The Possible
Hong Kong
Open Exchange Point

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Developing a Blueprint for Global R&E Network Architecture

http://gna-re.net

- The Global Network Architecture program (GNA) is an international collaboration between national research and education (R&E) networks.

- The GNA technical working group is charged with drafting a blueprint for interconnecting R&E networks on a global scale, based on the latest technologies and promising developments, with a ten-year horizon.

- This blueprint will enable R&E networks to align their spending for intercontinental bandwidth.

- Participation is open to all regions of the world.

Plan for GNA –
High-level Architecture #1

http://gna-re.net/our-plan/

- The discussions inside the GNA group have led to a global network architecture model that consists of a powerful intercontinental transmission substrate, consisting of:
  - Global Open Exchange Points (GXPs)
  - High-bandwidth transmission pipes (running between GXPs) **– for sharing**

GNA – artist's impression
Credit – Mian Usman (DANTE)
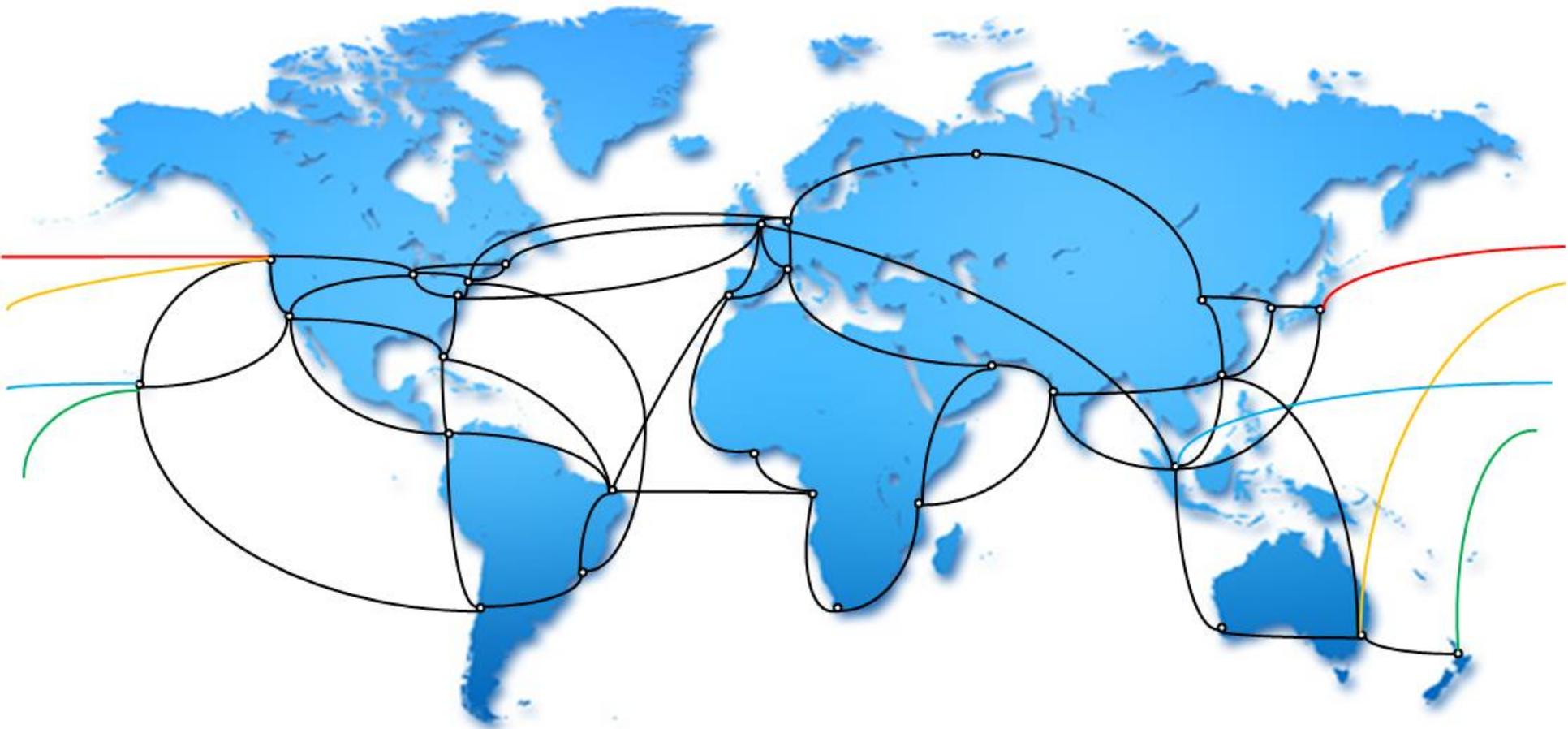
Plan for GNA – High-level Architecture #2

