Special Committee on Radio Interference
CKT	Circuit
CLK	Clock
CMI	Coded Mark Inversion
C/N	Carrier to Noise
COMB	Combiner
COMM	Communication
CONV	Converter
CTRL	Control
DADE	Differential Absolute Delay Equalization
DC	Direct Current
DCC	Data Communication Channel
DCCm	Data Communication Channel in MSOH
DCCr	Data Communication Channel in RSOH
DCN	Data Communication Network
DIST	Distributor
DM	Deferred Maintenance
DMR	Digital Microwave Radio
DSC	Digital Service Channel
DUP	Duplexer
ECC	Embedded Control Channel
EOW	Express Orderwire
EMC	Electromagnetic Compatibility
ES	Errored Second
ESD	Electro-Static Discharge
ETS	European Telecommunications Standard
ETSI	European Telecommunications Standards Institute
e/w	equipped with
EXT	Extension
FD	Frequency Diversity
FEC	Forward Error Correction
FET	Field Effect Transistor
FPGA	Field Programmable Gate Array
HDB	High Density Bipolar
HEMT	High Electron Mobility Transistor
HS	Hot Standby
IDB	Interface Distribution Board
IEC	International Electrotechnical Committee
IF	Intermediate Frequency
IN	Input
INTFC	Interface
IP	Internet Protocol
ITU	International Telecommunications

	Union
ITU-R	Radio communication Sector of ITU (formerly CCIR)
ITU-T	Telecommunication Standardization Sector of ITU (formerly CCITT)
L	Low, Lower
LDPC	Low Density Parity Check
LED	Light Emitting Diode
LEV	Level
LMS	Local Management Service
LSI	Large Scale Integrated Circuit
MAINT	Maintenance
MDP	Modulator/Demodulator Equipment
MIC	Microwave Integrated Circuit
MLM	Multi-Longitudinal Mode
MODEM	Modulator-Demodulator
MSOH	Multiplex Section Overhead
MST	Multiplex Section Termination
MUX	Multiplexer
NE	SDH Network Element
NFB	Non-Fuse Breakers
NMS	Network Management System
NMT	Network Management Terminal
NORM	Normal (no alarms)
NRZ	Non-Return to Zero
OAM&P	Operation, Administration, Maintenance and Provisioning
OC-3	Optical Carrier level-3
OH	Overhead
OOW	Omnibus Orderwire
OPT	Optical
OSC	Oscillator
OUT	Output
OW	Orderwire
P	Protection Channel
PM	Prompt Maintenance
ppm	Parts Per Millions
PROC	Processor
PROT	Protection
PS	Power Supply
PWR	Power
QAM	Quadrature Amplitude Modulation
R	Regular Channel
R-BER	Residual-BER
RCVD	Received
Rec.	Recommendation
REG	Regular
REI	Remote Error Indication
RF	Radio Frequency
RFCOH	Radio Frame Complementary Overhead
RSL	Receiving Signal Level
RSOH	Regenerator Section Overhead
RST	Regenerator Section Termination
RX	Receiver
S/N	Signal to Noise
SC	Service Channel
SD	Space Diversity
SDH	Synchronous Digital Hierarchy
SES	Severely Errored Second
SNMP	Simple Network Management Protocol
SOH	Section Overhead
STM	Synchronous Transport Module
SV	Supervision
SW	Switch
SWO	Switchover
SYNTH	Synthesizer
Sys	System
TRP	Transmitter/Receiver Equipment
TTL	Transistor-Transistor Logic
TX	Transmitter
U	Upper
VF	Voice Frequency
Vp-p	Volts peak to peak
vs.	versus
WS	Wayside
XPIC	Cross-Polarization Interference Canceller

1. GENERAL

The 5000S N+1 Series Synchronous Digital Hierarchy (SDH) long-haul microwave radio systems are designed for the transmission of synchronous transport module level 1 (STM-1) or optical carrier level 3 (OC-3).

They operate in frequency bands from 4 to 11 GHz; using 64 or 128 Quadrature Amplitude Modulation (QAM) as shown in Table 1 System Menu (page 5), and have a transmission capacity of STM-1 or OC-3 per radio frequency (RF) channel, and the following basic specifications:

- Capacity : 155.52 Mbps per system
- SDH Termination : RST only (MST available with built-in MUX)
- Configuration : Refer to the following Table:
  The capacity of system in one rack configuration is shown.
  The maximum capacity of system in two rack configuration is 11+1.

Items	For 4 to 8 GHz	For 11 GHz
Terminal	N+1 [N: 1 - 9] N+0 [N: 1 - 10]	N+1 [N: 1 - 5] N+0 [N: 1 - 6]
Back-Back (Dir. East N+1 & Dir. West N+1)	2 x (N+1) [N: 1 - 4] 2 x (N+0) [N: 1 - 5]	2 x (N+1) [N: 1 - 2] 2 x (N+0) [N: 1 - 3]
Repeater (East/West)	2 x (N+1) [N: 1 - 4] 2 x (N+0) [N: 1 - 5]	2 x (N+1) [N: 1 - 2] 2 x (N+0) [N: 1 - 3]
Twin Path	1+1 Twin Path	
Hot Standby	1+1 HS	
XPIC (Master N+1 & Slave N+1)	2 x (N+1) [N: 1 - 4] 2 x (N+0) [N: 1 - 5]	2 x (N+1) [N: 1 - 2] 2 x (N+0) [N: 1 - 3]

- Diversity System : FD, FD+SD, HS+SD
- SD Constitution : IF Combined system (up to 3 antennas)
- Mounting (ETSI Rack including MUX, refer to Figure 2 and 3)
  [For 4 to 8 GHz] : up to 10 systems
  [For 11 GHz] : up to 6 systems
- Cooling : Natural cooling (1-5 sys/rack*)
  Forced cooling (6-10 sys/rack*)

Note*: Cooling system varies depending on the system configuration.

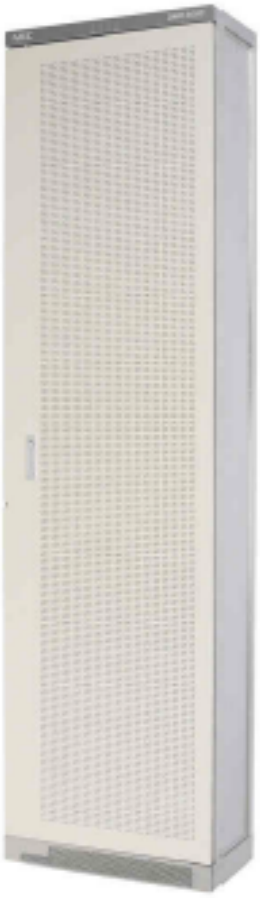


Figure 1 External View (Standard Rack)

Figure 2 Internal View (Standard Rack)

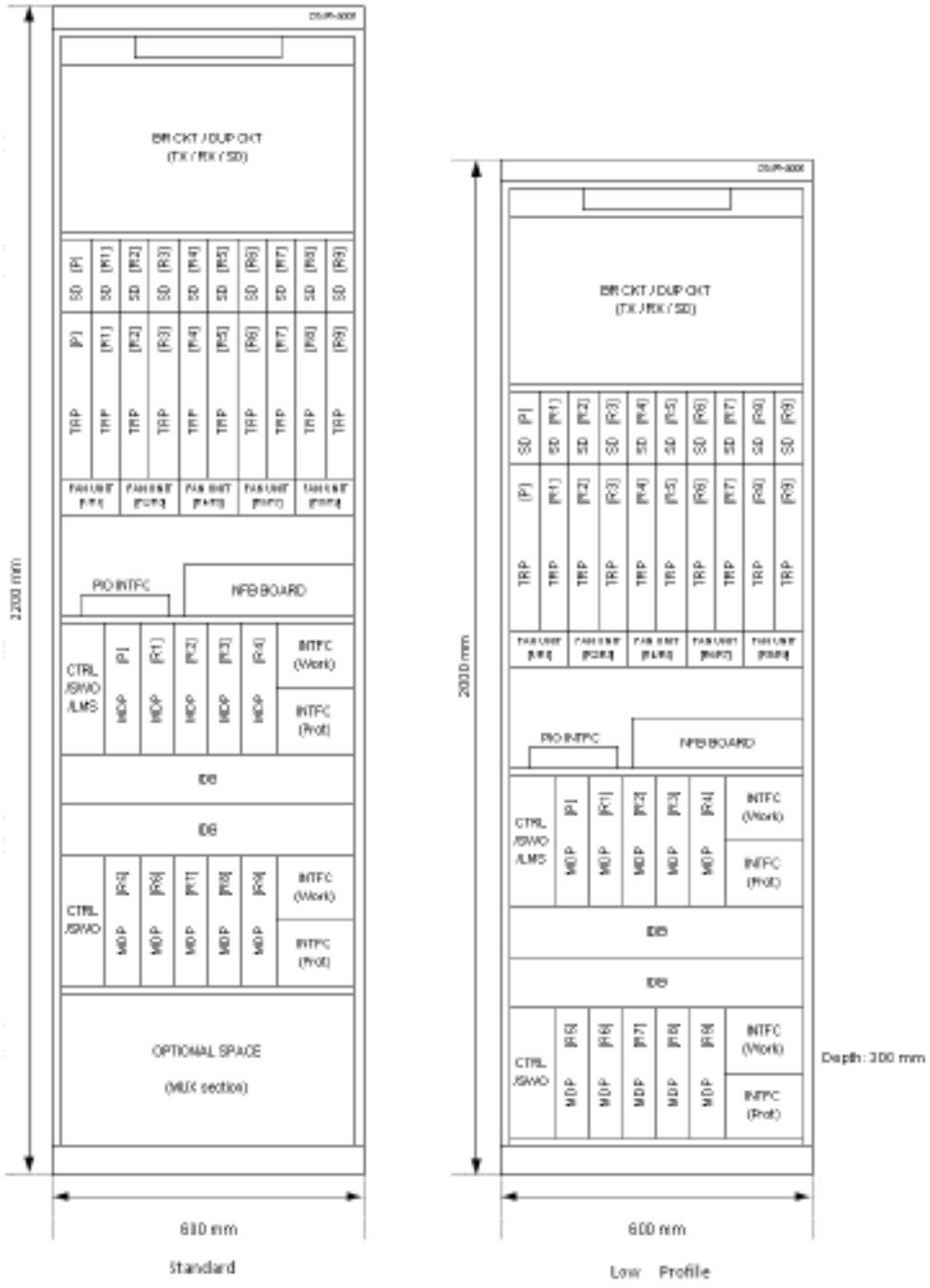
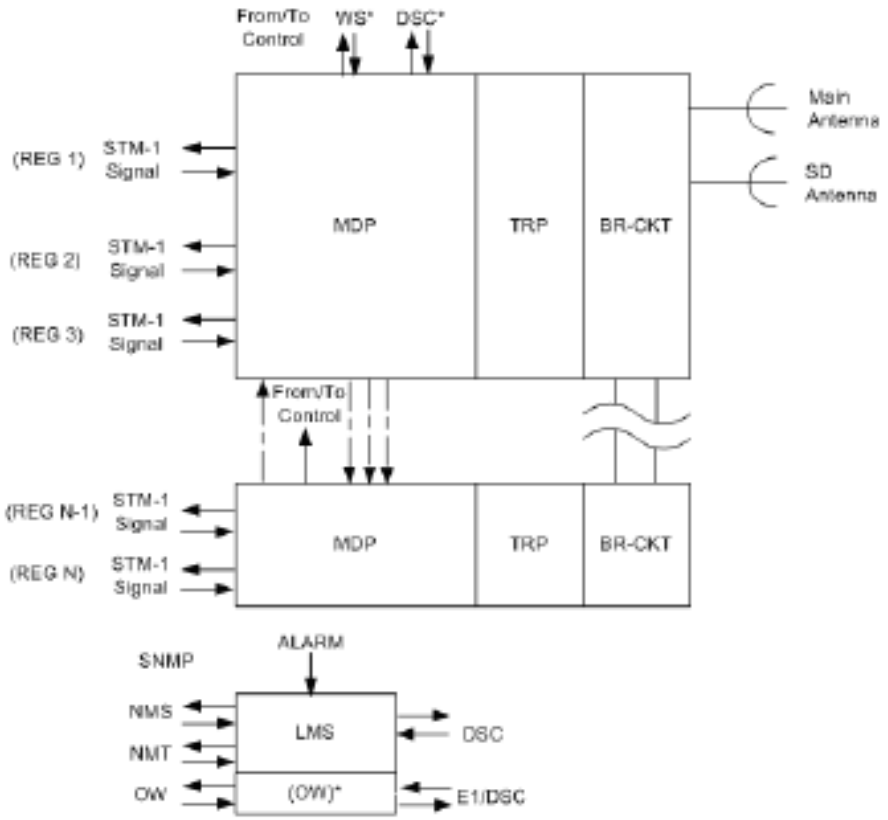


Figure 3 Equipment Configurations for a 9+1 Terminal



E1 : For Orderwire Channel in RSOH
DSC : Digital Service Channel
NMS : Network Management System
NMT : Network Management Terminal
OW : Orderwire
SD : Space Diversity
WS : 2 or 1.5 Mbps Wayside

* : Option

Figure 4 N+1 FD/SD Terminal Station Simplified System Block Diagram

Table 1 System Menu

Items		4 GHz		5 GHz		L6 GHz	U6 GHz		7 GHz	8 GHz		11 GHz
Modulation Scheme	64 QAM	O	-	O	-	-	O	-	-	O	-	O
	128 QAM	-	O	-	O	O	-	O	O	-	O	-
Diversity	FD	O	O	O	O	O	O	O	O	O	O	O
	FD/SD	O	O	O	O	O	O	O	O	O	O	O
	HS/HS	O	O	O	O	O	O	O	O	O	O	O
	HS/SD	O	O	O	O	O	O	O	O	O	O	O
	3 Antennas SD	-	-	-	-	O	O	-	-	-	O	-
TX Power (*1)	+33 dBm	O	-	O	-	-	O	-	-	O	-	-
	+30 dBm	O	-	O	-	-	O	-	-	O	-	O
	+32 dBm	-	O	-	O	O	-	O	O	-	O	-
	+29 dBm	-	O	-	O	O	-	O	O	-	O	-
Branching Circuit	Circulator	O	O	O	O	O	O	O	O	O	O	O
	Contiguous (*2)	-	-	-	-	O	O	-	-	-	-	-
	ACCP (*3)	O	-	-	-	-	-	-	O	-	O	-

Legend: O Available
- Not available

Note*

*1: Nominal level without ATPC operation.
Adjustable the minimum level with ATPC operation is -20 dB lower than the specified level in the table.

