What do we do?

• Two fora per year
• Maintain and develop the website, database and tools
• Annual European IXP Report
• Mentor-IX programme
• Fellowship programme
• Benchmarking Club (BMC)
Talk to us and each other

• Mailing lists
• Newsletter – Subscribe here:
  • euro-ix.net/news-and-events/newsletter/
• Working Groups
• Social Media
  • Twitter @euroix
  • Facebook fb.me/maineuroix
  • YouTube youtube.com/channel/UCFyucVRAAMzxyJIsxnGwsjw
Association of IXPs

82 affiliated IXPs:
• 56 IXPs in the Euro-IX Region 49 Countries, operating over 100 Peering LANs
• 26 IXPs from the rest of the world
• Newest Members:
  Global-IX
  DataIX
Patrons

• Arista
• Brocade
• Ciena
• Coriant
• ECI Telecom
• Equinix I Telecity
• Extreme Networks

• Huawei
• Interxion
• Juniper Networks
• MRV
• Nokia
• Telehouse
What is an IXP?
What is an IXP?

- An Internet Exchange Point (IXP) is a network facility that enables the interconnection of more than two independent Autonomous Systems, primarily for the purpose of facilitating the exchange of Internet traffic.

- An IXP provides interconnection only for Autonomous Systems.

- An IXP does not require the Internet traffic passing between any pair of participating Autonomous Systems to pass through any third Autonomous System, nor does it alter or otherwise interfere with such traffic.

- “Autonomous Systems” has the meaning given in BCP6/RFC4271, “A Border Gateway Protocol BGP4”.

- “Independent” means Autonomous Systems that are operated by organisational entities with separate legal personality.
What is an IXP?

Explanation notes:

1. An Internet Exchange Point is a technical facility. This is distinct from the organisation that provides that facility, which might be termed an IXP operator.

2. An IXP is distinct from an Internet access network or a transit network/Carrier.

3. The function of an IXP is to interconnect networks. An IXP does not provide network access or act as a transit provider/Carrier. An IXP also does not provide other services unrelated to interconnection (although this does not preclude an IXP operator from also providing unrelated services).
What is an IXP?

Explanation notes contd.:

4. An IXP exists to interconnect networks that are technically and organisationally separate.
   
   a. Without qualification the term “network” is too flexible and fails to identify the degree or kind of separation required. Once interconnected, separate networks are arguably part of the same network: the entire Internet is often considered a network, a network of networks.

   b. To resolve this terminological problem we employ the term “Autonomous System”, which is the standard technical definition of a technically stand-alone network.
How do IXPs work?

- A typical IXP consists of one or more router / switch
- To which each of the participating networks can connect to
- The technical and business logistics of the traffic exchange between networks is governed by mutual peering agreements
Why do we need IXPs?
Why do we need IXPs?

- IXPs enable local traffic to stay local
- This increases efficiency of internet traffic and allows settlement-free peering rather than paying for transit, i.e. reduce cost
- Reduce latency
- Allows and encourages content to be accessed locally
- Reduces dependency on critical nation infrastructure
- Local content business has a higher chance of success
- Greater chance of local businesses to survive
- Can increase knowledge sharing and experience (via IXP meetings and mailing lists)
Why do we need IXPs?

Traceroute
Kujtesa -> Artmotion

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
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<tbody>
<tr>
<td>Tracing route to 84.22.48.99 over a maximum of 30 hops</td>
<td>Tracing route to 84.22.48.99 over a maximum of 30 hops</td>
</tr>
<tr>
<td>1 1 ms 1 ms 1 ms 192.168.1.1</td>
<td>1 1 ms 1 ms 1 ms 192.168.1.1</td>
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<tr>
<td>2 132 ms 102 ms 23 ms 10.255.31.254</td>
<td>2 40 ms 84 ms 22 ms 10.255.31.254</td>
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<td>3 146 ms 100 ms 102 ms 10.20.30.254</td>
<td>3 44 ms 17 ms 10 ms 10.20.30.254</td>
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<tr>
<td>4 24 ms 22 ms 21 ms 82.114.64.185</td>
<td>4 12 ms 23 ms 24 ms 82.114.64.185 [Kujtesa]</td>
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<tr>
<td>5 25 ms 62 ms 19 ms 79.101.105.229 [Telekom Srbija]</td>
<td>5 22 ms 16 ms 12 ms 192.168.100.12 [KOSIX]</td>
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<tr>
<td>6 23 ms 19 ms 18 ms 212.200.227.225</td>
<td>6 31 ms 24 ms 12 ms 84.22.32.198 [Artmotion]</td>
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<tr>
<td>7 24 ms 19 ms 109 ms 212.200.232.90</td>
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<tr>
<td>Trace complete.</td>
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**Improvement:**
- Drop from 13 to 7 hops
- Average 3-packet delay drop from 75ms to 22ms
Why do we need IXPs?

