INTERNATIONAL TELECOMMUNICATION UNION

ITU-T G.694.1

(06/2002)

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Transmission media characteristics – Characteristics of optical components and subsystems

Spectral grids for WDM applications: DWDM frequency grid

ITU-T Recommendation G.694.1

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TESTING EQUIPMENTS	G.500–G.599
TRANSMISSION MEDIA CHARACTERISTICS	G.600–G.699
General	G.600–G.609
Symmetric cable pairs	G.610–G.619
Land coaxial cable pairs	G.620–G.629
Submarine cables	G.630–G.649
Optical fibre cables	G.650–G.659
Characteristics of optical components and subsystems	**G.660–G.699**
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999
QUALITY OF SERVICE AND PERFORMANCE	G.1000–G.1999
TRANSMISSION MEDIA CHARACTERISTICS	G.6000–G.6999
DIGITAL TERMINAL EQUIPMENTS	G.7000–G.7999
DIGITAL NETWORKS	G.8000–G.8999

For further details, please refer to the list of ITU-T Recommendations.

ITU-T Recommendation G.694.1

Spectral grids for WDM applications: DWDM frequency grid

Summary

This Recommendation provides a frequency grid for dense wavelength division multiplexing (DWDM) applications.

The frequency grid, anchored to 193.1 THz, supports a variety of channel spacings ranging from 12.5 GHz to 100 GHz and wider.

Source

ITU-T Recommendation G.694.1 was prepared by ITU-T Study Group 15 (2001-2004) and approved under the WTSA Resolution 1 procedure on 13 June 2002.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

ITU-T Recommendation G.694.1

Spectral grids for WDM applications: DWDM frequency grid

1 Scope

The purpose of this Recommendation is to provide the definition of a frequency grid to support dense wavelength division multiplexing (DWDM) applications.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

– ITU-T Recommendation G.671 (2002), *Transmission characteristics of optical components and subsystems*.

3 Definitions

3.1 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.1.1 Frequency Grid

A frequency grid is a reference set of frequencies used to denote allowed nominal central frequencies that may be used for defining applications.

3.2 Terms defined in other Recommendations

This Recommendation uses terms defined in ITU-T Rec. G.671:

– Coarse Wavelength Division Multiplexing (CWDM).

– Dense Wavelength Division Multiplexing (DWDM).

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

CWDM Coarse Wavelength Division Multiplexing

DWDM Dense Wavelength Division Multiplexing

WDM Wavelength Division Multiplexing

5 Dense WDM and its applications

Dense Wavelength Division Multiplexing (DWDM), a WDM technology, is characterised by narrower channel spacing than Coarse WDM (CWDM) as defined in ITU-T Rec. G.671. In general the transmitters employed in DWDM applications require a control mechanism to enable them to meet the application's frequency stability requirements, in contrast to CWDM transmitters which are generally uncontrolled in this respect.

The frequency grid defined by this Recommendation supports a variety of channel spacings ranging from 12.5 GHz to 100 GHz and wider (integer multiples of 100 GHz). Uneven channel spacings are also allowed.

The current steps in channel spacing have historically evolved by sub-dividing the initial 100 GHz grid by successive factors of two.

6 Nominal central frequencies for dense WDM systems

For channel spacings of 12.5 GHz on a fibre, the allowed channel frequencies (in THz) are defined by:

193.1 + n × 0.0125 where n is a positive or negative integer including 0

For channel spacings of 25 GHz on a fibre, the allowed channel frequencies (in THz) are defined by:

193.1 + n × 0.025 where n is a positive or negative integer including 0

For channel spacings of 50 GHz on a fibre, the allowed channel frequencies (in THz) are defined by:

193.1 + n × 0.05 where n is a positive or negative integer including 0

For channel spacings of 100 GHz or more on a fibre, the allowed channel frequencies (in THz) are defined by:

193.1 + n × 0.1 where n is a positive or negative integer including 0

Table 1 illustrates some nominal central frequencies within the C and L bands based on the 12.5 GHz minimum channel spacing anchored to the 193.1 THz reference. Table 1 also illustrates the 25, 50 and 100 GHz grid frequencies within the same region. The endpoints shown are illustrative, not normative.

Note that the value of "c" (speed of light in vacuum) that should be used for converting between frequency and wavelength is 2.99792458×10^8 m/s.