*2: Contiguous branching circuit is developed depend on the market needs and only available for XPIC system.

*3: Hybrid combiner less type for Adjacent Channel Co-Polarization frequency allocations.

2. FEATURES

2.1 Conformity with the latest Standards

All NEC NE's are fully SDH compatible and conform to the relevant ITU-R and ITU-T Recommendations and European Telecommunications Standards (ETS).

2.2 Advanced Technologies

Throughout the SDH radio system, NEC's own advanced technologies are used. Intensive use of Microwave Integrated Circuits (MIC's) makes the TRP durable and compact. In addition, custom-made large scale integrated circuits (LSI's) are applied. For example, the new digital MODEM is incorporated into a single LSI chip developed by NEC specifically for radio equipment. Furthermore, low-power high-speed Field Programmable Gate Array (FPGA) LSI's are extensively used, making the equipment more compact and reducing the power consumption.

2.3 Mounting in standard ETSI Racks

All sub-racks in NEC's SDH Family including radio, fiber optics transmission systems and add-drop multiplexers, are mounted in standard 2,200 mm high ETSI racks which meet ETS 300 119-3 (refer to Figure 3). The width of the electronics is 500 mm (standard), allowing 50 mm wide cable ducts at both sides of the rack. In addition, a low profile 2,000 mm high rack (without optional space for MUX section) can be selected as an option though it becomes ETSI non-standard. This vendor-independent solution provides full front access and simplifies future expansion. Standard SDH radio systems are shipped fully rack-mounted and intra-rack wired, enabling easy and quick installation.

2.4 Various System Applications and Easy Expandability

Various system applications such as N+1 Frequency Diversity (FD) and Hot-Standby (HS) protection switching systems are available. The system can easily be expanded by adding modules and/or subracks to the existing configuration to add transmission capacity. The maximum protected transmission capacity is 11+1. The N+1 protection switchover is hitless, resulting in error free switchover operation.

2.5 Superior Automatic Transmit Power Control

NEC's SDH radio equipment is equipped with Automatic Transmit Power Control (ATPC) function as standard. The ATPC function reduces interference against neighboring systems, reduces the adverse effect of "up fading" propagation, improves residual BER performance, reduces power consumption and improves equipment reliability.

2.6 Improved Error Performance with FEC

Low Density Parity Check (LDPC) Codes are used as a forward error correction (FEC) system to ensure a superior error correction performance.

The merit of LDPC is superior coding gain.

2.7 Superior Adaptive Equalizers

NEC's SDH radio equipment is equipped with a baseband type Adaptive Time Domain Equalizer (ATDE). The ATDE consists of linear equalizer as forward taps. Adoption of the latest in NEC's own LSI technology significantly enhances the ATDE capability to equalize waveform distortion and inter symbol interference in the time domain.

2.8 Various STM-1 Interfaces

The system can be equipped with an electrical or an optical STM-1 interface for each channel. The optical interface is available for two different cable lengths: for intra-office and long haul inter-office applications.

2.9 Automatic Protection Switching (APS)

This function enables the connection of a 1+1 redundancy for optical fiber cable directly to the radio equipment.

2.10 Alarm, Status and Performance Monitoring

Performance monitoring is built-in, including:

(a) Performance parameters as in ITU-T G.826 and G.828

(b) Counting the number of protection switchover operations (for 1+1 and N+1)

(c) Accumulation of the failed time for individual regular channels.

The operator can perform monitoring and control functions, by using the NMT (Network Management Terminal), or by using a Network Management System (NMS).

Furthermore, SV facilities enable monitoring and control of external equipment such as housekeeping facilities.

2.11 Orderwire Telephone Channels

Express Order Wire (EOW) and Omnibus Order Wire (OOW) are available on NEC's SDH Radio as option use. These channels provide voice communications throughout the entire SDH Radio network.

2.12 NMS based on Java

Management features are designed in convivial graphical interfaces based on Java development for local management by using NMT (Network Management Terminal Java version) and for central supervision by using NMS (Network Management System Java version). NMS System architecture is facilitated by NEs IP addresses auto-detection.

2.13 Unified Design Concept

NEC's SDH family includes a wide variety of transmission systems, such as the radio, add-drop multiplexer and NMS, thus opening a full range of configurations for various applications. As an example, a ring closure (see Figure 5) is possible with the combination of NEC's multiplexers (V-Node-S) and the 5000S N+1 Series SDH radio. Such systems have a self-healing ring function.

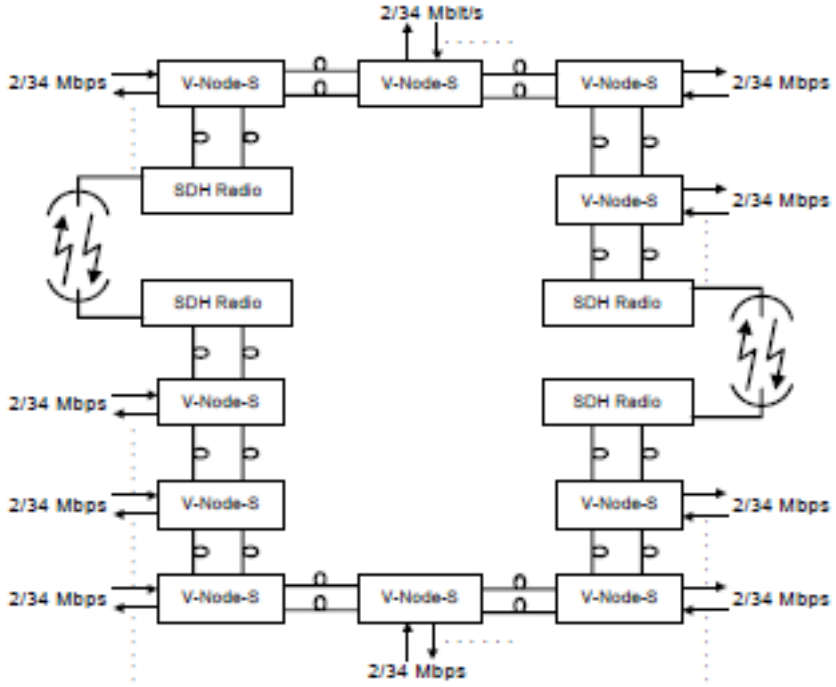


Figure 5 Ring Closure Network by applying a variety of NEC's NEs

3. SYSTEM ARCHITECTURE

The typical system architecture of a 3+1 FD/SD terminal station is shown in Figure 6 and of a repeater station in Figure 7.

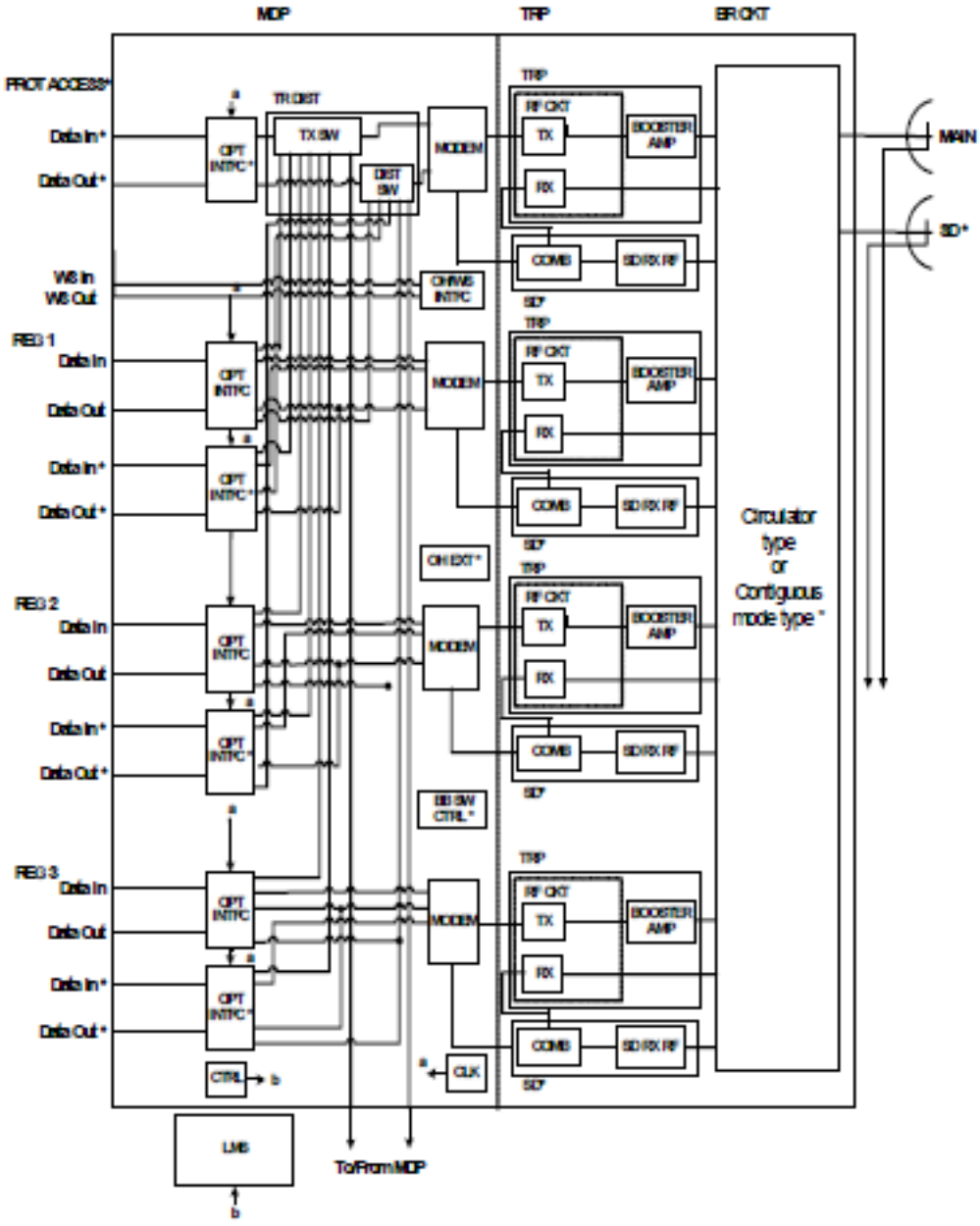
An optical or electrical STM-1 signal is fed to the interface units of the Modulator-Demodulator (MDP). SOH termination process of the line side and SOH insertion process of the radio side are performed in the interface units.

Then, the signal is fed to the modulator section of the MODEM, which produces a 64 QAM or 128 QAM modulated IF signal. For the modulation schemes and system menu, please refer to Table 1 (page 5). The modulated IF signal is fed to the transmitter section of the TRP which converts the IF signal to the RF signal.

At the opposite station, the RF signal is received by the receiver section of TRP, which converts the RF signal to an IF signal. The IF signal is demodulated to the digital signal and error correction is performed by the demodulator section of the MODEM.

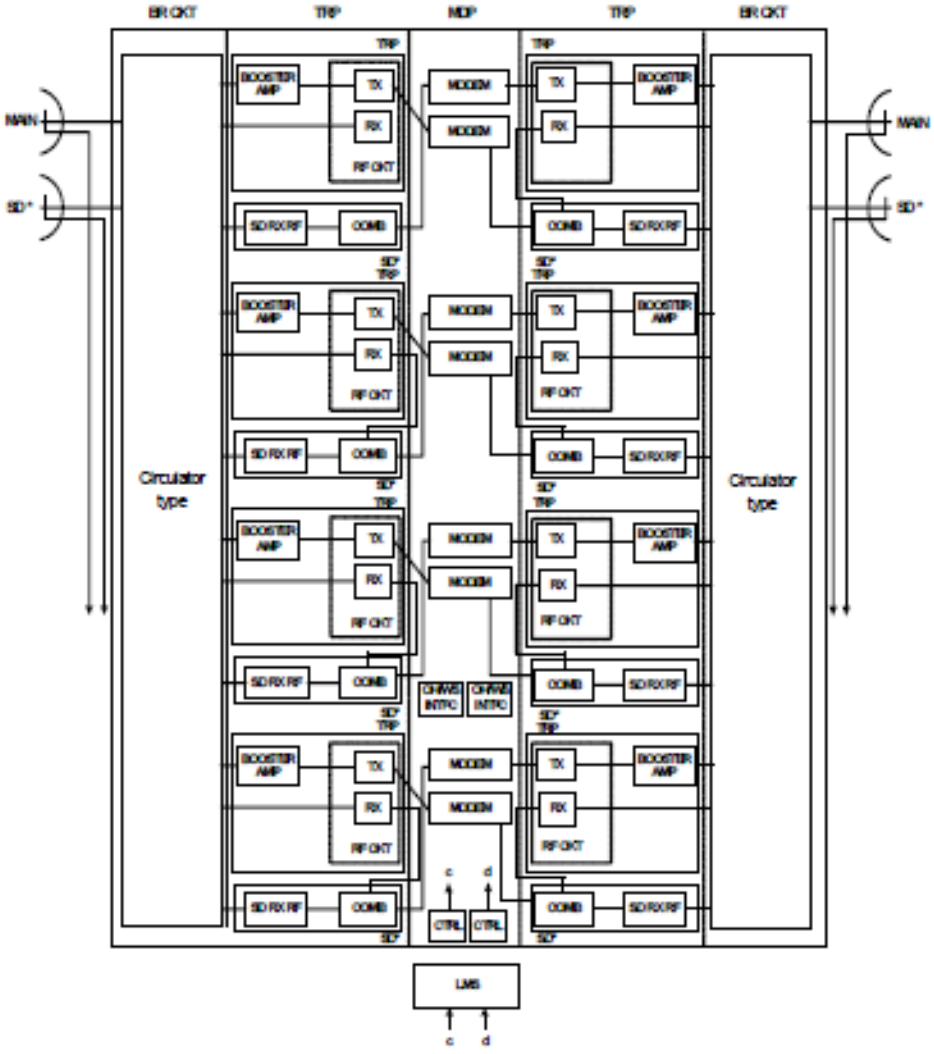
The demodulated baseband signal is fed to the interface units of MDP, which terminates the SOH bytes of the radio side and inserts the SOH bytes for the line side, and if applicable, provides hitless switching and electrical-optical conversion.

Furthermore, 1+1 redundancy for optical interface are provided as optional functions.



