

台灣網路交換中心的議題與挑戰

## **Internet Exchange in Taiwan**

**- Growing but still a long way to go!**

# Who is William Lu?

- 是方電訊 國際業務部協理 (現任)
- 是方電訊 TPIX專案負責人
- 北電網絡 業務經理
- 新加坡電信 通路經理
- 縱橫資通 產品經理
- 通訊雜誌 專案編輯
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- APNIC 44 Panel Committee 委員
- *A creative and inventive thinker who always welcome challenges and not afraid to work outside of his comfort zone, William is a motivated team player and team builder who consistently craves for outperforming expectations. Possesses superb communication skills and culture sensitivity, he can always build close relationship with clients, providers and stakeholders needed to accomplish his goals. Being results oriented and focusing on bottom line results, he has excellent track record of achieving and exceeding the standards. Also a successful leader in producing, presenting and managing the implementation of innovative business solutions. Strong managerial background and senior level of international business experience.*
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- 國立台灣大學 機械工程學士
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- PMP #1363822



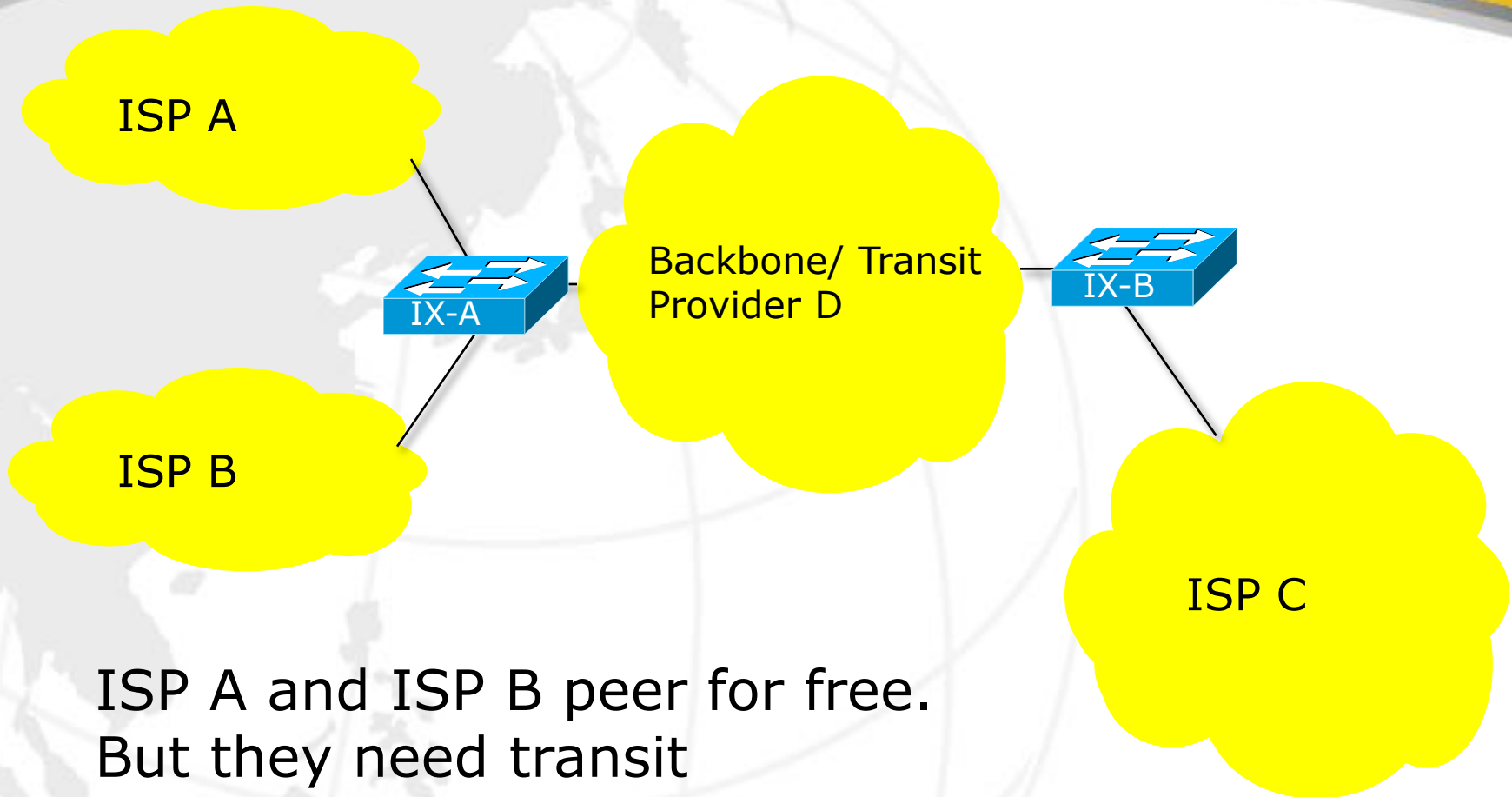
# 議程- Too Short to cover them...

- 定義: Peering vs Transit, Public vs Private
- 為何要Peering?
- 甚麼是交換中心 What is Internet Exchange?  
定義: Open vs Selective?
- Peering DB 很重要!!!
- FCC Open Internet Order (FCC 15-24)
- Where do Taiwan IXs Stands?

# 從ISP看Internet

- Internet 是由各種不同型態與大小的ISP互相串連終端使用者設備而成
- 這些ISPs 若不互相串連全世界數萬個ASN就無法互通
- ISP會透過Peering or 購買Transit Service讓其他ISP可以連到第三方的ISP去
- 所以ISP要：
  - 建置多個網路節點POP
  - 建置多重的骨幹網路
  - 對外建置多重網路連線
  - 透過IXP取得免費Peering
  - 透過付費取得未直連的 transit網路

# Peering and Transit example



ISP A and ISP B peer for free.  
But they need transit  
arrangements with ISP D to get  
packets to/from ISP C

# Transit vs Peering

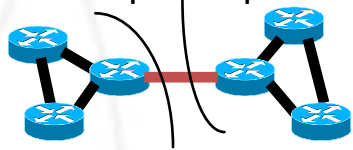
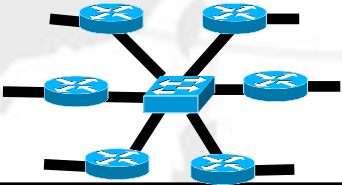
<p>Transit  <a href="https://en.wikipedia.org/wiki/Internet_transit">https://en.wikipedia.org/wiki/Internet_transit</a></p>	<p>Peering  <a href="https://en.wikipedia.org/wiki/Peering">https://en.wikipedia.org/wiki/Peering</a></p>
<p><b>Internet transit</b> is the service of allowing network traffic to cross or "transit" a computer network, usually used to connect a smaller Internet service provider (ISP) to the larger Internet.</p>	<p><b>Internet Peering</b> is the business relationship whereby two companies reciprocally provide access to each other's customers.</p>
<p>通常都需要付費</p>	<p>通常都是免費的 (settlement-free)</p>
<p>Provider 提供 Buyer 連線到其他網路</p>	<p>僅提供雙方網內的資源互換(不包含 Transit到上游的網路)</p>
	<p>雙方其實都因為Peering的關係互惠, 所以不需要互相麻煩雙方計費及協商等</p>

**Remark 1: 誰的traffic比較重要? Content vs Eyeball? 誰需要誰?**

# ISP/ Peering Manager的目標

- **Cost Down!!!**
- **Transit要負擔的成本**
  - ISP 負擔電路 (國內或國際)
  - ISP 負擔流量 (usually per M/G/Tbps)
  - 每多一個上游就需要同樣的支出
  - 負擔沉重
- **Peering要負擔的成本**
  - ISP 平均分攤Private Peering的電路(跳線)成本或各自提供Public Peering的電路(跳線)成本
  - 不須依照流量付費 (透過IX僅支付 Port Fee)
  - 成本低廉, 模式公平

