TECHNICAL INFORMATION GUIDE

Alcatel MDR-9000s-155

High Capacity/High Frequency SONET Microwave Radio

GUIDE

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Introduction

The Alcatel MDR-9000s-155 is the latest addition to Alcatel's industry leading wireless transmission product portfolio of microwave digital radios. The MDR-9000s-155 provides point-to-point transport of OC-3 SONET payloads in the higher microwave frequency bands, ranging between 15 and 38 GHz for deployment in North America. It is primarily designed for local access, urban and suburban applications. It provides a very cost-effective solution for SONET transport and is very easy to install and maintain. Because of the outstanding specifications of Alcatel's MDR-9000s-155, point-to-point transport of wideband services can be achieved very reliably and cost effectively over short to medium length paths.

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Product Description

Alcatel's wireless product portfolio responds to the needs of a variety of operators and service providers by supplying state-of-the-art transmission equipment in bands ranging from 6 to 11 GHz and 15 to 18 GHz, with capacities from 2 to 16 DS1, 1 to 3 DS3, 1 OC-3, and 2 to 16 DS1, and 1 DS3, respectively. The new MDR-9000s-155 complements the current product line by providing point-to-point, high capacity SONET radios in the 15-38 GHz bands.

Today's wireless transmission networks continue to evolve from two primary perspectives. First, systems supporting higher and higher capacities are required to carry the constantly increasing bandwidth needed by operators. Second, that the need for wireless connectivity is expanding from the traditional long haul transport functions to the access, last mile, and edge portions of the network.

This growing demand for wideband services is also combined with the need for flexible, reliable, affordable, and inexpensive-to-maintain transmission systems that must be quickly deployed throughout the network. As SONET, ATM, and IP networks continue to gain prevalence, the resulting access and interconnection needs are increasingly being met by point-to-point microwave digital radios. Wireless operators such as competitive local exchange carriers (CLECs), incumbent local exchange carriers (ILECs), interexchange carriers (IXCs), and regional Bell operating companies (RBOCs) are all competing to provide services to the edge, while some LMDS and MMDS license holders need a quick and inexpensive way to bring connectivity between hubs and points of presence (POPs).

The MDR-9000s-155 meets the specific needs of these operators by providing a low-cost, quick to install, easy to maintain and highly reliable SONET point-to-point solution. Some of its applications include:

- OC3/STM1 radio infrastructure
- Closure of OC12 and OC3 fiber optic rings
- Wideband wireless access, wireless local loop, and last mile solutions
- Wireless extension off fiber optic systems
- Back up for fiber optic trunks
- Radio spurs off fiber/radio OC-n/STM-n backbones or rings
- Regional links in SONET networks
- Support of ATM/IP networks and LAN/WAN connections

Customer Solutions

The Alcatel MDR-9000s-155 offers an ideal solution for a wide range of broadband wireless systems:

Cellular and Personal Communication Systems (PCS)

As the PCS networks continue to grow, the MDR-9000s-155 permits fast deployment of point-to-point links connecting cell sites and backhauling traffic to the switch. The various frequency bands allow the MDR-9000s-155 to accommodate shorter paths in metropolitan areas as well as some of the longer links required as the network extends to suburban areas.

