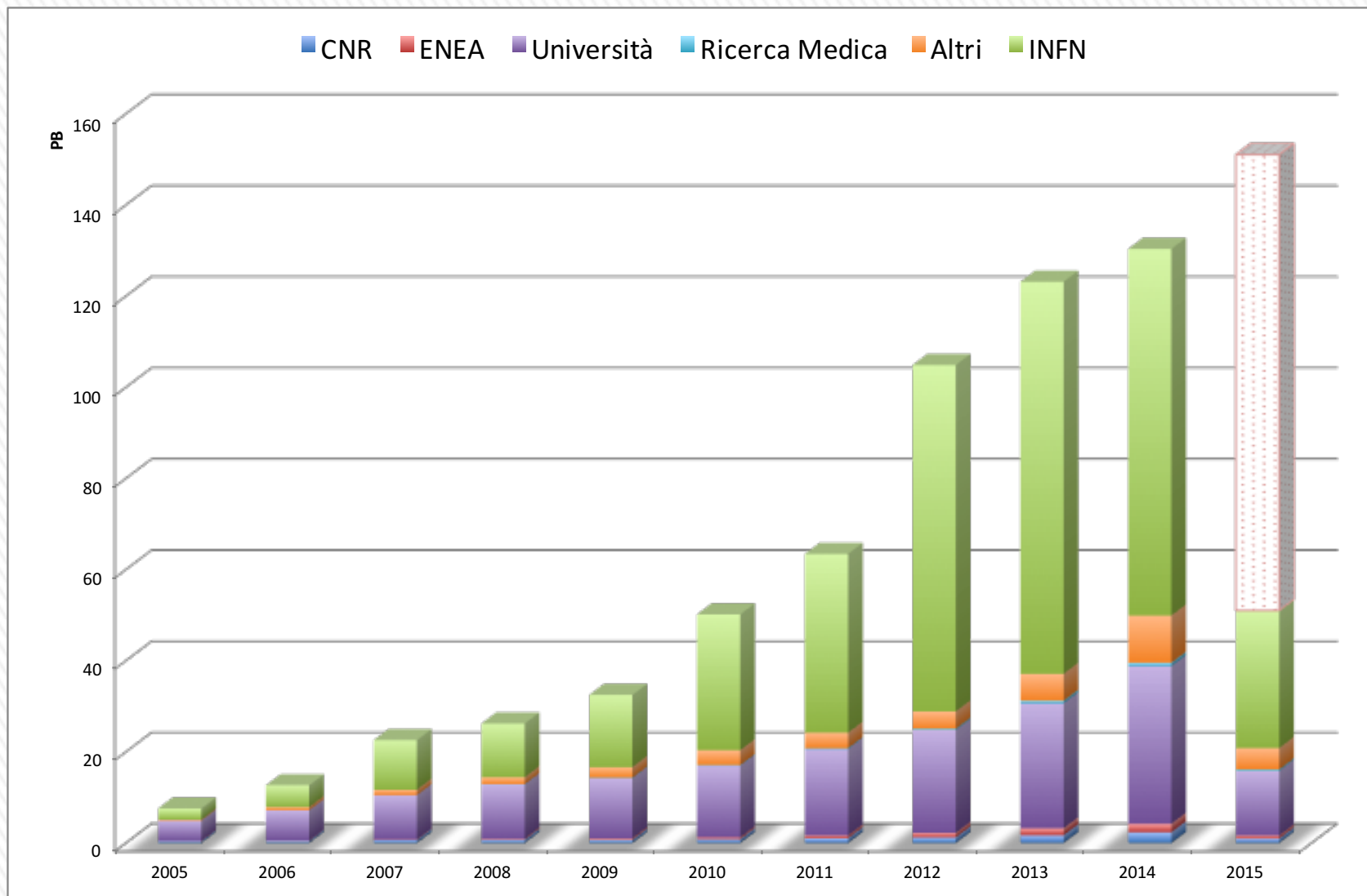




Evoluzione di Rete

- » Evoluzione del traffico INFN
- » ... gli accessi INFN
- » Come “dovrebbe” evolvere l’accesso
- » ... modello LHCONe → Science DMZ
- » Beyond GARR-X
- » ... da GARR-X Progress a GARR-X
- » ... Espansione a 100G
- » ... integrazione rete Infinera over Huawei