*: Option

Figure 6 Examples of 3+1 FD/SD with Protection Access Terminal Station Block Diagram



*: Option

Figure 7 Examples of 3+1 FD/SD Regenerative Repeater Station Block Diagram (expandable N+1)

4. OPERATIONAL DESCRIPTION

This chapter describes the operation of the transmitter-receiver, modulator-demodulator and CTRL Management (Management, Operation, Administration, and Maintenance & Provisioning).

4.1 Transmitter-Receiver (TRP)

4.1.1 Transmitter-Receiver (TRP unit)

The Transmitter-Receiver unit consists of a RF CKT and BOOSTER AMP.

RF CKT

The RF CKT consists of a TX circuit, RF circuit, SYNTH circuit, DC-DC CONV circuit and CONTROL circuit.

(TX)

The TX contains an IF AMP and TX frequency converter. The IF AMP amplifies the input IF signal. The frequency converter converts the 340 MHz IF signal into the RF signal by mixing it with the local oscillator signal generated by the TX SYNTH.

(SYNTH)

The SYNTH contains Automatic Phase Controlled Oscillator (APC OSC) utilizing a frequency-synthesized system that features high frequency stability and easy frequency setting.

(RX)

The RX consists of a pre-RF amplifier, RX frequency converter and IF amplifier. The pre-RF amplifier with high electron mobility transistor (HEMT) has an AGC function to avoid any distortion due to overload. The RX frequency converter contains a wideband, image-canceling, balanced mixer and converts the RF signal into the 140 MHz IF signal.

(DC-DC CONV)

The DC-DC CONV consists of a switching regulator and provides stabilized low voltage outputs for the Transmitter-Receiver using the primary DC input.

(CONTROL)

The CONTROL has the capability of Automatic Transmit Power Control (ATPC) and communication to the MODEM and CTRL module in the Modulator and Demodulator (MDP) section. The CONTROL generates an RF output power control signal depending on the RF receiver input power level at the opposite station.

BOOSTER AMP

The BOOSTER AMP consists of a linearizer and internal matched FET amplifiers. The operational output level is controlled with Automatic Level Control (ALC).

4.1.2 SPACE-DIVERSITY (SD unit) (option)

The SPACE-DIVERSITY unit consists of a SD RX RF and COMB.

SD RX RF

The SD RX RF consists of a pre-RF amplifier, RX frequency converter and IF amplifier. The pre-RF amplifier with HEMT amplifier has an AGC function to avoid distortion due to overload. The RX frequency converter contains a wideband, image-canceling, balanced mixer, which mixes the received RF signal and produces an IF signal.

COMB

The COMB is used for the space diversity system. The COMB comprises Maximal ratio combiner and SD control. The SD control detects the phase and amplitude difference between the two outputs IF signals from the RF CKT and SD RX RF in the phase and amplitude level difference detector, generates digital control signal to control the Maximal ratio combiner. The Maximal ratio combiner can modulate both IF signals from the RF CKT and SD RX RF, and acts to gain the maximum S/N level.

The delay time difference between the receive signals from the main antenna and SD antenna is compensated with an electrical IF differential absolute delay equalizer (DADE).

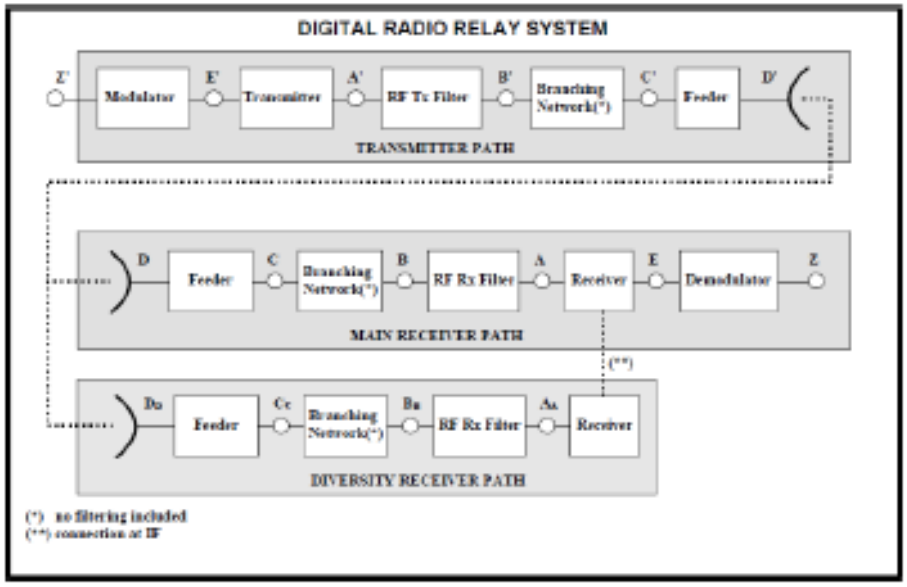


Figure 8 Fundamental Block Diagram for an N+1 Radio Relay System

4.2 Modulator-Demodulator

4.2.1 Modulator-Demodulator (MODEM) Module

The modulator-demodulator (MODEM) consists of FEC encoder, QAM modulator, QAM demodulator, time domain adaptive equalizer (ATDE), FEC decoder function.

The QAM Modulator / Demodulator coherently modulate / demodulate 64 QAM or 128 QAM.

The ATDE dynamically compensates for the delay and amplitude distortion of regenerated data signals, which are caused by multi-path fading.

The FEC encoder / decoder perform error correction by calculation with additional redundancy stream bits.

4.2.2 OH/WS INTFC Module (for SYS1/2: Standard, for SYS6/7: Option)

(1) SOH Interface and DSC Interface

The OH/WS INTFC is connected to the INTFC and MODEM. (Refer to Figure 9)

The OH/WS INTFC provides the access to the service channels transported in the STM-1 frame section overhead (SOH), service channels and wayside channels transported in the radio frame complementary overhead (RFCOH).

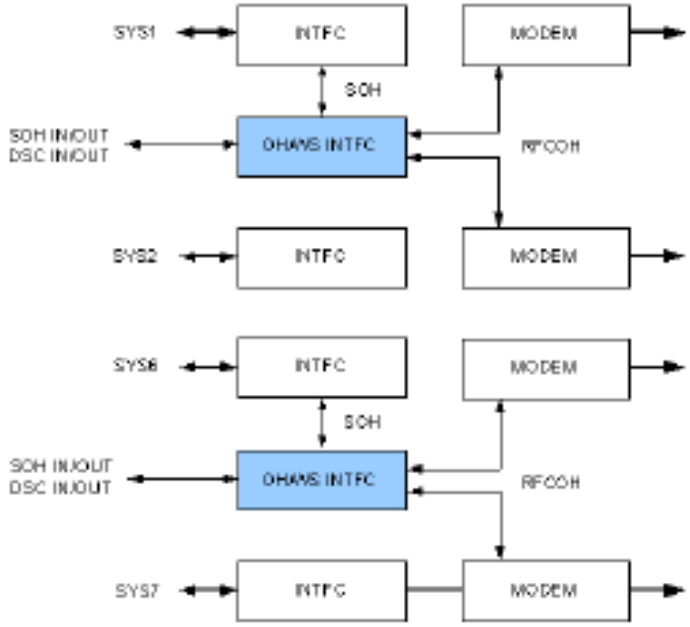


Figure 9 OH/WS INTFC (Examples of N+ 0 systems for SOH and RFCOH Drop/Insert)

The OH/WS INTFC provides access to the RSOH bytes in the terminal and repeater terminal. The overhead bytes that may be accessed are the E1, F1 and DCCr bytes, plus three (3) bytes reserved for national use (X3, X9 and X11) in the RSOH (Refer to Figure 10).

Only RSOH bytes are terminated in the 5000S Radio Section.

	1	2	3	4	5	6	7	8	9	
1	A1	A1	A1	A2	A2	A2	J0			RSOH
2	B1	X3		E1			F1			
3	D1	X9		D2	X11		D3			
4	AU POINTER									
5	B2	B2	B2	K1			K2			MSOH
6	D4			D5			D6			
7	D7			D8			D9			
8	D10			D11			D12			
9	S1	Z1	Z1	Z2	Z2	M1	E2			

Name	Bytes	Purpose ITU-R Rec. 750	
A1, A2	6	Frame alignment A1: 11110110/A2: 00101000 (defined). For STM-N bytes shall be 3xN for A1 and A2 respectively: Unscrambled.	RSOH
J0	1	Regenerator Section Trace	
B1	1	Error Monitor: detects bit error in hop base by BIP-8 (Bit Interleaved Parity	
E1	1	Orderwire (64 kbps): regenerator section orderwire channel.	
F1	1	Unset channel (64 kbps) to be used by operator.	
D1-D3	3	DCCr (Regenerator Section Data Communication Channel) 192 kbps SV and Control data communication.	
X3, X9, X11	(3)	Access enabled bytes with OH/WS INTFC module.	
	6	Media specific bytes: Available for Radio Specific usage.	
B2	3	Error Monitor: BIP-Nx4 Multiplex section bit error monitoring.	MSOH
E2	1	Orderwire (64 kbps): multiplex section orderwire channel.	
K1 - K2	2	Automatic protection switching (switch between terminals).	
D4 - D12	9	DCCm (Multiplex Section DCC).	
Z1 - Z2	4	Reserved Not yet defined.	
	4	National use bytes (NU): Reserved for national use (64 kbps).	R/MSOH
	26	Future International use bytes: Reserved for future International use.	
	2	National use bytes (NU): Reserved for national use (Unscrambled byte).	RSOH
S1	1	Synchronization status (b5 - b8).	MSOH
M1	1	Used for multiplex section REI (Remote Error Indication).	

Figure 10 Allocations and Usage of SOH Bytes

(2) WS Interface

The OH/WS INTFC supports up to four (4) wayside channels per module. Usable channels of the wayside vary connection depending on the system configuration (Refer to Figure 11).

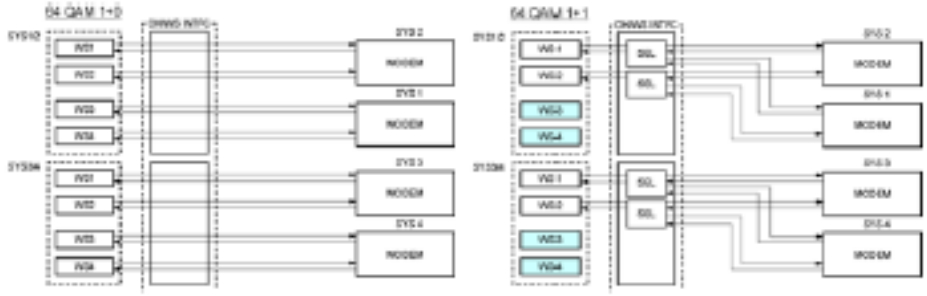


Figure 11 (a) WS Signal Transmission (64 QAM)

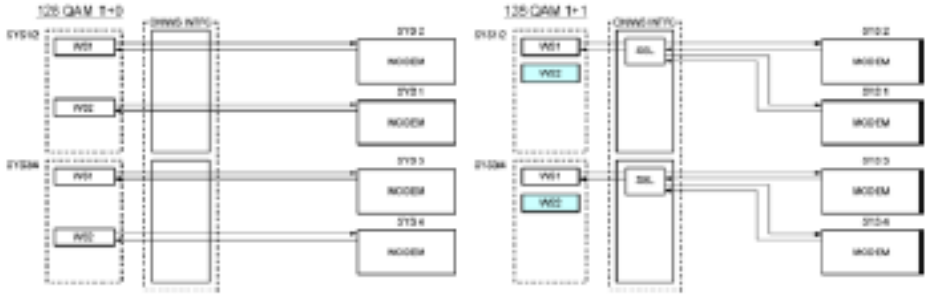


Figure 11 (b) WS Signal Transmission (128 QAM)

4.2.3 OH EXT Module (option)

The OH EXT connected to the OH/WS INTFC. (Refer to Figure 12)

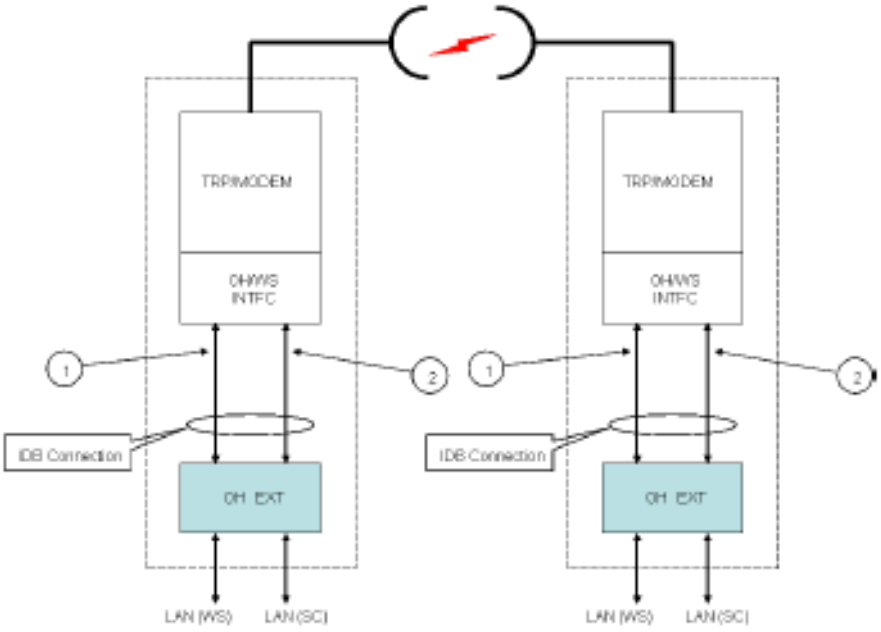
The OH EXT provides the following functions:

(a) LAN (WS): 10/100 Base-T(X) is converted into WS (G.703, 2 Mbps or 1.5 Mbps) 1ch.

(b) LAN (SC): 10/100 Base-T(X) is converted into SC (V.11, 192 kbps) 1ch.

(c) Either of G.703 (64 kbps) or VF signal is converted into V.11 (64 kbps) 1ch.

(d) The network of the VF signal can be composed of a digital hybrid function.



1: WS (G.703, 2 Mbps or 1.5 Mbps)
2: SC (V.11, 192 kbps)

Figure 12 LAN (WS), LAN (SC) Transmission

4.2.4 N+1 Protection Switchover Control

N+1 protection switching is provided by the protection switchover control circuitry consisting of the SWO PROC (Switchover Processor Unit) module.

The SWO PROC modules have control logic for N+1 protection switching and interface logic circuits for the protection channel and regular channels and the basic rack. Alarm, status and performance monitoring facilities are also provided in the SWO PROC module, which processes stores and interfaces this information to the LMS section.

