IXP Manager Workshop Introduction

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Company Limited by Guarantee

Johnson's Normans

Longmans, Green & Co., London, New York & Bombay.

dublin

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IXP Manager Workshop

INEX Overview

- Founded in 1996
- 95 peering members
- ~230Gbit/s peak traffic
- Two infrastructures, 6 points of presence in Dublin
- Local IXP in Cork

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IXP Manager Workshop

IXP Manager

- Full stack Management system for IXPs
- LAMP - Linux / Apache / PHP / MySQL
  - Any free unix clone
  - Any web server which supports PHP
  - MariaDB
  - Some Perl where PHP doesn't work well
- Open source software - GPLv2
- Available on github.com/inex

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History

- Early experience with operating an IXP using Excel and txt files (didn't work well)
- First CVS commits to IXP Manager v0.1 in May 2005
  - Based on in-house PHP framework written for another project in 2001/2002
  - In 2008, reduced route-server config complexity to a single tickbox per member
- Strategic realisation that INEX needed to invest in either people or software
- Hired Barry O'Donovan in 2008 to develop the application part-time
- Immediate decision to rewrite from scratch using Zend Framework
- IXP-Manager v1.0 deployed at INEX in July 2009
- Code de-INEX'd and released as IXP Manager v3.0 in Nov 2012.

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Current Status

- Full-time developer, Yann Robin, hired in Dec 2016
- IXP Manager v4 is mostly an infrastructure update
  - Current software release is v4.7.3
  - Migration from Zend Framework to Laravel nearly complete
  - Important but invisible work
- IXP Manager v5 will add new features
- Development model is mostly linear
- In production at 53 IXPs worldwide

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Development Model

- Development structure can be found on www.ixpmanager.org
  - 3 year development plan, with sponsored funding model
  - Currently main sponsors are ISOC, Netflix and SwissIX
  - Additional funding: GR-IX, NIX, SwissIX, STH-IX, Interlan, LONAP and DE-CIX
- All copyright owned by INEX - Internet Neutral Exchange Association CLG
- Day-to-day development handled by Island Bridge Networks Ltd
- Annual project report is publicly available from the web site
- Full financial details provided annually to all sponsors
- Euro-IX audit committee due to examine project accounts

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Functionality

- Administrative portal for managing an IXP
- Abstracted model of an IXP which includes:
  - Infrastructures, VLANs, locations, cabinets, patch panels, switches, switch ports, IP addresses, MAC addresses, IXP members, user accounts, route servers, IRRDB configuration
- Monitoring information includes per-member statistics (bits, packets, errors, discards), p2p traffic from sflow telemetry and Peering Matrix
- Integration with third party packages (Birdseye Looking Glass), BIRD, BIND, Mailman, smokeping, tac_plus4, Nagios, etc
- Member login system provides Peering Manager, route server prefix analysis tool, graph views

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Search for...

IXP CUSTOMER ACTIONS

Customers
Interfaces / Ports
Sflow Receivers
Patch Panels
Users
Contacts
Colocated Equipment

IXP ADMIN ACTIONS

Infrastructures
Facilities
Racks
Routers
Switches
Core Bundles
IP Addresses
MAC Addresses
Vendors
Console Server Connections
VLANs
IRRDB Configuration
Route Server Prefixes

IXP STATISTICS

Member Statistics - Graphs

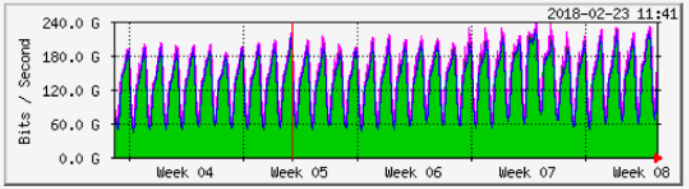
Customer Type	Count
Full	97
Associate	23
Internal	2
Pro-bono	5

Customer Ports by Location

Location	100 Mbits	1 Gbits	10 Gbits	100 Gbits	Total
Interxion DUB2	0	2	1	0	**3**
Equinix DB1 (Citywest)	5	18	46	1	**70**
Equinix DB2 (Kilcarbery)	3	36	34	0	**73**
Equinix DB3 (NWBP)	0	6	16	0	**22**
Vodafone Willsborough	0	1	2	0	**3**
Interxion DUB1	0	13	12	3	**28**
Cork Internet Exchange	0	11	9	0	**20**
Totals	**8**	**87**	**120**	**4**	**219**

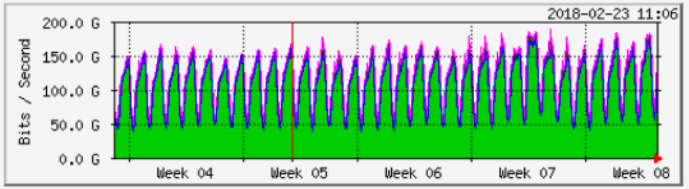
Customer Ports by Infrastructure

INEX Aggregate Traffic



	Max	Average	Current
In	236.446 Gbits	131.986 Gbits	153.209 Gbits
Out	236.594 Gbits	131.983 Gbits	153.200 Gbits

INEX LAN1 Aggregate Traffic



	Max	Average	Current
In	187.423 Gbits	106.700 Gbits	128.552 Gbits
Out	187.491 Gbits	106.711 Gbits	128.553 Gbits

