

# **1. TEIN, where are we?**

- a. OCTOBER 2016
- b. JULY 2022
- c. Changes

# **2. Data on the growth/change of Traffic volume & users**

- a. Traffic volume perspective
- b. Users/application perspective

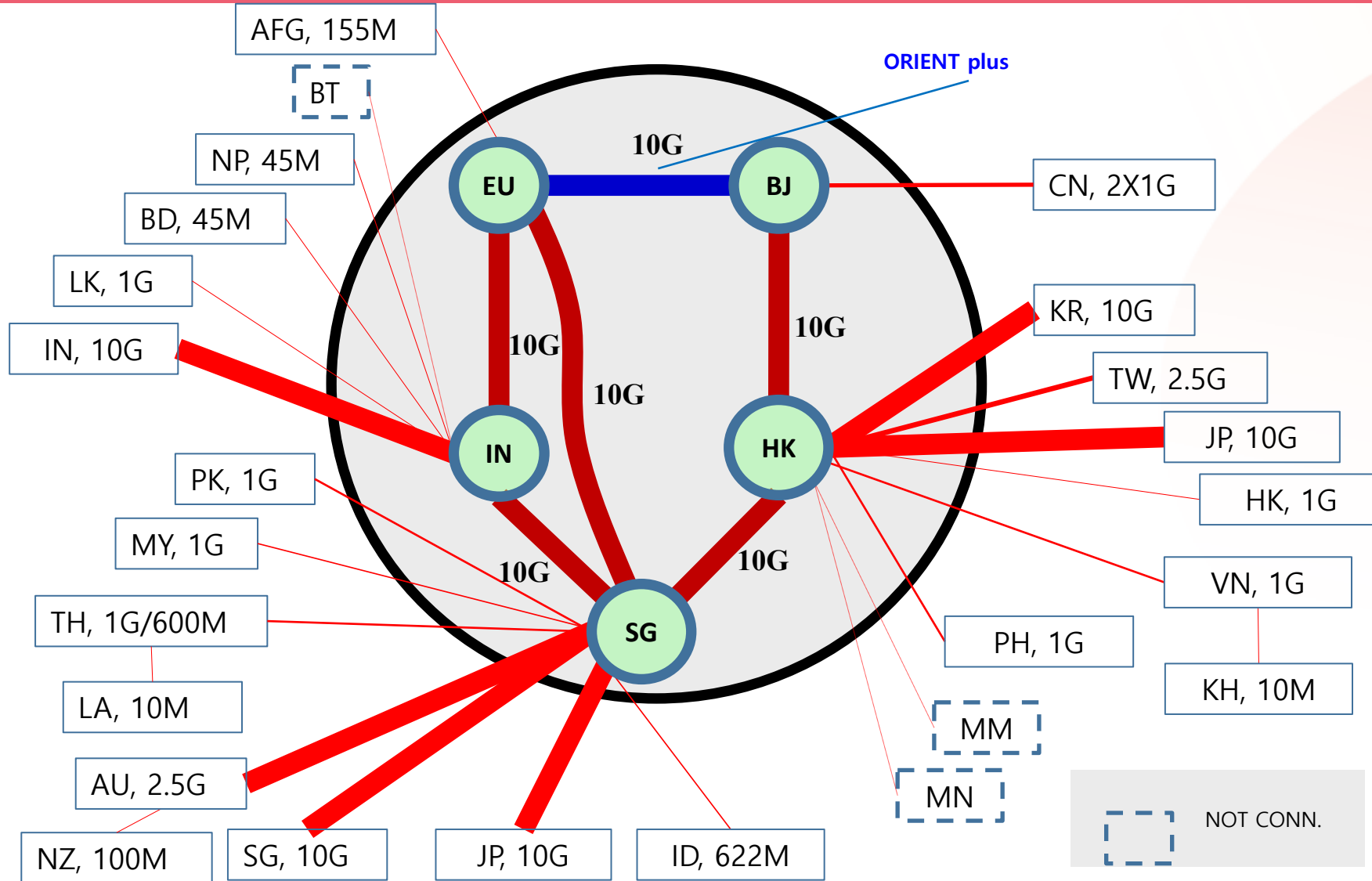
# **3. Securing sustainability of TEIN**