# Peering有兩種 – Public and Private

	Public Peering	Private Peering
	<p><b>Public peering</b> is performed across a shared network called an <b>Internet Exchange Point</b> (IX or IXP).</p>	<p><b>Private peering</b> is performed by creating a <b>direct physical connection</b> between two networks.</p>
Advantage	<ul style="list-style-type: none"> <li>• Efficient usage of ports</li> <li>• Hundreds of peers available at the larger IXs</li> <li>• Easy to administrate</li> <li>• New peers added instantly on a daily basis</li> <li>• 於IX可分攤實體連線費用因此可極大化單位成本效益</li> </ul>	<ul style="list-style-type: none"> <li>• Guaranteed capacity</li> <li>• Easy to monitor</li> <li>• More reliable than public peering</li> <li>• More secure than public peering</li> </ul> 
Disadvantage	<ul style="list-style-type: none"> <li>• Port or member fee only</li> </ul> 	<ul style="list-style-type: none"> <li>• Only cost-effective for large volumes of traffic (通常流量大時才會使用)</li> <li>• Takes more time to setup new peering connections (費時費工)</li> <li>• 實體連線電路成本高</li> </ul>
在哪裡	<p>IXP – Internet eXchange Point NAP – Network Access Point</p>	<ul style="list-style-type: none"> <li>• Can be ANYWHERE (哪裡都可以)</li> </ul> <p>因為僅存於雙方,也稱為 <b>Private Inter-connection</b>, 外界無從得知是Peering or Transit or...</p>

**Remark 2: Private Peering 非透過IX設施而是雙方直接連線,一般不計算於IX流量.**



# 為何要Peering?

雖然Transit單價不隨著流量而下降, 但整體Transit費用不斷攀升(流量漲幅大於Transit頻寬降幅). 因此必須透過極大化Peering來減少Transit成本

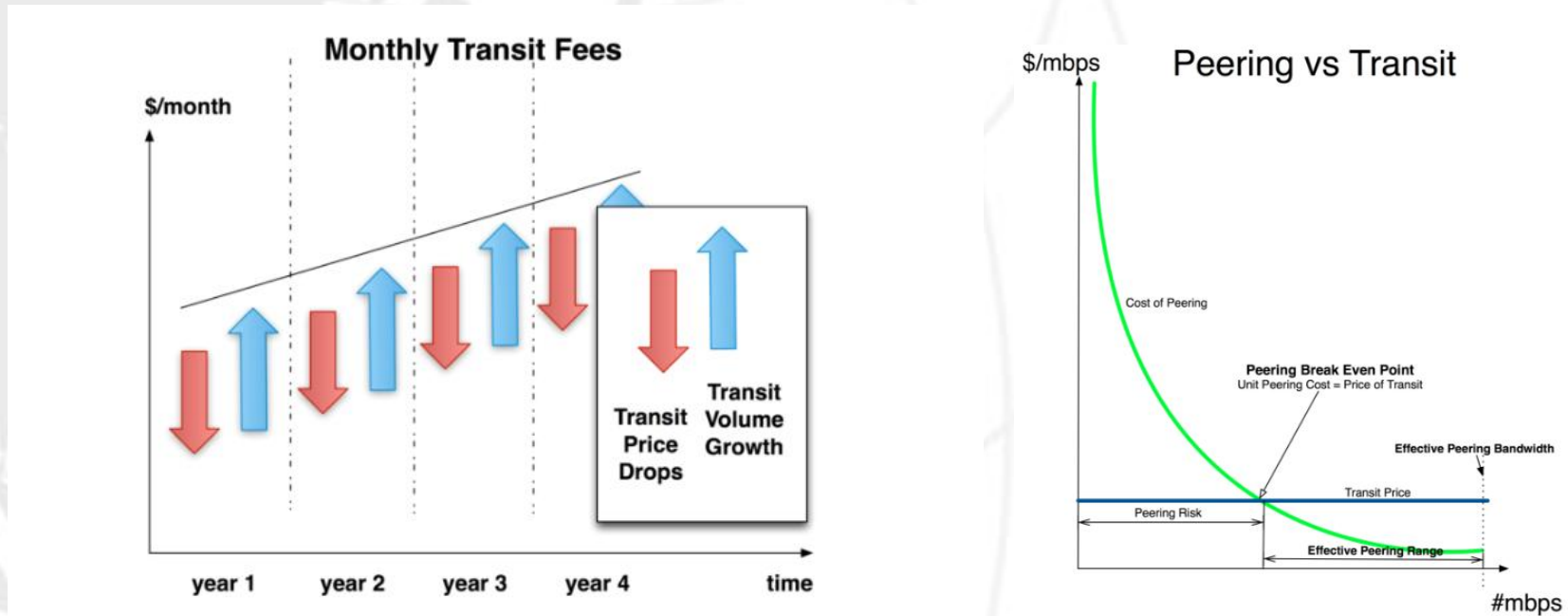


Figure 4-1. The unit cost of Internet bandwidth drops, but the volume increases.

# Peering 的五大誘因

- **Transit costs are reduced.** 降低Transit成本
- **End-user experience is better.** 透過Peering 可以降低Latency從而改善使用者體驗。
  - **Without Peering, Packets travel the Ocean. Twice.** 沒有Peering, 你跟隔壁的用戶封包可能會跨海透過美國來回才能交換
- **Control over routing is strategic.** 讓ISP可以策略性調整特殊對Performance要求較高(例如遊戲或影音)的路由。
  - **End-User Experience Key Driver for Content Provider Peering**
  - 對任何Content而言使用者體驗都是最重要的成功關鍵
- **Traffic billing is usage-based.**
  - 當消費者對付費使採用流量計費時, 就會對品質斤斤計較, 因此降低Packet loss及Latency就可以幫助ISP留住客戶
- **ISPs Make More Money by Peering**
  - Peering 可以幫ISP賺錢
  - **ISPs enjoy marketing benefits.** ISPs 利用他們廣布的 peering 網路, 包含更多的Peering 對象, 更短的路由, 更低的Latency及更穩定的網路來吸引更多客戶

# 甚麼是交換中心

[https://en.wikipedia.org/wiki/Internet\\_exchange\\_point](https://en.wikipedia.org/wiki/Internet_exchange_point)

