



WDM PON

Wavelength Division Multiplexing Passive Optical Network Technology

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(B.K. Kim)	WPON
(T.Y. Kim)	WPON
(J.J. Yoo)	WPON
(B.W. Kim)	WPON
(B.T. Kim)	가

WDM-PON 가
 가
 WDM 가
 FTTH 가
 가
 WDM/TDM, WDM/SCM, WDM/CDM 가
 가
 가
 가
 WDM-PON WDM
 가

I.

가 Gbps
 가 xDSL
 Mbps , 30Mbps 가
 0.4~1Mbps
 가
 Mbps 가 가
 10Mbps~10Gbps
 가
 가
 2000 가
 250Gbps 2005 250Tbps 1,000 가
 가
 (Contents Delivery Net- WDM 가
 work: CDN),
 50~80% 가 가
 WDM(Wavelength Division Multi- PON(Passive
 plexing) 가 TPON
 , LAN 10Mbps 100Mbps (Telephony PON) , FSAN(Full Ser-
 vice Access Networks) 155Mbps B-PON
 (Broadband PON), 622Mbps APON(ATM PON),

GPON(Gigabit PON), EFM(Ethernet in the First Mile) 1Gbps EPON(Ethernet PON) FTTH(Fiber To The Home) FTTB(Fiber To The Building) PON solutions

[1].

PON (Central Office: CO)

OLT(Optical Line Termination),

ONU

(Optical Network Unit) ONT(Optical Network Termination), tree topology

OLT ONU/ONT

cascade

PON

OLT

ONU ONT

optical split-

ter

PON

OLT ONU/ONT

가

[2].

TDM(Time

Division Multiplexing)

PON

가

, 가

가

가

가

WDM-

PON

II

가

(Optical Multiplexer: OMUX)

(Optical DeMultiplexer: ODMUX)

WDM 가

III

WDM-PON , WDM/SCM(Sub-Carrier

Multiplexing) PON , WDM/CDM(Code Divi-

sion Multiplexing)

가

WDM

II. WDM 가

WDM 가

WDM 가

가 가

가

가

1. WDM-PON

WDM 가

DFB-LD

(Distributed Feedback- Laser Diode)

가

가

가

가

DFB-LD 가

DFB-LD

가

가

DFB-LD inventory

, DFB-LD

가

가

. DFB-LD 가

but-

terfly

가

가

가

TO can

FP-

LD(Fabry-Perot Laser Diode)

가

가

WDM

가

, EDFA(Erbium

Doped Fiber Amplifier), LED(Light Emitting Diode) SLED(Superluminescent Light Emitting Diode)
 (Broadband Light Source: BLS) WDM spectrum sliced

WDM 가
 SOA(Semiconductor Optical Amplifier) RSOA(Reflective SOA) 가
 가 가 가

PLC(Planar Lightwave Circuit) 가
 가 가
 WDM

가. Injection - Locking

Injection-locking master slaver
 master
 slaver

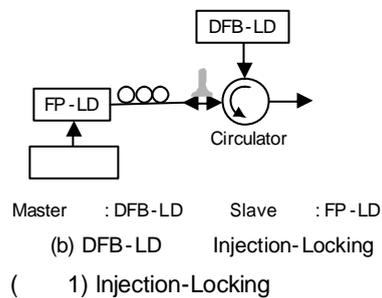
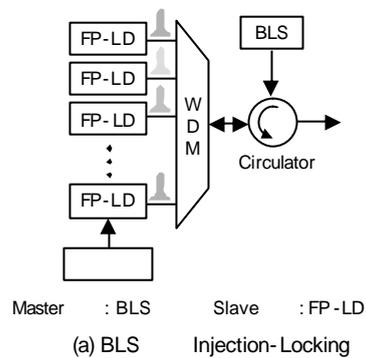
[3]. 가 가 가
 가 가

[4]. (1) injection-locking
 . (1) injection-

locking master slaver
 . (1(a)) BLS WDM
 slicing FP-LD injection-
 locking . FP-LD

injection
 locking 가
 injection-locking circulator
 Mode Suppression Ratio) SMSR(Side