4.2.5 Interface Section of Modulator-Demodulator

(1) TRANSMIT SECTION

The transmit section provides the following functions:

(a) Optical-to-electrical signal conversion (optical interface)

(b) Coded mark inversion (CMI) to non-return to zero (NRZ) code conversion (electrical interface)

(c) AIS detection and sending

(2) Receive Section

The receive section provides the following functions:

(a) Hitless switching

(b) AIS detection and sending

(c) Electrical-to-optical signal conversion (optical interface)

(d) NRZ to CMI conversion (electrical interface)

4.3 Operation, Administration, Maintenance and Provisioning

OAM&P functions available in the 5000S N+1 Series SDH Radio Systems are summarized as follows:

(1) Network Element Facilities with display and controls

- Alarm and status management
- Performance management

(2) NMS based management functions with SNMP interface

(3) N+1 Protection switchover control function (automatic/manual)

(4) NE auto discovery

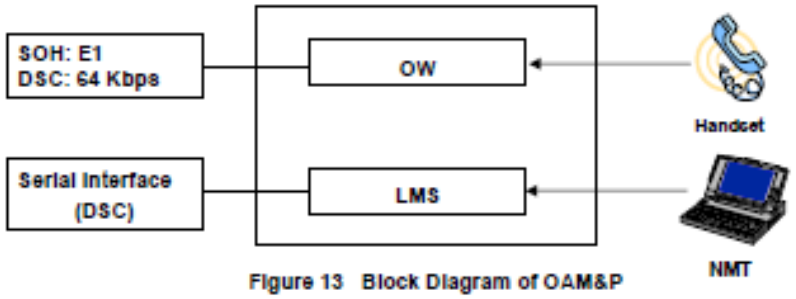


Figure 13 Block Diagram of OAM&P

(5) Engineering Order Wire

Engineering Order Wire is assignable use of E1 (SOH) for Express Order Wire (EOW) and DSC for Omnibus Order Wire (OOW) in the 5000S N+1 series Radio System network. The OW is available All Call, Selectable Call and Group Call using OW module. OW connection is shown in Figure 14.

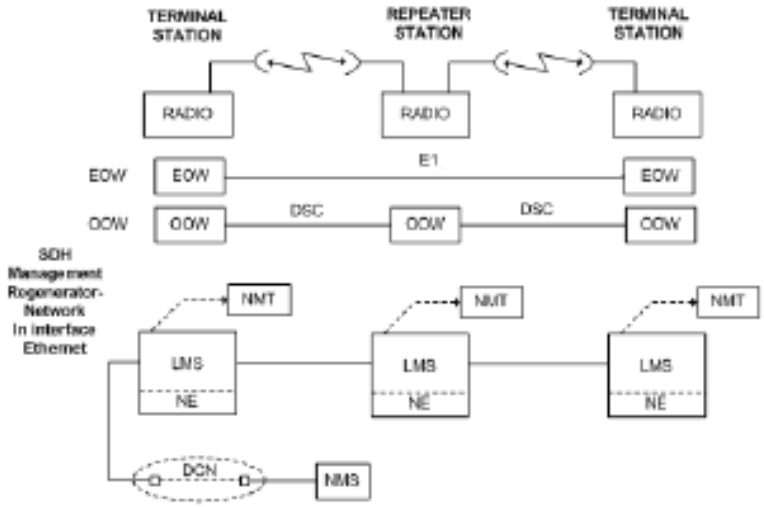


Figure 14 SDH Regenerator Network, OW and NE Typical System Configuration

5. OPTIONS

(1) Baseband Interface

The baseband interface can be selected from the following:

- STM-1 : Electrical
- STM-1/OC-3 : Optical Intra-office
- STM-1/OC-3 : Optical Inter-office Long Haul

(2) Wayside Traffic for System 1/6 (option)

The OH/WS INTFC module provides an access to the 2 Mbps or 1.5 Mbps wayside channels the RFCOH. The following numbers of wayside channels are available:

- 2 x 2 Mbps or 2 x 1.5 Mbps (64 QAM), 1 x 2 Mbps or 1 x 1.5 Mbps (128 QAM)

(3) Orderwire (option)

The OW module is available to provide an OOW channel at the repeater, and OOW and EOW channels at the terminal.

(4) Power Supply (+/-24 VDC or +48 VDC: option)

The system can be equipped with DC-DC converters selected from -48 VDC and additional DC-DC converters (*) are needed for ±24 VDC / +48 VDC

*Note: Installable quantities are limited according to the system configurations.

Power Supply	Non-Floating	Floating (option)		
	-48 VDC	-24 VDC	+24 VDC	-48 VDC
allowable range (V)	-40.5 to -57.0	-20.0 to -35.0	+20.0 to +35.0	-40.5 to -57.0
Natural Cooling	O	O*	O*	O*
Forced Cooling	O	O**	O**	O**

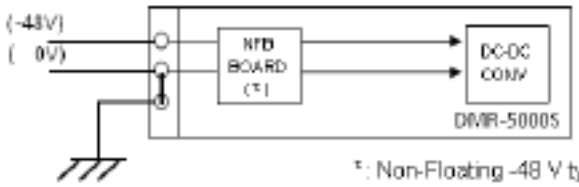
Legend: O Available

* In case of Natural Cooling type, Power Supply option is available.

** In case of Forced Cooling type, by using external power supply voltage converters (PS CONV RACK) for Power Supply option is available.

Standard: -48 VDC (Non-Floating)
Forced Cooling (For up to 6 or 10 sys/rack)
Natural Cooling (For up to 5 sys/rack)

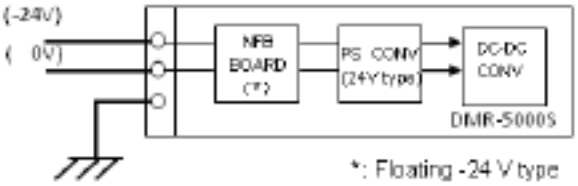
-48 VDC (Non-Floating)



*: Non-Floating -48 V type

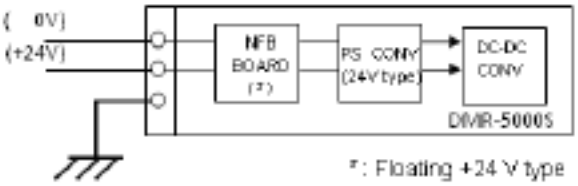
Option : -24 VDC (Floating), +24 VDC (Floating) or -48 VDC (Floating)
Natural Cooling (For up to 5 sys/rack)

-24 VDC (Floating)



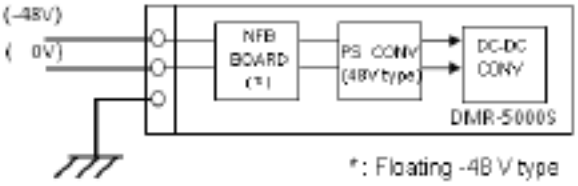
*: Floating -24 V type

+24 VDC (Floating)



*: Floating +24 V type

-48 VDC (Floating)



*: Floating -48 V type

(5) Space Diversity Receiver (option)

The space diversity receiver is available to improve the path performance during an abnormal propagation condition (i.e., deep fading).

(6) Transmitter Output Power (selectable)

Please refer to the performance and characteristics tables in Sections 6.1 and 6.2 for the available output power options.

6. PERFORMANCE AND CHARACTERISTICS

6.1 64 QAM Systems

Items	4 GHz	5 GHz	U6 GHz	8 GHz	11 GHz	Guaranteed
Frequency Plan Channel Spacing	ITU-R F.635 40 MHz	ITU-R F.1099 40 MHz	ITU-R F.384 40 MHz	ITU-R F.386 ANNEX 2 40.74 MHz	ITU-R F.387 40 MHz	–
TX Power (exclude BR CKT Loss) (5 W) (dBm) (10 W) (dBm)*1	 +30.0 +33.0	 +30.0 +33.0	 +30.0 +33.0	 +30.0 +33.0	 +30.0 –	 ±1.0 dB ±1.0 dB
Noise Figure (dB)	2.3	2.3	2.3	2.5	2.8	+1.0 dB
Frequency Stability	±5 ppm (at -5 to +40°C)					±10 ppm
C/N vs. BER 10^{-3} (dB) 10^{-6} (dB)	 20.1 20.8	 20.1 20.8	 20.1 20.8	 20.1 20.8	 21.5 23.0	 +2.0 dB +3.0 dB
RSL Overload (exclude BR CKT Loss) 10^{-3} (dBm)	 -15.0	 -15.0	 -15.0	 -15.0	 -15.0	 -2.0 dB
RSL vs. BER (exclude BR CKT Loss) 10^{-3} (dBm) 10^{-6} (dBm)	 -76.7 -76.0	 -76.7 -76.0	 -76.7 -76.0	 -76.5 -75.8	 -76.2 -75.5	 +3.0 dB +4.0 dB
System Gain (exclude BR CKT Loss) (5 W) 10^{-3} (dB) 10^{-6} (dB) (10 W) 10^{-3} (dB) 10^{-6} (dB)	 106.7 106.0 109.7 109.0	 106.7 106.0 109.7 109.0	 106.7 106.0 109.7 109.0	 106.5 105.8 109.5 108.8	 106.2 105.5 – –	 -3.0 dB -4.0 dB -3.0 dB -4.0 dB
R-BER	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}
BR CKT Loss *2, *3 (Circulator type) 1+0 (dB) 1+1 (dB) 1+2 (dB) 1+3 (dB) 1+4 (dB) 1+5 (dB)	 4.7 5.1 5.5 5.8 – –	 5.3 5.7 6.1 6.5 – –	 5.4 5.8 6.2 6.6 – –	 6.5 7.0 7.5 8.0 9.1 –	 8.0 8.3 8.6 8.9 9.2 9.5	 +1.0 dB +1.0 dB +1.0 dB +1.0 dB +1.0 dB +1.0 dB
BR CKT Loss *2, *3 (Contiguous type) 1+3 (dB) 1+7 (dB)	 – –	 – –	 6.0 7.3	 – –	 – –	 +1.0 dB +1.0 dB
BR CKT Loss *2, *3 (ACCP type) 1+0 (dB) 1+1 (dB) 1+2 (dB) 1+3 (dB) 1+4 (dB) 1+5 (dB)	 – – – 8.2 – –	 – – – – – –	 – – – – – –	 – – – – – –	 – – – – – –	 – – – +1.0 dB – –
Tunable Range	Half band					–
Waveguide Interface	UDR-40	UDR-48	UDR-70	UDR-84	UDR-100	–

*1: High Power Option
*2: The total of the loss value in one hop is shown.
*3: Shows the BR CKT Loss values included of Low Loss Cable loss. Loss of the BEF used to eliminate RF interference signal between Transmitter and Receiver is not included. BEF should be applied in case of the channel allocation as follows, highest channel in lower half band and lowest channel in upper half band are used in the same time.

6.2 128 QAM Systems

Items	4 GHz	5 GHz	L6 GHz	U6 GHz	7 GHz	8 GHz	Guaranteed
Frequency Plan Channel Spacing	ITU-R F.382 29 MHz	ITU-R F.746 ANNEX 2 28 MHz	ITU-R F.383 29.65 MHz	ITU-R F.384 30 MHz	ITU-R F.385 28 MHz	ITU-R F.386 ANNEX 1 29.65 MHz	–
TX Power (exclude BR CKT Loss) (5 W) (dBm) (10 W) (dBm)*1	+29.0 +32.0	+29.0 +32.0	+29.0 +32.0	+29.0 +32.0	+29.0 +32.0	+29.0 +32.0	±1.0 dB ±1.0 dB
Noise Figure (dB)	2.3	2.3	2.3	2.3	2.3	2.5	+1.0 dB
Frequency Stability	±5 ppm (at -5 to +40°C)						±10 ppm
C/N vs. BER 10^{-3} (dB) 10^{-6} (dB)	24.6 25.3	24.6 25.3	24.6 25.3	24.6 25.3	24.6 25.3	24.6 25.3	+2.0 dB +3.0 dB
RSL Overload (exclude BR CKT Loss) 10^{-3} (dBm)	-15.0	-15.0	-15.0	-15.0	-15.0	-15.0	-2.0 dB
RSL vs. BER (exclude BR CKT Loss) 10^{-3} (dBm) 10^{-6} (dBm)	-73.1 -72.4	-73.1 -72.4	-73.1 -72.4	-73.1 -72.4	-73.1 -72.4	-72.9 -72.2	+3.0 dB +4.0 dB
System Gain (exclude BR CKT Loss) (5 W) 10^{-3} (dB) 10^{-6} (dB) (10 W) 10^{-3} (dB) 10^{-6} (dB)	102.1 101.4 105.1 104.4	102.1 101.4 105.1 104.4	102.1 101.4 105.1 104.4	102.1 101.4 105.1 104.4	102.1 101.4 105.1 104.4	101.9 101.2 104.9 104.2	-3.0 dB -4.0 dB -3.0 dB -4.0 dB
R-BER	10^{-13}	10^{-13}	10^{-13}	10^{-13}	10^{-13}	10^{-13}	10^{-13}
BR CKT Loss *2, *3 (Circulator type) 1+0 (dB) 1+1 (dB) 1+2 (dB) 1+3 (dB) 1+4 (dB)	5.2 5.8 6.0 6.3 6.8	5.9 6.3 6.7 7.1 8.2	5.4 5.8 6.3 6.8 –	6.4 7.0 7.5 8.0 9.1	6.4 7.0 7.5 8.0 9.1	6.8 7.3 7.8 8.3 9.4	+1.0 dB +1.0 dB +1.0 dB +1.0 dB +1.0 dB
BR CKT Loss *2, *3 (Contiguous type) 1+3 (dB) 1+7 (dB)	– –	– –	6.0 7.3	– –	– –	– –	+1.0 dB +1.0 dB
BR CKT Loss *2, *3 (ACCP type) 1+0 (dB) 1+1 (dB) 1+2 (dB) 1+3 (dB) 1+4 (dB)	– – – – –	– – – – –	– – – – –	– – – – –	– – – 9.1 –	– – – 9.5 –	– – – +1.0 dB –
Tunable Range	Half band						–
Waveguide Interface	UDR-40	UDR-48	UDR-58 UDR-70 (*4)	UDR-70	UDR-70 UDR-84 (*4)	UDR-84	–

*1: High Power Option

*2: The total of the loss value in one hop is shown.