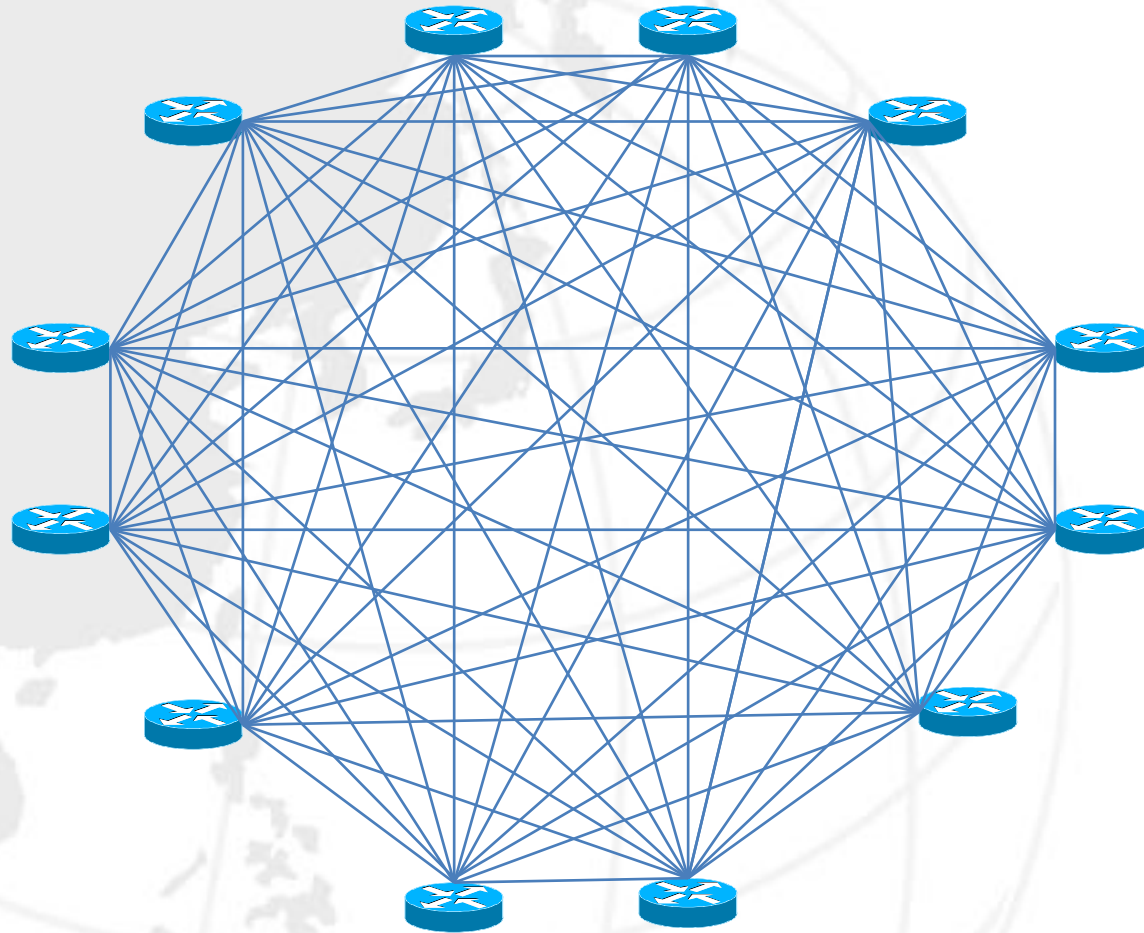
- An **Internet exchange point (IX or IXP)** is a physical infrastructure through which Internet service providers (ISPs) and Content Delivery Networks (CDNs) exchange Internet traffic between their networks (autonomous systems).

交換中心是一個供**ISP and ICP**交換流量的實體設施

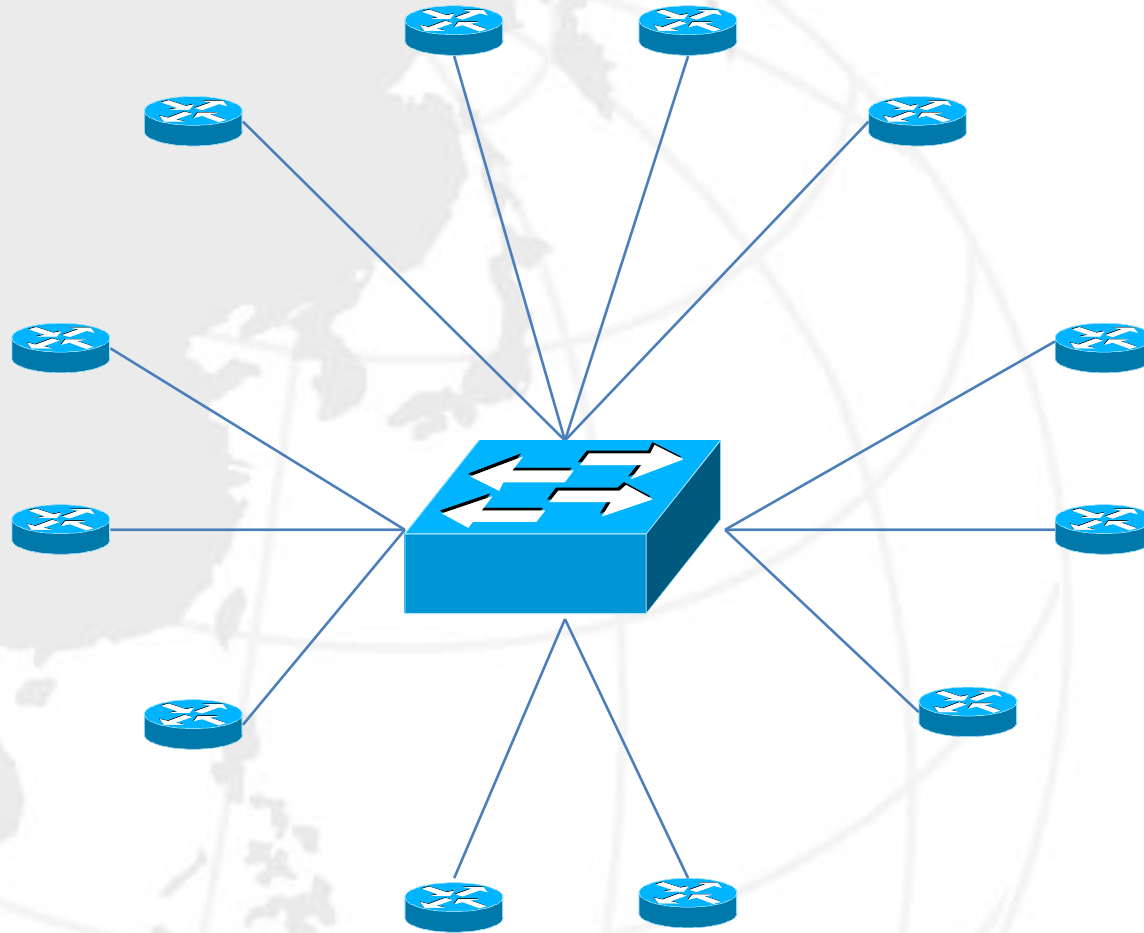
- IXPs **reduce the portion of an ISP's traffic** which must be delivered **via their upstream transit providers**, thereby **reducing the average per-bit delivery cost** of their service. Furthermore, the increased number of paths available through the IXP **improves routing efficiency and fault-tolerance**. In addition to that, IXPs exhibit the characteristics of what economists call the **network effect**.

交換中心可節省需要透過**Transit**的流量, 因此可降低單位成本, 藉由不斷成長的**IXP**會員及路由也可不斷改善路由效率及障礙容許能力, 此外, **IXP**也充分展現網路效應的特色!