Ping
Kujtesa -> Artmotion

Before

Ping 84.22.48.99 with 32 bytes of data:
2.48.99: bytes=32 time=181ms TTL=245
2.48.99: bytes=32 time=199ms TTL=245

Ping statistics for 84.22.48.99:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Round trip times in milli-seconds:
1ms, Maximum = 199ms, Average = 163ms

After

Ping 84.22.48.99 with 32 bytes of data:
Reply from 84.22.48.99: bytes=32 time=14ms TTL=249
Reply from 84.22.48.99: bytes=32 time=13ms TTL=249

Ping statistics for 84.22.48.99:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 13ms, Maximum = 16ms, Average = 14ms
euro-IX

IXP Hosting
Hosting IXPs

- Location is Key

- Should be **Neutral** (not competing with customers)

- Should have enough space, environment control, security, power, access to terrestrial infrastructure, cabling, support

- IXPs generally abstain from carrying out any activity that may compete with member business activities or opportunities.
The Important Point is that the ownership and management of the IXP should always remain neutral.

Many IXPs begin with donations of equipment, rack space, labour, and other assistance. This is part of the cooperative nature of most start-up IXPs.

Neutrality can be at stake if one member owns parts of the IXP.

Therefore the IXP should always maintain ownership and responsibility of its assets.
IXP Models
IXP Models

Free IXP

• The IXP location is donated or paid for by a willing sponsor

• No membership, joining or paid for by willing sponsor

• Members contribute (donate) equipment, money, human resources and time to the IXP based on their ability and needs

• Examples, UIXP (Uganda), SIX (Seattle)
IXP Hosting

Subsidized Business Model

- Certain aspects and operational costs of the IXP are met by a sponsor for a sustained period of time

- In most cases the Government through development fund subsidize the IXP operating costs

- The IXP meets some of the operating costs by charging members a nominal fee

- Examples, IXPN (Nigeria), MYIX (Malaysia)
IXP Models

Independent Business Model

- All aspects of operational expenses are met by the IXP
- The IXP generates revenue by charging fees for the service
- Additional revenue from value added services
- Examples, KIXP (Kenya), JINX (South Africa) and most EU IXP
Netnod – Swedish Internet Exchange

• First peering agreement between SUNET (Swedish University Network) and Swipnet in 1990 – this was the first step to forming an IXP

• In 1991/1992 Ebone is formed to handle EU traffic

• In 1995 the idea of forming a distributed global internet exchange D-GIXes – would connect to Paris and Washington

• In 1996 it grew from 20 operators connected to 40 for a cost of 2000 USD a year
Getting started

Netnod – Swedish Internet Exchange

• In 1996 the Swedish government ran a study on critical infrastructure and identified –
  • .se
  • And internet exchanges

• Proposal was to build 5 IXPs, one per 1M population

• That was the beginning of Netnod – the Swedish IXP
Getting started

FICIX – Finnish Internet Exchange

- 1993 – initial agreement between Telecom Finalnd, Helsinki telephone company and Eunet to interconnect forming the IXP
- Initially exchanged traffic on 10Mpbs Ethernet hub
- 1996, upgraded to a 155-ATM switch
- 1999, Upgraded to 622-ATM switch
- 2001, association founded, 11 founding members
Getting started

FICIX – Finnish Internet Exchange

• 2002, upgraded to Gige technology

• 2004, first 10Gige ports delivered

• 2013, upgraded to 100Gige Technology

• Adding value
  • Developing membership services further
  • Extended services to enable VoIP transport between telco’s
  • Taking part in regulatory and security work as CIP organisation
Getting started
LINX – London Internet Exchange

• In November 1994, using a donated piece of equipment 5 ISPs in the UK linked their networks in order to exchange data and avoid paying astronomical transatlantic bandwidth costs

• The goal was to keep traffic local

• Switching the first data through the Telehouse hub was a momentous event that was accomplished by primarily technical specialists who were unconcerned about the formalities of legal contracts.
Getting started

LINX – London Internet Exchange

• From the beginning it was agreed that LINX would be a non-profit organisation run for the benefit of members and governed by them collectively through regular member meetings, a practice which continues to this day.

• In summer 1996 LINX became the first Internet exchange in the world to deploy a 100-megabit switch - a Cisco Catalyst 5000.

• In January 1999 it pioneered the implementation of a Metropolitan Area Network (MAN) running over gigabit Ethernet connections.
Getting started

LINX – London Internet Exchange

• LINX membership reached 200 in mid-2006.

• In 2012, the first 100G member port went live (for BT), just before the start of the London Olympic Games.

• 2012 saw the launch of the ConneXions reseller programme.

• IXScotland went live in November 2013.

• In 2014 LINX opened an IXP in the USA
Website and the IXP Database
Website – Top Improvements!