Table 1/G.694.1 – Example nominal central frequencies of the DWDM grid

Nominal central frequencies (THz) for spacings of				**Approximate nominal central wavelengths (nm)**
12.5 GHz	**25 GHz**	**50 GHz**	**100 GHz and above**	
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
195.9375	–	–	–	1530.04
195.9250	195.925	–	–	1530.14
195.9125	–	–	–	1530.24
195.9000	195.900	195.90	195.9	1530.33

Table 1/G.694.1 – Example nominal central frequencies of the DWDM grid

Nominal central frequencies (THz) for spacings of				Approximate nominal central wavelengths (nm)
12.5 GHz	**25 GHz**	**50 GHz**	**100 GHz and above**	
195.8875	–	–	–	1530.43
195.8750	195.875	–	–	1530.53
195.8625	–	–	–	1530.63
195.8500	195.850	195.85	–	1530.72
195.8375	–	–	–	1530.82
195.8250	195.825	–	–	1530.92
195.8125	–	–	–	1531.02
195.8000	195.800	195.80	195.8	1531.12
195.7875	–	–	–	1531.21
195.7750	195.775	–	–	1531.31
195.7625	–	–	–	1531.41
195.7500	195.750	195.75	–	1531.51
195.7375	–	–	–	1531.60
195.7250	195.725	–	–	1531.70
195.7125	–	–	–	1531.80
195.7000	195.700	195.70	195.7	1531.90
195.6875	–	–	–	1532.00
195.6750	195.675	–	–	1532.09
195.6625	–	–	–	1532.19
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
193.2375	–	–	–	1551.42
193.2250	193.225	–	–	1551.52
193.2125	–	–	–	1551.62
193.2000	193.200	193.20	193.2	1551.72
193.1875	–	–	–	1551.82
193.1750	193.175	–	–	1551.92

Table 1/G.694.1 – Example nominal central frequencies of the DWDM grid

Nominal central frequencies (THz) for spacings of				Approximate nominal central wavelengths (nm)
12.5 GHz	**25 GHz**	**50 GHz**	**100 GHz and above**	
193.1625	–	–	–	1552.02
193.1500	193.150	193.15	–	1552.12
193.1375	–	–	–	1552.22
193.1250	193.125	–	–	1552.32
193.1125	–	–	–	1552.42
193.1000	193.100	193.10	193.1	1552.52
193.0875	–	–	–	1552.62
193.0750	193.075	–	–	1552.73
193.0625	–	–	–	1552.83
193.0500	193.050	193.05	–	1552.93
193.0375	–	–	–	1553.03
193.0250	193.025	–	–	1553.13
193.0125	–	–	–	1553.23
193.0000	193.000	193.00	193.0	1553.33
192.9875	–	–	–	1553.43
192.9750	192.975	–	–	1553.53
192.9625	–	–	–	1553.63
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
184.7750	184.775	–	–	1622.47
184.7625	–	–	–	1622.58
184.7500	184.750	184.75	–	1622.69
184.7375	–	–	–	1622.80
184.7250	184.725	–	–	1622.91
184.7125	–	–	–	1623.02
184.7000	184.700	184.70	184.7	1623.13
184.6875	–	–	–	1623.24
184.6750	184.675	–	–	1623.35

Table 1/G.694.1 – Example nominal central frequencies of the DWDM grid

Nominal central frequencies (THz) for spacings of				Approximate nominal central wavelengths (nm)
12.5 GHz	**25 GHz**	**50 GHz**	**100 GHz and above**	
184.6625	–	–	–	1623.46
184.6500	184.650	184.65	–	1623.57
184.6375	–	–	–	1623.68
184.6250	184.625	–	–	1623.79
184.6125	–	–	–	1623.90
184.6000	184.600	184.60	184.6	1624.01
184.5875	–	–	–	1624.12
184.5750	184.575	–	–	1624.23
184.5625	–	–	–	1624.34
184.5500	184.550	184.55	–	1624.45
184.5375	–	–	–	1624.56
184.5250	184.525	–	–	1624.67
184.5125	–	–	–	1624.78
184.5000	184.500	184.50	184.5	1624.89
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	**Transmission systems and media, digital systems and networks**
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks and open system communications
Series Y	Global information infrastructure and Internet protocol aspects
Series Z	Languages and general software aspects for telecommunication systems

22348

Printed in Switzerland
Geneva, 2002