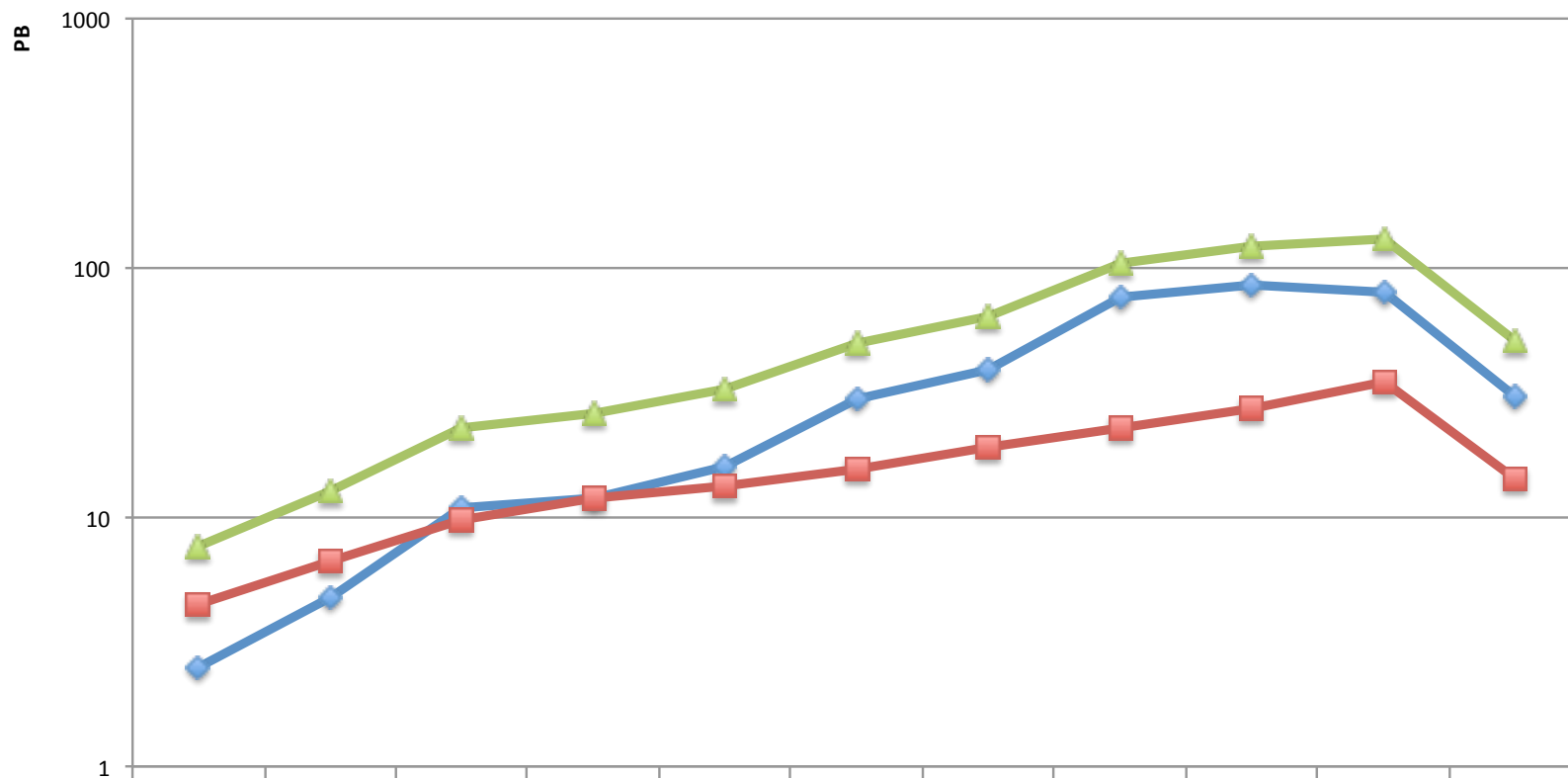
Agenda



Evoluzione Volume di Traffico

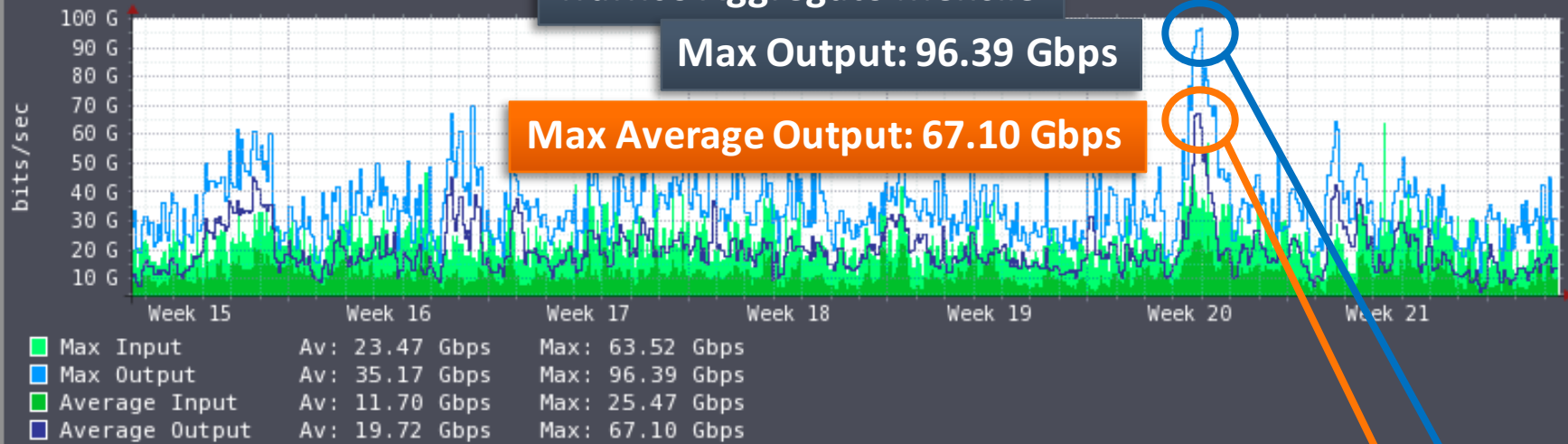


◆ infn ■ universita' ▲ volume globale

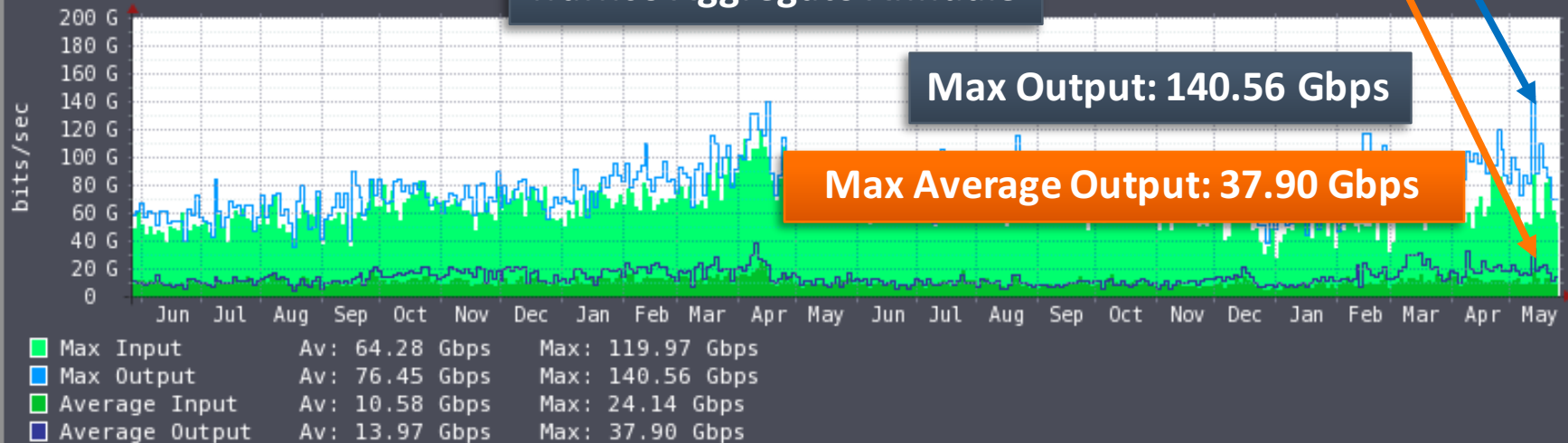


INFN vs Università > 4

Traffico Aggregato Mensile



Traffico Aggregato Annuale



Traffico INFN

Sede	Data attivazione	n Link	PoP / Sede	Tipo Link	Banda (Mbps)	Banda 2015
GSSI - L'Aquila	10/10/13	backup	PoP L'Aquila-Vetoio	DF 1Gbps GE	1000	1000
			PoP L'Aquila-Vetoio	DF 1Gbps GE	1000	1000
INFN - AC - Frascati	12/11/99		INFN - LNF - Frascati	L3	0	0
INFN - Alessandria	20/09/99		UNI-Alessandria	L3	0	0
INFN - Bari	12/06/12		PoP Bari-Amendola	Direct 1Gbps GE	1000	1000
INFN - Bari - TIER2	12/06/12		PoP Bari-Amendola	Direct 10Gbps 10GE	10000	20000
INFN - Bologna	15/06/12		PoP Bologna-Morassutti	DF MAN 1Gbps GE	1000	1000
INFN - Brescia	20/09/99		UNI-Brescia	L3	0	0
				Lambda-GARR 1Gbps GE		
INFN - Cagliari	23/07/12		PoP Cagliari-Marengo	GE	1000	1000
INFN - Catania	10/07/12		PoP Catania-Cittadella	DF MAN 1Gbps GE	1000	1000
INFN - Catania - TIER2	10/07/12		PoP Catania-Cittadella	DF 10Gbps 10GE	10000	20000
				CDN SDH 100Mbps		
INFN - CCSEM - Erice	15/06/12	Link 1	PoP Palermo-Scienze	FE	100	100
		Link 2	PoP Palermo-Scienze	FE	100	100
INFN - CNAF - Bologna	06/06/12		PoP Bologna-Morassutti	Direct 10Gbps 10GE	10000	20000
INFN - CNAF - Bologna - CDF	13/03/13		PoP Bologna-Morassutti	Direct 10Gbps 10GE	10000	10000
INFN - CNAF - Bologna - TIER1	26/03/14		PoP Bologna-Morassutti	Direct 4x10Gbps aggGE	40000	100000
INFN - CNAF sede secondaria - Bologna	28/09/10		INFN - CNAF - Bologna	L3	0	0
INFN - Cosenza	05/07/12		PoP Cosenza-Arcavacata	Direct 1Gbps GE	1000	1000
					0	10000
INFN - Ferrara	15/06/12		PoP Ferrara-Saragat	Direct 1Gbps GE	1000	1000
INFN - Firenze-Sesto	18/10/12		PoP Firenze-Sesto	DF MAN 1Gbps GE	1000	1000
INFN - Genova	01/08/12		PoP Genova-Vivaldi	DF MAN 1Gbps GE	1000	1000
		backup	PoP Genova-Vivaldi	DF MAN 1Gbps GE	1000	1000

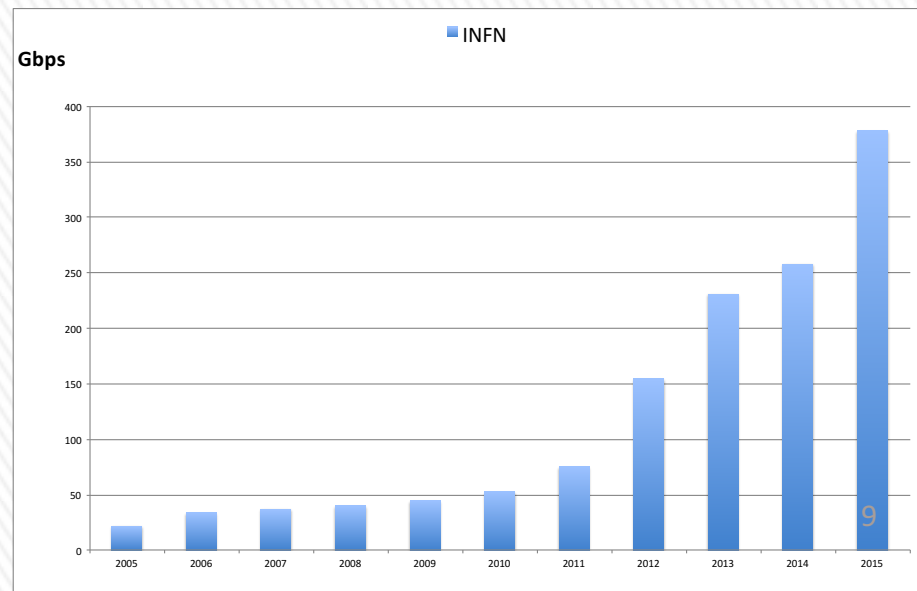
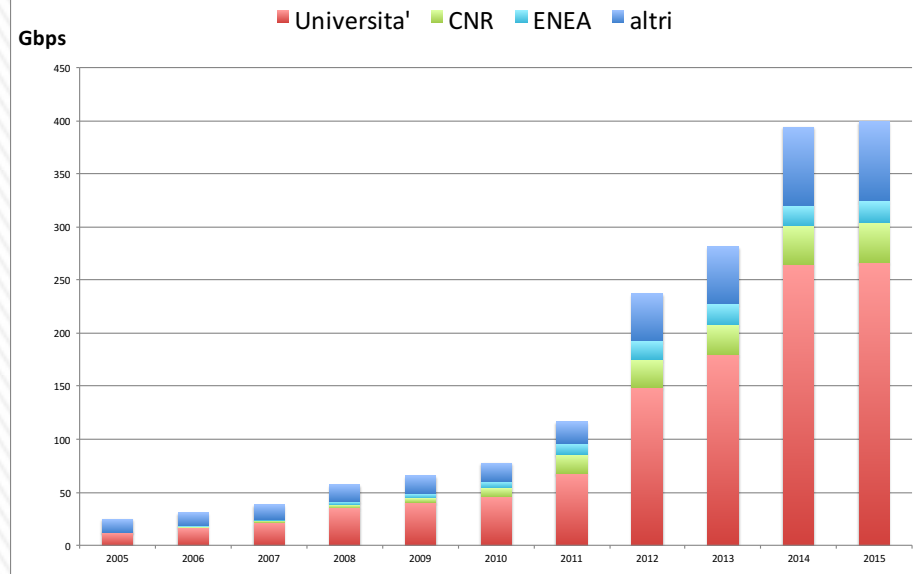
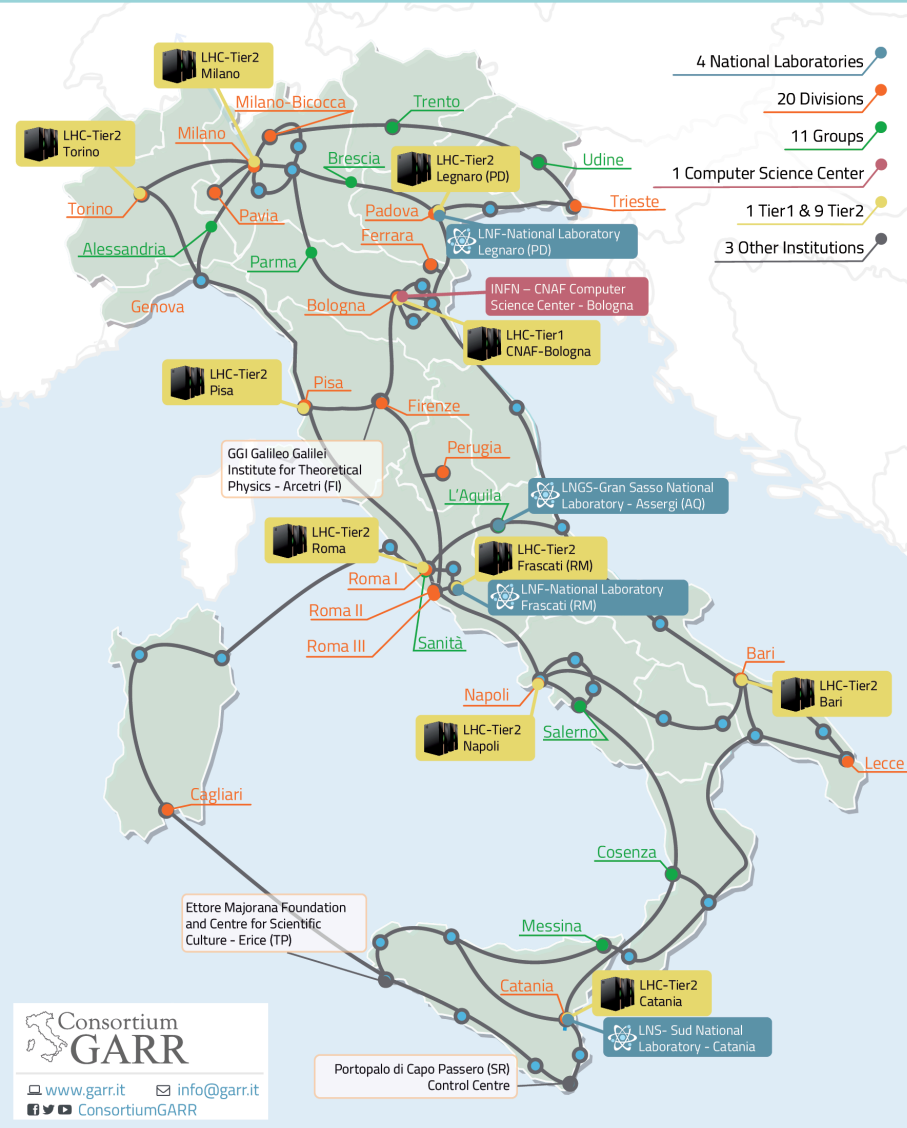
Sede	Data attivazione	n Link	PoP / Sede	Tipo Link	Banda (Mbps)	Banda 2015
INFN - L'Aquila	19/12/12		PoP L'Aquila-Vetoio	Direct 1Gbps GE	1000	1000
		backup	PoP L'Aquila-Vetoio	Direct 1Gbps GE	1000	1000
INFN - Lecce	25/07/12		PoP Lecce-Fiorini	DF 1Gbps GE	1000	1000
INFN - LNF - Frascati	16/05/12		PoP Frascati-Fermi	Direct 1Gbps GE	1000	1000
INFN - LNF - Frascati - KLOE	10/05/12		PoP Frascati-Fermi	Direct 1Gbps GE	1000	1000
INFN - LNF - Frascati - TIER2	28/03/14		PoP Frascati-Fermi	Direct 10Gbps 10GE	10000	10000
INFN - LNGS - Assergi (AQ)	27/06/12	backup	PoP Bologna-Morassutti	CDN SDH 100Mbps FE	100	100
		Link 1	PoP Roma-Tizii	CDN SDH 1Gbps GE	1000	1000
		Link 2	PoP Roma-Tizii	CDN SDH 1Gbps GE	1000	1000
		Link 3			0	10000
INFN - LNL - Legnaro (PD)	07/05/13		PoP Padova-Spagna	Direct 2x10Gbps aggGE	20000	20000
INFN - LNL - Legnaro - TIER2	07/05/13		PoP Padova-Spagna	Direct 2x10Gbps aggGE	20000	20000
INFN - LNS - Catania	10/07/12		PoP Catania-Cittadella	DF MAN 1Gbps GE	1000	1000
INFN - Messina	07/08/12		PoP Messina-Pugliatti	DF 1Gbps GE	1000	1000
INFN - Milano	17/07/12		PoP Milano-Colombo	DF MAN 1Gbps GE	1000	1000
INFN - Milano - Bicocca	17/07/12		PoP Milano-Colombo	DF 1Gbps GE	1000	1000
INFN - Milano - LASA	01/11/10		INFN - Milano	DF	0	0
INFN - Milano - TIER2	22/06/12		PoP Milano-Colombo	DF 10Gbps 10GE	10000	10000
INFN - Napoli	06/06/12		PoP Napoli-Mt.S.Angelo	Direct 1Gbps GE	2000	2000
INFN - Napoli - TIER2	05/06/12		PoP Napoli-Mt.S.Angelo	DF 10Gbps 10GE	10000	10000
INFN - Padova	13/02/13		PoP Padova-S.Francesco	DF 10Gbps 10GE	10000	10000
INFN - Parma	14/06/12		PoP Bologna-Morassutti	L2-CAR	100	100
		backup	PoP Bologna-Morassutti	L2-CAR	100	100



Sede	Data attivazione	n Link	PoP / Sede	Tipo Link	Banda (Mbps)	Banda 2015
INFN - Pavia	26/02/14	Link 1	PoP Pavia-Bassi	Direct 1Gbps GE	1000	1000
		Link 2	PoP Pavia-Bassi	Direct 1Gbps GE	1000	1000
INFN - Perugia	25/06/12		PoP Perugia-Duranti	DF 1Gbps GE	1000	1000
		backup	PoP Perugia-Duranti	DF 1Gbps GE	1000	1000
INFN - Pisa	29/01/13		PoP Pisa-Torricelli	Direct 2x10Gbps aggGE	20000	20000
INFN - Pisa - TIER2	29/01/13		PoP Pisa-Torricelli	Direct 2x10Gbps aggGE	20000	20000
INFN - Portopalo di Capo Passero (SR)	14/05/13		INFN - LNS - Catania	DF MAN 1Gbps GE	1000	1000
		backup	PoP Milano-Colombo	L3VPN MPLS 2Mbps xDSL	2	2
INFN - Presidenza - Roma	21/06/12	Link 1	PoP Roma-Tizii	DF 100Mbps FE	100	100
		Link 2	PoP Roma-Tizii	DF 100Mbps FE	100	100
INFN - Roma1	20/06/12		PoP Roma-Sapienza	DF 1Gbps GE	1000	1000
INFN - Roma1 - TIER2	11/07/12		PoP Roma-Tizii	DF 10Gbps 10GE	10000	20000
INFN - Roma2	03/07/12		PoP Roma-Tor Vergata	Direct 1Gbps GE	1000	1000
		backup	PoP Roma-Tor Vergata	Direct 1Gbps GE	1000	1000
INFN - Roma3	13/07/12		PoP Roma-Sapienza	DF 1Gbps GE	1000	1000
		backup	PoP Roma-Tizii	DF 1Gbps GE	1000	1000
INFN - Salerno	01/10/12		PoP Salerno-Fisciano	DF MAN 1Gbps GE	1000	1000
INFN - Sanita' - Roma	03/11/99		INFN - Roma1	L3	0	0
INFN - Siena	23/06/99		UNI-Siena	L3	0	0
INFN - TIFPA Povo (TN)	31/07/12		PoP Trento-Briamasco	DF MAN 100Mbps FE	100	100
INFN - Torino	07/11/12		PoP Torino-Giuria	Direct 1Gbps GE	1000	1000
INFN - Torino - TIER2	16/12/13		PoP Torino-Giuria	Direct 10Gbps 10GE	10000	10000
INFN - Trieste - Padriciano	13/06/12		PoP Trieste-Valerio	DF 1Gbps GE	996	996