- The GXPs in this architecture model have two major functions:

  - Attachment points for the high-bandwidth circuits of the substrate **– for sharing**

  - Connection points for the Regional and National R&E Networks that are part of and make use of the GNA infrastructure

Plan for GNA –
High-level Architecture #3

- We envision at least two GXPs per continent or region that are placed in consultation with the region's R&E Network organizations, taking the intercontinental fiber paths into account.

- The GNA substrate supports the creation, modification, and deletion of overlay networks. In the first instance, this is expected to be manual. Over time, it is expected that this can be fully automated.

Plan for GNA – High-level Architecture #4

- Examples of permanent overlay networks include:

  - General purpose IP routed interconnect, supporting IPv4 and IPv6, both for unicast and multicast

  - Commercial Peering Services

  - LHCOPN and other Optical Private Networks

  - LHCONE and other Open Network Environments

Plan for GNA –
High-level Architecture #5

- Examples of ad hoc overlay networks include:
  - Science instrument support networks like for e-VLBI that are only needed during a science run
  - Virtual Organization networks for large multi-continent science collaborations like LHC, ITER, Climate, or agencies like NIH.

GXP Expectations #1

http://gna-re.net/wp-content/uploads/2016/02/GNA-Open-Exchange-Expectations-v1.0-Technical.pdf

- Services and Capabilities:
  - a fabric able to accommodate a consistent set of port types and technologies
  - Colocation
  - Cross-connects to other R&E, commercial & carrier facilities
  - Out of Band access
  - Termination and cross-connection point for international circuits as well as domestic/local connections
  - Remote hand and on-call support (24x7)
  - Security and access
  - Carrier neutral
  - Space, power, cooling, access to a meet me room, physical access

GXP Expectations #2

- Principles of Operation
  - Open Acceptable Use Approach: Ability to interconnect with any R&E Entity
  - Open Acceptable Use Approach: Support for "Commercial" Traffic
  - Production Quality Operations Regime & Community Engagement
  - **Measurement**
  - Privacy of Data Policy Statement
  - **Flexibility and agility in accommodating evolving technologies**
  - **Performance Assurance Node and Ad Hoc Testing**
  - **QoS / Queuing Support**
  - Open Access to peering
  - Timeliness of Service Support and Service Delivery

GXP Expectations #3

- Technology and Functionality
  - To support the network services required by the GNA more than just layer 2 best-effort
  - Layer 2 circuits
    - **Support VLAN translation**
    - **Support Guaranteed Bandwidth allocation**
    - **Policer and Shapers on per VLAN and set of VLANs basis**
    - **Traffic Burst allowed**
    - **QinQ capabilities**
  - Support path protection and restoration
  - **Dynamic Circuit Provisioning**
    - **Support dynamic circuit provisioning using a standardized provisioning protocol, e.g. NSI**
  - **Policy Implementation**
    - **GNA will consist of links provided by different participants. It is expected that exchange points will be able to implement and enforce different policies on each link as requested by the link owner.**
    - **The exchange points should be able to act as both Policy Decision Point (PDP) and Policy Enforcement Point (PEP) to enforce admission and user control as dictated by connected organization policy.**

Internet Exchange Point (IXP)