- a. IRU – definition
- b. SG-EU 100Gbps (CAE-1)
- c. Expansion of IRU approach

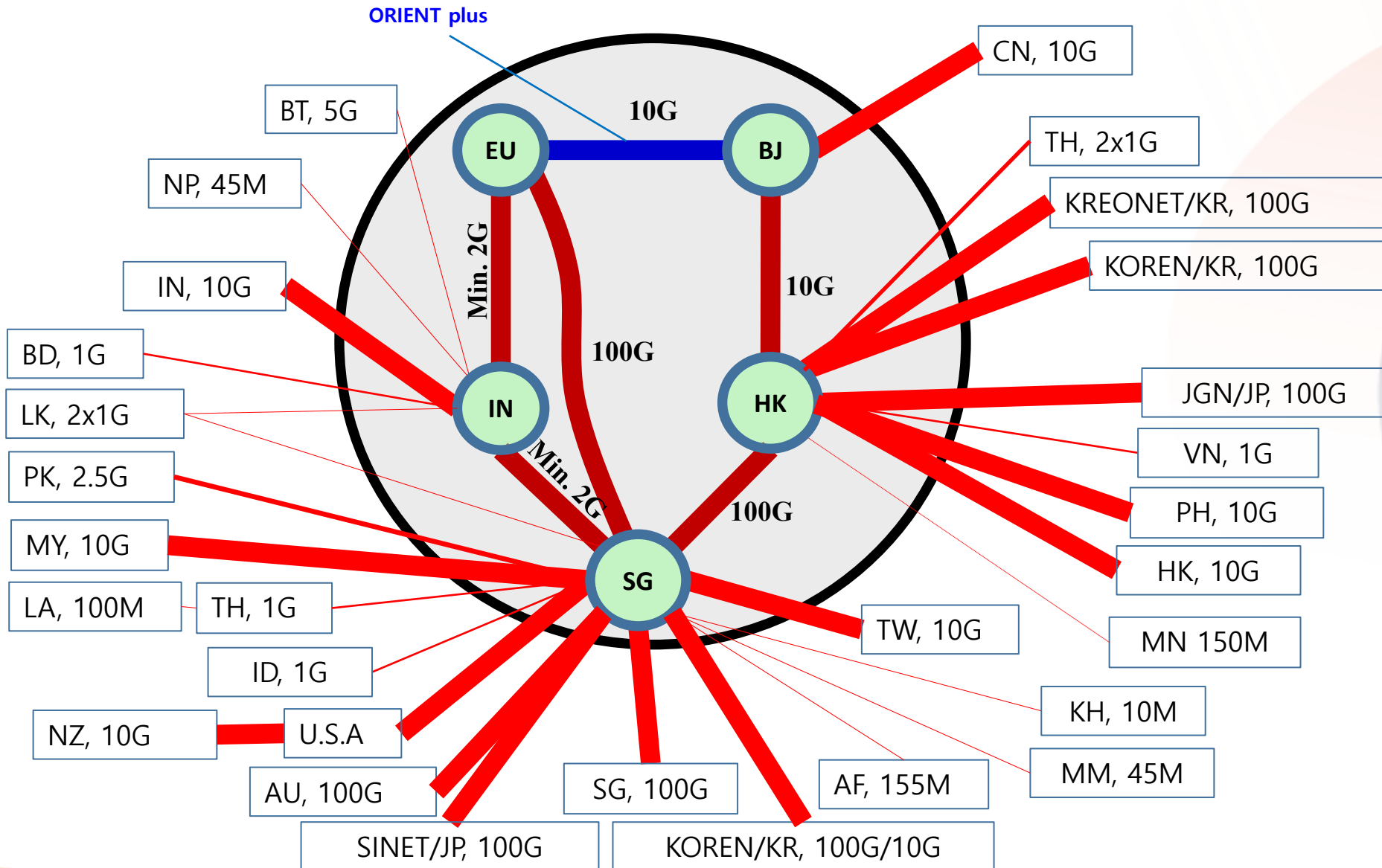
**Patch Lee**

**25 AUGUST 2022**

# 1.a TEIN Network Topology(OCT. 2016)



# 1.b TEIN Network Topology(JULY 2022)



# 1.c Changes (unit: Mbps)

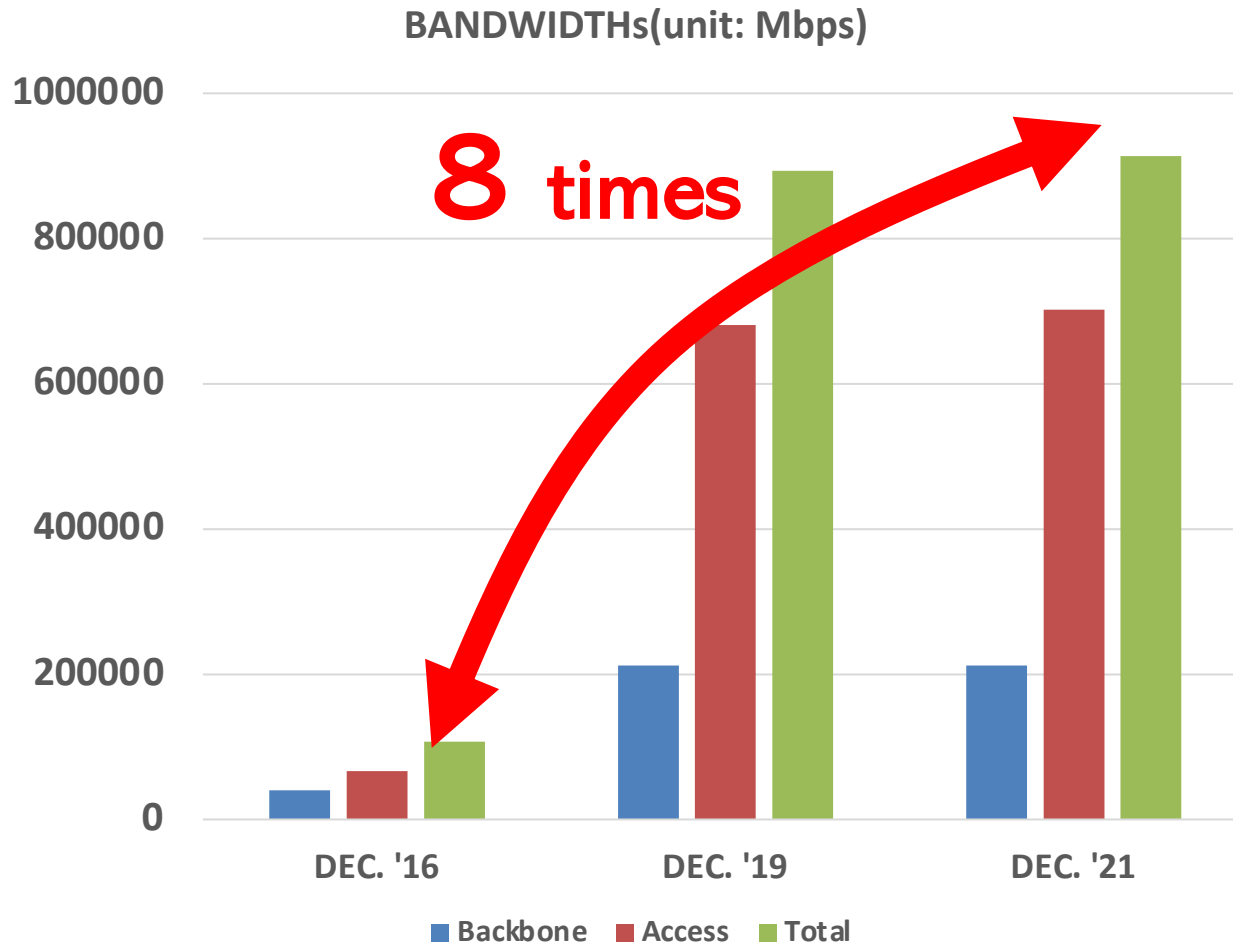
CN	2016	2022	CN	2016	2022
AF	155	155	AU	2,500	10,000
BD	45	1,000	CN	2,000	10,000
BT	0	5,000	HK	1,000	10,000
KH	10	10	IN	10,000	10,000
ID	622	1,000	JP	20,000	200,000
LA	10	100	KR	10,000	310,000
MY	1,000	10,000	SG	10,000	100,000
NP	45	45	NZ	100	N/A
PH	1,000	10,000	TW	2,500	10,000
LK	1,000	2,000			
MM	0	45			
MN	0	150			
PK	1,000	2,500			
TH	1,600	3,000			
VN	1,000	1,000			