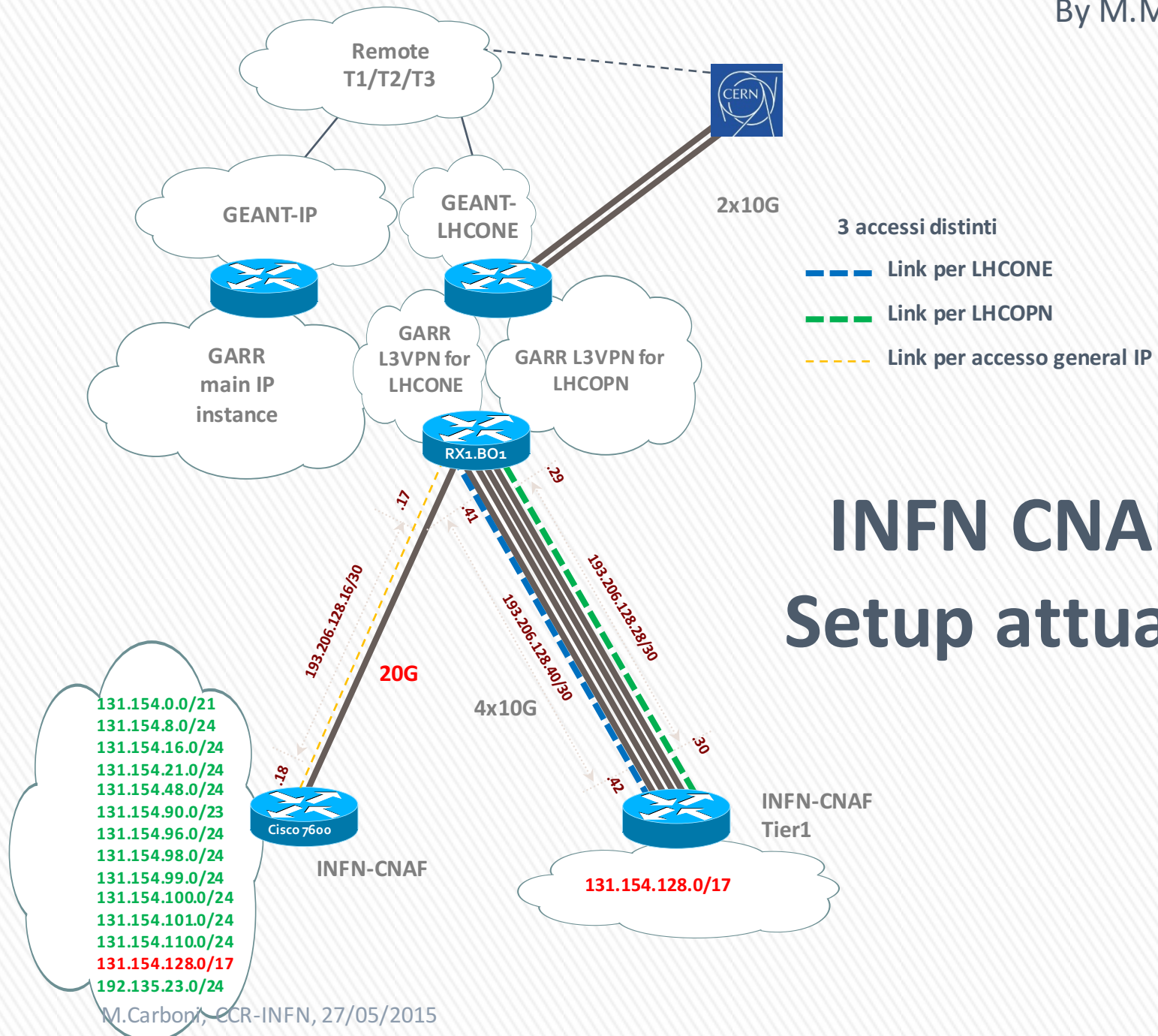
INFN SITES ON GARR NETWORK

THE ITALIAN RESEARCH AND EDUCATION NETWORK



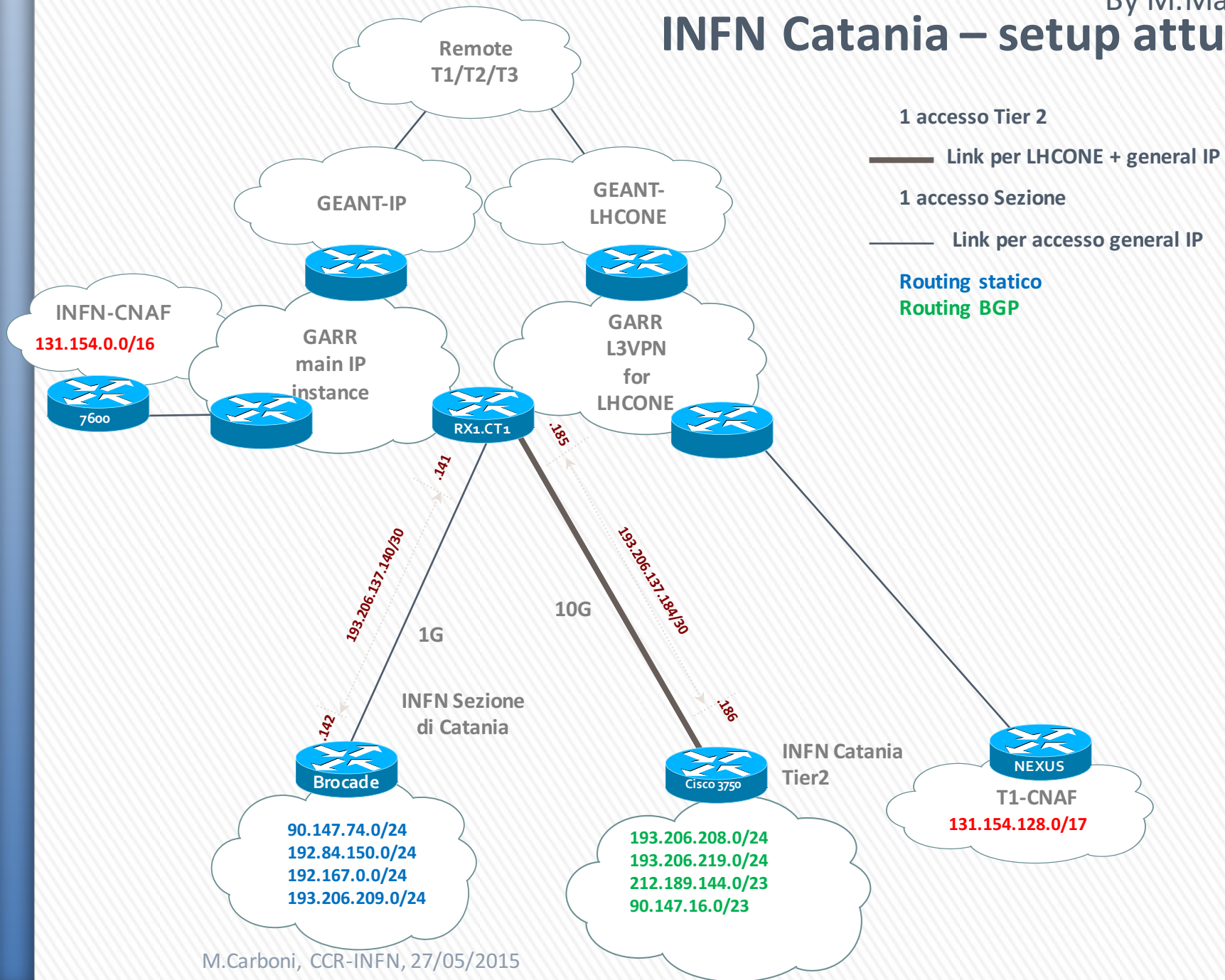
Il modello di accesso LHC

Che modello di rete  10



Setup di accesso INFN Catania

INFN Catania – setup attuale



INFN Catania – setup futuro

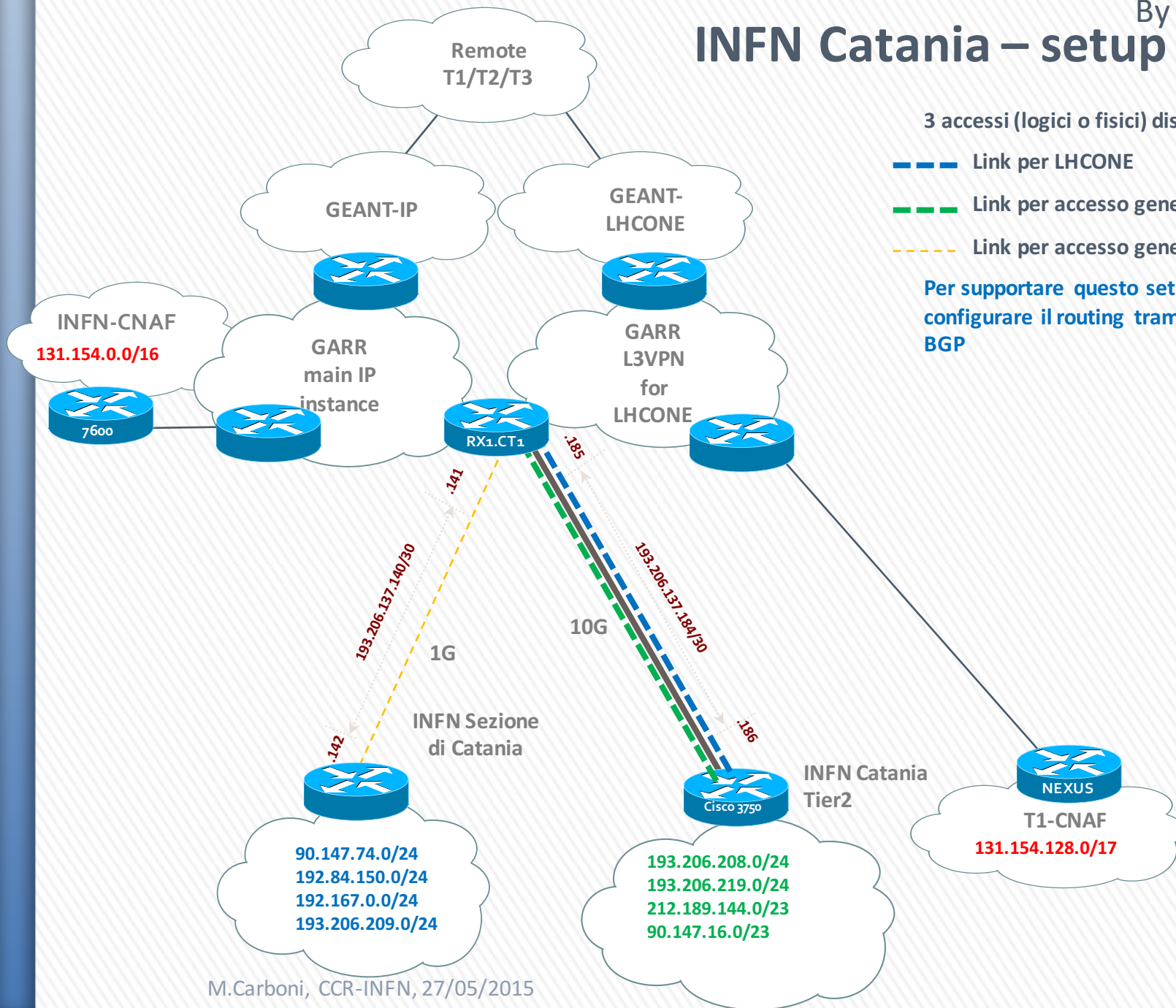
3 accessi (logici o fisici) distinti

— — — Link per LHCONE

— — — Link per accesso general IP Tier2

- - - - Link per accesso general IP Sezione

Per supportare questo setup è **NECESSARIO** configurare il routing tramite protocollo BGP