Local Exchange Carriers

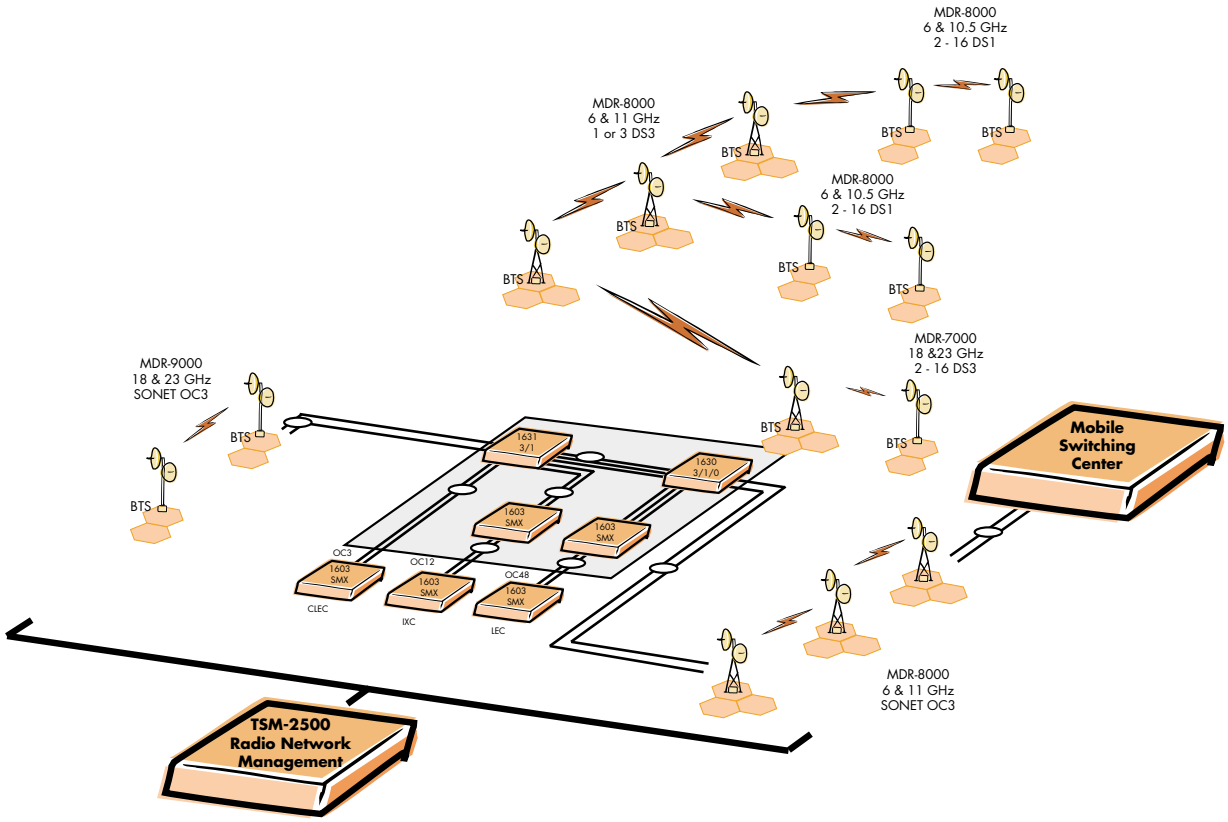
Microwave radios are a reliable and cost effective way to route traffic directly from a customer location to a switch, IXC point of presence or directly to another customer terminal, and to provide wireless extentions off of fiber rings. The MDR-9000s-155 can be used to provide high speed OC-3 interconnections, permitting easy and cost effective access to the network.

Private Networks

Its features and frequency choices make the MDR-9000s-155 ideal for many different types of private users to meet the internal communications needs of corporate networks.

State, Local, and Federal Government Systems

Government agencies can rely on the MDR-9000s-155 to provide reliable, high quality voice and data communications. While state agencies can operate at the 18 and 23 GHz frequency bands along with other users, the federal government in the U.S. has exclusive use of the 15 GHz band.



The wide array of operating frequency bands and configurations allow this radio to satisfy the traffic needs of a variety of requirements for short and medium haul applications. Like the rest of the Alcatel Microwave Digital Radio family, the MDR-9000s-155 offers a wireless alternative when fiber is not available or is not a cost-effective or timely option.

