

R-OADM

* ** ***

Division Multiplexing) WDM(Wavelength
WDM

OADM(Optical Add/Drop Multiplexer)
/ OADM(Fixed OADM)
(Network Operator) R-OADM(Reconfigurable OADM)

R-OADM
가 R-OADM R-OADM



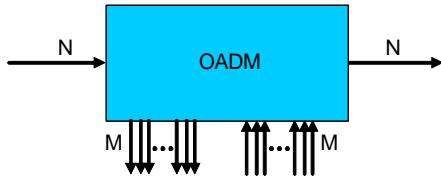
- I.
- II. R-OADM
- III. R-OADM
- IV.

I.
가
2006 56%
CAGR(Compound Annual Growth Rate:
) [1].

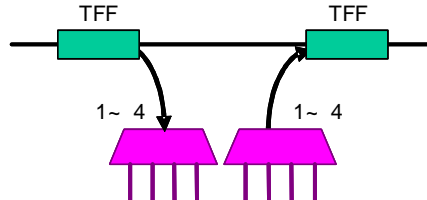
가
WDM(Wavelength
Division Multiplexing)
가
WDM

WDM
/ 가 OADM
. OADM (1) N

* ETRI WDM /
** ETIR /
*** ETIR WDM /



(1) OADM



(2) F-OADM

$M(<N)$

. OADM

F-OADM(Fixed OADM)

(2) TFF(Thin Film Filter)

F-OADM

F-OADM

가

가

가

가

R-OADM(Reconfigurable OADM)

F-OADM

WDM

(capex)

가

. R-OADM

(opex)

가

가

[2].

2004

R-OADM

RFP(Request

for Proposal)

8,500

[3], 2004

R-OADM

[4].

II. R-OADM

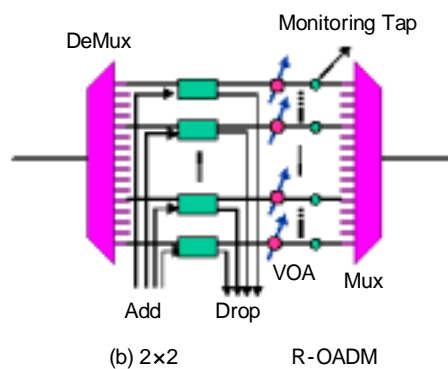
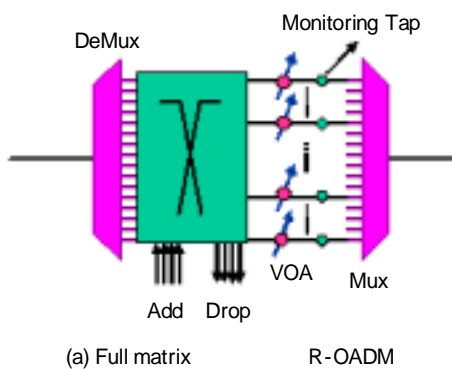
Network Element 가 R-OADM Broadcast and Select R-OADM [2].

DCE(Dynamic Channel Equalizer) Broadcast and Select R-OADM . DCE Broadcast and Select .

1. R-OADM

(3) WDM R-OADM VOA(Variable Optical Attenuator) .

가 (3) (a) Full matrix Full matrix



(3) R-OADM

matrix / 가 가 가 가 가 가 Full

(3) (b) WDM 2x2 / 가 2x2

가 WDM / 가 Full matrix

가 WDM / 가 Full matrix

가 Full matrix 가 가 2x2 가 가 failure 가

가 failure 가 point 가 failure 가

R-OADM Full matrix MEMS(Micro Electro-

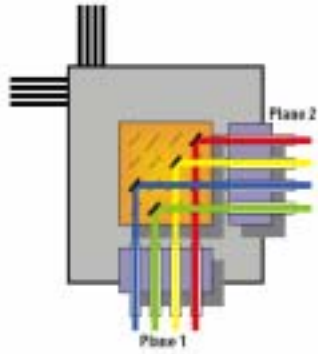
Mechanical System) [5]. MEMS 가

MEMS 2-D 3-D . 2-D MEMS msec

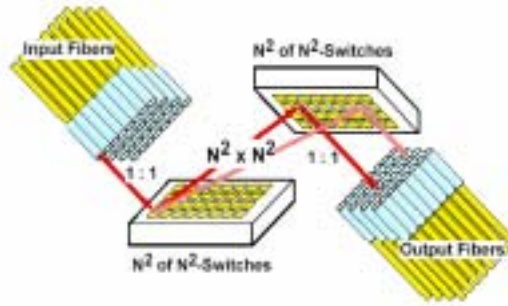
가 on/off . 16x16

. 3-D MEMS 가 가

. (4) 2D 3D MEMS



(a) 2-D



(b) 3-D

(4) MEMS

. 2x2

가

[5].