- » Il traffico LHCONE è necessario che sia compliant con le AUP LHCONE
<https://twiki.cern.ch/twiki/bin/view/LHCONE/LhcOneAup>
 - il collegamento LHCONE può veicolare SOLO il traffico delle macchine appartenenti agli esperimenti LHC e Belle-II
- » Qualora fosse necessario routare su collegamenti fisici del Tier2 il traffico delle macchine appartenenti agli altri esperimenti INFN, inclusi progetti ReCaS, è necessario creare almeno un ulteriore link logico (VLAN)
 - Link logico LHCONE
 - Link logico General IP
- » il link logico General IP va impiegato come UNICA USCITA per le macchine non LHC e Belle-II
 - Questo vuol dire che per queste macchine **deve essere configurato un source routing** (policy-based routing Cisco) sul router di accesso del Tier2
- » Per gestire sullo stesso router Tier2 entrambi i link logici è **obbligatoria la configurazione del routing tramite BGP**
- » **In caso il Tier2 abbia più di 1 router di accesso, il discorso è valido per ciascuno di essi**

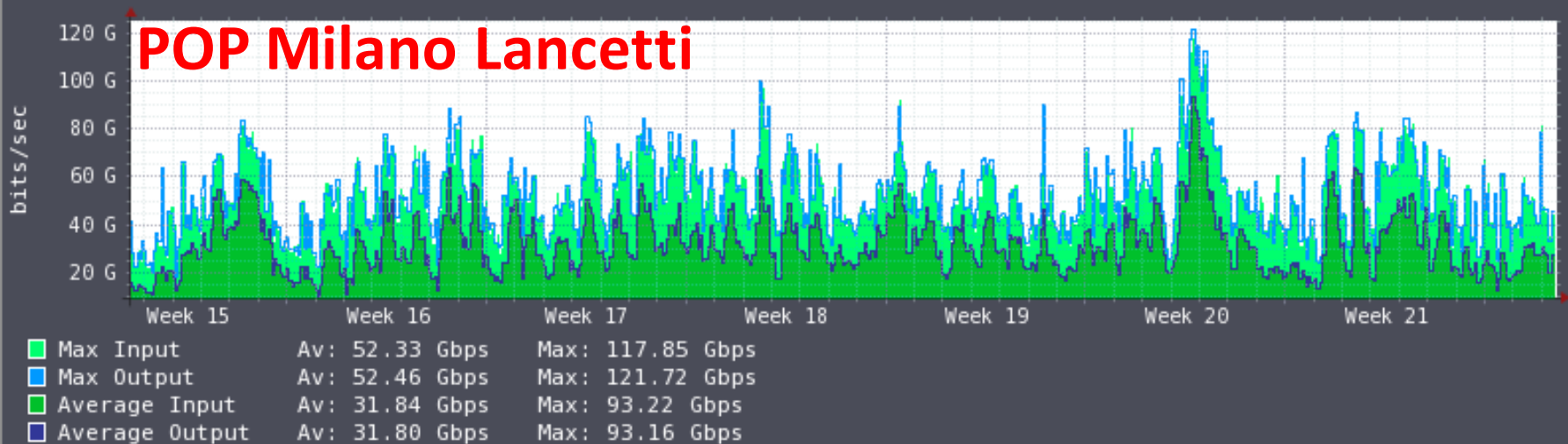
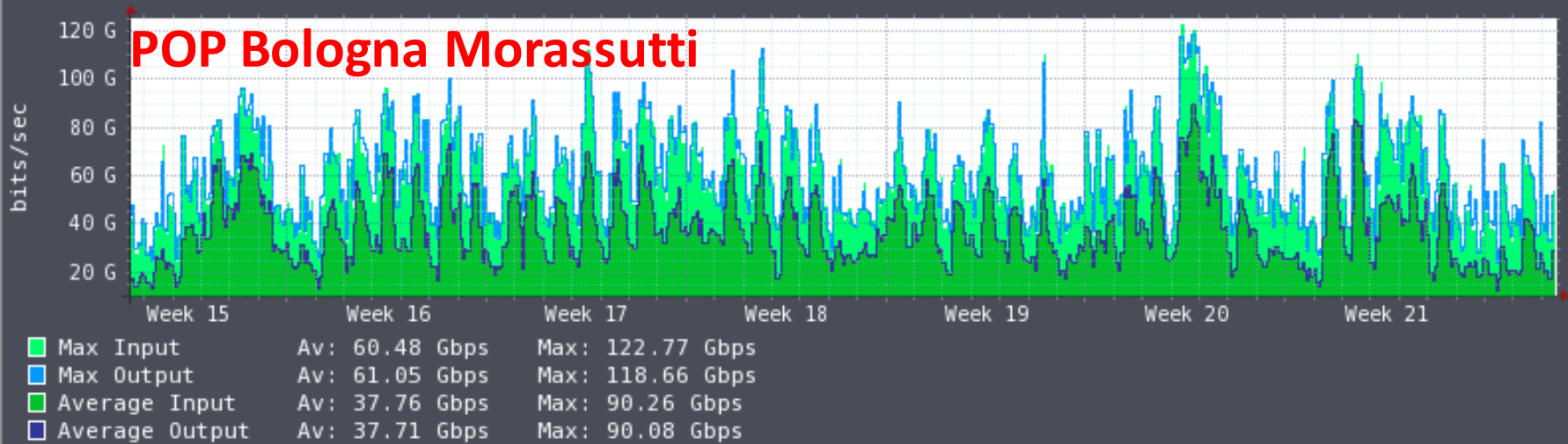
Estensione della Rete a 100Gbps

Beyond GARR-X

GARR-X

GARR-X Progress





POP Mi1 e Bo1

BB:230G

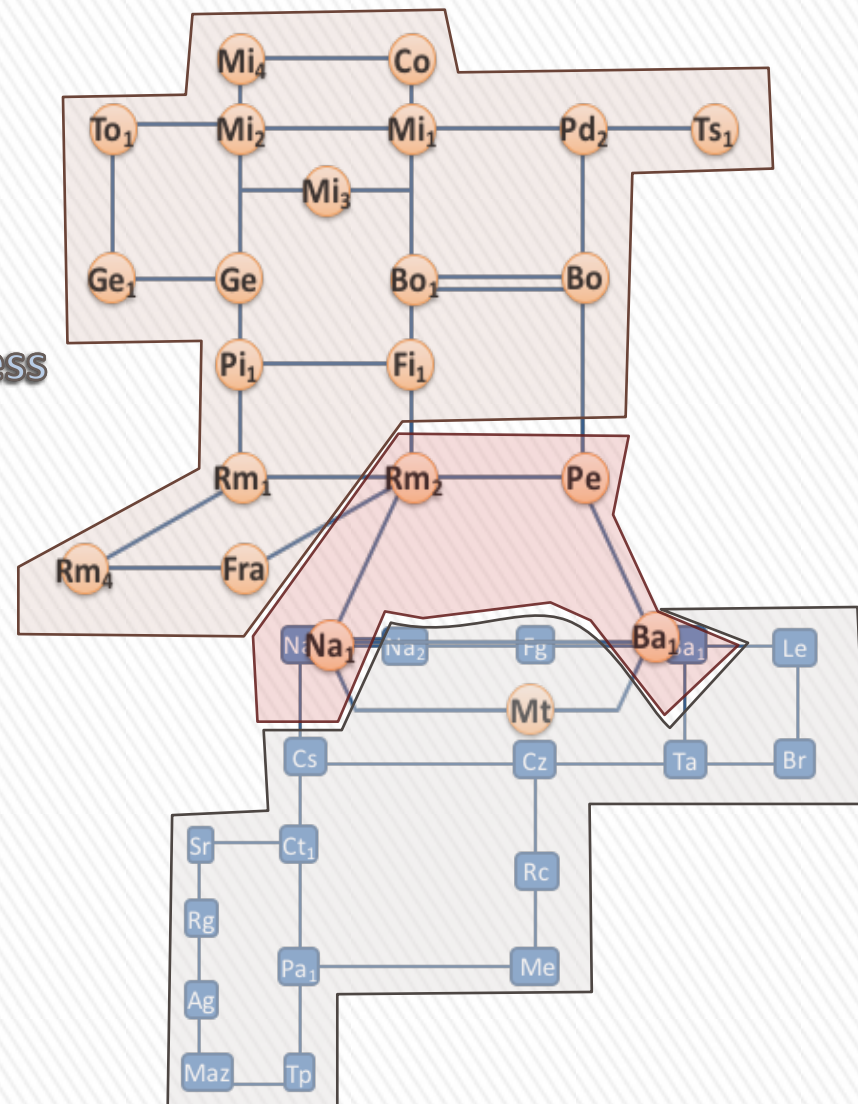
BB:290G

Edge: 130G

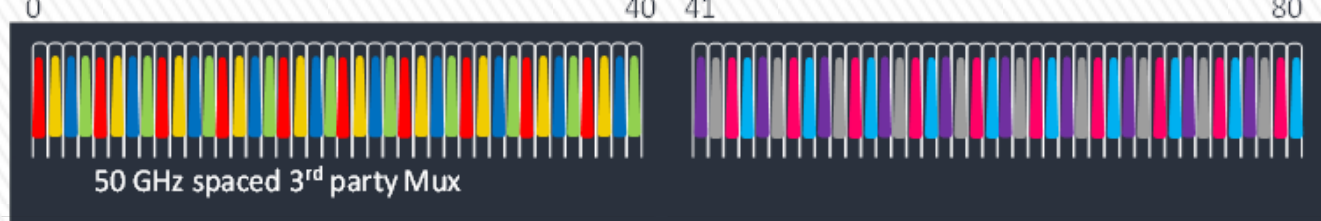
Acc:



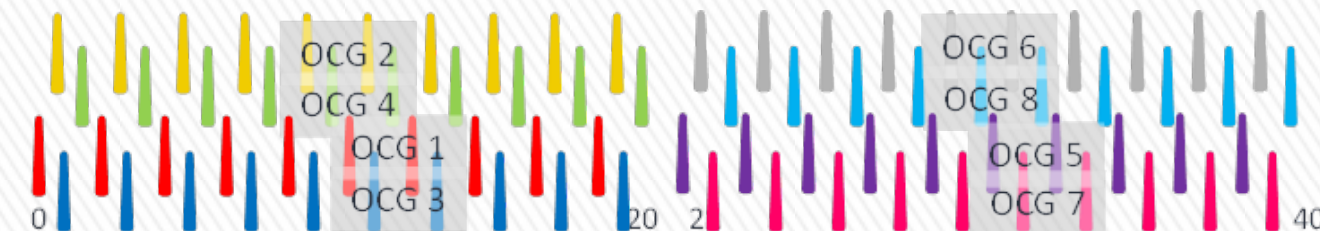
GARR-X Progress
e GARR-X



GARR-X Progress e GARR-X > 19



Max Capacity
4Tb/s - DTN-X
800G - DTN



OCG channel
10Gb/s or 50 Gb/s



OFM-40 (per OCG) 1
channel/100GHz
OCG 2,4,6,8



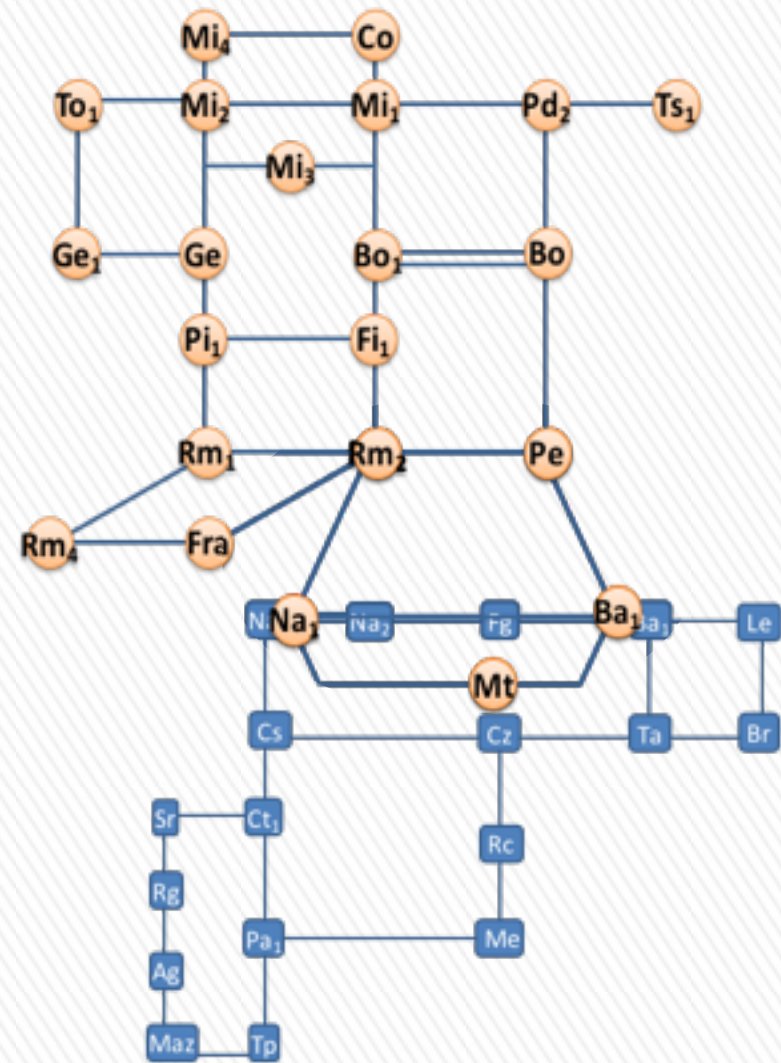
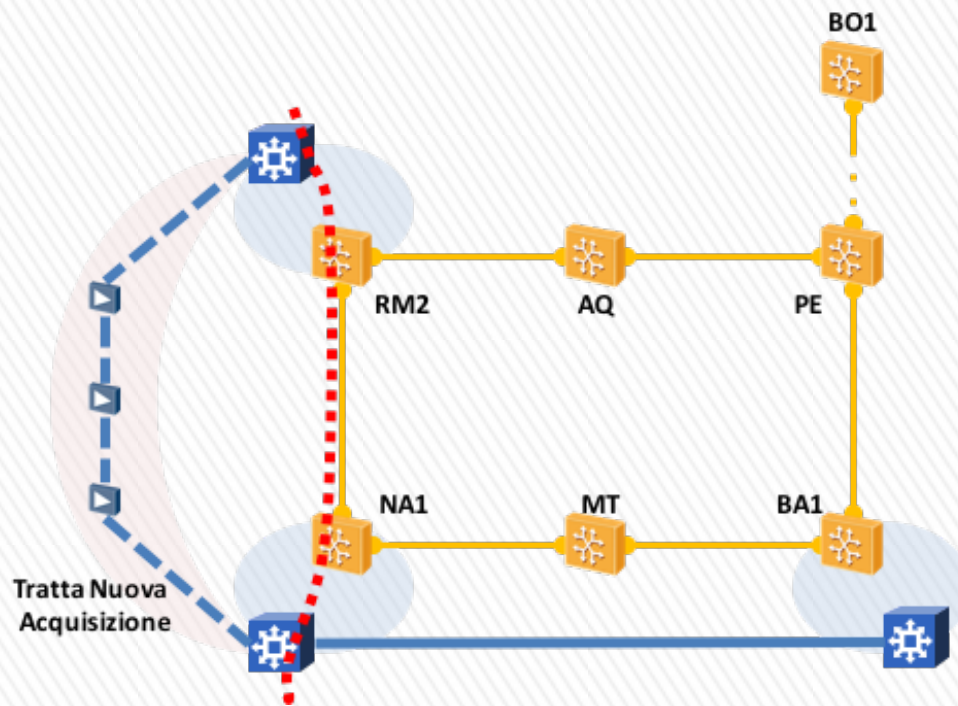
OFM-40 w/50 GHz
offset for OCG 1,3,5,7



I segnali INFINERA all'interno dello spettro DWDM @ 80 Ch

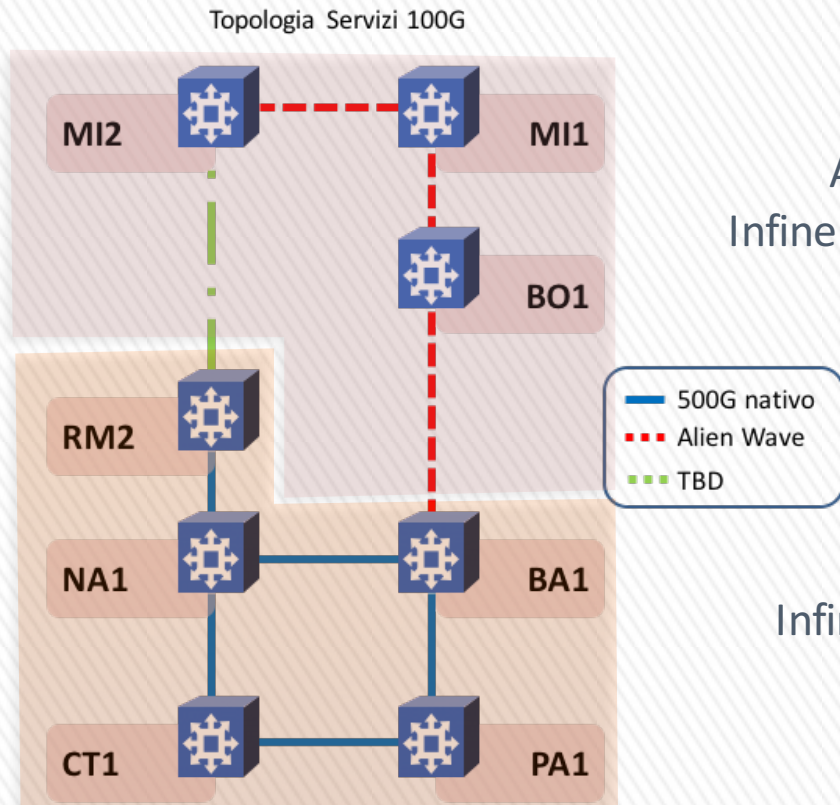
- » Con questa funzionalità è possibile immettere in linea in modo controllato solo i Carrier necessari
- » In questo modo è possibile erogare servizi su SuperChannel (**Alieni-Infinera**) accesi in modo parziale
- » L'obiettivo è di evitare sovrapposizioni con i canali nativi (**Huawei**) in caso di contese sul piano di colore

Infinera: Gestione flessibile dei Carrier



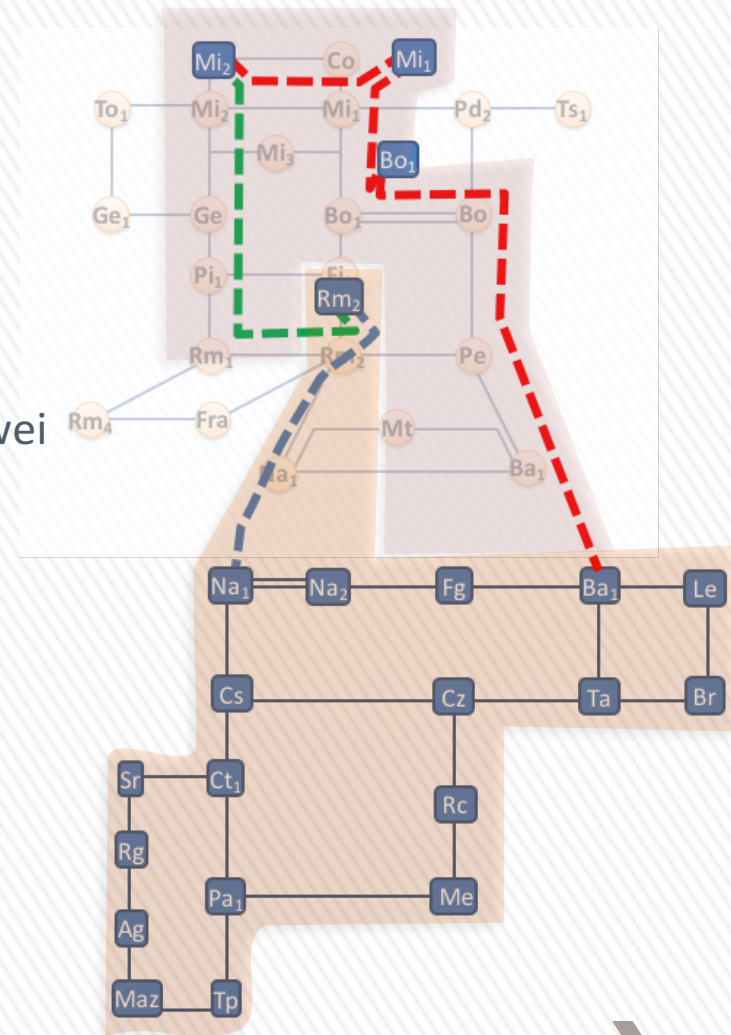
Ambiente di Test

Il Disegno Ottico 100G

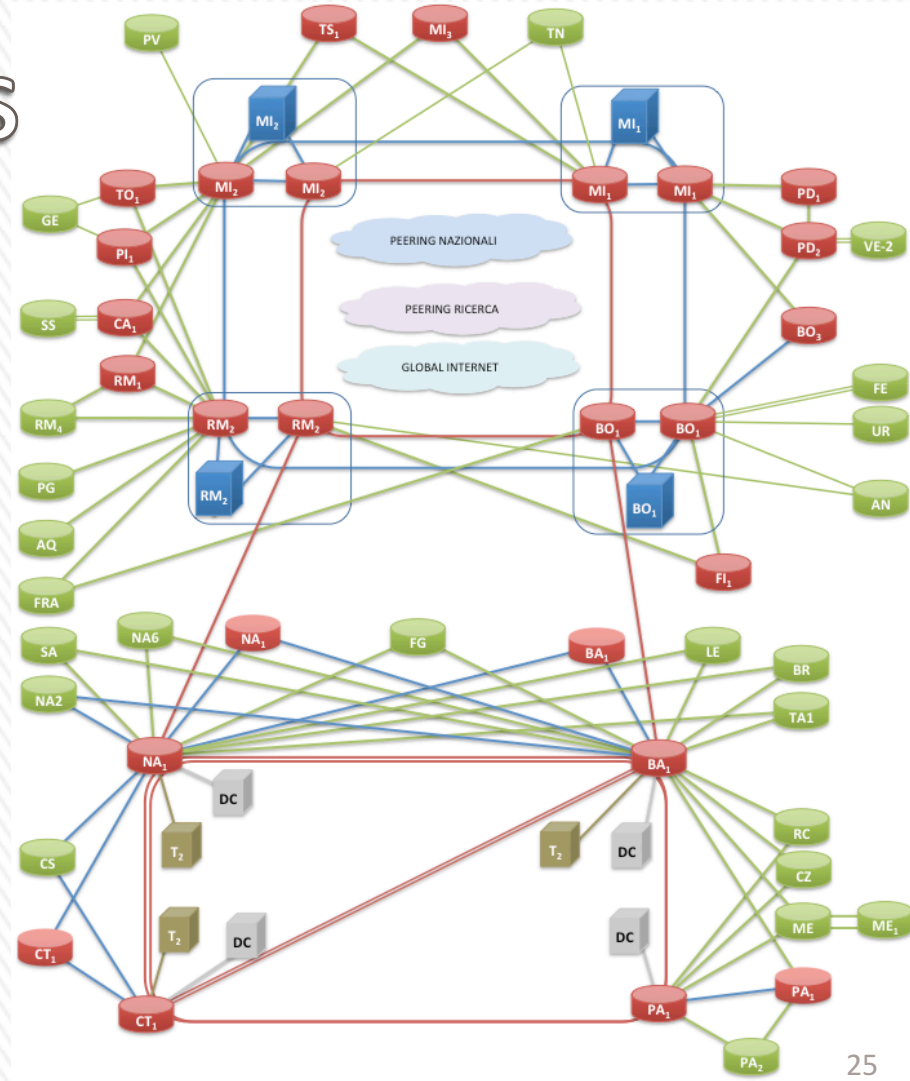
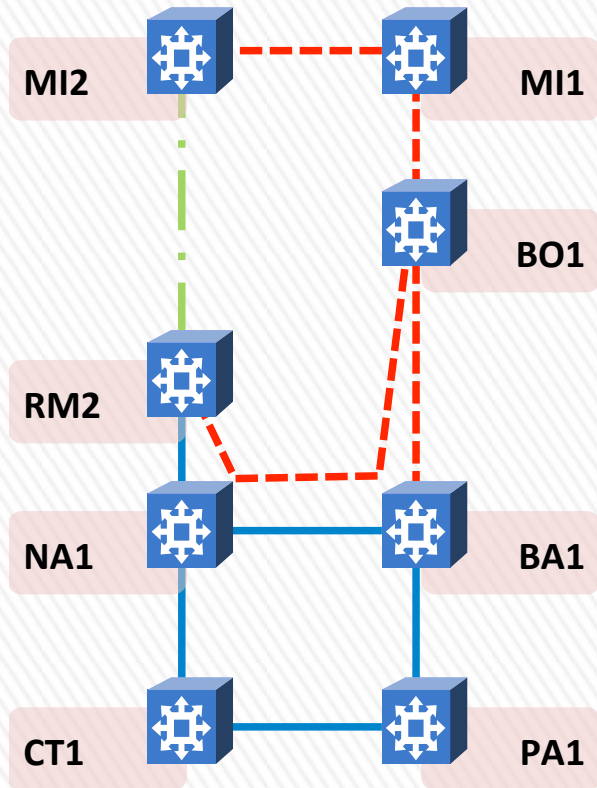