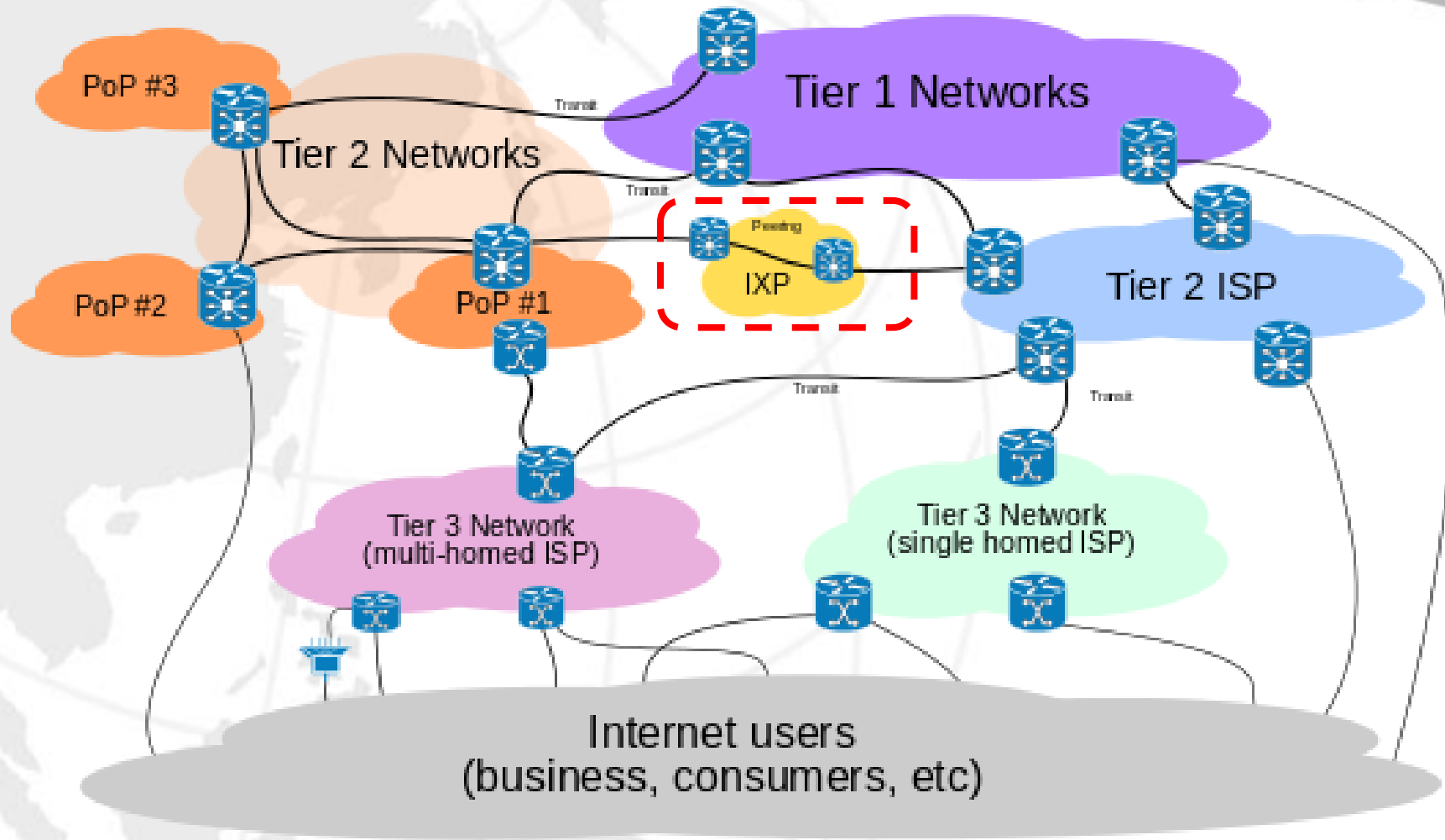
# Why we need IX?



# Why we need IX?



# Global Interconnection, Peering Status



# The IXP's role 交換中心的角色

- Private peering 只適用於少數大量連線
- 愈多private peers 成本愈高
- IXP 才是可長可久的方案 (more scalable solution)
- 連線到IX的成本: **one** router port, **one** circuit, and **one router** to locate at the IXP
- Some IXPs charge 年費, 會員費, 但**大多只收Port Charge**
- 最應加入IX的對象:
  - Access ISP Providers
  - Regional ISP Providers
  - ICP, CDN
  - Global ISP

# 如何挑選 IXP?

- **Member**數量及可取得多少路由? 這些路由與自己的關係?
  - What is traffic to & from these destinations, and by how much will it reduce cost of transit?
- **Port** 成本? 跳線成本? **Colo** 成本? (若已經colo在內可不計)
  - If prohibitive or space not available, pointless choosing this IXP
- 連線到該IX成本, 線路選擇? (**\*Peering**應該是雙方各自負擔電路) (**\*\*若以Colo在內可不計**)
  - If prohibitive or competitive with transit costs, pointless choosing this IXP
- 配套**Remote Hand**或其他服務成本?
  - If no remote hands, doing maintenance is challenging and potentially costly with a serious outage
- **IX**自訂其他限制條件? (台灣註冊公司? 電信執照? **XX會員?**)

**Saving money, improving QoS,  
Generating a local Internet economy**



# 加入IXP注意事項- Open vs Selective?

- Each participant needs to **run BGP**
  - They need **their own AS number**
  - **Public** ASN, **NOT Private** ASN
- Each participant configures external BGP directly with the other participants in the IXP

## (選擇你的Peering 政策)

- Peering with all participants (Multi-Lateral Peering )  
又稱為 **Open Peering Policy**
- or
- Peering with a subset of participants (Bi-Lateral Peering) 又稱為 **Selective Peering Policy**

**Remark 3: In IX there is no “Public” or “Private” only “Open” or “Selective”?**

# IXP可能誤入歧途

- 有些ISP只是想藉IX之名來獲利
- 有些ISP假借IXP之名其實是要賣Peering or Transit
  - “We are exchanging packets with other ISPs, so we are an Internet Exchange Point!”
  - 用Router來包裝L3 Exchange: 其實是要賣Transit
- 有些IX只是靠會員數來獲利
- 有些IX根據使用流量來計費 (port traffic)
  - IXs 不是 transit service, 不應該用traffic計費, 不只抑制流量而且可能會導致惡性競爭
  - (合理的方式是用分級固定 **different flat fees** for 1Gbps, 10Gbps or 100Gbps ports as they all have different hardware costs on the switch.)

# IXP可能誤入歧途

## 過多IX

- 在同一地區過多IX反而導致惡性競爭
- 對各ISP來說增加太多IX反而增加連線成本  
失去IX的意義
- 總而言之 IX:
  - 不能跟會員競爭 (**NOT** a competition)
  - 不是個賺錢的生意 (**NOT** a profit making business)

# 其他IX的迷思

- IXs try to compete with their membership (與會員提供相同服務給相同客戶群, 利益衝突)
  - Offering services that ISPs would/do offer their customers
- IXs run as a closed privileged Club (以特殊條件限制會員資格)
  - Restrictive membership criteria
- IXPs providing Internet Access to end users rather than just Service Providers (自己提供服務給終端客戶)
- IXPs interfering with ISP business decisions (干涉會員的政策)
  - (e.g. Mandatory Multi-Lateral Peering or their Peering Policy)
- IXP use special transit as incentive to support Colo or other business (除了賣Transit還用特別低價來綁定其他產品)

# Peering DB 很重要!!!

<https://www.peeringdb.com/>

PeeringDB facilitates the exchange of information related to Peering.

Specifically, we are a **database of networks that are peering, where they are peering, and if they are likely to peer** with you.

If you don't know what peering is, and/or you don't currently engage in peering, this probably won't have any meaning for you.

是一個專屬網路流量交換的資料庫, 許多公司直接設計程式自動抓取該資料庫並自動建立新的Peering連線

# Peering DB 很重要!!!

<https://www.peeringdb.com/ix/823>

## TPIX-TW

Organization	<a href="#">TPIX-TW</a>
Long Name	Taipei Internet Exchange
City	Taipei/Taiwan
Country	TW
Continental Region	Asia Pacific
Media Type	Multiple
Protocols Supported	<input checked="" type="radio"/> Unicast IPv4 <input type="radio"/> Multicast <input checked="" type="radio"/> IPv6

### Contact Information

Company Website	<a href="http://www.tpix.net.tw/">http://www.tpix.net.tw/</a>
Traffic Stats Website	<a href="http://www.tpix.net.tw/traffic.html">http://www.tpix.net.tw/traffic.html</a>
Technical Email	<a href="mailto:t21@chief.com.tw">t21@chief.com.tw</a>
Technical Phone	+886226576688
Policy Email	<a href="mailto:tpix@chief.com.tw">tpix@chief.com.tw</a>
Policy Phone	+886226576688

### LAN

MTU	
DOT1Q	<input type="radio"/>
IPv4	203.163.222.0/24
IPv6	2406:d400:1:133:203:163:222:0/112