*3: Shows the BR CKT Loss values included of Low Loss Cable loss. Loss of the BEF used to eliminate RF interference signal between Transmitter and Receiver is not included. BEF should be applied in case of the channel allocation as follows, highest channel in lower half band and lowest channel in upper half band are used in the same time.

*4: Optional Flange

6.3 ATPC

(1)	Dynamic Range	:	20 dB to 0 dB
(2)	Control Steps	:	1 dB
(3)	Fading Tracking Speed	:	100 dB/second
(4)	RSL Operating Range	:	-40 to -70 dBm
(5)	DC Power Consumption Reduction	:	-40%/BOOSTER AMP

6.4 Interfaces

(1) Main Traffic, Electrical (STM-1)

Type (ITU-T G.703)	:	In station section, full functionality
Bit Rate	:	155.520 Mbps ±20 ppm
Level	:	1 Vp-p (nominal) TX accepts 12.7 dB cable loss at 78 MHz
Code Format	:	CMI
Impedance	:	75 ohms, unbalanced (nominal)

(2) Main Traffic, Optical (STM-1)

TYPE (ITU-T G.957)	Intra-office (I.1/S.1.1)	Long haul Inter-office (L.1.1)
Functionality	Full	
Bit Rate	155.520 Mbps	
Code Format	NRZ	
Wavelength	1,310 nm	
Connect (On front of panel)	LC-type	
Transmitter (Data OUT)		
• Source Type	MLM	
• Maximum Spectral Width	40 nm / 7.7 nm	4 nm
• Mean Launched Power	-8 to -15 dBm	0 to -5 dBm
• Minimum Extinction Ratio	8.2 dB	10 dB
Optical Path		
• Attenuation Range	0 to 7 dB / 0 to 12 dB	10 to 28 dB
Receiver (Data IN)		
• Minimum Sensitivity	-23 dBm / -28 dBm	-34 dBm
• Minimum Overload	-8 dBm	-10 dBm
• Maximum Optical Path Penalty	1 dB	
Safety		
• Laser Product Safety	IEC 825 Class 1	
• Automatic Laser Shutdown (ALS)	ITU-T G. 958	

(3) Digital Service Channels (Option, on MDP, using RFCOH)

Bit Rate (*1)	:	1 x 64 kbps + 1 x 192 kbps, or 4 x 64 kbps
Input/Output Level	:	RS-422 (ITU-T V.11) comply
Impedance (nominal)	:	110 ohms, balanced
Interface	:	Contra-directional

*1: When OH EXT (option) is used, SC 1ch is available as LAN signal.

(4) Wayside Traffic Transmission (Option, on MDP, using RFCOH)

Number of channels (*2)		
64 QAM	:	2 x 2 Mbps or 2 x 1.5 Mbps
128 QAM	:	1 x 2 Mbps or 1 x 1.5 Mbps
Bit Rate	:	2.048 Mbps ± 50 ppm 1.544 Mbps ± 130 ppm
Input/Output Level	:	ITU-T G.703 comply
Code Format	:	High Density Bipolar (HDB)-3 (2.048 Mbps), AMI or B8ZS selectable (1.544 Mbps)
Impedance (nominal)	:	75 ohms, unbalanced or 120 ohms, balanced selectable (2.048 Mbps), 100 ohms, selectable (1.544 Mbps)

*2: When OH EXT (option) is used, WS 1ch is available as LAN signal.

(5) Parallel Interface for Housekeeping Alarm/Control

Input (Monitoring) Items	:	16 (standard) or 32 (option)
Input Interface	:	Photo Coupler (2 pins)
Output (Control) Items	:	8
Output Interface	:	Dry Contact, Form C (3 pins)

6.5 Common

(1) Power Requirements : -48 VDC (-40.5 to -57.0 VDC)

(2) Power Consumption (for 4 to U6 GHz, 1+1 Terminal. e/w SD, Natural cooling)

The data is as follows:

BOOSTER Type	Power Consumption (Approx.)			
	Total	TRP (e/w SD)	MDP	COMMON MODULE
10 W	220 W	80 W/ch	20 W/ch	20 W
5 W	200 W	70 W/ch		

Configuration		Power Consumption (Approx.)			
		1+1	2+1	3+1	4+1
BOOSTER Type	10 W	220 W	320 W	420 W	520 W
	5 W	200 W	290 W	380 W	470 W

(3) Temperature Range (Excluding NMT), ETS300 019-2-3
Guaranteed Operation : -5°C to +50°C
Workable Operation : -10°C to +55°C
Transport and Storage : -30°C to +70°C

(4) Relative Humidity (Excluding NMT)
Guaranteed Operation : Less than 95% at +45°C (non-condensing)
Workable Operation : Less than 95% at +50°C (non-condensing)
Transport and Storage : Less than 95% at +50°C (non-condensing)

(5) Altitude
Guaranteed Operation : Up to 4,000 m

(6) Electrostatic Discharge (ESD) : 4 kV on external surface - No error (Test method: IEC 861-2)

(7) Electro-Magnetic Compatibility (EMC) : In accordance with ETSI standard and CISPR Pub.22/85 Class A, equivalent to CENELEC EN 55022 Class A (with front cover)

(8) Weight : Maximum 200 Kg

7. SUPERVISION ITEMS

7.1 Alarm Events*

No.	Event Name	Event Condition	LED
1	LOSS OF SIGNAL	Input signal lost	*
2	LOSS OF FRAME	Frame synchronization lost	*
3	EXCESSIVE BER	BER degraded worse than preset value (BER=10^{-3} to 10^{-5})	*
4	SIGNAL DEGRADE	Signal degraded worse than preset value (BER=10^{-6} to 10^{-9})	-
5	MAINTENANCE	MAINT SW switch on CTRL module set to MAINT status	*
6	OUTPUT LEVEL DOWN	MOD IF output signal level decreases	*
7	INPUT LEVEL DOWN	Synchronization lost / DEM IF input signal level decrease	*
8	TX LEVEL ALM	TX output power down below normal	*
9	TX APC ALM	TX local oscillator becomes unlocked	*
10	RECEIVE LEVEL ALM	RX RF input level decreased	*
11	RX APC ALM	RX Local Oscillator unlocked	*
12	MAIN RECEIVE LEV ALM	Main receiver IF level decreased	*
13	ATPC COMM ALM	ATPC communication failure	*
14	HS SW SERVICE FAILURE	Hot standby system failure	*

* : The alarm events are tabulated for major items only.

Rack top LED alarm

No.	Items	Alarm
1	PM	Prompt maintenance alarm (red LED)
2	DM	Deferred maintenance alarm (red LED)

7.2 Status Events*

No.	Event Name	Event Condition
1	AIS RECEIVED	Detection of AIS

* : The status events are tabulated for major items only.

7.3 Remote Monitoring Items (displayed by the NMT)*

No.	Parameter Name	Impairment Event
1	TX PWR	Transmitter Output Power at TX OUT (dBm)
2	RX IN LEV	Received Signal Level (dBm)
3	MAIN IN LEV	Received Main Signal Level (dBm)
4	SD IN LEV	Received SD Signal Level (dBm)
5	BBE	Summary of Background Block Error
6	ES	Summary of Errored Second
7	SES	Summary of Severely Errored Second

* : The monitoring items are tabulated for major items only.

7.4 Local Metering Items (measured by test equipment)

No.	Item Name	Description
1	TX PWR	Transmitter Output Power at Antenna port
2	RX IN LEV	Received Signal Level
3	MAIN IN LEV	Received Main Signal Level
4	PS V	Output Voltage of DC-DC CONV (-48 V)

NEC

Empowered by Innovation NEC

Integrated and Compact SDH Microwave Radio System for Long-Haul Transmission

5000S

NEC Corporation
http://www.nec.com/pasolink/

System and Equipment Parameters

System Parameters

64 QAM

Frequency Band	4 GHz	5 GHz	L6 GHz	U6 GHz	7 GHz	8 GHz	11 GHz
Range (GHz)	3.6 – 4.2	4.4 – 5.0	–	6.43 – 7.11	–	7.725 – 8.275	10.7 – 11.7
Channel Spacing (MHz)	40	40	–	40	–	40.74	40
Modulation Scheme	64 QAM + LDPC						
TX Output Power (dBm) (excluding BR CKT loss) (10W / 5W)	33/30	33/30	–	33/30	–	33/30	–/30
System Gain (dB at BER = 10^{-3}) (excluding BR CKT loss) (10W / 5W)	109.0/106.0	109.0/106.0	–	109.0/106.0	–	108.8/105.8	–/105.5

128 QAM

Frequency Band	4 GHz	5 GHz	L6 GHz	U6 GHz	7 GHz	8 GHz	11 GHz
Range (GHz)	3.6 – 4.2	4.4 - 5.0	5.925 – 6.425	6.43 - 7.11	7.125 – 7.725	7.725 – 8.275	–
Channel Spacing (MHz)	29	28	29.65	30	28	29.65	–
Modulation Scheme	128 QAM + LDPC						
TX Output Power (dBm) (excluding BR CKT loss) (10W / 5W)	32/29	32/29	32/29	32/29	32/29	32/29	–
System Gain (dB at BER = 10^{-3}) (excluding BR CKT loss) (10W / 5W)	104.4/101.4	104.4/101.4	104.4/101.4	104.4/101.4	104.4/101.4	104.2/101.2	–

Equipment Parameters

Transmission Capacity			STM-1 or OC-3 (155.52 Mbps, electrical or optical interface)
Wayside Capacity (In RFCOH) [1]			64 QAM System: 2 x 2.048 Mbps or 2 x 1.544 Mbps 128 QAM System: 1 x 2.048 Mbps or 1 x 1.544 Mbps
Service Channel Capacity (In RFCOH) [1]			4 x 64 kbps or 1 x 192 kbps + 1 x 64 kbps
Power Supply Requirement			-48 VDC (-40.5 to -57 VDC) +48 VDC (+36 to +60 VDC) (Optionally available) -24 VDC (-20 to -35 VDC) / +24 VDC (+20 to +35 VDC) (Optionally Available)
Total Power Consumption			Approx. 250 W (for 4 to U6 GHz, 1 + 1 Terminal, s/w SD)
Mounting Rack			ETSI – Rack (ETS 300 119-3)
Dimensions	Standard Rack	ETSI Standard	600 (W) x 300 (D) x 2,200 (H) mm
	Low-Profile Rack	ETSI Non-Standard	600 (W) x 300 (D) x 2,000 (H) mm
Operating Temperature (Guaranteed)			-5 to +50°C

*1: When OH EXT (option) is used, 1ch is available as LAN signal.

Specifications are subject to change without prior notice.

Abbreviations:

ASP:	Automatic Signal Protection	EXT:	Extension	LDPC:	Low-Density Parity Check	QAM:	Quadrature Amplitude Modulation
ATDE:	Adaptive Time Domain Equalizer	s/w:	Equipped with	MDP:	Modulator/Demodulator Equipment	RF:	Radio Frequency
BB:	Base Band	FD:	Frequency Diversity	MST:	Multiplex Section Termination	RFCOH:	Radio Frame Complementary Overhead
BER:	Bit Error Rate	FEC:	Forward Error Correction	MUX:	Multiplexer	RST:	Regenerator Section Termination
BR CKT:	Branching Circuit	FOTS:	Fiber Optic-Transmission System	NMS:	Network Management System	SD:	Space Diversity
CAPEX:	Capital Expenditure	GbE:	Gigabit Ethernet	NMT:	Network Management Terminal	SDH:	Synchronous Digital Hierarchy
CTRL:	Control	HS:	Hot-Standby	OC-3:	Optical Carrier level 3	STM-1:	Synchronous Transport Module level 1
DIR:	Direction	IDB:	Interface Distribution Board	OH:	Overhead	TRP:	Transmitter/Receiver Equipment
DSC:	Digital Service Channel	IF:	Intermediate Frequency	OPEX:	Operating Expenditure	V/H-pol:	Vertical/Horizontal Polarization
ETSI:	European Telecommunications Standards Institute	ITU:	International Telecommunications Union	PDH:	Plesiochronous Digital Hierarchy	XPIC:	Cross Polarization Interference Canceller

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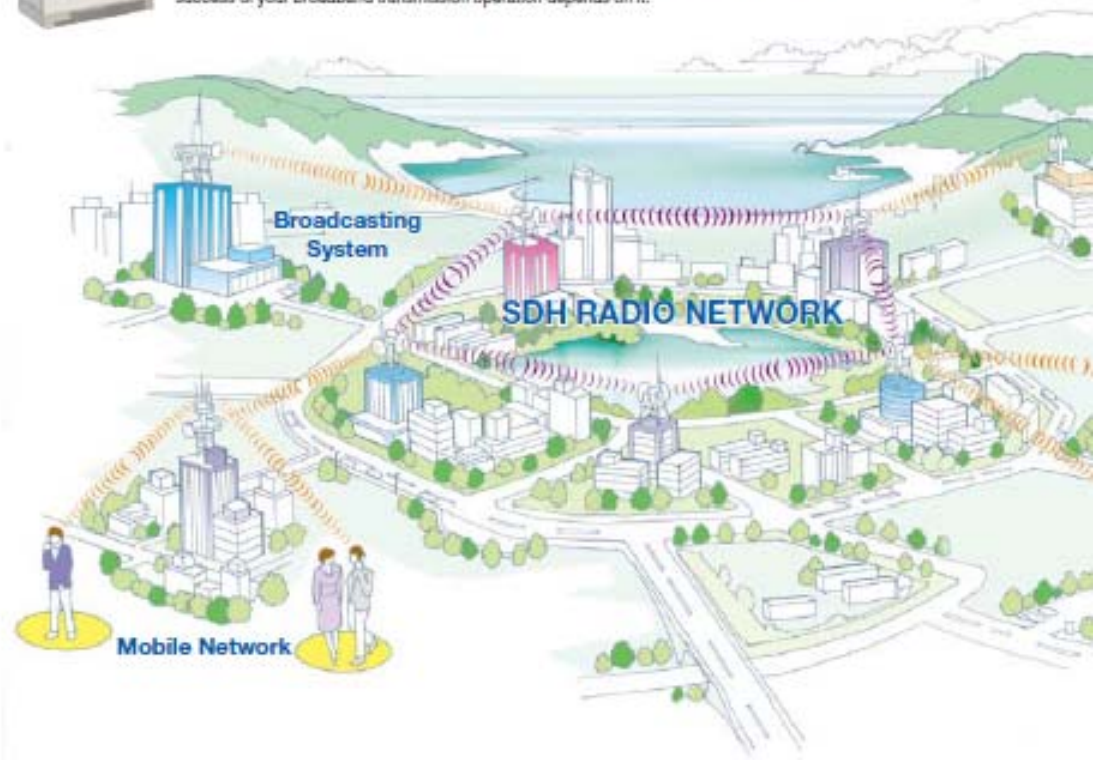
The ultimate in speed and capacity at the core of broadband transmission

As the demand for high-volume data transmission accelerates, radio systems need capacity large enough to accommodate the evolving market.