- Differences from OXP
  - Internet focused
  - Inter-AS interconnections with BGP4
  - Big IX VLAN (Broadcast Domain) for public peering with strict control
    - Port Security – Single MAC/IPv4/IPv6 per "port"
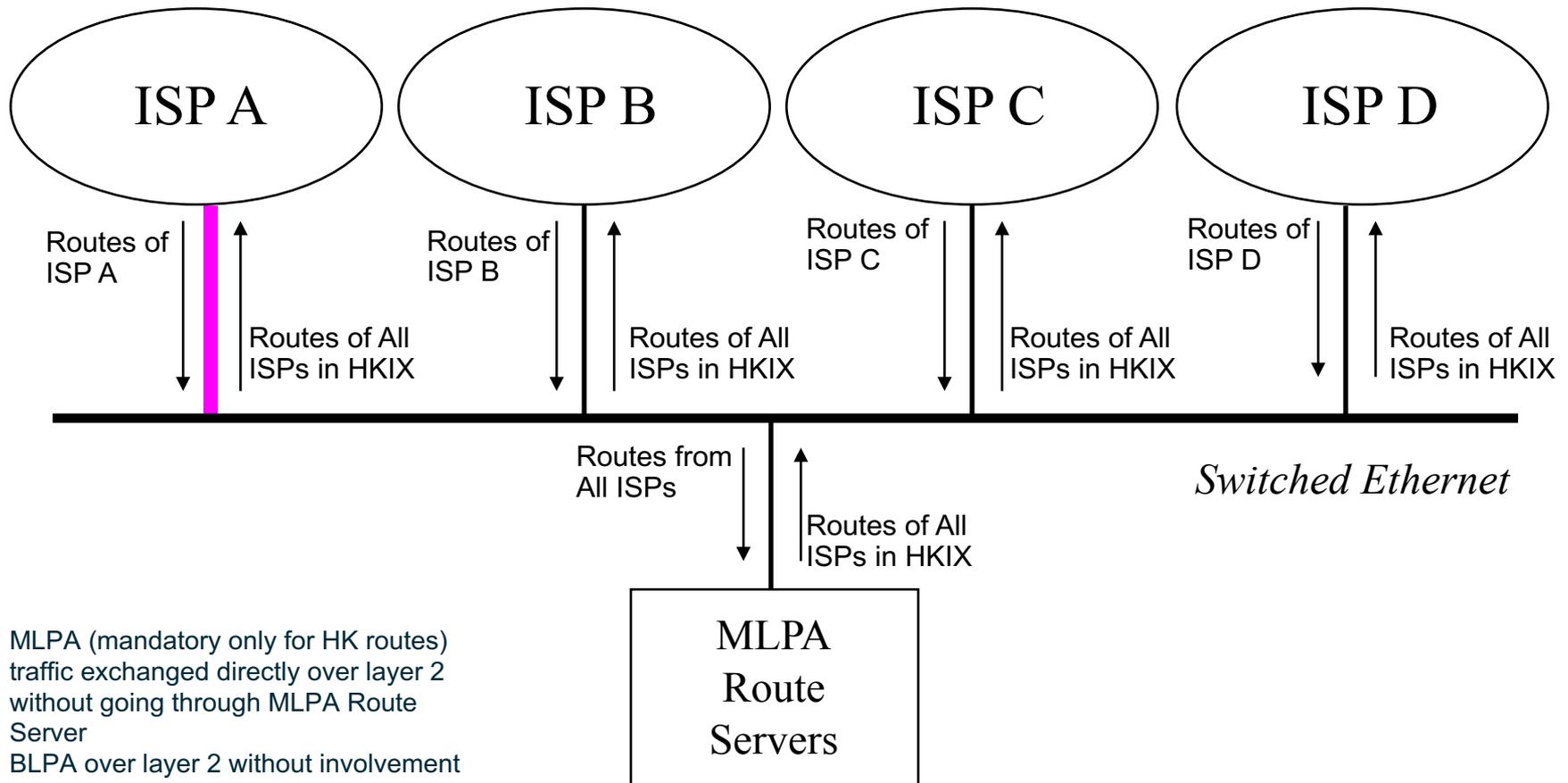 - BLPA & MLPA via Route Servers
  - Mostly layer-2 best effort

What is HKIX?

- Hong Kong Internet eXchange (HKIX) is the main layer-2 Internet Exchange Point (IXP) in HK where various autonomous systems can interconnect with one another and exchange traffic

- HKIX was a project initiated by ITSC (Information Technology Services Centre) of CUHK (The Chinese University of Hong Kong) and supported by CUHK in Apr 1995 as a community service

- **HKIX serves both commercial networks and R&E networks**

- The original goal is to keep intra-HongKong traffic within Hong Kong

21ˢᵗ Anniversary of HKIX

- HKIX started with thin coaxial cables **in Apr 1995**
- Participants had to put co-located routers at HKIX sites in order to connect
- It was a free service

- HKIX started very early, well before incumbent telcos started to do ISP business, so that is why HKIX can be successful