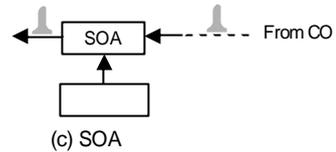
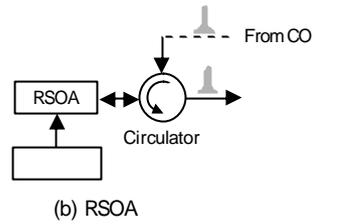
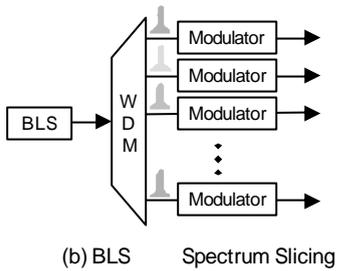
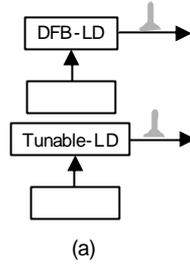
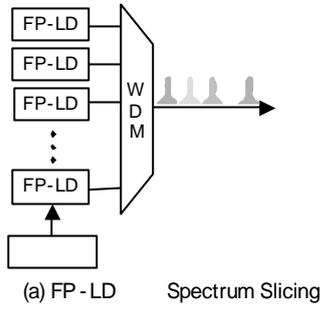
(1(b))
 DFB-LD master
 LD FP-LD
 injection DFB-LD
 injection-locking FP-LD RSOA



. Spectrum Slicing

WDM slicing

BLS



(2) Spectrum Slicing

(3)

가

[5]. (2) spectrum slicing . Spectrum slicing

가

가

(2(a))

CO

. (3(b)), (3(c))

가 FP-LD WDM

(loopback)

RSOA(SOA)

가 WDM . FP-LD

, CO

가 WDM

SOA)

RSOA(

. (2(b))

가 . 3가

BLS WDM

가

가

WDM

가

가 .

2. WDM - PON

PIN - PD(Photodiode) APD(Ava-
lanche PD) 2가 ,

가

APD

. (3)

가

가

. (3(a))

가

가

, PIN-PD

(3(a)) DFB-LD tunable LD(

가

가

3. WDM - PON ()

가 . arrayed waveguide , output slab waveguide

가 , . AWG type

가 . (4) AWG (Arrayed Waveguide Grating) type, thin film type diffraction grating() type

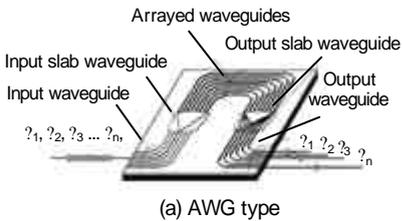
. AWG type , crosstalk가 가 type AWG가 , 가 athermal 가

AWG type 가 slab waveguide (4(a)) . AWG

Thin film type thin film cascade

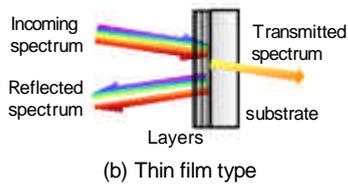
input slab waveguide arrayed waveguide

가 가 가 , thin film

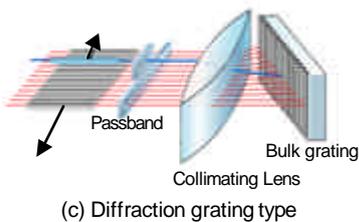


Diffraction grating type

. (4)



grating type , 가 Diffraction 가 type 가 , 가 가 type



UDWDM(Ultra Dense WDM)

1,000 GHz DWDM CWDM(Coarse WDM) 30 100 가

(4) /

가
WDM-PON
UDWDM
1,022
10GHz
UDWDM
[6], K2 Op-
tronics UDWDM
external cavity
($<0.02\text{nm}/^\circ\text{C}$)
12.5GHz / Essex 8
3.125GHz
[7]. London 1.8THz
가 optical comb generator 1~25GHz
UDWDM
875 12.5GHz
UDWDM
[8], 2003 UDWDM