AlienWave
Infinera over Huawei

Infinera Only



Schema di Rete IP/MPLS



fine

Traffico di rete sedi INFN

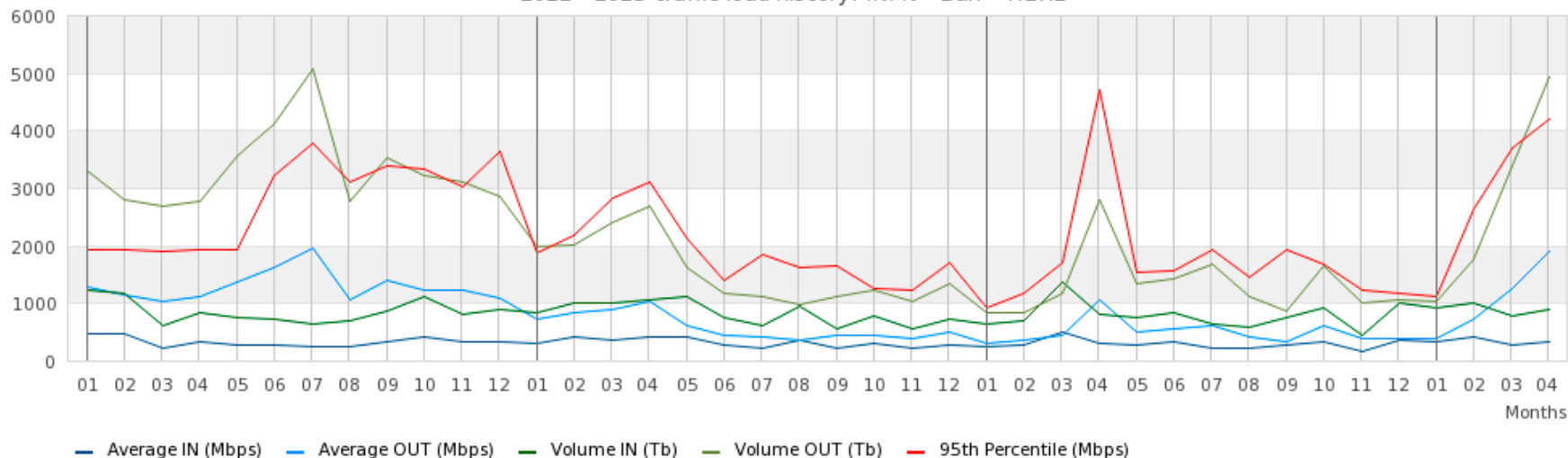
Slide extra

INFN - Bari - TIER2

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	346.38	388.56	2766.97	3565.51	927.96	1040.95	899.57	1124.83	1124.83
02	415.15	726.86	3165.82	9789.09	1004.58	1758.85	1091.14	2631.27	2631.27
03	290.91	1266.62	2314.32	7474.59	778.31	3388.71	804.64	3710.93	3710.93
04	342.88	1901.31	6350.74	8342.54	888.95	4929.34	852.55	4214.50	4214.50

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	348.83	1070.84	6350.74	9789.09	3599.8	11117.85	911.98	2920.38	2920.38

2012 - 2015 traffic load history: INFN - Bari - TIER2



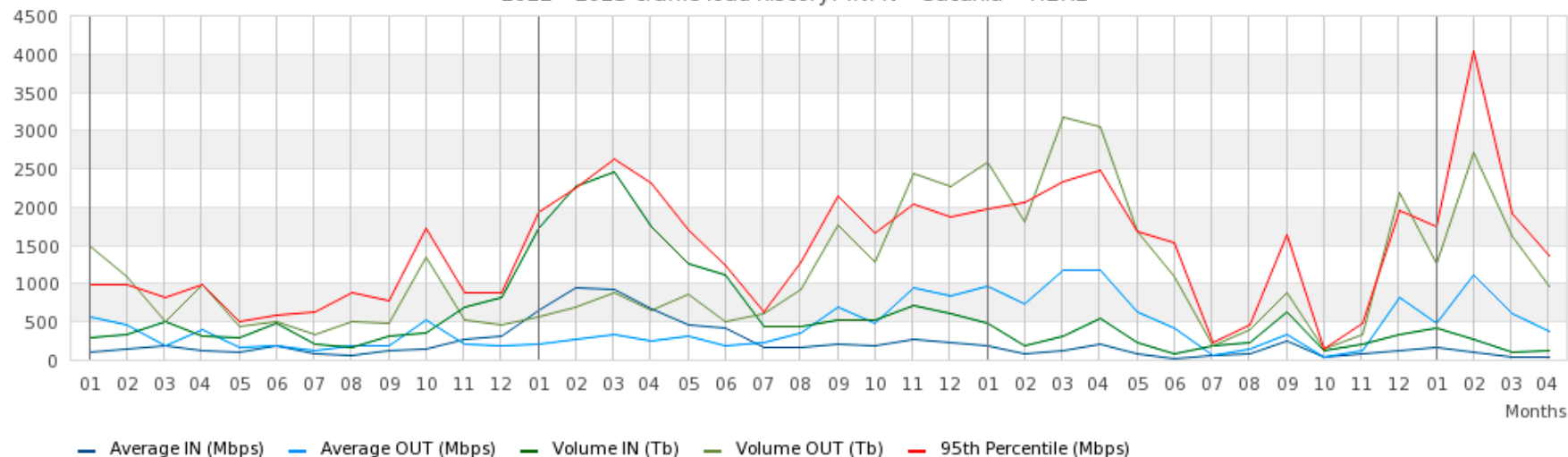
Bari – Tier2

INFN - Catania - TIER2

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	159.62	473.78	1328.54	5846.32	427.62	1269.26	574.72	1742.98	1742.98
02	115.34	1117.28	1241.55	7350.77	279.09	2703.59	377.88	4045.95	4045.95
03	39.53	607.49	1776.14	7208.38	105.75	1625.27	132.70	1905.97	1905.97
04	48.96	374.21	1864.31	6321.71	126.95	970.18	152.17	1368.08	1368.08

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	90.86	643.19	1864.31	7350.77	939.41	6568.3	309.37	2265.75	2265.75

2012 - 2015 traffic load history: INFN - Catania - TIER2



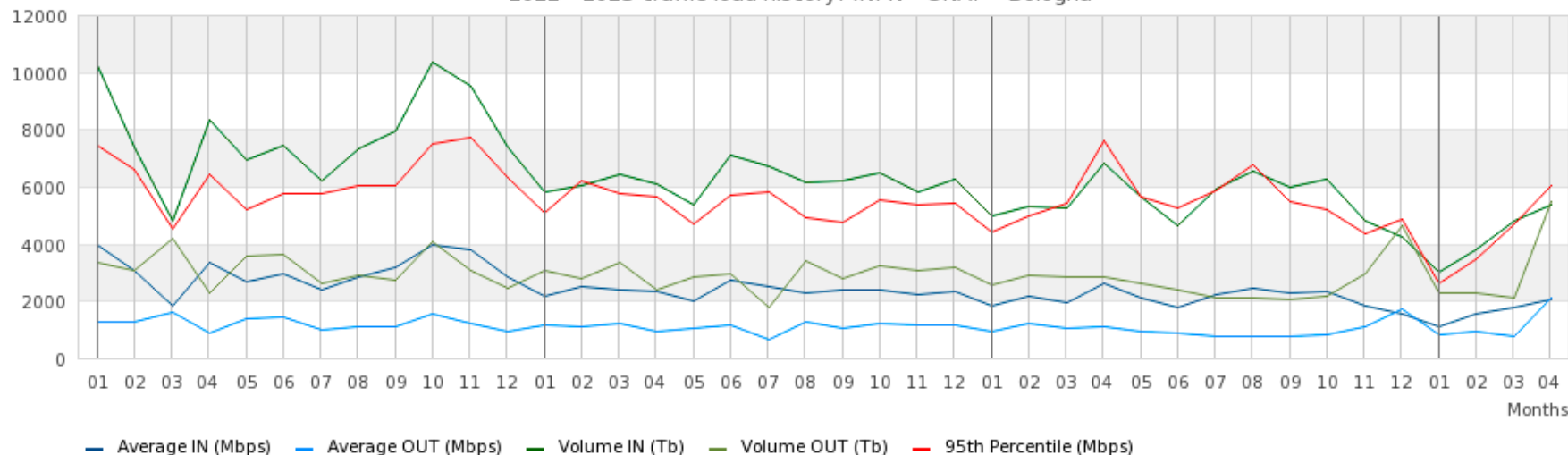
Catania

INFN - CNAF - Bologna

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	1126.09	852.13	9024.80	9028.97	3016.80	2282.87	2617.80	2351.11	2617.80
02	1578.43	956.17	9323.70	6425.19	3819.48	2313.75	3466.06	2264.59	3466.06
03	1806.66	792.19	9795.73	8206.88	4833.53	2119.43	4695.44	1869.77	4695.44
04	2085.12	2130.00	9849.35	9679.83	5405.88	5522.23	6035.19	6051.62	6051.62

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	1649.08	1182.62	9849.35	9679.83	17075.69	12238.28	4203.62	3134.27	4203.62

2012 - 2015 traffic load history: INFN - CNAF - Bologna

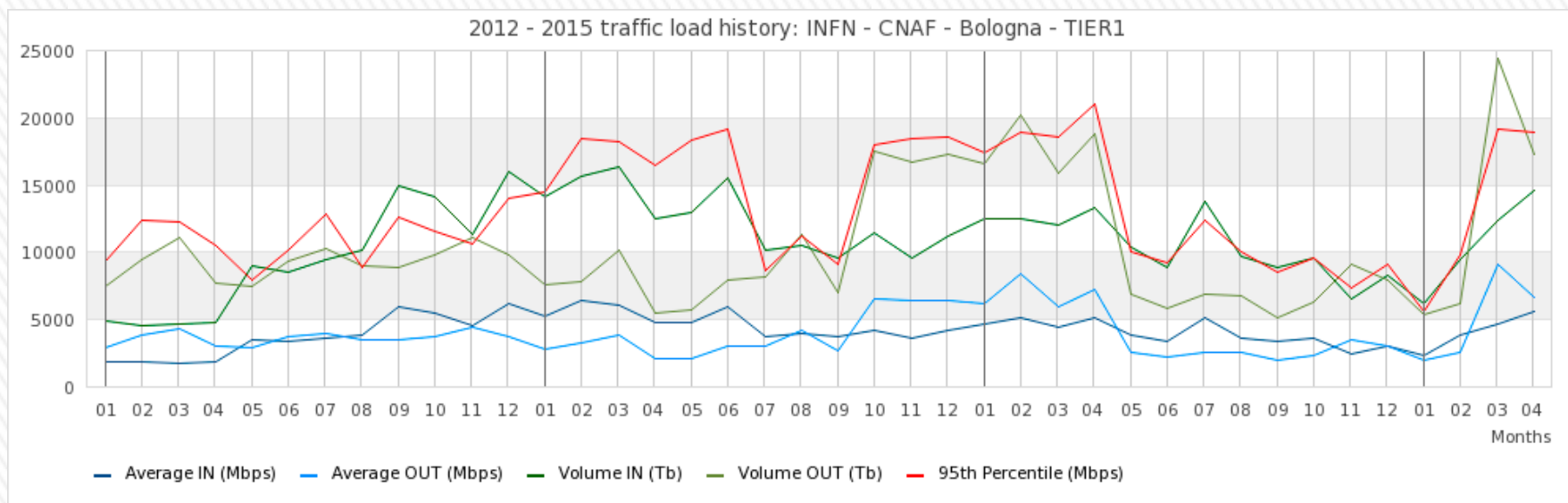


CNAF – IP only

INFN - CNAF - Bologna - TIER1

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	2330.42	1995.38	16709.20	145724.00	6243.21	5345.62	5567.59	4729.80	5567.59
02	3899.35	2569.01	21266.50	145554.00	9435.65	6216.49	9767.18	7014.76	9767.18
03	4617.38	9104.55	22963.50	148123.00	12353.30	24358.30	9969.28	19202.90	19202.90
04	5653.65	6681.39	26828.70	33212.10	14657.70	17322.20	11250.80	18912.30	18912.30

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	4125.20	5087.58	26828.70	148123.00	42689.86	53242.61	9138.71	12464.94	12464.94