1. ASN Automation
2. Switch Database
3. Route Server Database
4. Peering matrix, service matrix and ASN
5. Database quality improvements
6. Edit your organisation and team members
### Organization Profile

**Internet Neutral Exchange Association**

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**Edit**
## IXP Database

### Organization Profile

**Amsterdam Internet Exchange B.V.**

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### IXP Database

#### IXP Profile

**Internet Neutral Exchange Association**

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#### Traffic


- **ASN Link**: ✔
- **Traffic Link**: ✗
## IXP Database

### ASN Database

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### IXP Database

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 ixPs

AMS-IX
AMS-IX Bay Area
AMS-IX Chicago
AMS-IX Hong Kong
AMS-IX New York
BBIX - Tokyo
BCIX
BIX.BG
BIX
Big APE
CATNIX
CoreSite - Any2 Denver / RIX Denver
CoreSite - Any2 Los Angeles
DE-CIX Frankfurt
DE-CIX Hamburg
DE-CIX Marseille
DE-CIX Munich
DE-CIX New York
DIX - Lyngby
ECIX Berlin
# IXP Database

## Peering Matrix

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# IXP Database

## IXP Service Matrix

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IXP Database

Switch Database

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IXP Database – where are we?

- Database schema is in place for IXPs to record their information about themselves and the operators they serve

- IXP API is live - [https://db.ix-f.net/api/ixp](https://db.ix-f.net/api/ixp)
IXP Database – What’s next?

- Extend and internationalise the admin interface for all IXPAs (APIX, LAC-IX and AF-IX)
- Create bespoke maintained APIs
- Future revisions to the database schema to capture more data
Thanks to Andy Davidson for the example

“who am I not peering with at LONAP?”

• You have a script which load direct adjacencies into an array
• You need a complete and canonical list of peers to compare differences
IXP Database – use case

Using the IXP API

https://db.ix-f.net/api/ixp
IXP Database – use case

```json
{
  "ixp_info": {
    "status": "active",
    "updated": "2014-02-17T08:07:51Z",
    "name": "London Network Access Point",
    "created": "2011-08-16T13:36:26Z",
    "shortname": "LONAP",
    "ixp_id": "IX-F#18"
  },
  "timestamp": "2015-09-16T08:17:31.116Z",
  "version": "2014110401",
  "member_list": [
    {
      "asnnum": 28915,
      "name": "180 Percent"
    },
    {
      "url": "http://www.2connectbahrain.com/",
      "asnnum": 51406,
      "name": "2Connect"
    },
    {
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      "asnnum": 41337,
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      "asnnum": 21321,
      "name": "Alentus UK Ltd"
    }
  ]
}
```
IXP Database – use case

```python
import urllib, json

url = "http://db.ix-f.net/api/ixp/18/member-list"
response = urllib.urlopen(url)

ixpdata = json.loads(response.read())

my_peers = [8916, 20940, 20915, 51406, 41357, 31463, 12041, 21321, 12536, 16509, 20712, 33920, 4

for member in ixpdata["member_list"]:
    if member["asnum"] not in my_peers:
        print "Get some peering with " + str(member["name"])
```

IXP Database – use case

```
enigma:Desktop andy$ python ixp.py
Get some peering with 6871 (PlusNet)
Get some peering with 8689 (PowerGroup (Power Internet Ltd))
Get some peering with 8676 (PRT Systems)
Get some peering with 28792 (Public Internet Limited)
Get some peering with 31402 (Rank Interactive (Blue Square Limited))
Get some peering with 35662 (Redstation)
Get some peering with 5552 (Redstone Communications Ltd)
Get some peering with 5503 (RM Education Plc)
Get some peering with 51409 (Sectorsix)
Get some peering with 50056 (Advantage Interactive Ltd)
Get some peering with 29550 (Simply Transit Ltd.)
Get some peering with 48961 (Warwicknet Ltd)
Get some peering with 20738 (Webfusion)
Get some peering with 44444 (Websense Hosted R&D Ltd. (UK))
Get some peering with 49158 (Wifinity)
Get some peering with 13037 (Zen Internet)
enigma:Desktop andy$
```
• Contains both IXP data & IXP participant data
• ASN (member list), locations, switch, RS, etc etc
• Open, consistent & an atomic design
• Currently 24 IXP independent implementations
  (API includes data from euro-ix portal entered manually or via .csv)
• Open source implementation in IXP Manager
• Source available on GitHub;
  https://github.com/euro-ix/json-schemas
Why not just use the IXPs own data?

- This gives you a single API for many IXPs
- Get the same format for all IXPs, its standard – wohoo!
- Data is fed from the IXP – IXPs have accurate data, they own it.
- Portable, supportable and scale-able!
In search of accurate information

- Peering networks can go to two sources of data to guarantee accuracy
- Tools and portal available on the Euro-IX website, future development for APIX, LAC-IX and AF-IX
- IXPAs have regional reach to local IXPs
- The data is complementary to database services that the RIR/NIRs & PeeringDB provide
Thank You!

Bijal Sanghani
bijal at euro-ix dot net
Twitter: @euroix