HKIX Model —
MLPA over Layer 2 + BLPA

ISP A   ISP B   ISP C   ISP D

Routes of
ISP A

Routes of
ISP B

Routes of
ISP C

Routes of
ISP D

Routes of All
ISPs in HKIX

Routes of All
ISPs in HKIX

Routes of All
ISPs in HKIX

Routes of All
ISPs in HKIX

Switched Ethernet

Routes from
All ISPs

Routes of All
ISPs in HKIX

MLPA
Route
Servers

- MLPA (mandatory only for HK routes) traffic exchanged directly over layer 2 without going through MLPA Route Server
- BLPA over layer 2 without involvement of MLPA Route Server
- Supports both IPv4 and IPv6 over the same layer 2 infrastructure

HKIX Today

- the Hong Kong Internet eXchange Ltd
  - 100% owned by CUHK
  - Chargeable services but not really for profit
- Supports both MLPA (Multilateral Peering) and BLPA (Bilateral Peering) over layer 2
- Supports IPv4/IPv6 dual-stack
- More and more non-HK participants
- 241 autonomous systems connected
- 463 connections in total
  - **257 x 10GE** & 206 x GE
  - A few 100GE connections are coming
- 630+Gbps (5-min) total traffic at peak
- Annual Traffic Growth = 30+%

Yearly Traffic Statistics
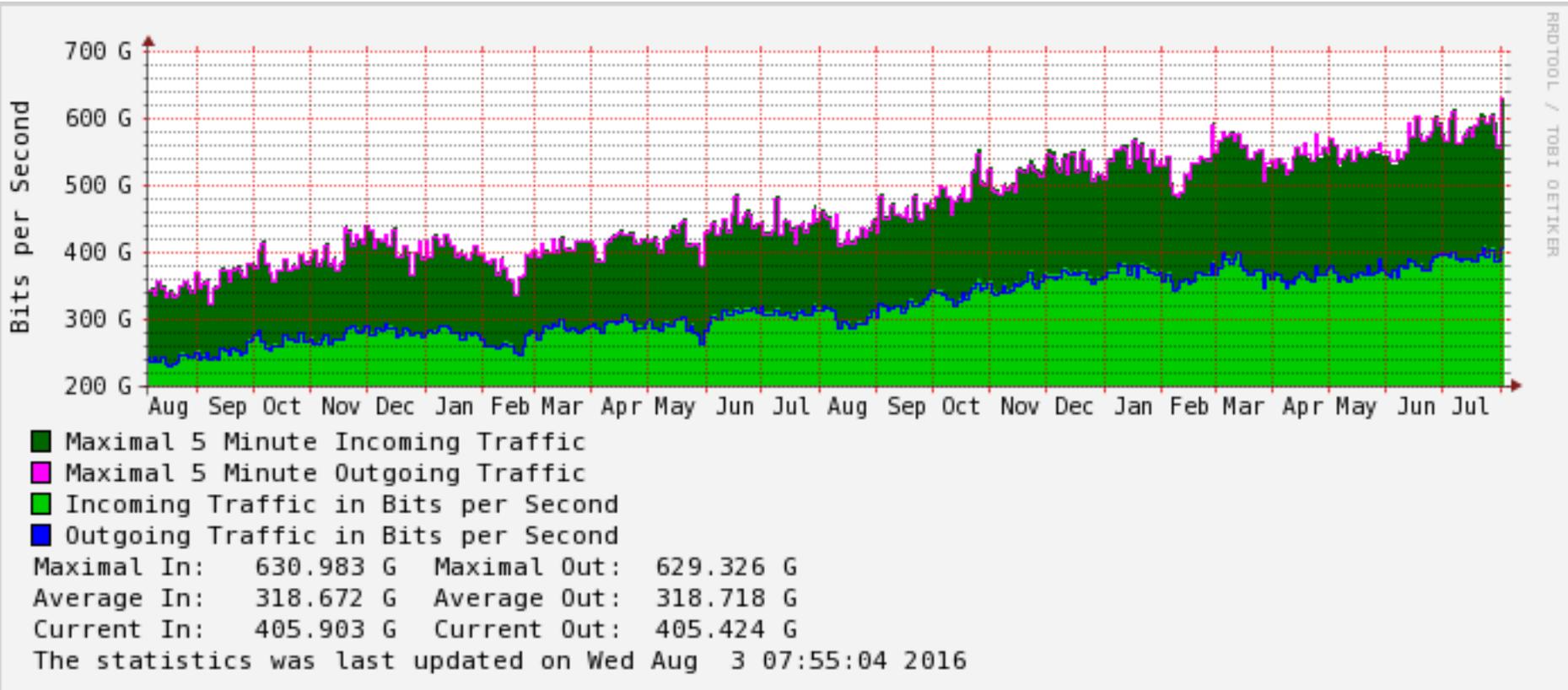
Setting up
Multiple HKIX Satellite Sites