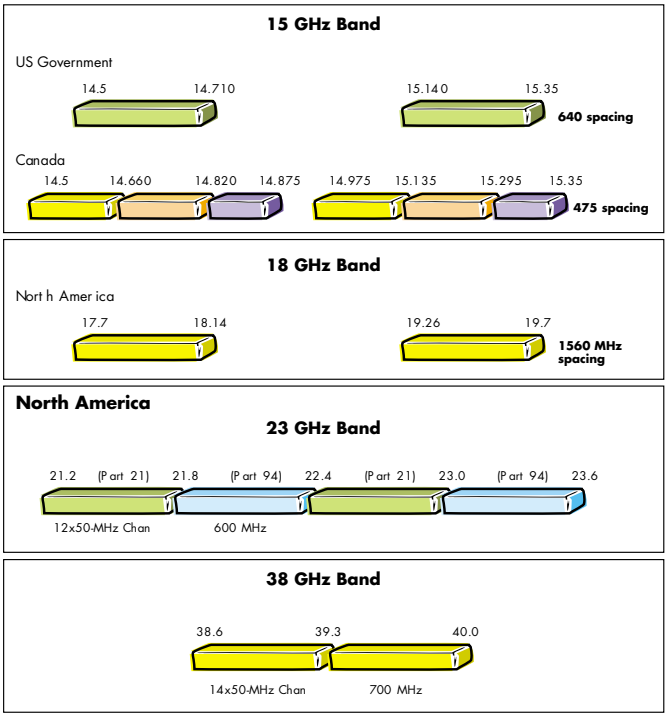
Product Features and Benefits

The new high-frequency/high-capacity SONET radio, the MDR-9000s-155, provides operators with the bandwidth now needed in the access and transport networks. In urban applications, it is ideal for bringing buildings untouched by fiber "on-net," providing the OC-3 capacity often needed in these applications. It also allows closure of fiber ring systems where terrain obstruction makes fiber burial difficult or impossible. The MDR-9000s-155 provides transport and access solutions to traditional wireless operators such as cellular and PCS service providers; to power utility, private, state, and local governments; and to the CLECs and IXCs deploying wireless infrastructures in the fast growing metropolitan access networks.

Some of the features and benefits of the MDR-9000s-155 are described in the table on this page.

Feature	Function	Benefits
Operates in high frequency bands	Provides transmission in the 15, 18, 23, 28, and 38 GHz bands	> Flexibility with licensing and path length > Smaller antenna, easier zoning and lower structural loads > Available spectrum
OC-3 SONET interface	Optical or electrical 155 Mb payload	> Transport of wideband service > ATM network standard and telecom interface of the future > Easier fiber integration > Promotes ring protection
Choice of modulation scheme	Select between 16, 32 or 128 QAM	> Choice of high system gain or spectral efficiency > Permits deployment in frequency congested areas
Frequency agility	Use of Synthesized L.O. to select RF frequencies	> Transmit and receive frequencies can be selected easily using software > Easy frequency setting, which makes it ideal in relocation and redeployment situations > Optimized for quick initial deployment
Automatic transmit power control	Reduces transmit output power during normal operations	> Reduced power consumption and frequency coordination advantages > Increased frequency reuse

Bands of Operation



coaxial cable links the IDU to the ODU and carries the traffic, the communication channels, and the DC power to the outdoor unit. The IDU and ODU can be separated by up to 1,150 feet of coaxial cable.

The radios are available in 1+0 non-standby (NS), 2+0 and 1+1 hot-standby (HS) configurations, with either electrical or optical user interfaces.

The outdoor unit is housed in a compact, robust, weatherproof container that can be deployed easily and rapidly. The slim, front access indoor unit occupies one vertical rack space (1.75 inches) for the non-standby version and two vertical rack spaces (3.5 inches) for the hot standby.

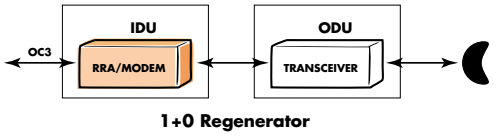
The MDR-9000s-155 incorporates five digital service channels in the overhead of the radio for DTMF orderwire and data channel interfaces and provides SNMP protocol for network management functions.

Architecture

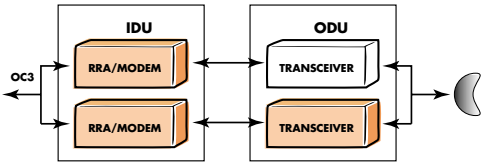
The Alcatel MDR-9000s-155 is based on a highly versatile and flexible platform and offers a full set of system configurations and protection schemes to meet any specific requirements in a network with high degree of flexibility. It is designed in an indoor-outdoor architecture. The indoor unit (IDU) provides the interface with the customer's traffic, the digital processing, modulation/demodulation functions, and the connections with the service channels and craft terminal. The outdoor unit (ODU) is where the IF and RF conversions, power amplification and RF filtering functions take place.