### Local Facilities

Filter

Facility ▼	Country	City
<a href="#">Chief LY Building Taipei</a>	Taiwan	Taipei

### Peers at this Exchange Point

Filter

Peer Name ▼	IPv4	Speed
ASN	IPv6	Policy
<a href="#">So-net Entertainment Taiwan Limited</a>	203.163.222.24 None	10G Open
18182		
<a href="#">So-net Entertainment Taiwan Limited</a>	203.163.222.25 None	10G Open
18182		
<a href="#">Taiwan Academic Network(TANet)</a>	203.163.222.28 2406:d400:1:133:203:163:222:28	20G Selective
1659		
<a href="#">Taiwan Academic Network(TANet)</a>	203.163.222.29 2406:d400:1:133:203:163:222:29	10G Selective
1659		
<a href="#">Taiwan Intelligent Fiber Optic Network Co.,Ltd.</a>	203.163.222.20 None	1G Open
131584		
<a href="#">Taiwan Optical Platform Group</a>	203.163.222.30 None	10G Open
18049		
<a href="#">Taiwan Star Telecom Corporation Limited.</a>	203.163.222.34 None	10G Selective
24157		
<a href="#">TWGate</a>	203.163.222.11 2406:d400:1:133:203:163:222:11	10G Open
9505		
<a href="#">VeeTIME</a>	203.163.222.26 None	10G Open
17809		
<a href="#">Worldstar Network</a>	203.163.222.44 None	Open
131603		
<a href="#">Yahoo!</a>	203.163.222.36 2406:d400:1:133:203:163:222:36	40G Selective
10310		
<a href="#">Yahoo!</a>	203.163.222.37 2406:d400:1:133:203:163:222:37	40G Selective
10310		

# Peering DB 很重要!!!- Facebook

<https://www.peeringdb.com/net/979>

## Facebook Gold Sponsor

Organization	<a href="#">Facebook</a>
Also Known As	Facebook, Instagram, WhatsApp
Company Website	<a href="https://www.facebook.com/">https://www.facebook.com/</a>
Primary ASN	32934
IRR Record	AS-FACEBOOK
Route Server URL	
Looking Glass URL	
Network Type	Content
IPv4 Prefixes	100
IPv6 Prefixes	100
Traffic Levels	1 Tbps+
Traffic Ratios	Heavy Outbound
Geographic Scope	Global
Protocols Supported	<input checked="" type="radio"/> Unicast IPv4 <input type="radio"/> Multicast <input checked="" type="radio"/> IPv6
Last Updated	2016-07-06T00:29:07Z
Notes	<p>We have a selective peering policy requiring a minimum of 50 Mbps of in-continent traffic destined to or through your network. We welcome the opportunity to engage in peering with responsible BGP speakers in an effort to improve the experience of our millions of users throughout the globe.</p> <p>We require an up-to-date peeringdb entry for all public peering requests, including exchange information with properly formatted public fabric addresses, asns, and noc/peering contact information.</p> <p>We ask that peers also maintain their private peering facilities, as we use this information for private peering (PNI) targeting.</p>

### Peering Policy Information

Peering Policy	<a href="https://www.facebook.com/peering/">https://www.facebook.com/peering/</a>
General Policy	Selective
Multiple Locations	Not Required

## Public Peering Exchange Points

Filter

Exchange	IPv4	Speed
ASN	IPv6	RS Peer
32934	2001:504:16::211:0:80a6	<input type="radio"/>
<a href="#">SOX d.o.o. Serbia</a>	185.1.27.68	20G
32934	2001:7f8:1e::68	<input type="radio"/>
<a href="#">STHIX (Stockholm IX)</a> Stockholm Peering	192.121.80.76	20G
LAN	2001:7f8:3e:0:a500:3:2934:1	<input type="radio"/>
32934		
<a href="#">STHIX (Stockholm IX)</a> Stockholm Peering	192.121.80.77	20G
LAN	2001:7f8:3e:0:a500:3:2934:2	<input type="radio"/>
32934		
<a href="#">TOP-IX</a> Public Peering VLAN	194.116.96.92	10G
32934	2001:7f8:23::fff:92	<input type="radio"/>
<a href="#">TOP-IX</a> Public Peering VLAN	194.116.96.93	10G
32934	2001:7f8:23::fff:93	<input type="radio"/>
<a href="#">TPIX-TW</a>	203.163.222.13	20G
32934	2406:d400:1:133:203:163:222:13	<input type="radio"/>
<a href="#">TPIX-TW</a>	203.163.222.31	20G
32934	2406:d400:1:133:203:163:222:31	<input type="radio"/>
<a href="#">Thinx</a>	212.91.0.247	20G
32934	2001:7f8:60::face:b00c:1	<input type="radio"/>
<a href="#">Thinx</a>	212.91.0.246	20G
32934	2001:7f8:60::face:b00c:2	<input type="radio"/>
<a href="#">TorIX</a>	206.108.35.2	30G
32934	2001:504:1a::35:2	<input type="radio"/>
<a href="#">TorIX</a>	206.108.35.3	30G
32934	2001:504:1a::35:3	<input type="radio"/>
<a href="#">VIX</a>	193.203.0.194	60G
32934	2001:7f8:30:0:2:1:3:2934	<input type="radio"/>
<a href="#">VIX</a>	193.203.0.205	60G
32934	2001:7f8:30:0:2:2:3:2934	<input type="radio"/>

## Private Peering Facilities

Filter

Facility	Country
ASN	City
<a href="#">AIMS Kuala Lumpur</a>	Malaysia
32934	Kuala Lumpur
<a href="#">CSF CX1 Cyberjaya</a>	Malaysia
32934	Cyberjaya
<a href="#">Chief LY Building Taipei</a>	Taiwan
32934	Taipei
<a href="#">CoreSite - LA1 - One Wilshire</a>	United States of America

# Peering DB 很重要!!!- Google

<https://www.peeringdb.com/net/433>

Google Inc. Platinum Sponsor

Organization	<a href="#">Google Inc.</a>
Also Known As	Google, YouTube (for Google Fiber see AS16591 record)
Company Website	<a href="https://www.google.com/">https://www.google.com/</a>
Primary ASN	15169
IRR Record	AS-GOOGLE
Route Server URL	
Looking Glass URL	
Network Type	Content
IPv4 Prefixes	15000
IPv6 Prefixes	750
Traffic Levels	Not Disclosed
Traffic Ratios	Mostly Outbound
Geographic Scope	Global
Protocols Supported	<input checked="" type="checkbox"/> Unicast IPv4 <input type="checkbox"/> Multicast <input checked="" type="checkbox"/> IPv6
Last Updated	2017-01-05T14:08:35Z
Notes	<p>Peering Operational Issues: Contact <a href="mailto:noc@google.com">noc@google.com</a> 24x7</p> <p>Peering Requests: <a href="https://isp.google.com/iwantpeering">https://isp.google.com/iwantpeering</a></p> <p>We have a generally open peering policy. Please visit the following link: <a href="https://peering.google.com/#/options/peering">https://peering.google.com/#/options/peering</a></p> <p>This link also has information about our traffic delivery and management practices.</p> <p>Please note, not all Google content and services may be available at each PoP or Exchange.</p> <p>Related ASNs Google also manages the following ASNs: AS36040, AS43515, AS36561</p>

**Peering Policy Information**

Peering Policy	<a href="https://peering.google.com/#/options/peering">https://peering.google.com/#/options/peering</a>
General Policy	Open
Multiple Locations	Preferred