## CONNECTIONS

- ✓ 21 -> **24**
- **BT, MM, MN**

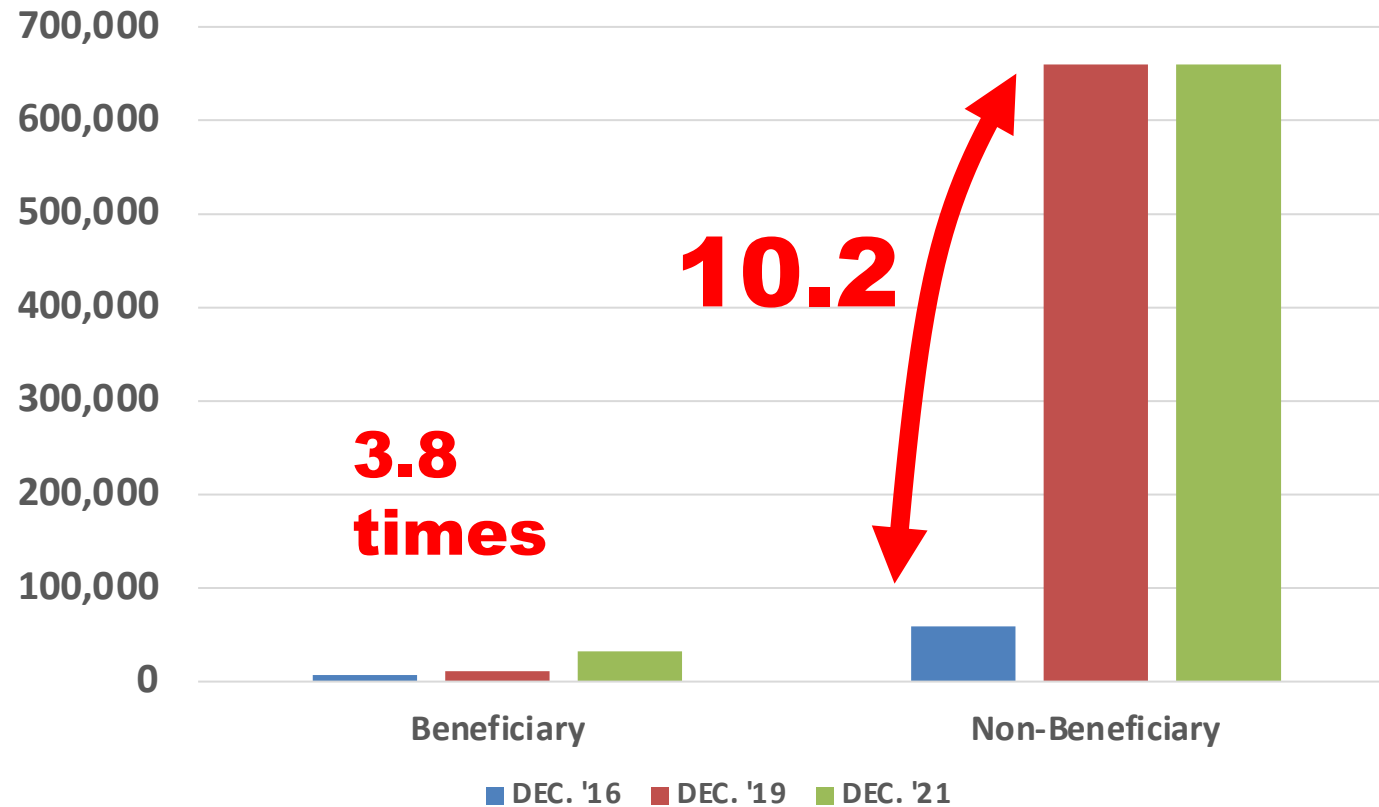
## BANDWIDTHS

- ✓ **Backbone**
- **SG-EU (10->100Gbps)**
  - **SG-HK (10->100Gbps)**
- ✓ **Access links**
- **10Gbps -> 100Gbps**



- ✓ **Backbone** - Launch of 100G link between Asia and Europe
- ✓ **Access** – 100Gs in the economically developed countries such as in JP, KR and AU (spectrum)

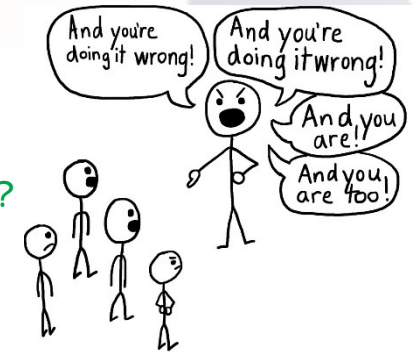
Beneficiary vs. Non-beneficiary (unit: Mbps)



## GAPs are widening

=> Market favors who has absolute size of money to spend

Are we, really???  
Oops !!!!