WDM

. R-OADM

(3)

VOA

. VOA MEMS[7], thermooptic[8],

liquid crystal[9]

WDM / FBG(Fiber Bragg Grating), Bulk grating, TFF, AWG (Arrayed Waveguide Grating) [6]. FBG (circulator)

R-OADM

, Bulk grating

가

가

. TFF

가

가

. AWG

가

가

가

가

2. Broadcast & Select

R-OADM

Broadcast and Select

R-OADM (5)

broadcast

가 DCE ,
 . DCE (6) WDM

. Broadcast and select

가 ,

AWG TFF

(5) Broadcast and Select . (5) (a)

가 가

Full matrix

(4) (a) , Broadcast and Select 가

가 가

3dB

16

15dB

가

가

가

가

5

가

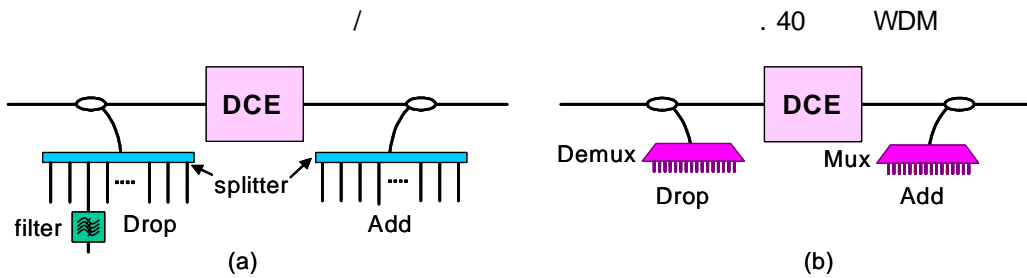
(5) (b)

/

2x2

(4) (b)

가



(5) Broadcast and Select R-OADM

3dB / / 8dB

(5) (b) / /

Full matrix 가 / (4) (a)

matrix , 40 WDM (5) (b) Full

12dB / 가 .

Full matrix 가 , 가 가 .

DCE Broadcast and Select

. DCE (6) WDM . DCE

WDM . DCE

(Wavelength block)

가 . DCE Wavelength

blocker 35~45dB . DCE /

Bulk grating, PLC(Planar Lightwave Circuit) [6], VOA MEMS

[7],[10]-[12] liquid crystal [13]-[15] . MEMS VOA mirror,

shutter, diffractive MEMS . Liquid crystal VOA liquid

crystal 가 . < 1> MEMS

, < 2> liquid crystal .

Broadcast and Select DCE 가

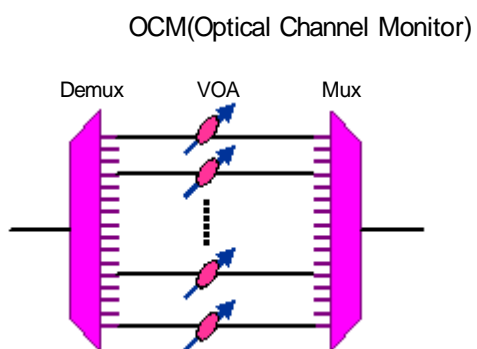
가 .

. 60dB

dynamic range, 0.5dB , 30~

50pm , ~ ms scanning

time



(6) DCE

< 1> MEMS

DCE

	Active Optical	LightConnect	Polychromix	Santec
	Dynamic Spectrum Equalizer	Dynamic Channel Equalizer	P-DCO	λ Blocker
	PLC grating	Bulk grating	Micro diffraction grating	Thin Film
	MEMS	Diffractive MEMS	MEMS	MEMS
	20/40/80	50/100	50/100	4~16
(GHz)	200/100/50	100/50	100/50	100
(dB)	3.5	4/5	6	7
Dynamic Range(dB)	40	20/10	15	20
(dB)	0.05		0.1	
(dB)	40	43/40	40	45
Ripple(dB)		0.2		
PDL(dB)	0.4	0.3	0.3	0.4
PMD(ps)		0.5	0.3	
(ms)	0.3	30	1	10