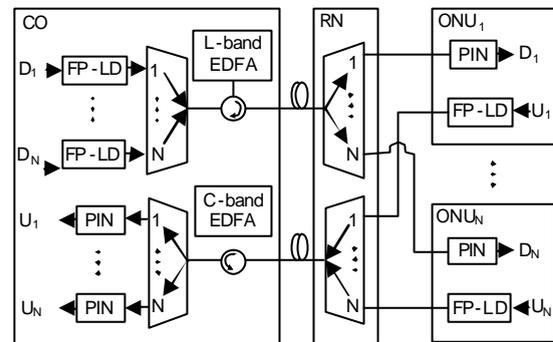
III. 가

가 OLT, RN
(Remote Node) ONT . OLT
MSO(Multi System Operator)
CO
가
, 가 . RN 가
(,)
가 . ONT 가
WDM 가 WDM-PON , WDM/

SCM-PON WDM/CDM

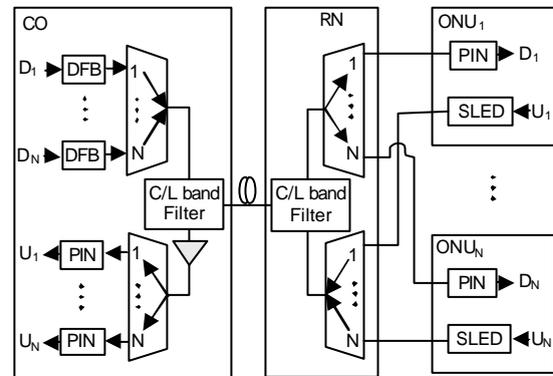
1. WDM-PON

가 WDM-PON
(ONT) 가 CO
가 CO
(OLT)
inventory
WDM-PON II 3가
가
Injection-locking WDM-PON
(5) EDFA BLS master [4].



(5) Injection-Locking

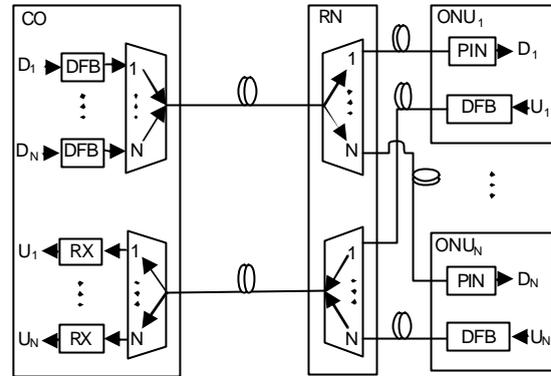
WDM-PON



(6) Spectrum Slicing

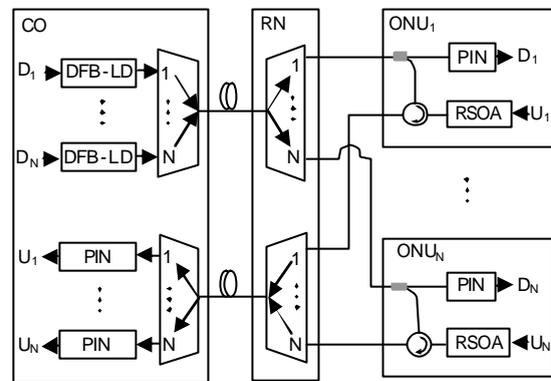
WDM-PON

(5) FP-LD injection-locking master
 CO RN
 injection-locking
 DFB-LD
 가
 (6) spectrum slicing
 [5]. CO
 DFB-LD , 가



(7) WDM-PON

SLED
 SLED SOA LED
 CO
 EDFA spectrum slicing
 가 가
 , C/L band
 가
 (7)



(8) Loopback WDM-PON

가
 , DFB-LD 가
 WDM-PON (8)
 [9]. (8)
 가 RSOA optical coupler/circulator
 DFB-LD 가
 CO DFB-LD
 가 ONT 2x2