- Allow participants to **connect to HKIX more easily** **at lower cost** from those satellite sites in Hong Kong

- Open to commercial data centres in HK which fulfil minimum requirements so as to maintain neutrality which is the key success factor of HKIX

- Intend to create win-win situation with satellite site collaborators

- To be named HKIX2/3/4/5/6/etc
  - HKIX2 already confirmed - being migrated from old architecture to new architecture

- *HKIX1 and HKIX1b (the two HKIX core sites **located within CUHK Campus**) will continue to serve participants directly*

R&E Networks
Having Presence in HK

- APAN-JP/JGN-X
- ASCC-ASNET
- ASGC
- ASTI-PREGINET
- CERNET/CERNET2
- CSTNET
- **JUCC-HARNET**
- KISTI-KREONET2
- NIA-KOREN
- NUS
- TEIN4
- **Most of these R&E networks have network presence at MEGA-iAdvantage (MEGA-i) Building (but on different floors)**
- **Most are connected to HKIX-R&E at MEGA-i**
    - **HKIX-R&E is a special node of HKIX (www.hkix.net) which serves R&E networks only and connects to HKIX core switches with 2 x 10GE circuits**

HKIX-R&E – Special Support for R&E Networks Having Presence in HK

- **HKIX helps those R&E Networks to interconnect with <u>commercial networks</u> without restrictions via HKIX-R&E switch at MEGA-i**
- Support GE/10GE Trunk Ports for R&E Networks only
- Support special point-to-point VLANs for R&E Networks only
  - For private interconnections among any 2 R&E networks
  - Jumbo Frame support
- *Offer colo at new HKIX1b site inside CUHK Campus*
  - *Up to 2 racks per R&E network*
    - *Discounted MRC*
  - *No MRC for fiber cross-connects*
  - *Basic Remote Hands & Eyes included*
  - *This offer always stands*
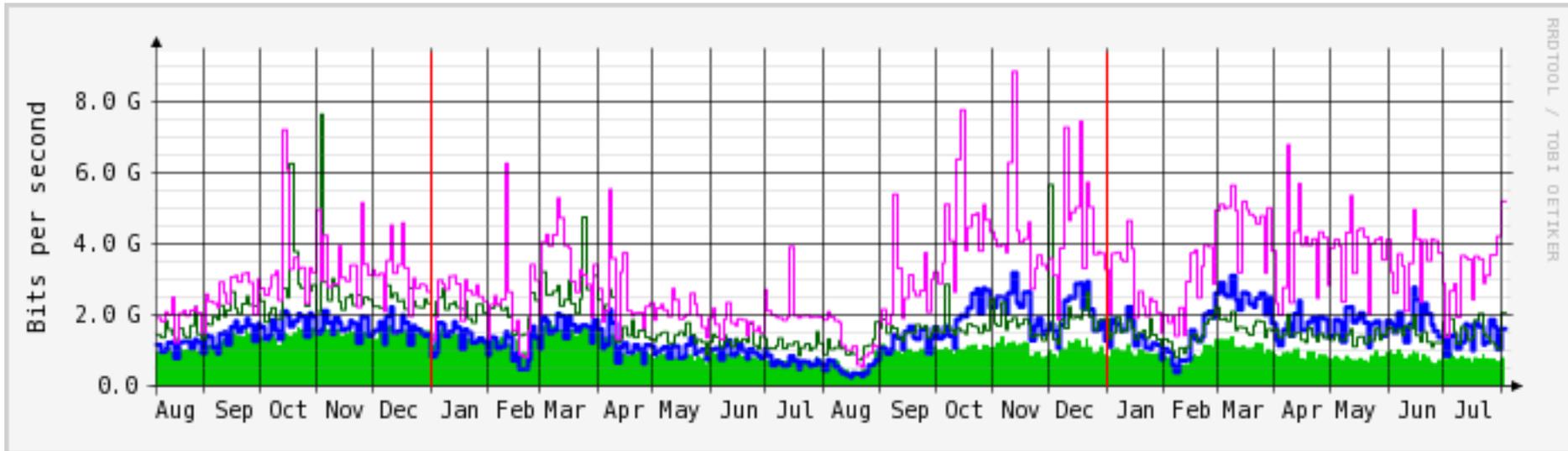
HKIX Network Diagram (AUG 2016)
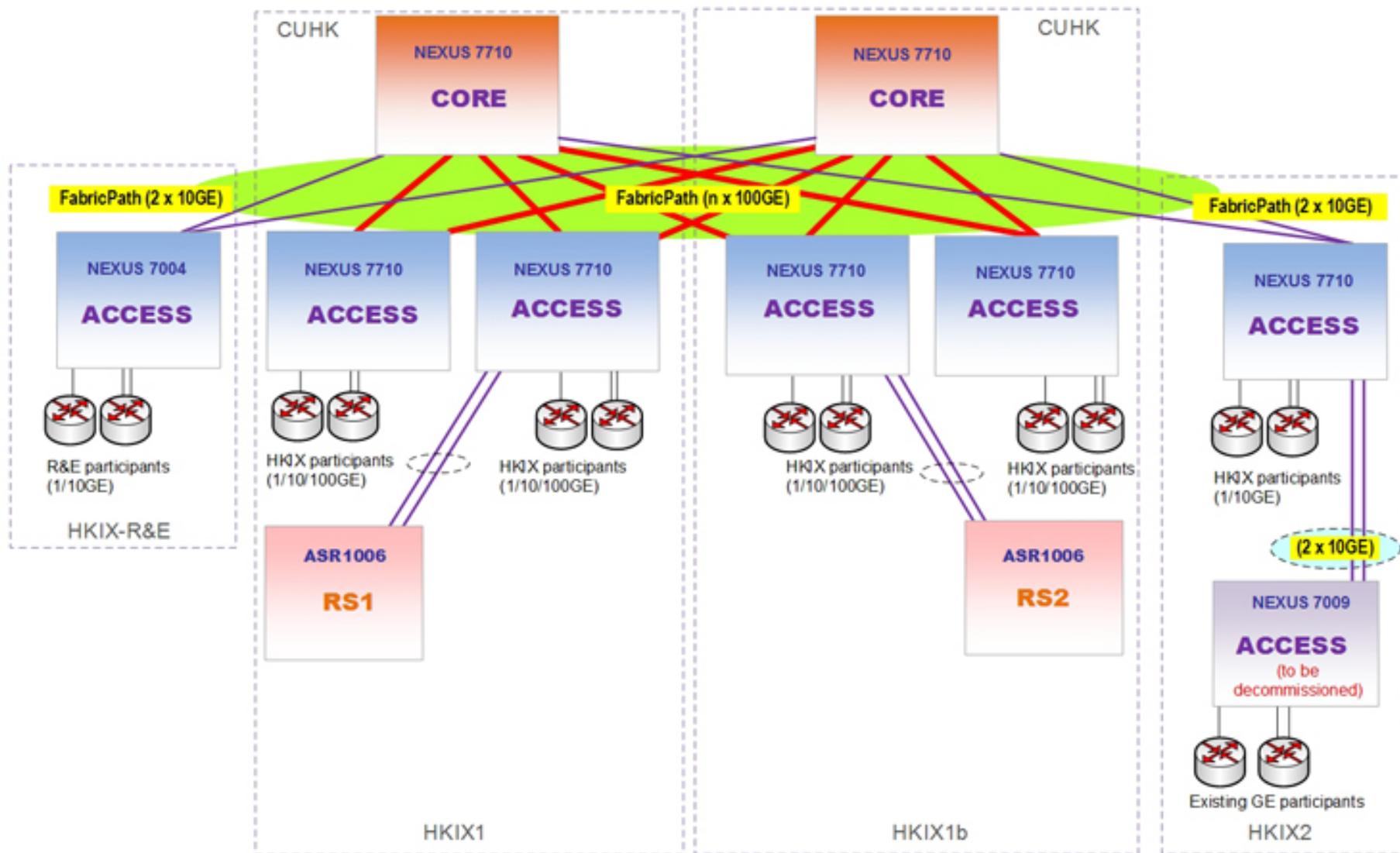
1. HKIX1 and HKIX1b are the two core sites of HKIX while the others are satellite sites.
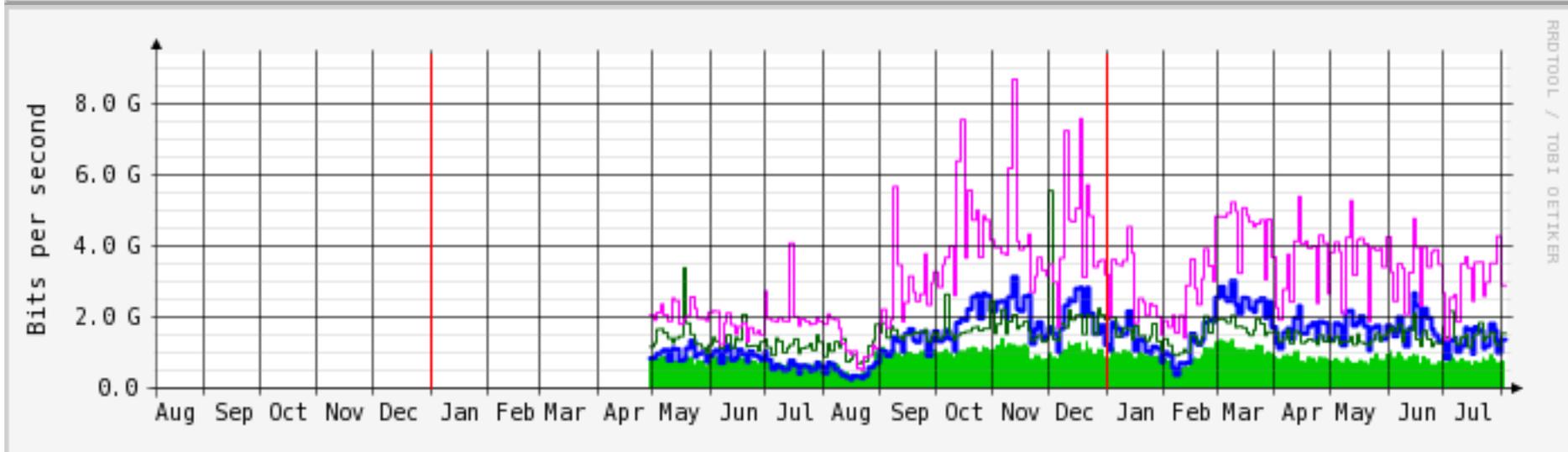2. HKIX participants are encouraged to connect to multiple sites for site resilience.