< 2> Liquid crystal

DCE

	Nettest	Xtellus	Avanex	JDS
	DynaMics CE	Dynamic Blocker Equalizer	Power Blocker	Wavelength Blocker
	Bulk grating	Bulk grating	Bulk grating	
	Liquid crystal	Liquid crystal	Liquid Crystal	
	40	40/80	40/80	50
(GHz)	100	100/50	100/50	100
(dB)	4~6	5	6	7
Dynamic Range(dB)	35	15	20	20
(dB)	0.05	0.1	0.1	
(dB)	35	35	40	32
Ripple(dB)	0.2	0.1	0.3	0.3
PDL(dB)	0.3	0.3	0.5	0.5
PMD(ps)	0.5	0.2	0.3	
(ms)	50	30		30

III. R-OADM

R-OADM

R-OADM

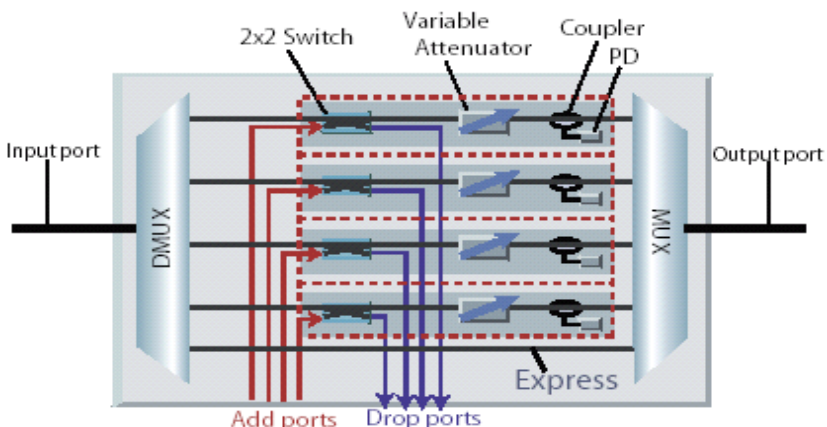
, R-OADM

.....

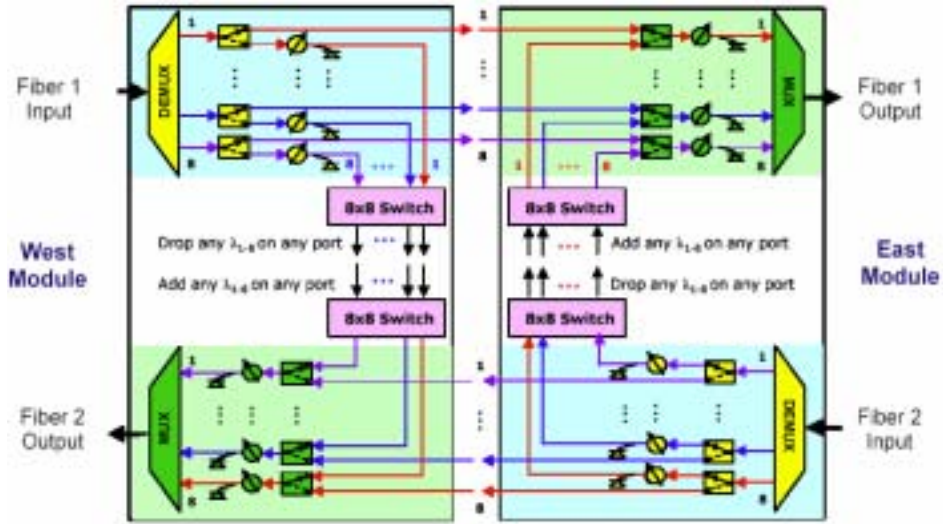
2x2 가 , 4~20
 DCE Broadcast and
 Select R-OADM , 32 WDM 15~20
 , 600~1,000km 가 . R-OADM
 , R-OADM .

1. R-OADM

(7) Santec i-OADM 2x2 R-OADM
 / , 2x2 4 , VOA, [12]. 5
 1 4 / .
 Optoplex tunable OADM , , / ,
 / . Micro-optics, micro-
 actuator design, thin film coating C-band(L-band) 35nm /
 [16].
 가 [17]. Koncent configurable
 OADM TFT 4 10ms /
 [18]. Chromux ROADplexer R-OADM /
 PLC MEMS 2x2 /
 100GHz 40 가 6dB,



(7) Santec i-OADM



(8) DuPont iRoad 888

25~28dB, 3ms [19]. Infineon

R-OADM , AWG, VOA, 20

[20].