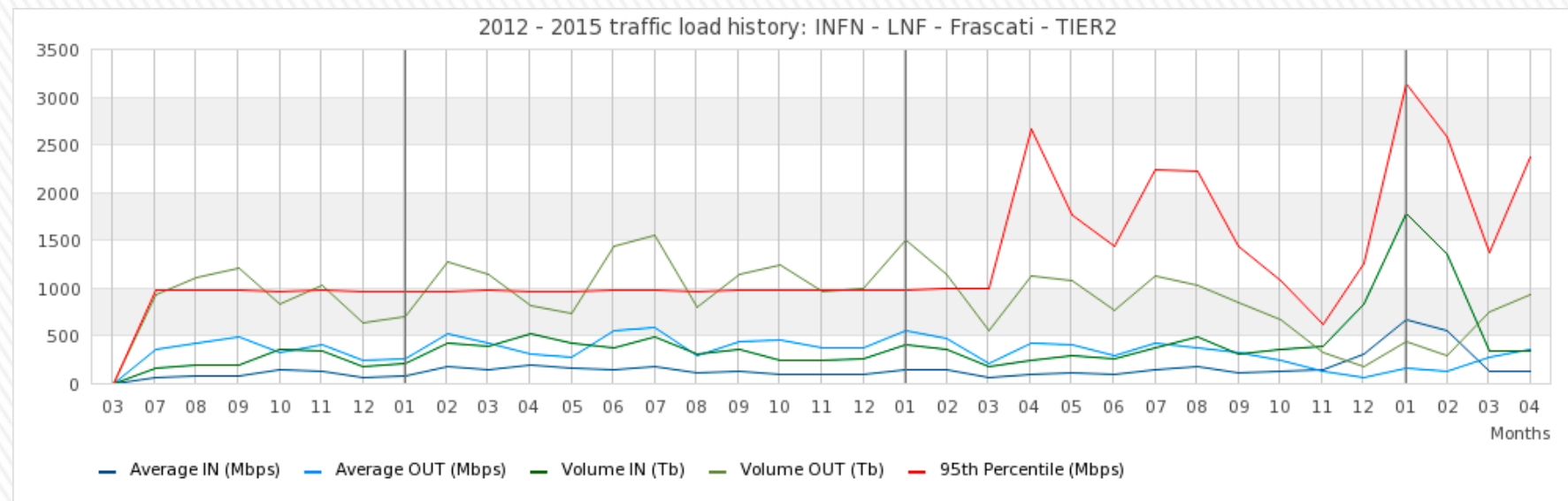


CNAF – Tier1

INFN - LNF - Frascati - TIER2

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	662.58	167.79	7899.92	5927.63	1775.06	449.51	3141.51	1006.80	3141.51
02	558.48	123.63	6729.35	4013.40	1351.42	299.16	2577.14	501.11	2577.14
03	125.81	278.91	3993.67	7372.08	336.58	746.21	384.19	1369.53	1369.53
04	133.36	361.72	8101.99	9653.55	345.74	937.79	432.13	2377.93	2377.93

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	370.06	233.01	8101.99	9653.55	3808.8	2432.67	1633.74	1313.84	1633.74



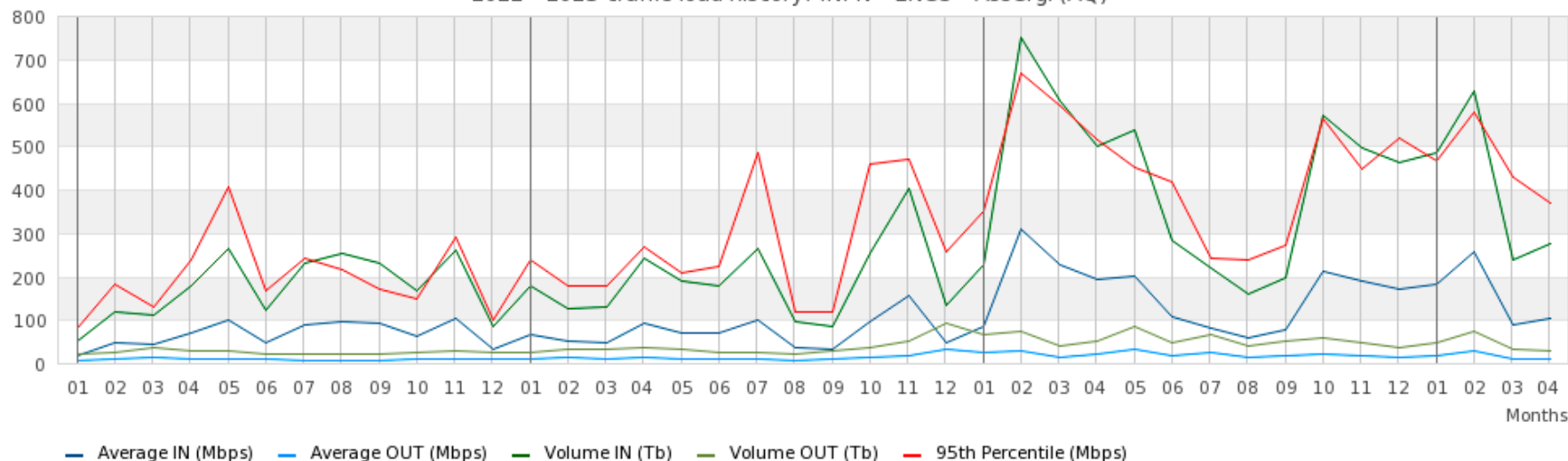
LNF – Tier2

INFN - LNGS - Assergi (AQ)

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	181.68	17.71	909.01	257.43	486.72	47.44	468.63	49.57	468.63
02	259.75	30.23	1042.30	266.41	628.53	73.15	577.72	136.00	577.72
03	89.12	12.20	955.89	214.01	238.44	32.64	429.78	42.17	429.78
04	106.35	12.07	728.93	144.15	275.72	31.28	370.86	41.72	370.86

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	159.23	18.05	1042.30	266.41	1629.41	184.51	461.75	67.37	461.75

2012 - 2015 traffic load history: INFN - LNGS - Assergi (AQ)

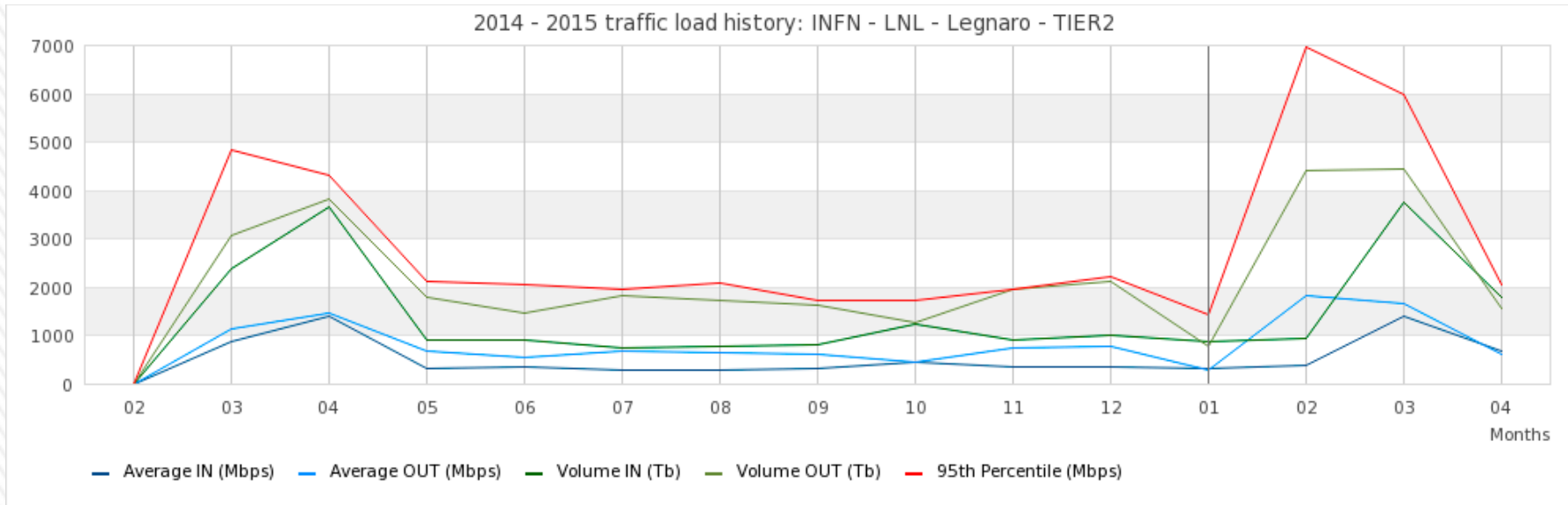


LNGS

INFN - LNL - Legnaro - TIER2

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	334.20	296.11	4470.93	9950.00	895.32	793.29	1441.25	925.07	1441.25
02	388.83	1824.18	6124.24	10947.40	940.89	4414.14	1035.75	6956.97	6956.97
03	1403.60	1659.81	7833.69	9062.21	3755.20	4440.66	3923.35	5976.75	5976.75
04	694.72	611.72	7094.64	7113.56	1801.12	1585.94	1959.32	2068.78	2068.78

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	705.34	1097.96	7833.69	10947.40	7392.53	11234.03	2089.92	3981.89	3981.89



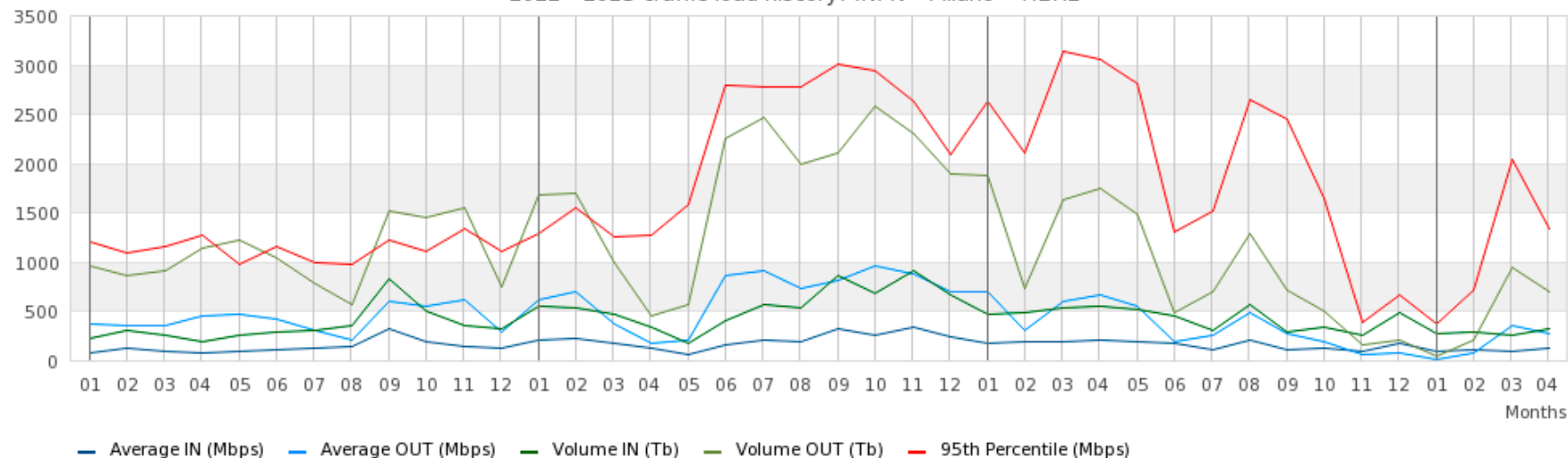
LNL - Tier2

INFN - Milano - TIER2

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	103.28	21.06	3407.58	1873.15	276.70	56.43	372.31	111.80	372.31
02	119.00	89.56	4742.00	2251.32	287.96	216.71	388.71	717.41	717.41
03	95.65	356.41	3484.28	9587.10	255.90	953.53	283.58	2038.11	2038.11
04	124.72	271.12	3643.44	3071.45	323.34	702.91	471.59	1333.79	1333.79

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	110.66	184.54	4742.00	9587.10	1143.9	1929.58	379.05	1050.28	1050.28

2012 - 2015 traffic load history: INFN - Milano - TIER2



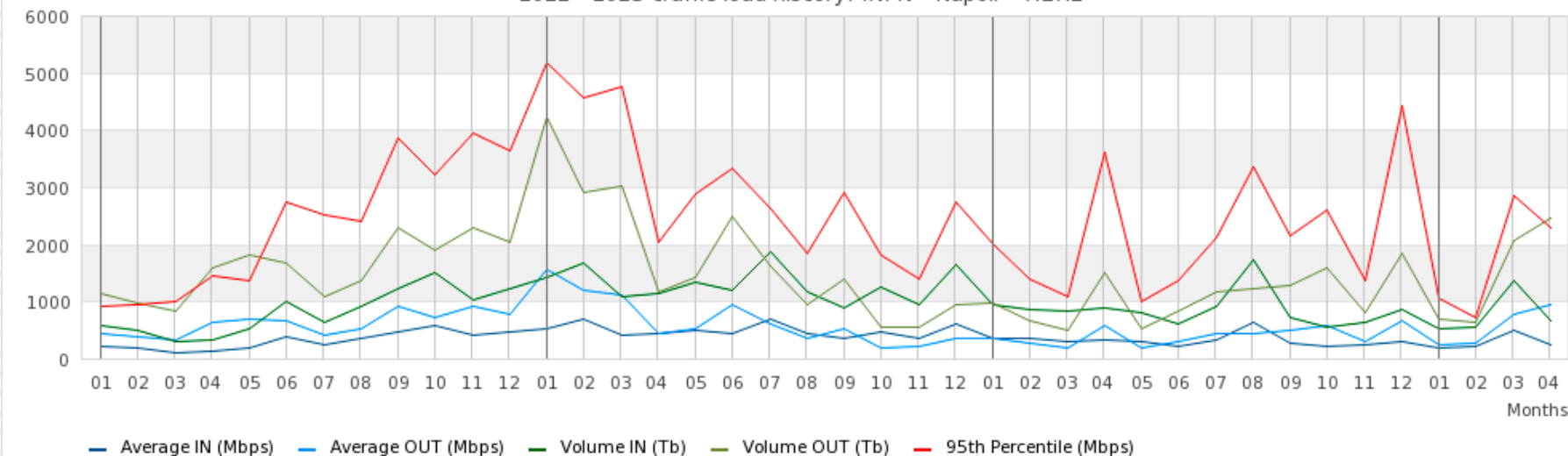
Milano – Tier2

INFN - Napoli - TIER2

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	197.22	258.75	8690.80	3460.51	528.34	693.19	436.49	1071.90	1071.90
02	237.18	270.51	6398.82	3730.67	573.93	654.57	581.32	738.28	738.28
03	518.52	773.82	6845.12	5493.59	1387.26	2070.27	1743.29	2859.91	2859.91
04	256.07	949.58	7816.95	8524.77	663.88	2461.87	873.41	2312.30	2312.30