In standard applications, the ODU mounts on a monopole and is integrated with a one or two-foot antenna. Larger dishes can also be used in non-integrated configurations. A single

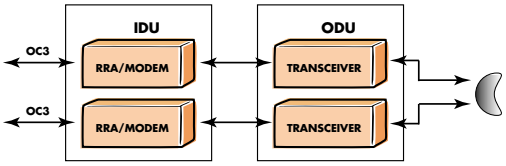
MDR-9000s Non-Standby **MDR-9000s Hot-Standby**



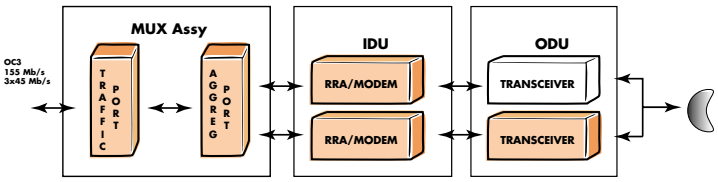
1+0 Regenerator



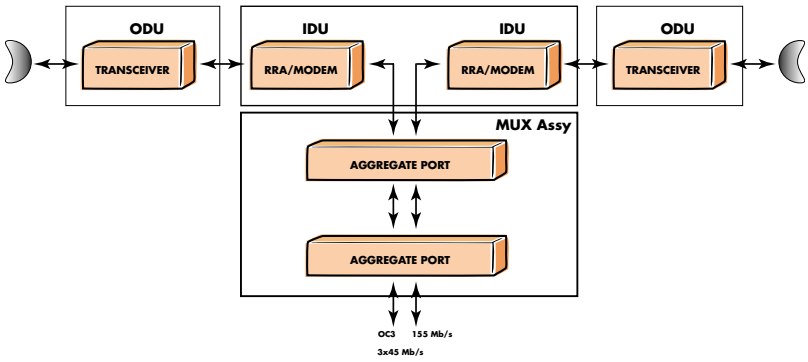
1+1 HS/1+1 FD Regenerator



2+0 Cross pol Regenerator



1 + 1 HET/1 + 1 HST WMSN LT configuration



1 + 0 WMSN configuration

The configurations offered with the MDR-9000s-155 are as follows:

- 1+0 - non-standby
- 1+0 - expandable to 1+1
- 1+1 - hot-standby or frequency diversity
- 2+0 - cross-polarized system

How Far Can You Go?

A question often asked by operators is “How far can I go?” Several parameters, such as frequency, climatic conditions, rainfall rate, terrain, antenna size and height, radio parameters, interference, and the desired objective for availability, will affect the length of a radio hop. While rain is not a dominant factor in the lower frequency bands, rain outages tend to exceed all other parameters in determining path limits in the higher bands.

The seven rain regions in the United States are depicted on the map on this page.

Alcatel MDR-9000

The following tables provide a guideline for maximum path distance in the MDR-9000s-155 frequency bands of operation, based on the radio performances, the rain region, and the antenna size. The calculations are shown for an availability of 99.999% (or “five” nines, corresponding to 315 seconds of outage per year).

Path length in miles for 99.999% availability (2-way), with 2 ft antenna

Radio Frequency (GHz)	Modulation (QAM)	Channel Bandwidth (MHz)	Rain Region 1 (New Orleans)	Rain Region 2 (Dallas)	Rain Region 3 (Philadelphia)	Rain Region 4 (Minneapolis)	Rain Region 5 (Denver)	Rain Region 6 (Phoenix)	Rain Region 7 (San Francisco)
15 GHz	128	30	2.3	2.6	3.2	3.6	4.1	4.6	5.7
18 GHz	16	50	2.2	2.4	2.9	3.4	4.0	4.7	6.6
18 GHz	32	40	2.0	2.2	2.7	3.0	3.6	4.2	5.8
18 GHz	128	30	1.7	1.9	2.3	2.6	3.0	3.5	4.6
23 GHz	16	50	1.6	1.7	2.1	2.4	2.7	3.3	4.6
23 GHz	32	40	1.5	1.6	2.0	2.2	2.6	3.0	4.2
23 GHz	128	30	1.3	1.4	1.7	1.9	2.6	2.5	3.4
38 GHz	16/32/128	50/40/30	0.9	1.0	1.2	1.6	1.5	1.7	2.4