(8) DuPont iROADTM 888 8 / 가

/ , VOA, PD PLC . 8

1x2 / 8x8

east/west

[21]. Active Optical Networks R-OADM / PLC

MEMS [22]. Clarendon 4 R-OADM

CP-3104 CMOS DMR(Dynamic, Multifunctional, Reconfigurable)

optical processor

. 8, 16 / 가 , CMOS

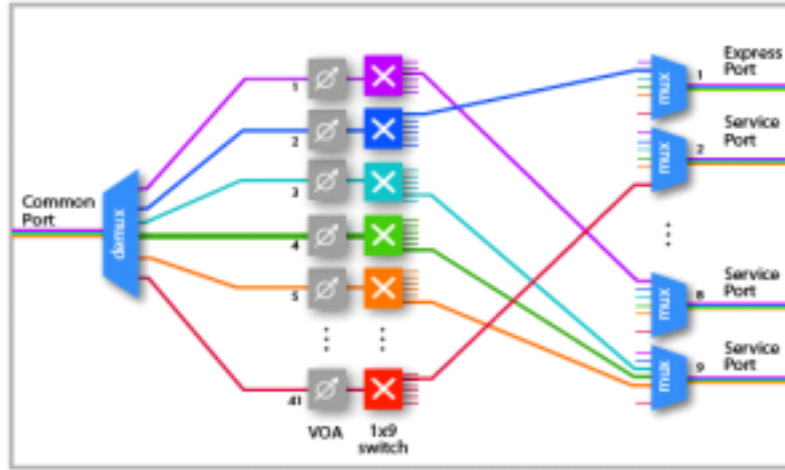
가 가가 [23].

Metconnex WSS 5400 (9) 9

WSS(Wavelength Selective Switch) . WDM VOA

1x9

가 . . 9



(9) Metconnex WSS

8

2 가 , R-OADM 가
 [24]. Capella WavePath 4500 WSS [25].

2. R-OADM

Marconi PMA32 가

[26]. PMA32 Corning liquid crystal

Wavelength blocker Broadcast and Select R-OADM

[27],[28], C-band 32 10 Gb/s 320Gb/s , L-band

640 Gb/s , tunable laser filter 가 tunable transponder

가

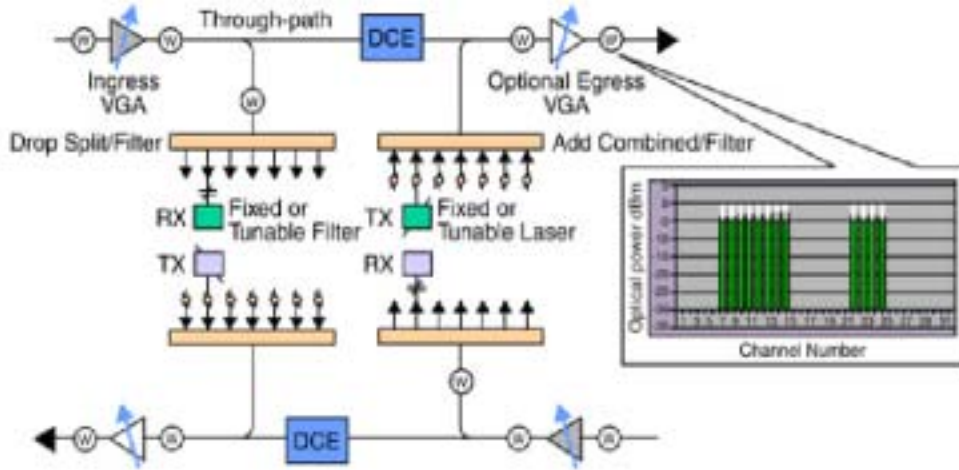
. Ciena Select OADM CoreStream Agility optical transmission

system [29]. Broadcast and Select [27] Corning

Wavelength blocker [28]. 가

(10) Tropic Networks TRX-24000 Broadcast and Select R-OADM

Wavelength Tracker metro-DWDM



(10) Tropic Networks TRX-24000

platform	[30].	WDM	1:2	
DCE		1:N		
		N:1	DCE	
TRX-24000	20	600km	가	1
	100	가		
Meriton	7200	OADM	OADM	[31],
2004	Capella	WSS	40	가 7200 OADM
	R-OADM	[27],[32].	Cisco ONS15454	R-OADM
	WSS	Demultiplexer		32
		/	[27],[32].	
Movaz	40		가	RayROADM
metro box	[27],[33].	RayROADM	Goodrich	MEMS
		R-OADM		Ray
Express	가	. Lucent, Motorola	Movaz	
	[32].	Fujitsu	TFT	OADM , Flashwave
7500	R-OADM	[27],[34].	Mahi Vx7	16
1,000km			1	32 가
	[35].			

IV.

가 / R-
OADM .
OADM 가 ,
가 / OADM .
가 R-OADM F-OADM .
2004 RFP R-OADM
. OADM , F-OADM
R-OADM OADM .
< >

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