The optimal solution for more stable, reliable long-term performance is the 5000S—the high-capacity Synchronous Digital Hierarchy (SDH) long-haul microwave radio system made by NEC for synchronous transport module level 1 (STM-1) and optical carrier level 3 (OC-3) data transmission.

NEC SDH (Synchronous Digital Hierarchy) transmission equipment for a range of configurations includes an add-drop-multiplexer and an NMS (Network Management System). Various systems applications such as N+1 Frequency Diversity (FD)/Space Diversity (SD) and Hot-Standby (HS) protection switching systems are available. Expand an existing system configuration simply by adding modules and/or sub-racks to boost transmission capacity. Up to 10 systems with MUX (Multiplexer) can be built into a single ETSI rack.

A complete NEC broadband transmission package, including training and managed service, can maximize the value of your capital and operating expenditures (CAPEX and OPEX). Upgrade speed and capacity at every stage from feasibility study to survey and up to implementation. Gain advantage and apply it on a global scale. The long-term success of your broadband transmission operation depends on it.



Total Design Concept

The NEC family of SDH system equipment features a highly compatible, unified design platform.
5000S microwave system technology is based on the longstanding integrity of NEC expertise. With its advanced integrated design, the 5000S accommodates higher rack density than other systems of its kind. The equipment comprises two main shelves on a single European Telecommunications Institute (ETSI) rack. Branching (BR) and Transmitter/Receiver Equipment (TRP) sections are built on the upper shelf, with Modulator/Demodulator Equipment (MDP) and Multiplexer (MUX) sections on the lower shelf (Fig. 2).

Key Specifications

- Frequency bands: 4 to 11 GHz
- Capacity: 155.52 Mbps per system
- Modulation: 64 QAM, 128 QAM
- Interface: STM-1 Electrical/Optical, GbE (with built-in MUX)
- SDH Termination: RST (MST available with built-in MUX)
- Configuration:
  - N + 0 (N: 1 to 10), N + 1 (N: 1 to 9)
  - Back to Back: 2 x (N + 0) (N: 1 to 5), 2 x (N + 1) (N: 1 to 4)
  - Repeater: 2 x (N + 0) (N: 1 to 5), 2 x (N + 1) (N: 1 to 4)
  - XPIC system: 2 x (N + 1) (N: 1 to 4)
  - 1 + 1 Hot-Standby/Twin Path/Space Diversity
  - 2 x (1 + 1) Hot-Standby/Twin Path/Space Diversity (Repeater)
- SD Constitution: IF Combined (up to 3 antennas)
- Accommodation: Maximum 10 systems in ETSI rack including MUX
  - 1 – 5 sys (Natural cooling)
  - 6 – 10 sys (Long-life fan cooling)

Main Features

- Excellent Characteristics
  - Enhanced modem characteristics
  - Automatic Transmit Power Control
  - Automatic Protection Switch for optical interface
  - Adaptive Equalizer (Adaptive Time Domain Equalizer (ATDE) is applied.)
  - Space Diversity system, available to retrofit
  - Redundant configuration of XPIC equipment
- Improved Error Correction Performance with FEC
  - Low-Density Parity Check (LDPC) Codes are employed as a forward error correction (FEC) to ensure superior error correction performance.
- Abundant Digital Service Channels and Wayside Traffic
  - DSC: 1ch 64 kbps + 1ch 192 kbps or 4ch 64 kbps
  - WS: 1ch (128 QAM) 2 Mbps or 2ch (64 QAM) 1.5 Mbps
- Alarm, Status and Performance Monitoring
  - Built-in Performance Monitoring function
  - The operator can perform monitoring and control functions by using the NMT (Network Management Terminal), or by using a Network Management System (NMS).
- Built-in MUX for 5000S
  - NEC's Small Multiplexers offer various types of traffic interfaces such as PDH, SDH and Gigabit Ethernet with flexible network configurations of linear, ring, multiple rings, etc.
- Conforms to Latest Standards (ITU/ETSI)

Fig. 1 SDH Network Application

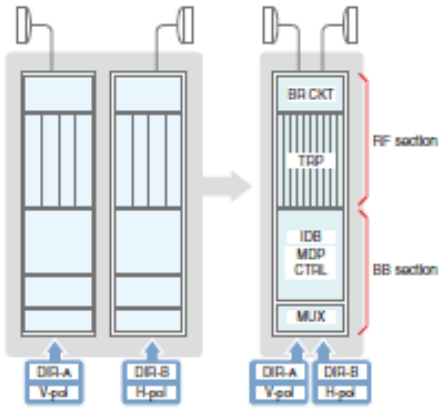


Fig. 2 System Downsizing

Anexo 4.4

Sistema de Gestión Radio NEC

MS3201 NETWORK MANAGEMENT SYSTEM

Introduction

The MS3201 is a fully integrated network management system for NEC's SDH radio and multiplex equipment.

Overall System Configuration

The MS3201 can support the following SDH equipment and network configuration.

- The SDH NE can comprise of NEC's SDH radio (2000S or 3000S) and SDH FOTS (SMS 150V, SMS 600V) equipment.
- The network configuration can be a linear and/or ring connection comprising of radio and FOTS NE. (SNC-P: Sub Network Connection Protection with Path)
- Line Protection can comprise of N+1 radio section protection, Twin Path Radio protection and FOTS Line Protection.

Features

Common Platform

Integrated management of SDH radio, SDH Mux and SDH FOTS on a common platform

Flexible scalability

Manage small or large network (max.: 120 Network Elements (NE))

Standardization

The TMN complies with M.3010 Principle for a Telecommunication management network.

- Q.811 Lower Layer Protocol Profiles Q3 interface
- Q.812 Upper Layer Protocol Profiles Q3 interface
- M.3100 - Generic Network Information Model The SDH G. 784 - Synchronous Digital Hierarchy (SDH) Management

OAM&P

The MS3201 provides the following TMN concepts performing the Operation, Administration, Maintenance and Provisioning Function.

1. Fault Management includes:
   Network Alarm Monitoring, NE Status Monitoring, Current Event List, Event History and Event Filtering (date, target object, event type, severity).
2. Performance Management includes:
   Performance Data Display, Scheduled performance data retrieval (from NE), Quality of service (QOS) monitoring and Quality of service (QOS) threshold setting.
3. Configuration Management includes:
   Building of overall network view, Provisioning of network element, Protection switching, Path management and Maintenance Functions.
4. Security Management includes:
   User registration, Assignment of user privilege and Logging of security related actions.

Open Interface

Use of Q3 interface between Manager and Radio NE. Use of Qx interface between Manager and MUX/FOTS NE. Qnn interface to upper Network Management Layer (based on ETS 300 653/future plan).
Refer to Fig. 3.

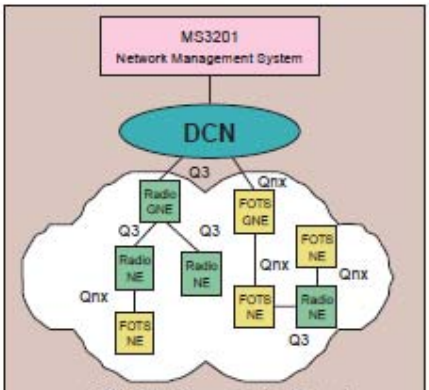


Fig.3 System Configuration Architecture

The NMS consists of:

Operator Terminal

- Provides GUI driven functions. One operator terminal can communicate with multiple servers. One server can support multiple operator terminals.
- A typical operator terminal hardware comprises of a IBM PC or equivalent.

Server

MIB (Information about Managed Objects (MO) of SDH NEs). NE communication and unifies the data exchange between each NE type. CORBA/X Window communication with operator terminals. Qnn Communication provides an interface to an upper level NML. (future plan)

A typical server hardware comprises of a SUN Ultra60 Model 250 or equivalent.

- Redundancy of server (future plan)
  In case of failure of the working server, the system automatically switches to the stand-by server.

Specifications

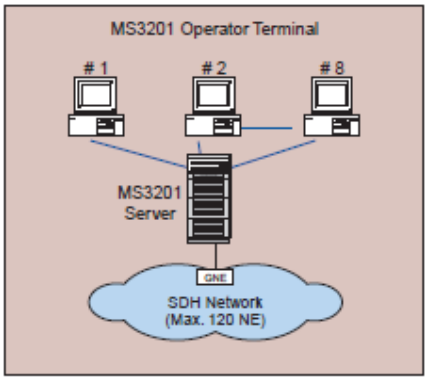
The NMS specifications are:

- Maximum number of servers is 10.
- Maximum number of operator terminals is 16. (Each NE is registered in max. 8 operator terminals.)
- Maximum number of NEs managed by one server is 120.
- Server to Remote Operator Terminal uses a G.703 or V.35 - 2 Mbps (minimum).
- Server to GNE uses G.703 or V.35 - 2 Mbps.

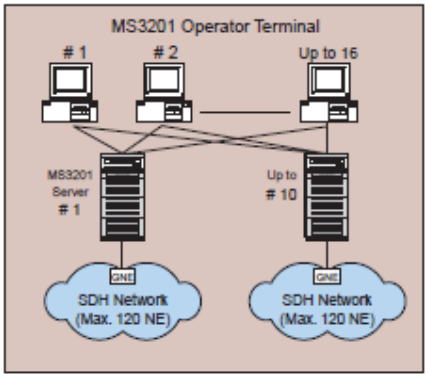
Operator/Server Configuration

The MS3201 can be configured as:

1) Multi-operator terminal per server



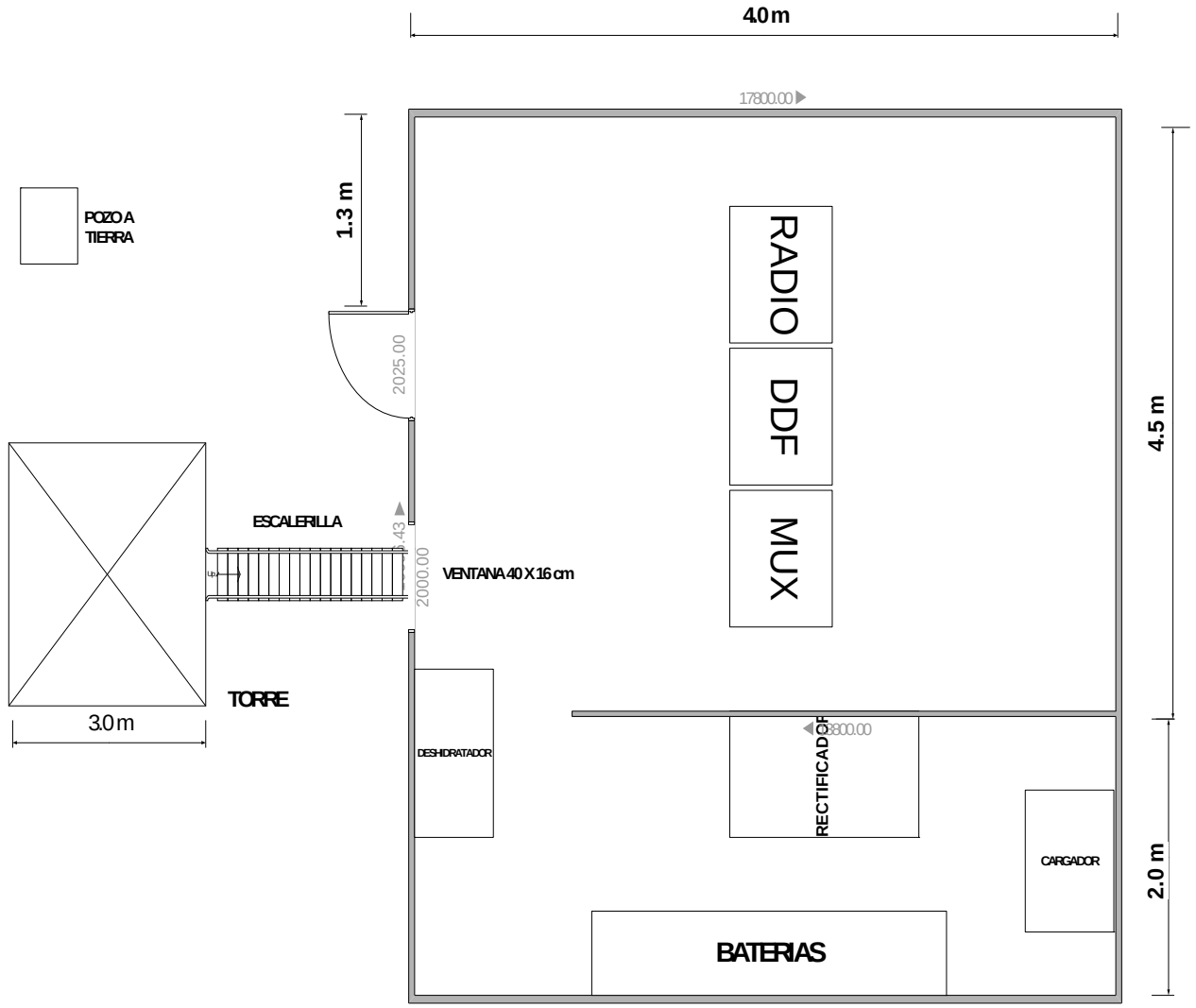
2) Multi-operator terminal/Multi-server
(Future Plan)