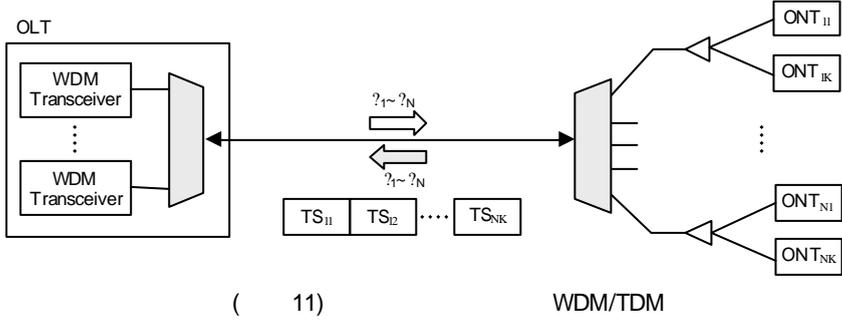
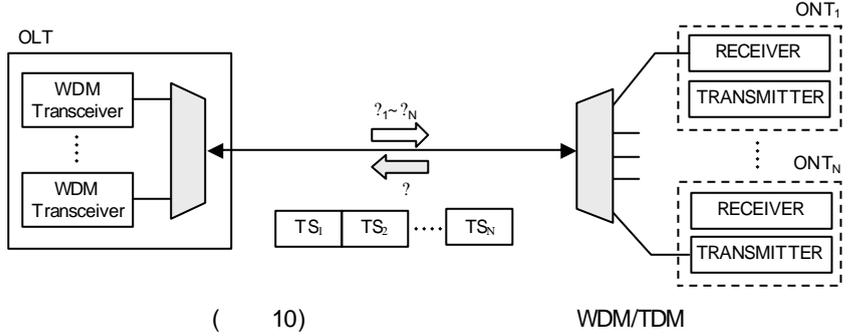
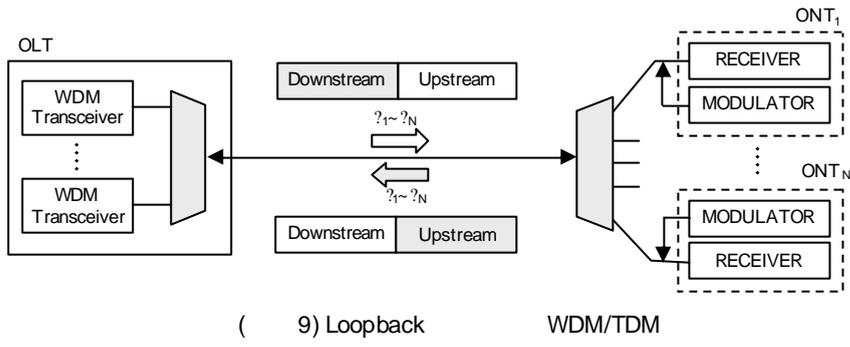
OADM
 (Optical Add/Drop Multiplexer)

2. WDM-PON

가
 optical circulator RSOA
 RSOA
 star , ring
 . Ring /

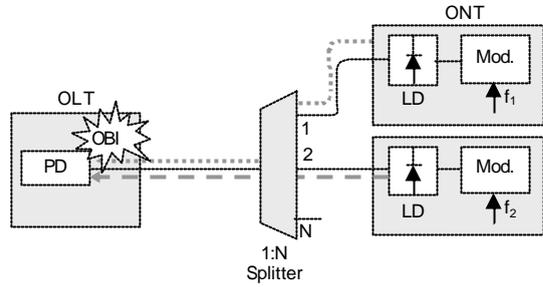
WDM-PON
 WDM
 WDM
 가 가
 WDM
 가
 가

가 . PON
 가 가
 , 가
 TDM, SCM, CDM 가
 가
 가. WDM/TDM
 WDM/TDM
 APON, EPON,
 GPON , WDM 가 OLT
 ONU/ONT
 (9) WDM- 가



- (3) in-band & overlay 가
- (4) Protocol & bit rate transparency 가
- ranging, burst mode 가

WDM/SCM < 1 > [10],[11].