HKIX-R&E Switch at MEGA-i

HKIX-R&E Connections and VLAN Assignment
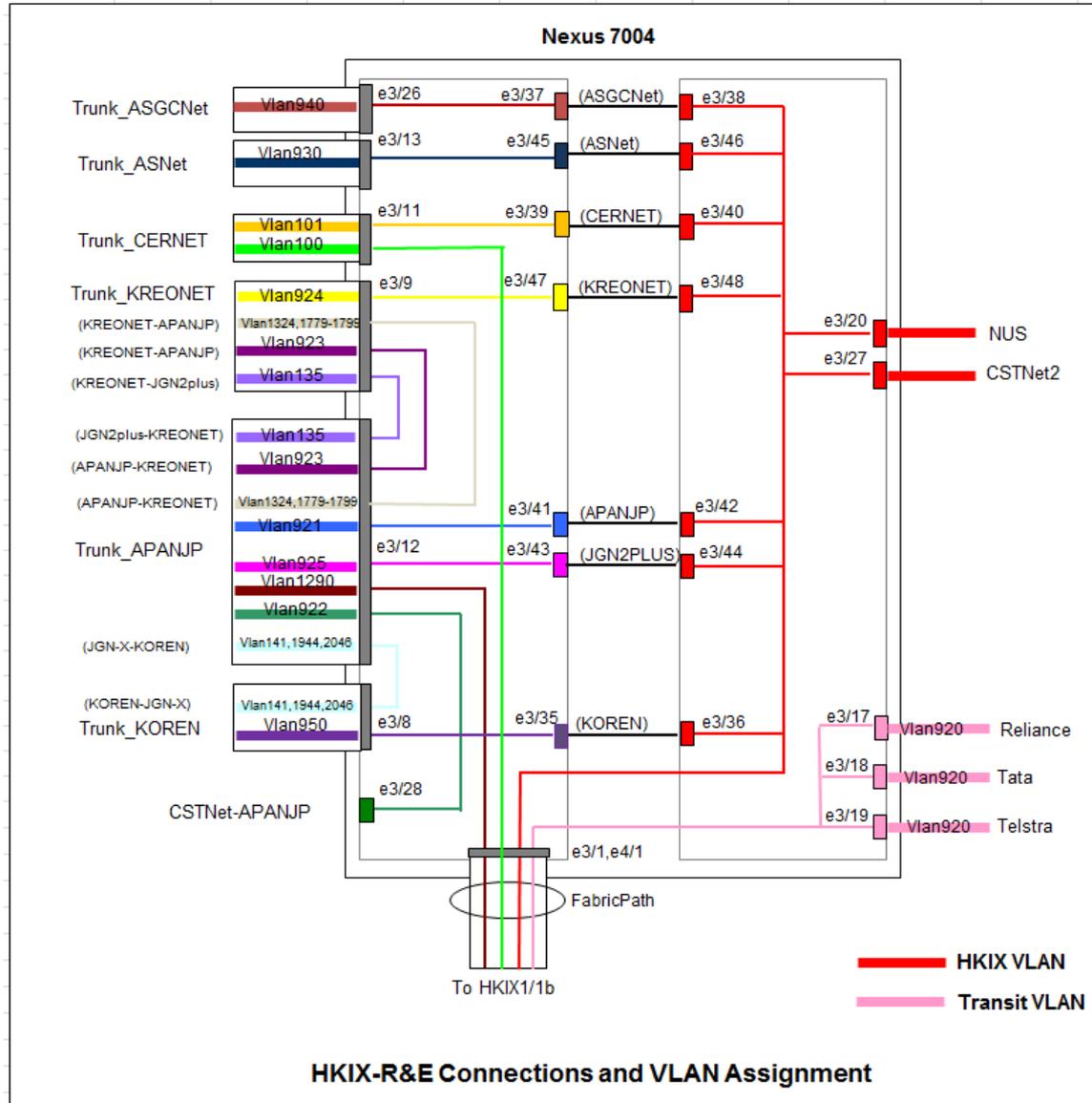
Utilization of the 2 x 10GE Links