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	302.25	563.17	8690.80	8524.77	3153.41	5879.9	908.63	1745.60	1745.60

2012 - 2015 traffic load history: INFN - Napoli - TIER2



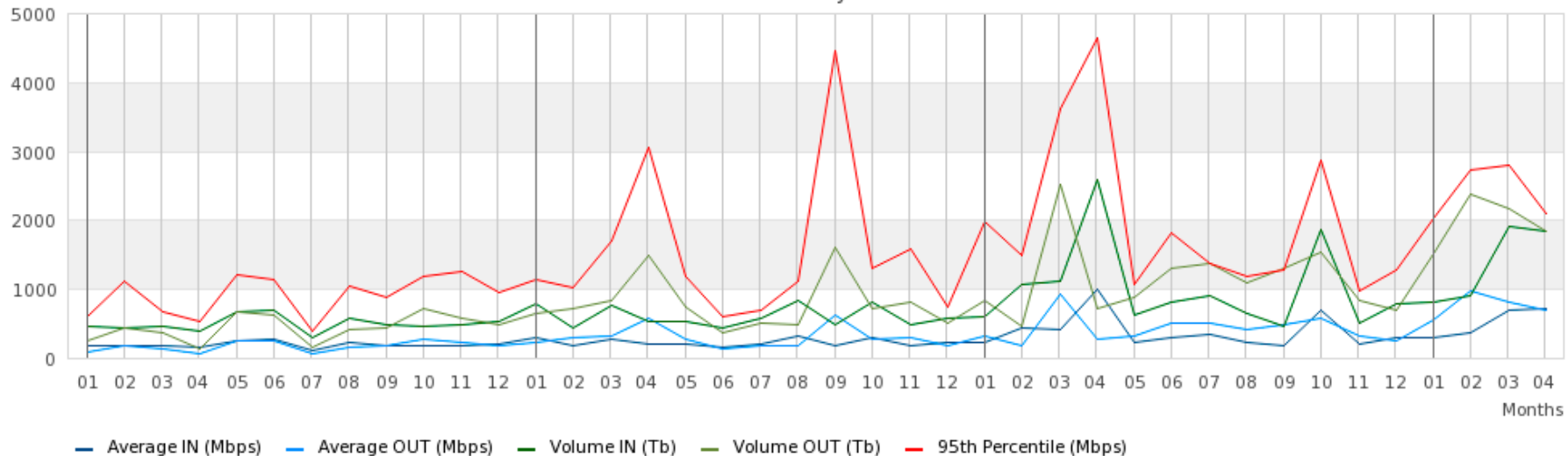
Napoli – Tier2

INFN - Pisa - TIER2

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	303.71	566.29	3960.87	5848.04	813.64	1517.10	992.05	2030.25	2030.25
02	379.11	986.03	4689.35	14305.50	917.37	2385.99	1205.30	2741.54	2741.54
03	712.21	814.51	8353.82	12093.80	1905.43	2179.14	2808.32	2249.02	2808.32
04	715.71	710.40	10358.80	11283.90	1855.55	1841.77	2093.62	1782.07	2093.62

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	527.69	769.31	10358.80	14305.50	5491.99	7924	1774.82	2200.72	2200.72

2012 - 2015 traffic load history: INFN - Pisa - TIER2



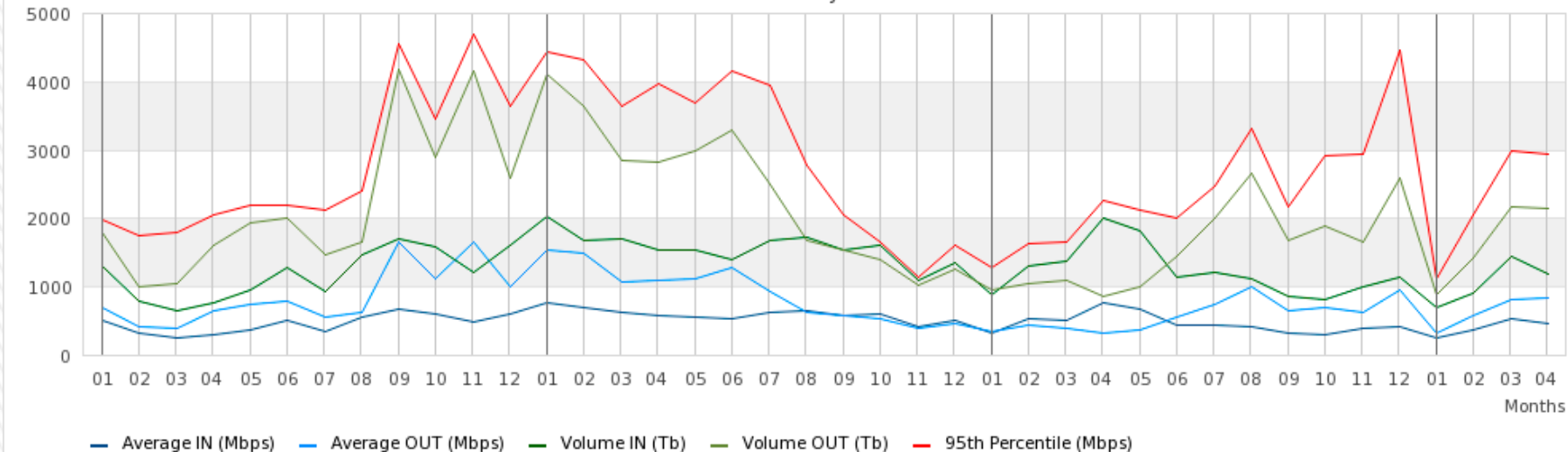
Pisa – Tier2

INFN - Roma1 - TIER2

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	261.42	330.55	4678.54	5426.95	700.35	885.55	752.67	1113.03	1113.03
02	376.69	588.89	3795.88	6479.90	911.51	1425.00	1208.24	2045.65	2045.65
03	537.63	813.06	4107.34	6744.41	1438.37	2175.26	1522.04	2990.24	2990.24
04	457.57	831.59	4607.95	7480.91	1186.30	2155.97	1197.06	2952.45	2952.45

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	408.33	641.02	4678.54	7480.91	4236.53	6641.78	1170.00	2275.34	2275.34

2012 - 2015 traffic load history: INFN - Roma1 - TIER2



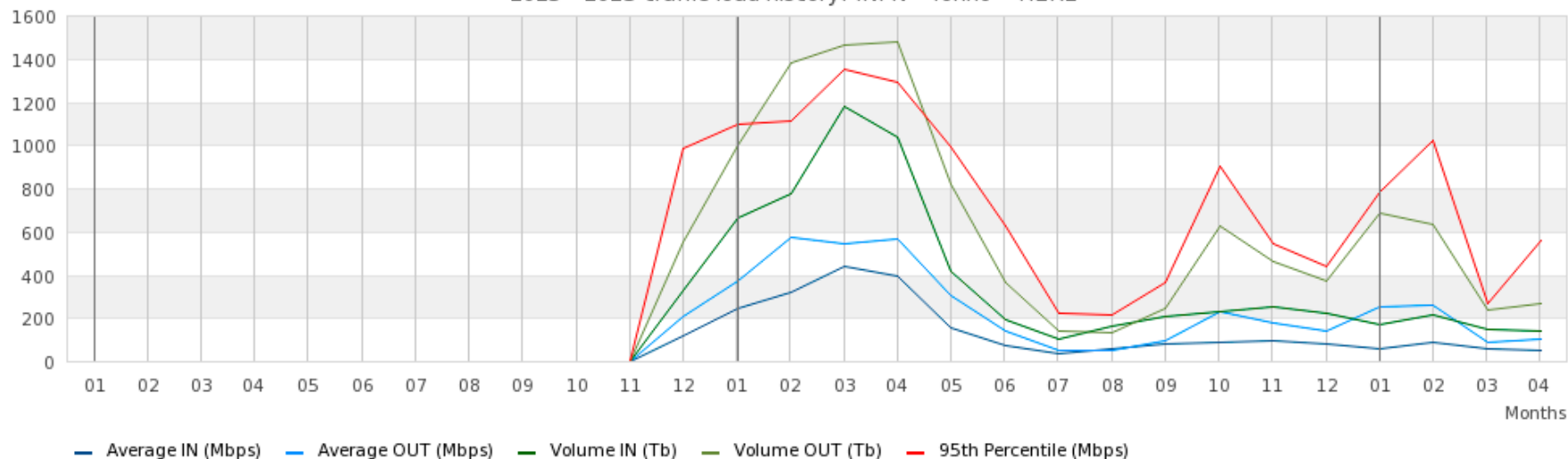
Roma1 – Tier2

INFN - Torino - TIER2

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	63.09	256.49	1775.55	1383.18	169.03	687.15	189.95	787.57	787.57
02	89.74	262.37	1974.84	2209.28	217.14	634.87	273.04	1025.65	1025.65
03	56.73	89.95	1744.60	2067.91	151.78	240.66	156.66	271.84	271.84
04	53.61	102.99	773.75	994.60	138.99	267.02	157.25	557.10	557.10

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	65.79	177.95	1974.84	2209.28	676.94	1829.7	194.23	660.54	660.54

2013 - 2015 traffic load history: INFN - Torino - TIER2



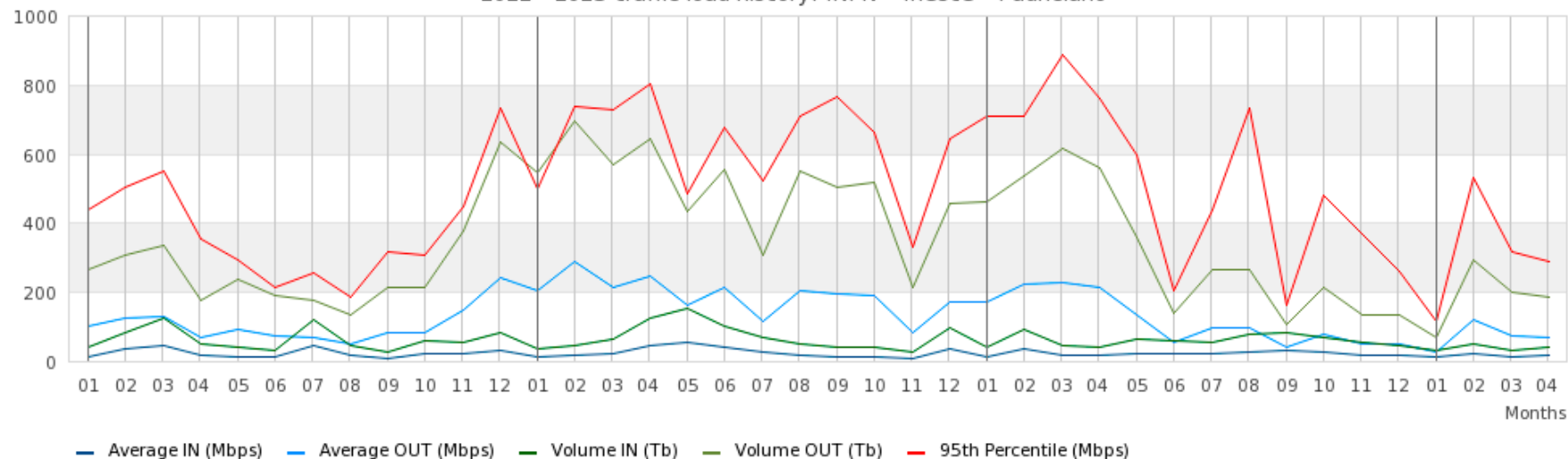
Torino – Tier2

INFN - Trieste - Padriciano

Month	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
01	11.96	26.68	826.99	945.48	32.04	71.48	32.87	114.49	114.49
02	21.87	121.03	645.06	958.72	52.93	292.86	47.29	530.44	530.44
03	12.37	75.34	484.75	947.16	33.10	201.55	41.00	317.80	317.80
04	16.79	71.64	971.09	963.87	43.54	185.73	56.44	288.83	288.83

	Average		Maximum		Total volume		Average percentile		
	Average In (Mbps)	Average Out (Mbps)	Max In (Mbps)	Max Out (Mbps)	Volume In (Tb)	Volume Out (Tb)	95th percentile In (Mbps)	95th percentile Out (Mbps)	95th percentile (Mbps)
Year	15.75	73.67	971.09	963.87	161.61	751.62	44.40	312.89	312.89

2012 - 2015 traffic load history: INFN - Trieste - Padriciano



Trieste