**Public Peering Exchange Points** Filter

Exchange ASN	IPv4 IPv6	Speed RS Peer
<a href="#">SIX G.G. Serbia</a>	103.1.27.60	20G
15169	2001:7f8:1e::60	<input checked="" type="checkbox"/>
<a href="#">STHIX (Stockholm IX) Stockholm Peering LAN</a>	192.121.80.47	10G
15169	2001:7f8:3e:0:a500:1:5169:1	<input checked="" type="checkbox"/>
<a href="#">SwissIX Peering</a>	91.206.52.74	30G
15169	2001:7f8:24::4a	<input checked="" type="checkbox"/>
<a href="#">I-CIX</a>	185.1.40.15	20G
15169	2001:7f8:98::15	<input type="checkbox"/>
<a href="#">TESPOK-KIXP-MBA Peering LAN</a>	196.60.2.15	10G
15169	2001:43f8:c0::15	<input checked="" type="checkbox"/>
<a href="#">TSP-IX Public Peering VLAN</a>	194.116.96.60	10G
15169	2001:7f8:23:fff::20	<input checked="" type="checkbox"/>
<a href="#">TPIX-TW</a>	203.163.222.21	40G
15169	2406:d400:1:133:203:163:222:21	<input checked="" type="checkbox"/>
<a href="#">TPIX</a>	212.91.0.250	40G
15169	2001:7f8:60::1:5169:1	<input checked="" type="checkbox"/>
<a href="#">TorIX</a>	206.108.34.6	100G
15169	2001:504:1a::34:6	<input checked="" type="checkbox"/>
<a href="#">UA-IX</a>	185.1.50.166	60G
15169	2001:7f8:5d::166	<input checked="" type="checkbox"/>
<a href="#">UAE-IX</a>	185.1.8.28	20G
15169	2001:7f8:73::3b41:0:1	<input checked="" type="checkbox"/>
<a href="#">W-IX vian800</a>	193.106.112.21	60G
15169	2a00:1b30::21	<input checked="" type="checkbox"/>
<a href="#">W-IX vian800</a>	193.106.112.138	20G
15169	2a00:1b30::138	<input checked="" type="checkbox"/>
<a href="#">YYCIX</a>	206.126.225.128	10G
15169	2001:504:2f:1:5169:1	<input checked="" type="checkbox"/>

**Private Peering Facilities** Filter

Facility ASN	Country City
<a href="#">151 Front Street West Toronto</a>	Canada Toronto
15169	
<a href="#">AIMS Kuala Lumpur</a>	Malaysia Kuala Lumpur
15169	
<a href="#">Bharti Airtel Santhome</a>	India Chennai
15169	
<a href="#">Blue City</a>	Oman Barka
15169	
<a href="#">Borovaya 57</a>	Russia St. Petersburg
15169	
<a href="#">CE Colo Prague</a>	Czech Republic Prague
15169	



# FCC Open Internet Order 2010

[https://en.wikipedia.org/wiki/FCC\\_Open\\_Internet\\_Order\\_2010](https://en.wikipedia.org/wiki/FCC_Open_Internet_Order_2010)

The **Federal Communications Commission Open Internet Order** is a set of regulations that move towards the establishment of the **internet neutrality** concept. .... Open Internet strikes a balance between these two camps by creating a compromised set of regulations **that treats all internet traffic in “roughly the same way”**.

**FCC 15-24**是基於開放式互聯網架構發展出為了建立網路中立理念的一套法令

# FCC Open Internet Order 2010

[https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-15-24A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-24A1.pdf)

## I INTRODUCTION

1. The open Internet drives the American economy and serves, every day, as a critical tool for America's citizens to conduct commerce, communicate, educate, entertain, and engage in the world around them. The benefits of an open Internet are undisputed. But it must remain open: open for commerce, innovation, and speech; open for consumers and for the innovation created by applications developers and content companies; and open for expansion and investment by America's broadband providers. For over a decade, the Commission has been committed to protecting and promoting an open Internet.

開放式互聯網式驅動美國經濟而且是美國民眾每一天經商，溝通，教育，娛樂及跟世界互動的最重要工具，因此開放式互聯網的好處無庸置疑。但是網路務必保持開放，對商務、創新、言論開放，對消費者、對應用開發者及內容公司的創新開放，對美國寬頻業者的擴充及投資開放。

# FCC Open Internet Order 2010

**Strong Rule that protect Consumers from Past and Future Tactics that Threaten the Open Internet:**

利用明確的規則保障消費者免於侵害**Open Internet**的威脅

Because the record overwhelmingly supports adopting rules and demonstrates that three specific practices invariably harm the open Internet—**Blocking**, **Throttling**, and **Paid Prioritization**—this Order bans each of them, applying the same rules to both fixed and mobile broadband Internet access service.

(因為紀錄顯示 **阻擋**, **壅塞**, 及**收費優先權**三個手段是固定及移動式網路業者最常用來傷害開放網路的手法)

因此FCC設立三個禁止及2個原則:

1. **No Blocking (不可阻擋)**
2. **No Throttling (不可壅塞)**
3. **No Paid Prioritization (不可收費優先)**
  - A. **No Unreasonable Interference or Unreasonable Disadvantage to Consumers or Edge Providers (不可干擾或劣化消費者或內容供應商網路)**
  - B. **Enhanced Transparency (須公開正確資訊包含網管政策,品質)**

# FCC Open Internet Order 2010- No Blocking 不可阻擋

## ***No Blocking.***

Consumers who subscribe to a retail broadband Internet access service must get what they have paid for—access to all (lawful) destinations on the Internet. This essential and well-accepted principle has long been a tenet of Commission policy, stretching back to its landmark decision in *Carterfone*, which protected a customer's right to connect a telephone to the monopoly telephone network.<sup>16</sup> Thus, this Order adopts a straightforward ban:

消費者應該能存取/拜訪“所有”網路上的合法目的地

Thus, this Order adopts a straightforward ban:

*A person engaged in the provision of broadband Internet access service, insofar as such person is so engaged, shall not block lawful content, applications, services, or non-harmful devices, subject to reasonable network management.*

因此本法案明確禁止:

提供網路服務者不得阻擋任何合法內容, 應用程式, 網路服務或任何沒有傷害性的設備.

# FCC Open Internet Order 2010- No Throttling不可壅塞

## ***No Throttling.***

The 2010 open Internet rule against blocking contained an ancillary prohibition against the degradation of lawful content, applications, services, and devices, on the ground that such degradation would be tantamount to blocking.

不只阻擋，開放網路法令也包含禁止使用相關的手段降低合法內容，應用程式，網路服務及設備的網路品質，因為這些手段無異於阻擋

This Order creates a separate rule to guard against degradation targeted at specific uses of a customer's broadband connection:

*A person engaged in the provision of broadband Internet access service, insofar as such person is so engaged, shall not impair or degrade lawful Internet traffic on the basis of Internet content, application, or service, or use of a non-harmful device, subject to reasonable network management.*

提供網路服務者不得妨害或降低基於網路內容、應用程式、服務或無傷害性設備使用而產生的合法互聯網流量品質

# FCC Open Internet Order 2010-

## No Paid Prioritization 不可付費取得優先

### ***No Paid Prioritization.***

Paid prioritization occurs when a broadband provider accepts payment (monetary or otherwise) to manage its network in a way that benefits particular content, applications, services, or devices.

付費優先是指當某個寬頻業者因為收了費用而讓自己的網路圖利特定的內容, 應用程式, 服務或設備

To protect against “fast lanes,” this Order adopts a rule that establishes that:

*A person engaged in the provision of broadband Internet access service, insofar as such person is so engaged, shall not engage in paid prioritization.*

因此本法令嚴禁提供網路服務者進行付費優先

*“Paid prioritization” refers to the management of a broadband provider’s network to directly or indirectly favor some traffic over other traffic, including through use of techniques such as traffic shaping, prioritization, resource reservation, or other forms of preferential traffic management, either (a) in exchange for consideration (monetary or otherwise) from a third party, or (b) to benefit an affiliated entity.*

付費優先指網路業者的網路直接或間接的圖利某些流量, 包含使用技術手段例如流量塑型 (traffic shaping), 優先順序(Prioritization), 資源保留(resource reservation), 或其他手段, 無論這是基於與第三方利益交換(\$ or ...)或對自己的關聯公司

# FCC Open Internet Order 2010

## 好處在哪裡?

2. Four years ago, the Commission adopted open Internet rules to protect and promote the “virtuous cycle” that drives innovation and investment on the Internet—both at the “edges” of the network, as well as in the network itself. In ..... **broadband providers invested \$212 billion** in the three years following adoption of the rules—from 2011 to 2013—more than in any three year period since 2002. **\*ISP於三年內共投資 2千1百2十億美金(2002年以來最高)**

3. Likewise, innovation at the edge moves forward unabated. ... 2010 was the first year that the majority of **Netflix** customers received their video content via online streaming rather than via DVDs ..... Today, Netflix sends the most peak downstream traffic in North America of any company. Other innovative service providers have experienced extraordinary growth—Etsy reports that it has **grown from \$314 million in merchandise sales in 2010 to \$1.35 billion** in merchandise sales in 2013. ...., **new kinds of innovative businesses are busy being born**. In the video space alone, in just the last sixth months, **CBS** and **HBO** ... announced new plans for streaming their content free of cable subscriptions; **DISH** has launched ....**ESPN**, and **Sony** ...; and **Discovery Communications** ... announced a new over-the-top service providing bandwidth-intensive programming. This year, **Amazon** took home two Golden Globes for its new series “Transparent.”