INDIANA UNIVERSITY

NETWORKS
At Indiana University

Possible Guam-HK 10G/100G Circuit Termination Point

- To be funded by NSF of US: Confirmed? Timeline?

- If go ahead, where is the best termination point in HK?
  - Best to terminate it at the possible HKOXP

- Best to have all R&E networks co-located in the same room with long-term contract for easiest interconnections and sustainable development
  - Currently, individual R&E networks at MEGA-i need to relocate from one floor to another within MEGA-i once every 2 to 3 years due to change of supplier
  - Laying fiber cross-connects across floors within MEGA-i can be difficult sometimes

- Two main options were identified, but there are other options:
  - MEGA-i
    - Colo, Power and Cross-Connects are expensive
    - Best to move to the same room on the same floor inside MEGA-i
      - Already confirmed with iAdvantage that this is feasible, subject to commercial agreement
  - CUHK/HKIX1b
    - Backhaul for international circuits may be more expensive

Things to Determine

- **Do we need Open Exchange Point in Hong Kong (HKOXP)? Who to set up and operate it?**
  - If HK has a Global Open Exchange Point (GXP), it can benefit most part of R&E community
    - Note that a lot of R&E networks have already chosen to have network presence in Hong Kong
  - **JUCC/HARNET is willing to contribute by providing and operating the switch needed for GXP**
    - **Must support 100G**
    - **May gradually take over the existing role of HKIX-R&E node (the left part)**
- **Where should be the location of the shared colo space in Hong Kong for all R&E networks having presence in HK?**
  - MEGA-i?
  - CUHK/HKIX1b?
  - Other commercial data center options?
    - Better be HKIX Satellite Sites
  - Better be long-term and cost-effective but NOT very critical though

The Decision Process?

- **Too many stakeholders involved**
- **Different stakeholders have different restrictions**
- Will all R&E networks follow?
  - Relocate their equipment to new location?
  - Terminate their existing international circuits to the new HKOXP switch?
    - For sharing among all R&E networks
- Will existing layer-3 networks (such as TEIN) become overlay networks?
- **It is NOT easy…**

HKOXP Forum on Aug 3 (Wed)

- Healthy discussion on different options
- Some stakeholders still prefer to stay at MEGA-i
- **"Rough Consensus" was to maintain the status quo and to do regular review at the future APAN meetings, while the set-up for HKOXP and the establishment of Guam-HK circuit are being determined**
- **Status quo is a good starting point as things are working for now**
- **Evolution, not revolution**

- *Also received further comments from other stakeholders <u>after</u> the Forum*
  - *Some prefer to have everybody in the same room inside MEGA-i*
  - *Some prefer to move away from MEGA-i*
- <u>*More comments are welcome*</u>

Any Questions / Comments / Suggestions?