* 16 QAM

Path length in miles for 99.999% availability (2ft & larger antenna) 15 & 18 Ghz

Radio Frequency (GHz)	Modulation (QAM)	System Gain (dB)	Rain Region 1 (New Orleans)	Rain Region 2 (Dallas)	Rain Region 3 (Philadelphia)	Rain Region 4 (Minneapolis)	Rain Region 5 (Denver)	Rain Region 6 (Phoenix)	Rain Region 7 (San Francisco)
15 GHz	128	2	2.3	2.6	3.2	3.6	4.1	4.6	5.7
		3	2.8	3.1	3.9	4.4	5.2	5.9	7.3
		4	3.3	3.6	4.6	5.4	6.3	7.3	9.2
		6	4.0	4.4	5.9	6.9	8.4	9.8	12.6
		10	5.7	6.5	9.3	11.4	14.1	16.4	19.2
15 GHz	16	2	2.2	2.4	2.9	3.4	4.0	4.7	6.6
		3	2.4	2.7	3.4	3.9	4.6	5.5	8.0
		4	2.7	3.0	3.9	4.5	5.4	6.5	9.8
		6	3.2	3.6	4.7	5.4	6.6	8.2	12.9
15 GHz	32	2	2.0	2.2	2.7	3.0	3.6	4.2	5.8
		3	2.3	2.5	3.1	3.6	4.2	5.0	7.1
		4	2.6	2.8	3.6	4.1	4.9	5.9	8.6
		6	3.0	3.4	4.3	5.0	6.0	7.4	11.3
15 GHz	128	2	1.7	1.9	2.3	2.6	3.0	3.5	4.6
		3	2.0	2.2	2.7	3.0	3.5	4.2	5.7
		4	2.3	2.4	3.1	3.5	4.2	4.9	7.0
		6	2.7	2.9	3.7	4.3	5.1	6.2	9.1

Path length in miles for 99.999% availability, 23 & 38 Ghz

Radio Frequency (GHz)	Modulation (QAM)	Antenna Diameter (feet)	Rain Region 1 (New Orleans)	Rain Region 2 (Dallas)	Rain Region 3 (Philadelphia)	Rain Region 4 (Minneapolis)	Rain Region 5 (Denver)	Rain Region 6 (Phoenix)	Rain Region 7 (San Francisco)
23 GHz	16	1	1.2	1.3	1.5	1.7	1.9	2.2	3.0
		2	1.6	1.7	2.1	2.4	2.7	3.3	4.6
		3	1.8	2.0	2.4	2.7	3.2	3.8	5.5
		4	2.0	2.2	2.7	3.1	3.7	4.4	6.4
		6	2.3	2.5	3.2	3.6	4.3	5.2	7.8
23 GHz	32	1	1.1	1.2	1.4	1.5	1.7	2.0	2.7
		2	1.5	1.6	2.0	2.2	2.6	3.0	4.2
		3	1.7	1.8	2.3	2.5	2.9	3.5	5.0
		4	1.9	2.0	2.6	2.9	3.4	4.0	5.8
		6	2.2	2.4	3.0	3.4	4.0	4.8	7.2
23 GHz	128	1	0.9	1.0	1.1	1.3	1.4	1.6	2.2
		2	1.3	1.4	1.7	1.9	2.2	2.5	3.4
		3	1.5	1.6	2.0	2.2	2.5	3.0	4.2
		4	1.7	1.8	2.2	2.5	2.9	3.4	4.9
		6	1.9	2.1	2.6	3.0	3.5	4.2	6.1
38 GHz	16	1	0.7	0.75	0.9	1.0	1.15	1.35	1.85
		2	0.9	1.0	1.2	1.6	1.5	1.7	2.4

MDR-9000s-155 Technical Specifications Summary

	15 GHz	18 GHz	23 GHz	38 GHz
Modulation (OAM)	128	16/32/128	16/32/128	16/32/128
RF Channel Bandwidth (MHz)	30	50/40/30	50/40/30	50/40/30
TX Power (dBm)	+20	+19.5/+18.5/+18.5	+19.5/+18.5/+18.5	+14/+11/+11
Receiver Threshold 10^{-6} BER (dBm)	–66.5	–74/–70.5/–67.5	–73.5/–70/–67	–71/–69.5/–65.5
System Gain (dB)	86.5	93.5/89/86	93/88.5/85.5	85/80.5/76.5
Environmental IDU	–5 to +55°C/23 to 131°F			
Environmental ODU	–35 to +55°C/–31 to 131°F			

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