**\*創新網路事業如雨後春筍, 各項網路事業營收大增**

# Where do Taiwan IXs Stands?

[http://www.ncc.gov.tw/chinese/show\\_file.aspx?table\\_name=news&file\\_n=48052](http://www.ncc.gov.tw/chinese/show_file.aspx?table_name=news&file_n=48052)

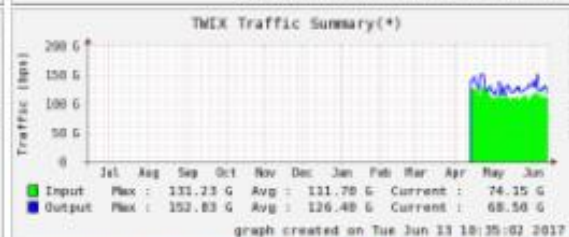
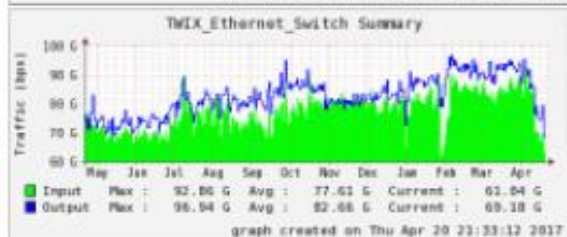
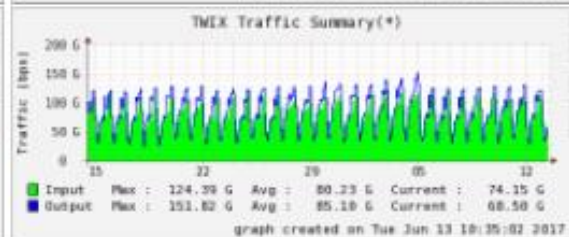
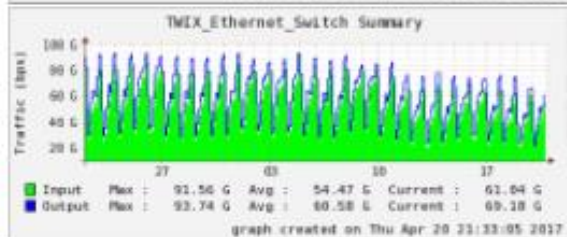
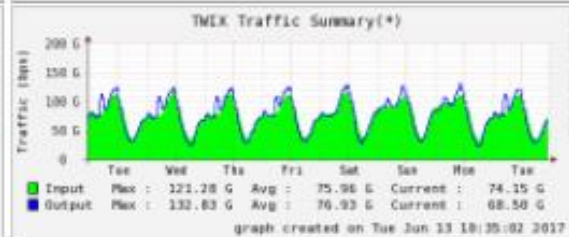
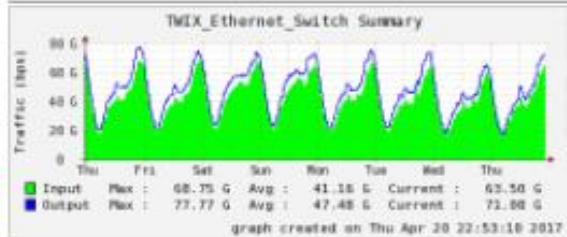
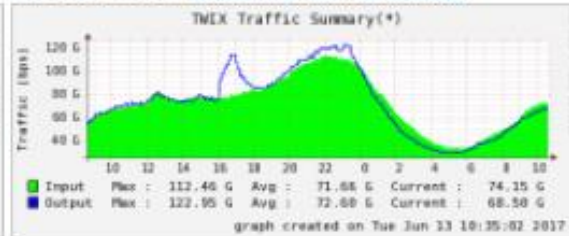
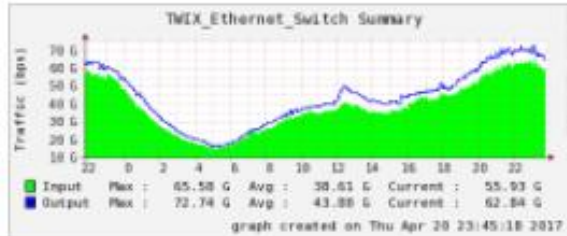
網際網路交換中心(Internet Exchange IX) 客戶數及訊務量						
日期		106 年 第 1 季				
項目 交換中心		客戶數	訊務量 (Mbps)			
			來(Inbound)		去(Outbound)	
			平均(Average)	最大(Maximum)	平均(Average)	最大(Maximum)
台灣網際網路交換中心 TWIX	1月	26	36,090	61,060	38,250	60,570
	2月	26	38,340	61,650	39,520	61,310
	3月	26	36,840	62,680	37,420	62,210
台北網際網路交換中心 TPIX	1月	29	44,203	53,429	44,164	54,149
	2月	29	43,690	51,219	43,041	51,275
	3月	29	51,467	57,456	51,146	58,086
亞太網際網路交換中心 EBIX	1月	19	27,300	54,400	28,400	53,200
	2月	19	29,700	61,600	30,800	59,700
	3月	19	29,000	61,800	30,200	62,900
中華民國網際網路交換中心 TWNAP	1月	1	0	0	0	0
	2月	1	0	0	0	0
	3月	1	0	0	0	0



# TWIX Traffic

## Total Traffic For TWIX

(\* )106年4月12日起，TWIX將Public Peering與Private Peering訊務併計為IX訊務總量

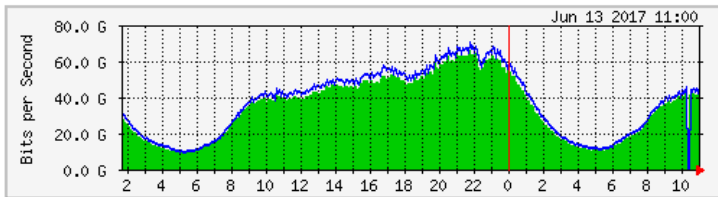


(\* )106年4月12日起，TWIX將Public Peering與Private Peering訊務併計為IX訊務總量

# TPIX Traffic

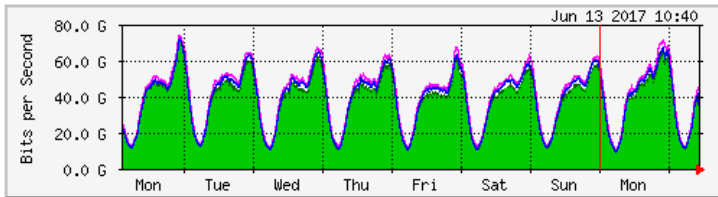
The statistics were last updated **Tuesday, 13 June 2017 at 11:00**

## 'Daily' Graph (5 Minute Average)



	Max	Average	Current
In	66.2 Gb/s (71.1%)	33.9 Gb/s (36.4%)	42.6 Gb/s (45.8%)
Out	69.9 Gb/s (75.1%)	36.5 Gb/s (39.2%)	45.7 Gb/s (49.0%)