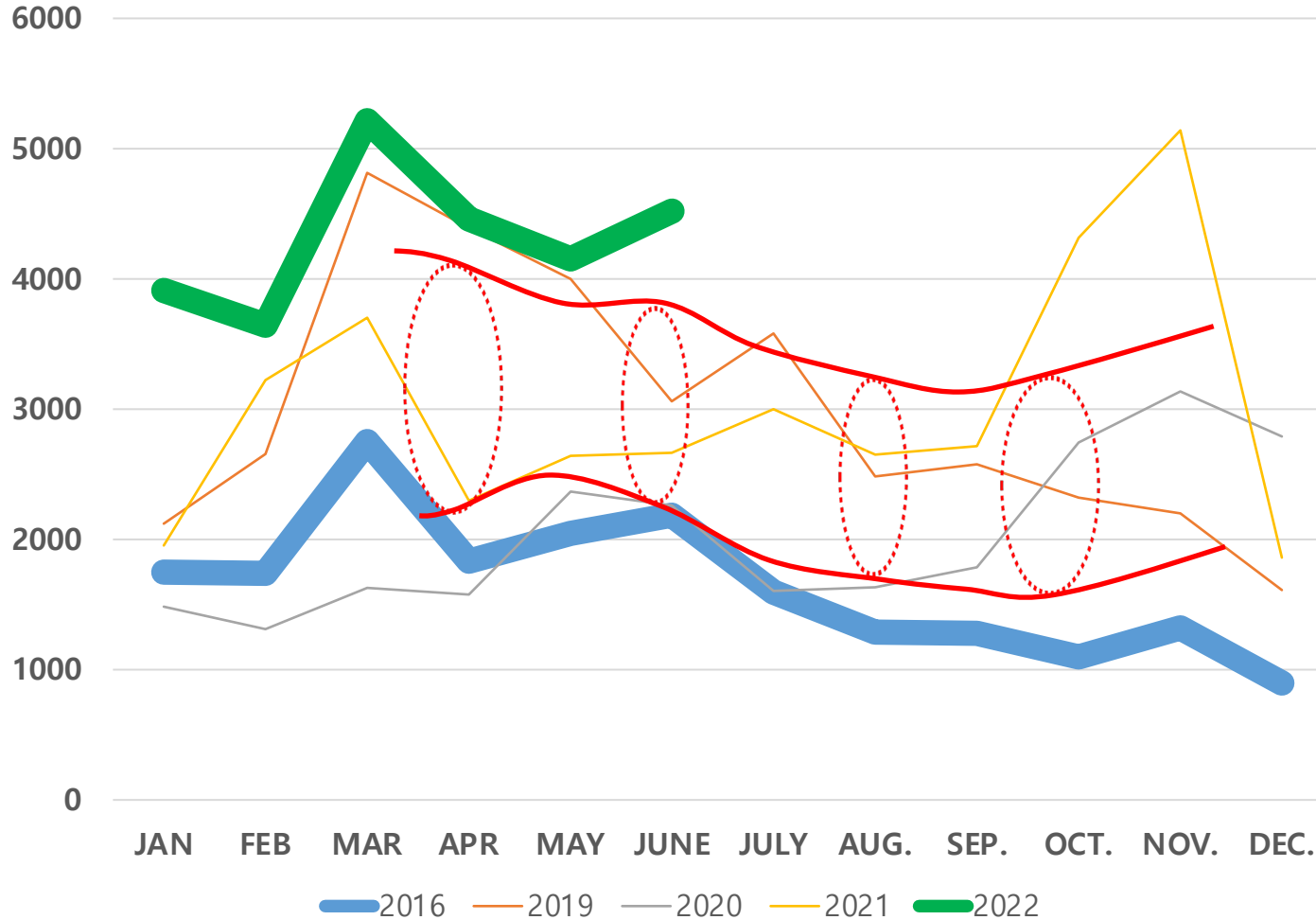


## **2. Data on the growth/change of Traffic volume and users**

- a. Traffic volume perspective
- b. Users/application perspective

# 2.a Traffic Volume 2021 - 2016

(unit: TB)