(14)

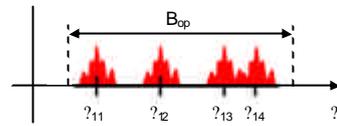
가 WDM/SCM (14)

OLT (Optical Beat Interference: OBI) 가

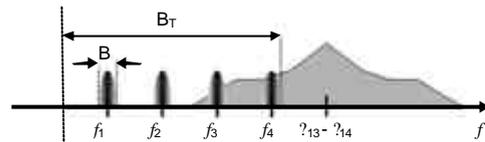
(15)

?13 ?14 WDM/SCM

(15) OBI



(a)



(b) Photocurrent

(15) OBI

가 WDM/SCM OBI

ETRI WPON SCM

100Mbps

OBI

< 1 > WDM/SCM

	Centerpoint	Sprint	NTT
Number of ?	64	-	32
? spacing	100GHz	-	100GHz
Bandwidth/?	20G	10G	6.2G
Number of SC	128	4	310
Modulation	16QAM	PSK	16QAM
bps/channel	155Mbps	2.5Gbps	20Mbps
Tx distance	80km	160km	20km
	Reed Solomon	-	Reed Solomon
	-	2.6~18GHz	2~3.9GHz
? range	-	-	1537 ~ 1562nm
	2001	2001	2003

. WDM/CDM

WDM/CDM WDM

가 . WDM

가 가 ,

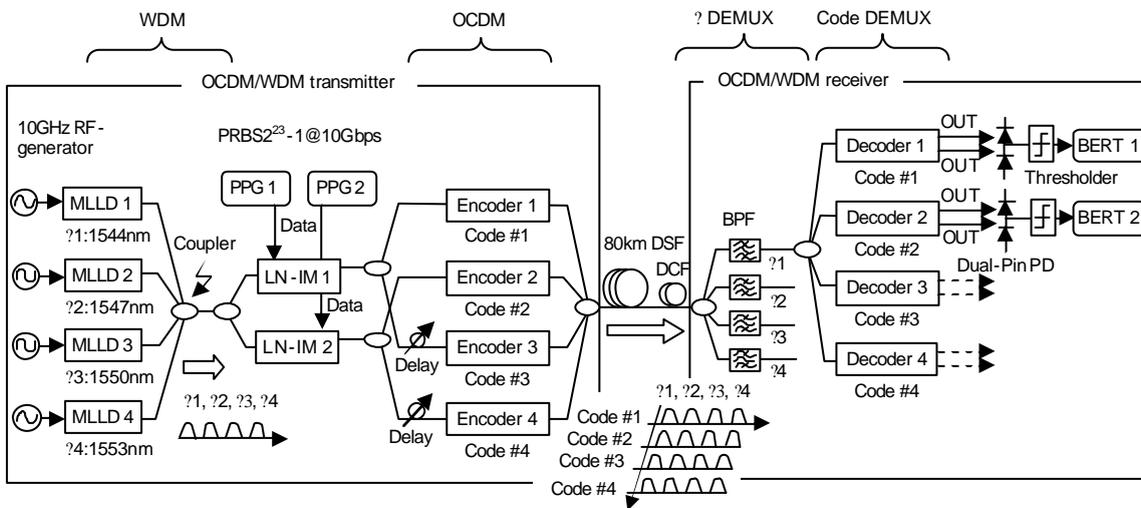
가

CDMA(Code Division Multiplexing Access)

가 ,

가

가 1980 가 CDMA , WDM 가 CDM 가 , OKI , APN , DARPA(Defense Advanced Research Projects Agency) IV. CDMA FTTH 가 PON , WDM-PON 가 , ETRI CDMA 가 가 가 (16) CRL WDM/CDM WDM-PON 가 Hybrid [13]. (Mode Locked laser-Diode: MLLD) PLC 가 (Lithium Niobate-Intensity Modulator: LN-IM) 가 가 encoder 가 가 decoder 가 가 WDM



(16) CRL WDM/CDM Hybrid

WDM

가

가

가

WDM-PON 가

가

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