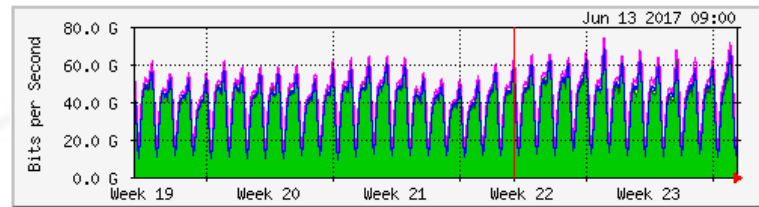
## 'Weekly' Graph (30 Minute Average)



	Max	Average	Current
In	71.7 Gb/s (76.9%)	36.1 Gb/s (38.8%)	27.2 Gb/s (29.2%)
Out	73.5 Gb/s (78.9%)	38.9 Gb/s (41.7%)	29.0 Gb/s (31.1%)

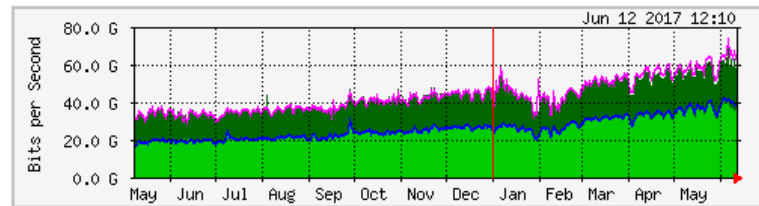
不包含"Private" Peering

## 'Monthly' Graph (2 Hour Average)



	Max	Average	Current
In	71.7 Gb/s (76.9%)	35.8 Gb/s (38.5%)	18.0 Gb/s (19.3%)
Out	73.5 Gb/s (78.9%)	37.6 Gb/s (40.4%)	19.6 Gb/s (21.0%)

## 'Yearly' Graph (1 Day Average)



	Max	Average	Current
In	71.7 Gb/s (76.9%)	25.5 Gb/s (27.4%)	35.1 Gb/s (37.7%)
Out	73.5 Gb/s (78.9%)	25.6 Gb/s (27.4%)	38.0 Gb/s (40.8%)

# Facts about TPIX

- 18 members are using multiple 10G ports
- 16 members are using multiple 1G port
- 13 ICP- Content members including Akamai, Amazon, CloudFlare, Facebook, Google, Microsoft, Yahoo! etc.
- 21 ISP/ Carrier members
- 100G\*2 customer is on-the-way

34

members

73G

Peak Traffic

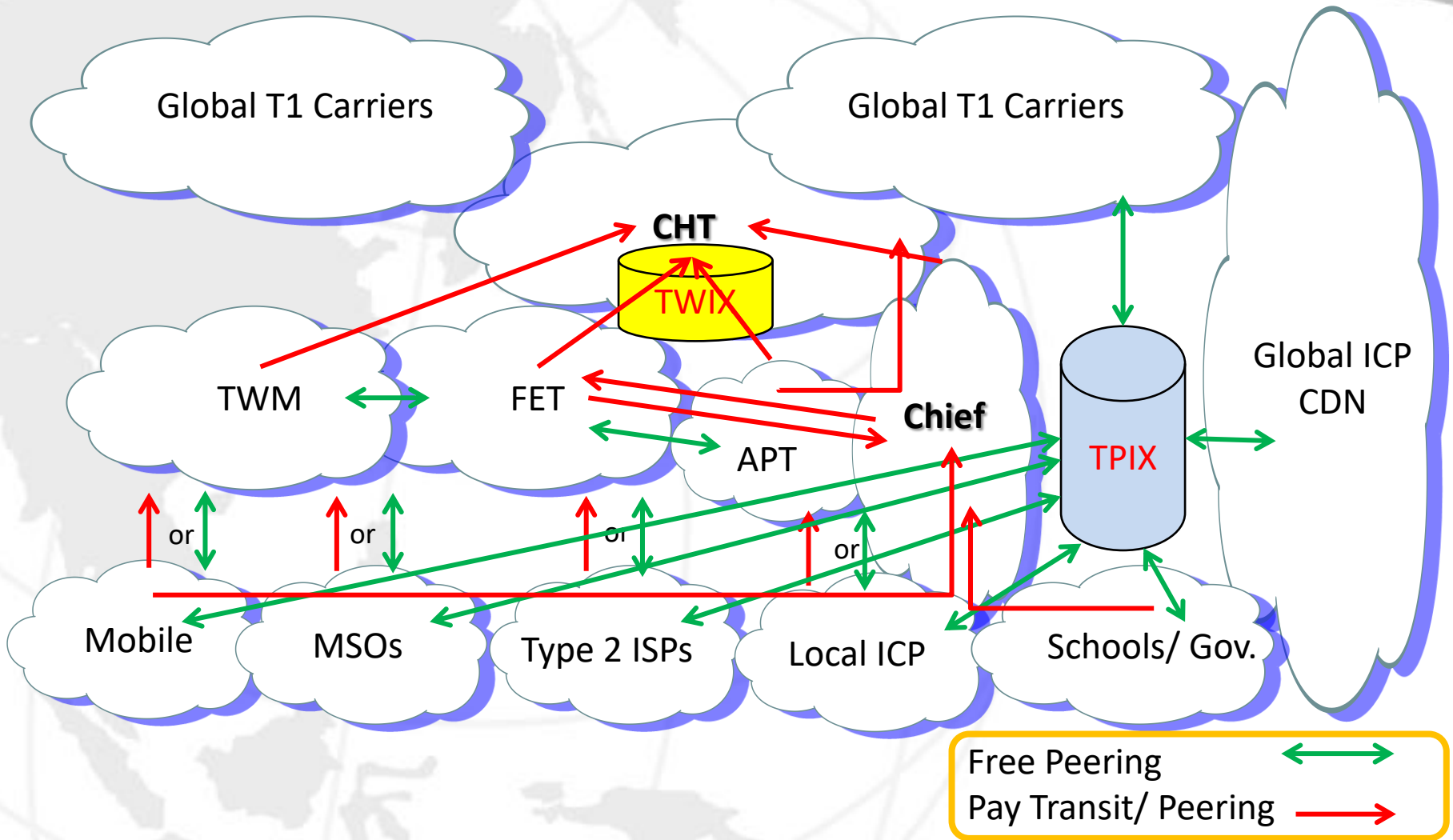
IPv4/v6

Supported

100G

Connection  
available

# Taiwan ISP Interconnection, Peering Status



# Where do Taiwan IXs Stand-

## 現況, 困境與展望

1. NO Peering, NO Internet!
2. IX is Home to Public Peering
3. Peering is typically Free
4. Private Peering is not IX's business
5. In IX, there is only "Open" or "Selective" peering policy.
6. Major ISPs in Taiwan don't want to join IX because:
  - a. They all want to sell "Peering" 通通想要賣Peering
  - b. Consumer's needs or performance requirement is not their major concern 民之所欲不在我心
  - c. They would rather keep it's position rather than cost down. 本位主義, 不願為中立IX抬轎
  - d. Whale eats shark. Shark eats tuna. 只想大魚吃小魚
  - e. 自己想做IX (或是不想做但也丟不掉)
  - f. 沒有類似美國Open Internet法律
7. 退一步海闊天空, 給台灣創新網路事業在台灣落地一個機會, 不然大家永遠都是網路外國人 (FB, AWS, Line, Google, Netflix, Wechat...)



<http://www.tpix.com.tw>

<http://www.chief.com.tw>

<https://www.facebook.com/chieftelecom/>

<https://www.facebook.com/williamluyau>

[William\\_lu@chief.com.tw](mailto:William_lu@chief.com.tw)