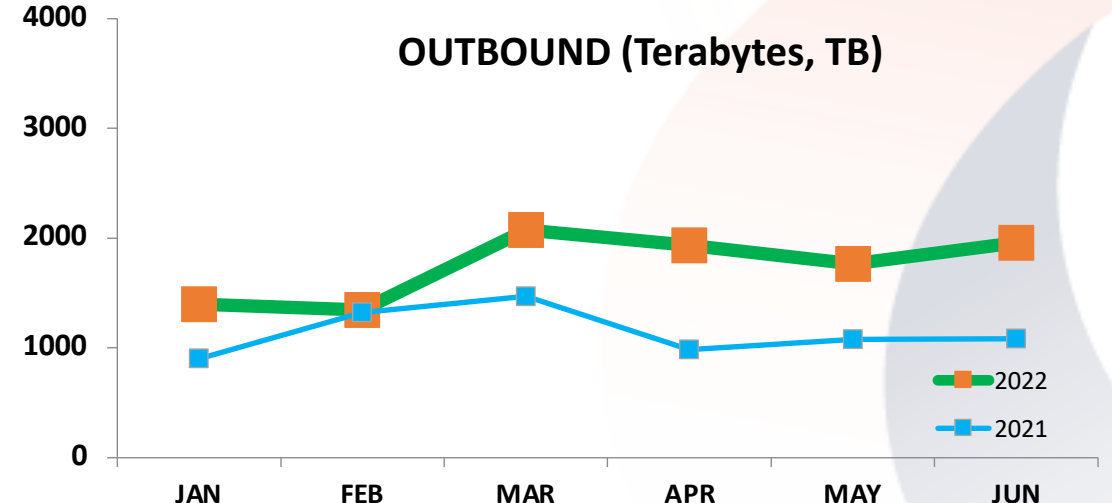
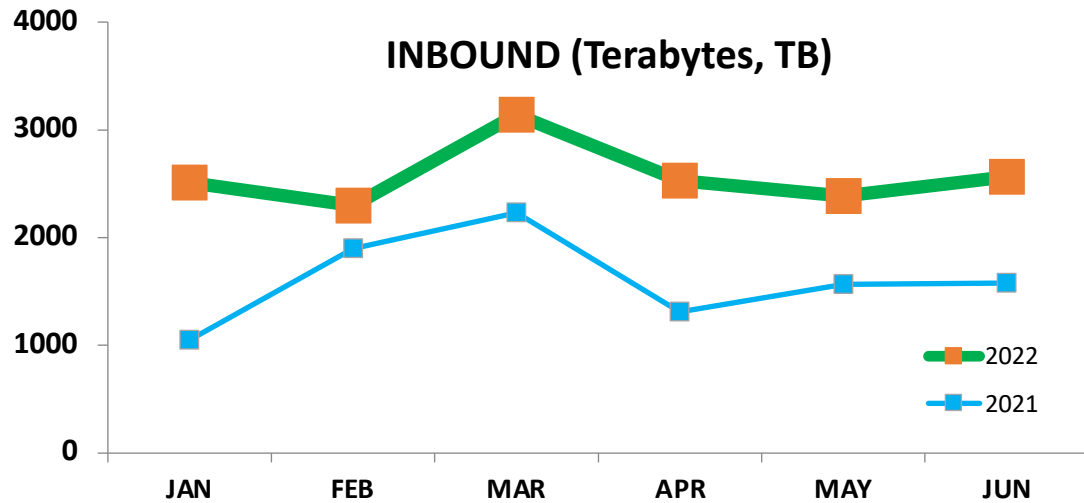
Fluctuations due to COVID pandemic

**36,167 TB (2021)**  
**19,789 TB (2016)**

**=> 83% increase**



## Traffic Volume change in TEIN backbone



**9,634 TB (2021) → 15,424 TB (2022)**

**6,845 TB (2021) → 10,479 TB (2022)**

- **57%** increase in total (**60%** for inbound, **53%** for outbound)