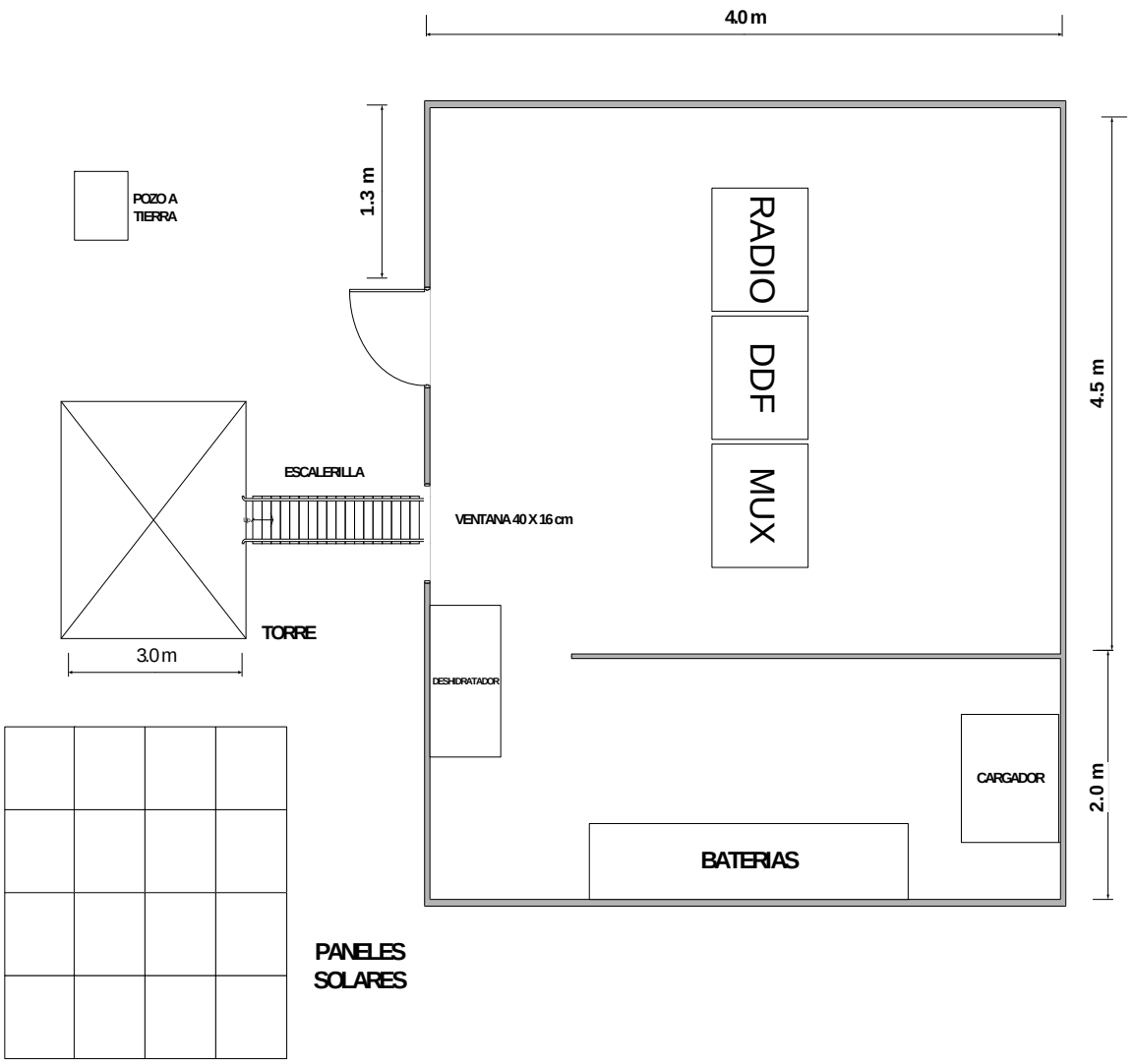
Anexo 4.5

Plano general de la infraestructura en las estaciones y esquemas típicos

ANEXO 4.5 – A: PLANO DE ESTACIÓN ALIMENTADA POR ENERGÍA AC

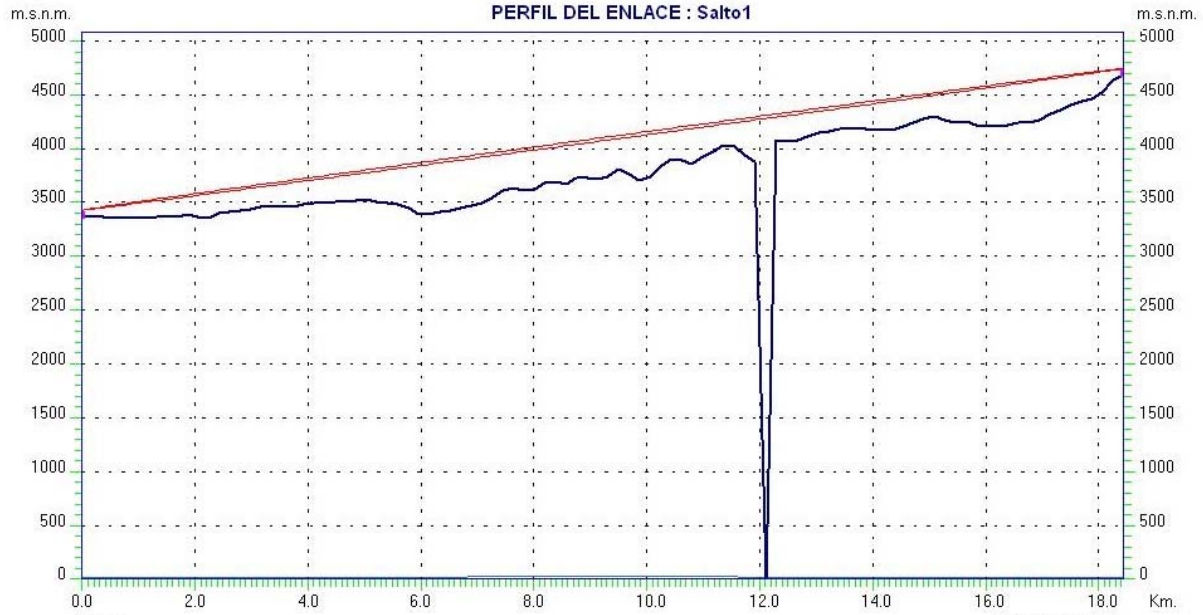


ANEXO 4.5 – B: PLANO DE ESTACIÓN ALIMENTADA POR ENERGÍA SOLAR



Anexo 4.6

Perfiles de Línea de vista de la ruta del radio enlace



Cusco						Cerro Pachatusan	
Altura de antena	60 m.	Longitud del Enlace	18.44 Km.			Altura de antena	60 m.
Cota de estación	3368.68 m.	Azimuth	87.77°			Cota de estación	4684.80 m.
Elevación	4.0822°	Frecuencia Central	6175.0 MHz.			Elevación	-4.0822°
Coord. Longitud	W 71° 57' 58.3"	Factor. K	0.666			Coord. Longitud	W 71° 47' 44.7"
Coord. Latitud	S 13° 31' 16.3"	Fresnel	100.0 %			Coord. Latitud	S 13° 30' 52.9"
Preparado por	Renzo	Punto de reflexión				Requerido por	PUCP

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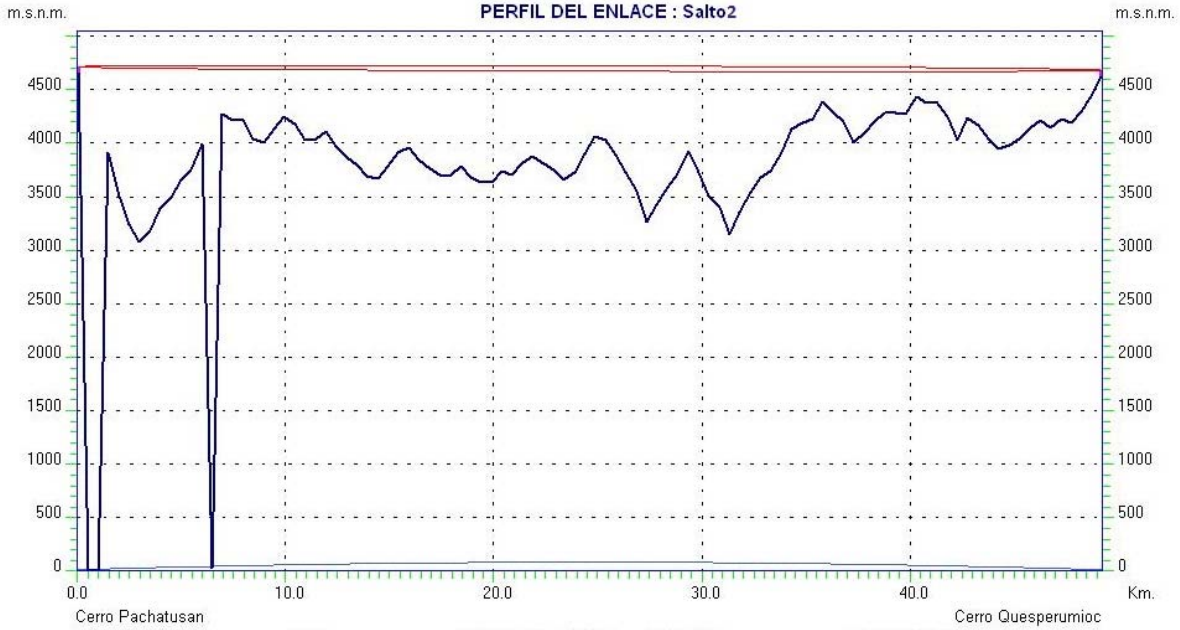
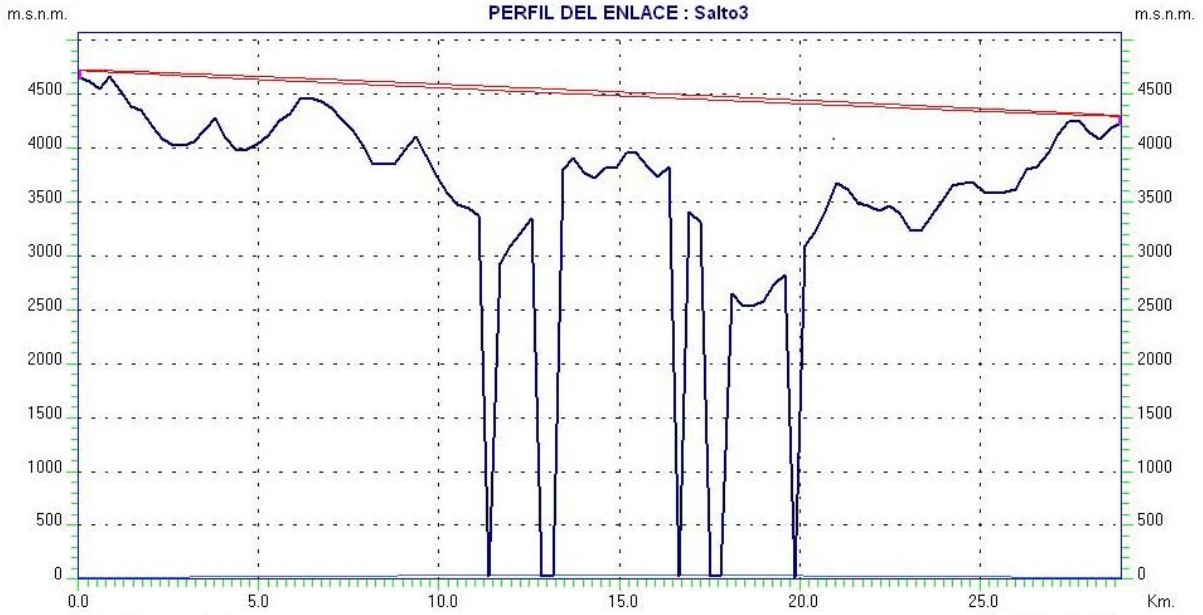
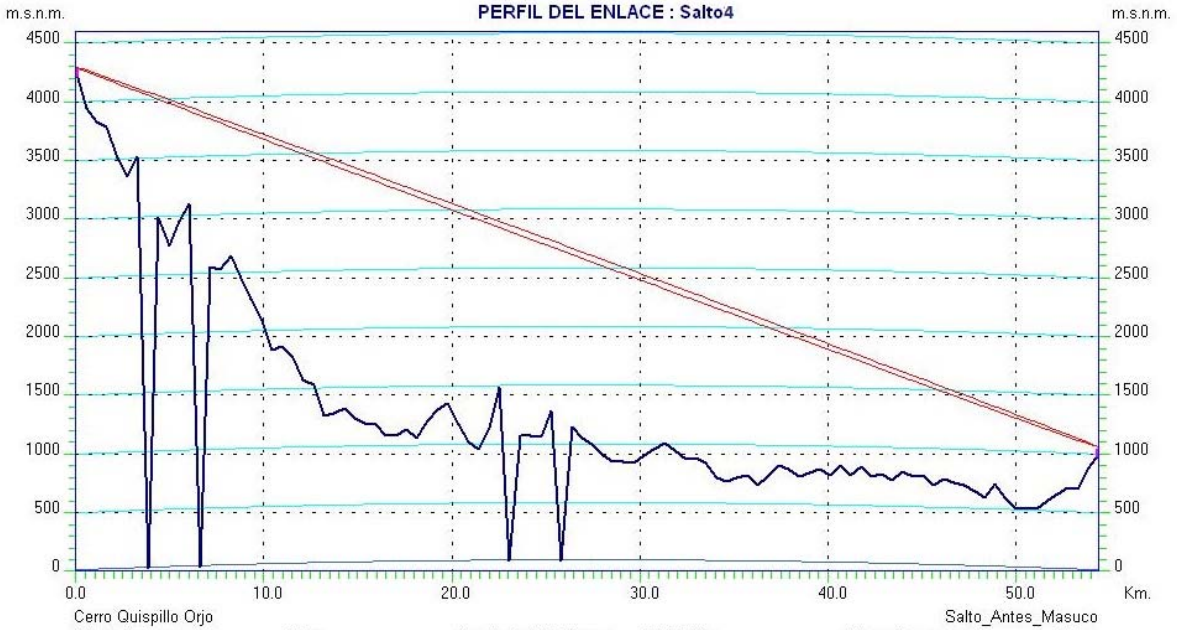
14/09/2012



Cerro Pachatusan						Cerro Quesperumioc	
Altura de antena	30 m.	Longitud del Enlace	49.25 Km.			Altura de antena	30 m.
Cota de estación	4684.97 m.	Azimuth	72.34°			Cota de estación	4653.07 m.
Elevación	-0.0371°	Frecuencia Central	6175.0 MHz.			Elevación	0.0371°
Coord. Longitud	W 71° 47' 44.7"	Factor. K	0.666			Coord. Longitud	W 71° 21' 42.8"
Coord. Latitud	S 13° 30' 52.9"	Fresnel	100.0 %			Coord. Latitud	S 13° 22' 47.9"
Preparado por	Renzo	Punto de reflexión				Requerido por	PUCP