# 2.b Users/applications(SG-EU link)

2021	Rank	Sorted by Src-IP			Sorted by Dst-IP		
		AS	No. of Packets	Traffic Volume	AS	No. of Packets	Traffic Volume
	1	786(JANET/GB)	3.0G	4.0T	3661(CUHKNET/HK)	1.4G	1.2T
	2	680(DFN/DE)	509.2M	638.6G	4528(HKU/HK)	649.7M	855.1G
	3	513(CERN)	314.3M	367.8G	10052(KNU/KR)	466.7M	571.3G
	4	31705(EUMETSAT)	289.7M	356.2G	3363(HKUST/HK)	424.1M	563.4G
	5	2200(RENATER/FR)	225.5M	317.2G	1781(KAIST/KR)	417.1M	562.9G
	6	137(GARR/IT)	193.2M	222.9G	9270(NIA/KR)	365.5M	453.3G
	7	20965(GEANT/GB)	143.6M	201.0G	24490(TEIN)	277.0M	340.3G
	8	1103(SURFNET/NL)	207.2M	173.1G	4158(CITYU/HK)	250.3M	331.4G
	9	789(IN2P3/FR)	128.4M	136.3G	45773(PERN/PK)	302.8M	320.8G
	10	2843(LIUNET/SE)	72.3M	108.0G	24348(CERNET2/CN)	201.5M	236.4G

## Top 10 in both years

SOURCE	DESTINATION
JANET	KNU
DFN	HKUST
CERN	PERN
EUMETSAT	
GARR	
IN2P3	

2017	Rank	Sorted by Src-IP			Sorted by Dst-IP		
		AS	No. of Packets	Traffic Volume	AS	No. of Packets	Traffic Volume
	1	786(JANET/GB)	1.7G	2.3T	45773(PERN/PK)	2.4G	2.8T
	2	31705(EUMETSAT)	1.3G	1.7T	24490(TEIN)	1.4G	1.5T
	3	789(IN2P3/FR)	557.3M	791.8G	7472(NUS/SG)	666.8M	788.3G
	4	513(CERN)	486.4M	673.6G	3363(HKUST/HK)	361.6M	468.1G
	5	137(GARR/IT)	476.3M	600.9G	4796(ITB/ID)	274.7M	371.8G
	6	680(DFN/DE)	349.1M	401.8G	55545(SUT/TH)	261.5M	342.4G
	7	1213(HEANET/IE)	265.6M	391.3G	4528(HKU/HK)	277.3M	305.9G
	8	13041(CESCA-AC/ES)	218.0M	314.2G	23767(A-STAR/SG)	191.9M	250.4G
	9	58069(KIT-GRIDKA/DE)	240.4M	313.9G	23456	230.6M	241.7G
	10	559(SWTICH/CH)	215.0M	265.1G	9419(NTU/SG)	214.5M	231.7G

- ✓ Leap of KR/HK/CN users
- ✓ Presume High Energy, weather data are dominant force



### **3. Securing sustainability of TEIN**

- a. IRU – definition**
- b. SG-EU 100Gbps (CAE-1)**
- c. Expansion of IRU approach**

IRU is long-term contract of 15 to 10 years

1. Expansion of IRU into Backbone & Access links

2. IRU

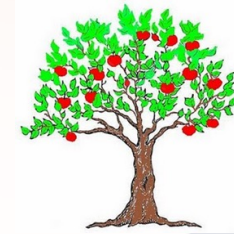
3. IRU

4. IRU

5. IRU

5 years or less for cost recovery

- Materialized its economic benefit through first 100Gbps between Asia to Europe in 2019



## 1. Collaboration and its parties

- Co-funding of a 100Gbps Singapore to London, facilitation of Open Exchange
- Six (6) parties – AARNet, SingAREN, TEIN\*CC (Asi@Connect), NORDUnet, SurfNET, GEANT (Europe)
- Each participant financially takes up 1/6<sup>th</sup> of the TCO
- GEANT led the procurement in line with the European Commission's guidelines and AARNet did contract signing with the awardee

## 2. Expected Effect/Outcome (In particular, in terms of Asi@Connect)

- Achieve cost effectiveness. Three (3) years to reach to recover cost
- Meet bandwidths demands
- Secure long-term sustainability of the use of R&E network between Asia and Europe – symbolic link for Asi@Connect project

## 3. Important dates

- Launch of 100Gbps: May 2019, expiry date: ~ May 2034

## Interested Links : TEIN backbone, Access links of Developing NRENs

<Budgetary quotes, Feb. 2019 >

Points	Bandwidths	Terms	TCO(USD)	REMARKs
HK - SG	100Gbps	15 yrs	1M	
MY - SG	10Gbps	10 yrs	720K	
TH - SG	10Gbps	10 yrs	910K	
ID - SG	10Gbps	10 yrs	?	

# Q&A

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