RED PUERTO MALDONADO
14/09/2012


PERFIL DEL ENLACE : Salto3
m.s.n.m.
m.s.n.m.
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0.0
5.0
10.0
15.0
20.0
25.0
Km.
Cerro Quesperumioc
Altura de antena : 70 m.
Cota de estación : 4653.07 m.
Elevación : -0.8461°
Coord. Longitud : W 71° 21' 42.8"
Coord. Latitud : S 13° 22' 47.9"
Preparado por : Renzo
Longitud del Enlace : 28.93 Km.
Azimuth : 72.30°
Frecuencia Central : 6175.0 MHz.
Factor. K : 0.666
Fresnel : 100.0 %
Punto de reflexión :
Cerro Quispillo Orjo
Altura de antena : 60 m.
Cota de estación : 4235.84 m.
Elevación : 0.8461°
Coord. Longitud : W 71° 6' 26.0"
Coord. Latitud : S 13° 18' 2.8"
Requerido por : PUCP
RED PUERTO MALDONADO
14/09/2012


PERFIL DEL ENLACE : Salto4
m.s.n.m.
m.s.n.m.
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0.0
10.0
20.0
30.0
40.0
50.0
Km.
Cerro Quispillo Orjo
Altura de antena : 60 m.
Cota de estación : 4236.16 m.
Elevación : -3.4086°
Coord. Longitud : W 71° 6' 26.0"
Coord. Latitud : S 13° 18' 2.8"
Preparado por : Renzo
Longitud del Enlace : 54.39 Km.
Azimuth : 72.37°
Frecuencia Central : 6175.0 MHz.
Factor. K : 0.666
Fresnel : 100.0 %
Punto de reflexión :
Salto_Antes_Masuco
Altura de antena : 60 m.
Cota de estación : 996.58 m.
Elevación : 3.4086°
Coord. Longitud : W 70° 37' 42.6"
Coord. Latitud : S 13° 09' 7.9"
Requerido por : PUCP
RED PUERTO MALDONADO
14/09/2012

Salto_Antes_Masuco					Masuco	
Altura de antena	50 m.	Longitud del Enlace	35.63 Km.		Altura de antena	50 m.
Cota de estación	996.45 m.	Azimuth	72.28°		Cota de estación	531.69 m.
Elevación	-0.7474°	Frecuencia Central	6175.0 MHz.		Elevación	0.7474°
Coord. Longitud	W 70° 37' 42.6"	Factor. K	0.666		Coord. Longitud	W 70° 18' 54.7"
Coord. Latitud	S 13° 09' 7.9"	Fresnel	100.0 %		Coord. Latitud	S 13° 03' 16.1"
Preparado por	Renzo	Punto de reflexión	▲		Requerido por	PUCP

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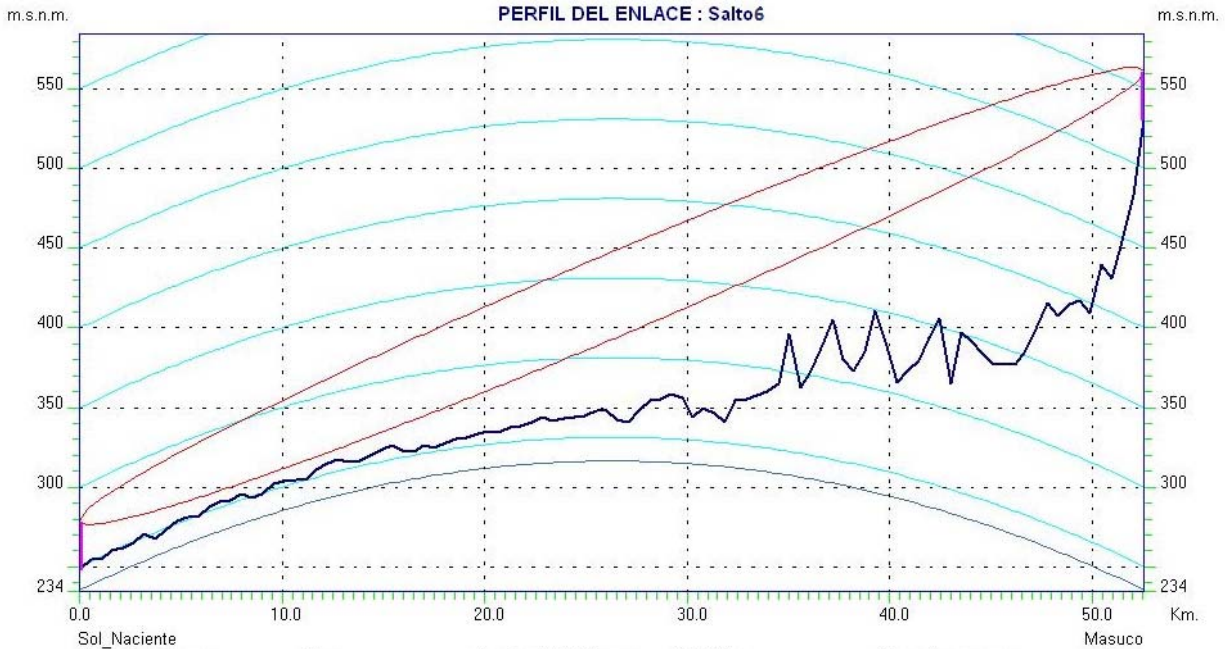

Sol_Naciente					Masuco	
Altura de antena	30 m.	Longitud del Enlace	52.55 Km.		Altura de antena	30 m.
Cota de estación	248.85 m.	Azimuth	250.53°		Cota de estación	531.62 m.
Elevación	0.3083°	Frecuencia Central	6175.0 MHz.		Elevación	-0.3083°
Coord. Longitud	W 69° 51' 28.0"	Factor. K	0.666		Coord. Longitud	W 70° 18' 54.7"
Coord. Latitud	S 12° 53' 50.6"	Fresnel	100.0 %		Coord. Latitud	S 13° 03' 16.1"
Preparado por	Renzo	Punto de reflexión	▲		Requerido por	PUCP

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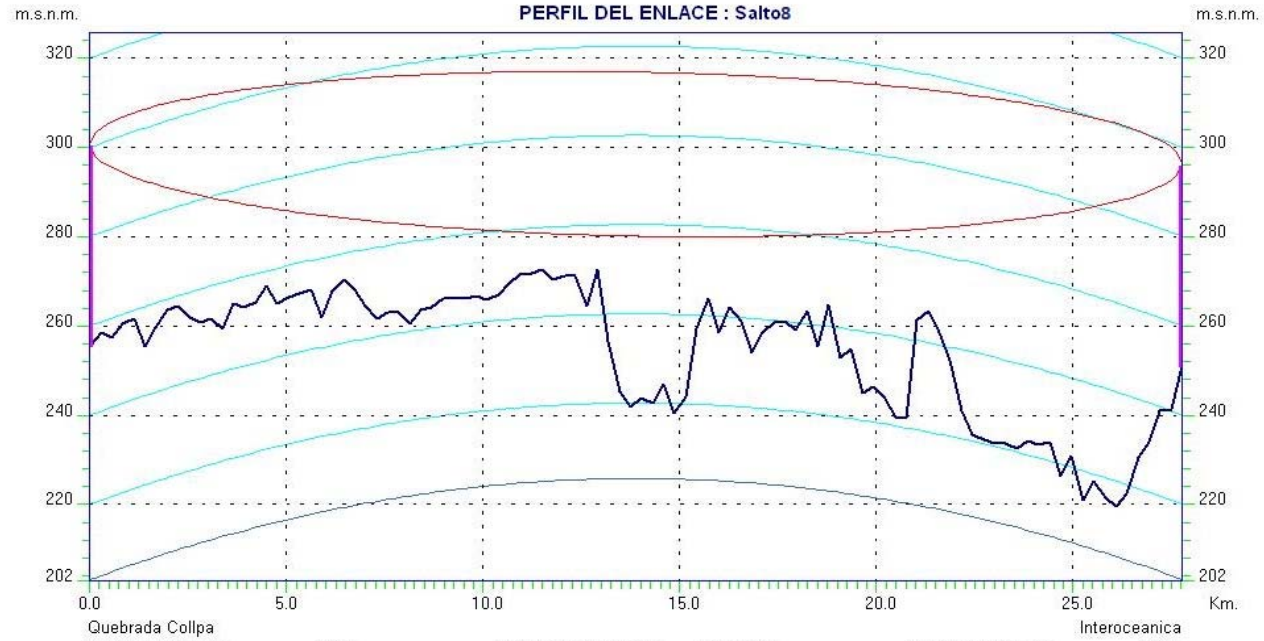
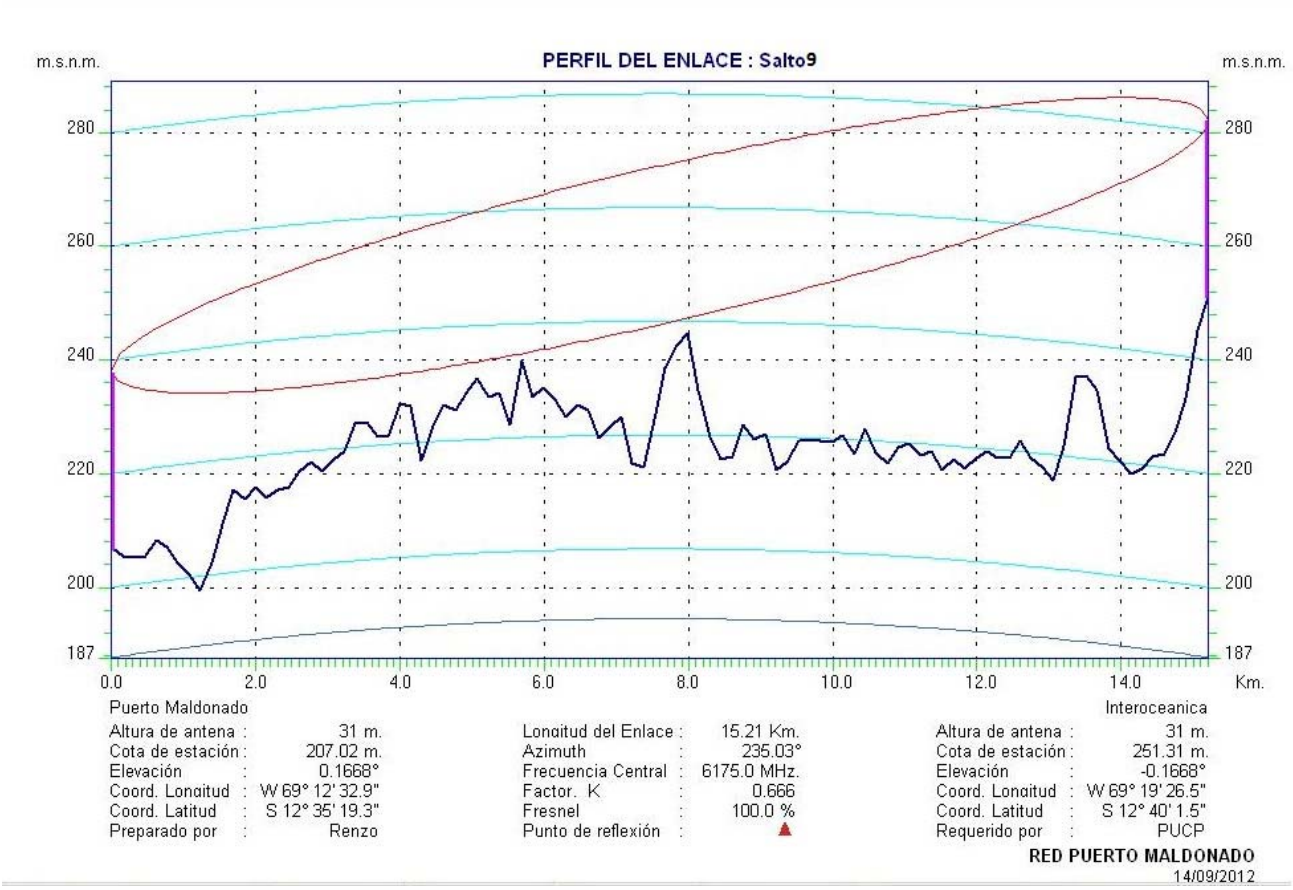
Sol_Naciente						Quebrada Collpa	
Altura de antena	:	65 m.	Longitud del Enlace	:	36.34 Km.	Altura de antena	: 65 m.
Cota de estación	:	248.80 m.	Azimuth	:	74.20°	Cota de estación	: 255.77 m.
Elevación	:	0.011°	Frecuencia Central	:	6175.0 MHz.	Elevación	: -0.011°
Coord. Longitud	:	W 69° 51' 28.0"	Factor. K	:	0.666	Coord. Longitud	: W 69° 32' 7.1"
Coord. Latitud	:	S 12° 53' 50.7"	Fresnel	:	100.0 %	Coord. Latitud	: S 12° 48' 29.7"
Preparado por	:	Renzo	Punto de reflexión	:	▲	Requerido por	: PUCP

RED PUERTO MALDONADO
14/09/2012



Quebrada Collpa						Interoceanica	
Altura de antena	:	45 m.	Longitud del Enlace	:	27.78 Km.	Altura de antena	: 45 m.
Cota de estación	:	255.77 m.	Azimuth	:	55.61°	Cota de estación	: 251.31 m.
Elevación	:	-0.0092°	Frecuencia Central	:	6175.0 MHz.	Elevación	: 0.0092°
Coord. Longitud	:	W 69° 32' 7.1"	Factor. K	:	0.666	Coord. Longitud	: W 69° 19' 26.5"
Coord. Latitud	:	S 12° 48' 29.7"	Fresnel	:	100.0 %	Coord. Latitud	: S 12° 40' 1.5"
Preparado por	:	Renzo	Punto de reflexión	:	▲	Requerido por	: PUCP

RED PUERTO MALDONADO
14/09/2012


PERFIL DEL ENLACE : Salto9
m.s.n.m.
m.s.n.m.
280
260
240
220
200
187
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
Km.
Puerto Maldonado
Altura de antena : 31 m.
Cota de estación : 207.02 m.
Elevación : 0.1668°
Coord. Longitud : W 69° 12' 32.9"
Coord. Latitud : S 12° 35' 19.3"
Preparado por : Renzo
Longitud del Enlace : 15.21 Km.
Azimuth : 235.03°
Frecuencia Central : 6175.0 MHz.
Factor. K : 0.666
Fresnel : 100.0 %
Punto de reflexión :
Interoceanica
Altura de antena : 31 m.
Cota de estación : 251.31 m.
Elevación : -0.1668°
Coord. Longitud : W 69° 19' 26.5"
Coord. Latitud : S 12° 40' 1.5"
Requerido por : PUCP
RED PUERTO MALDONADO
14/09/2012