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User Portal

- Graphs and Statistics, Cross-connects, Port configuration
- Peering Manager
  - Provides an interface to help IXP participants handle bilateral peering
  - System for sending templated emails
  - “De-mystification” mechanism to make it easier for IXP users
- Route server prefix analysis tool
  - Compares prefixes learned via BGP to route server to what members have included in their irrDB policy
  - IXP Manager uses strict IRRDB filtering by default
- IXP administrators can temporarily switch privileges to any user

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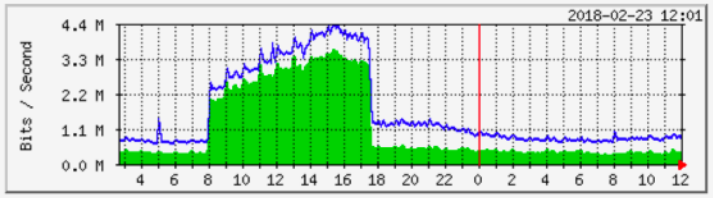
Aggregate Peering Statistics



	Max	Average	Current
In	3.596 Mbits	1.108 Mbits	387.704 Kbits
Out	4.358 Mbits	1.619 Mbits	938.736 Kbits

Recent Members

Our three most recent members are listed below. Have you arranged peering with them yet?

Name	AS Number	Date Joined	Peering Contact
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

Your Logo

You have not uploaded a logo which means it is not currently displayed on our public website. Please click here to add one now.

IXP Manager Workshop

IXP Port Configuration

- Supports all the usual things you'd expect to see at an IXP
- Enables port configuration using an abstracted model
  - Physical interfaces: what you plug a cross-connect into
  - VLAN interfaces: what the customer sees
  - Virtual interfaces: attaches vlan interfaces to physical interfaces

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Search for...

IXP CUSTOMER ACTIONS

Customers
Interfaces / Ports
Physical Interface
Vlan Interface
Sflow Receivers
Patch Panels
Users
Contacts
Colocated Equipment

IXP ADMIN ACTIONS

Infrastructures
Facilities
Racks
Routers
Switches
Core Bundles
IP Addresses
MAC Addresses
Vendors
Console Server Connections
VLANs
IRRDB Configuration
Route Server Prefixes

IXP STATISTICS

Home / (Virtual) Interfaces / Edit Physical Interface

Physical Interface Settings

Switch swi1-nwb1-1

Switch Port Ethernet11 (Peering)

Status Connected

Speed 1 Gbps

Duplex full

Auto-Negotiation Enabled

Monitor Index 1

Notes

Save Changes | Cancel | Help

Search for...

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Route Server Prefixes

IXP STATISTICS

/ Home / Vlan Interfaces / Edit VLAN Interface (AS112 Reverse DNS [AS112])

General VLAN Settings

Vlan Peering VLAN #1

Max BGP Prefixes 0

- [ ] Multicast Enabled
- [ ] Busy host
- [x] IPv6 Enabled
- [x] IPv4 Enabled
- [x] Route Server Client
- [x] Apply IRRDB Filtering
- [ ] IRRDB - Allow More Specifics?
- [ ] AS112 Client

IPv6 Details

IPv6 Address 2001:7f8:18::6

IPv6 Hostname as112-vl10.inex.ie

IPv6 BGP MD5 Secret

- [ ] IPv6 Ping Allowed / Possible
- [x] IPv6 Monitor Route Collector BGP

IPv4 Details

IPv4 Address 185.6.36.6

IPv4 Hostname as112-vl10.inex.ie

IPv4 BGP MD5 Secret

- [x] IPv4 Ping Allowed / Possible
- [x] IPv4 Monitor Route Collector BGP

Save Changes | Cancel | Help

Search for...

IXP CUSTOMER ACTIONS

- Customers
- Interfaces / Ports
  - Physical Interface
  - Vlan Interface
- Sflow Receivers
- Patch Panels
- Users
- Contacts
- Colocated Equipment

IXP ADMIN ACTIONS

- Infrastructures
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- IRRDB Configuration
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IXP STATISTICS

Customer AS112 Reverse DNS

Use 802.1q framing

Link aggregation / LAG framing

Type Peering

Save Changes | Help | Advanced Options | Return to Customer Overview

Physical Interfaces

Facility	Peering Port	Speed/Duplex
Equinix DB3 (NWBP)	swi1-nwb1-1 :: Ethernet11	1 Gbps / full duplex AN

VLAN Interfaces

VLAN Name	VLAN Tag	Configured MAC Address(es)	IPv4 Address	IPv6 Address
Peering VLAN #1	10	0a:9a:1a:ce:42:9f	185.6.36.6	2001:7f8:18::6

Sflow Receivers

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MAC Addresses

- Static MAC addresses
  - Allows the IXP operator to configure a list of MAC addresses per VLAN interface
  - This information is exportable and can be used to configure switches
- Dynamic MAC addresses
  - A database of MAC addresses pulled from the IXP switches via SNMP
  - Used for Sflow integration and the Peering Matrix

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Patch Panels

- Everyone has difficulty with patch panels and cross-connects
  - … including data centres
- Most people manage their cross-connect deployments using
  - Text files
  - Spreadsheet
  - Wiki
  - Post-it notes

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Search for...

IXP CUSTOMER ACTIONS

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- Interfaces / Ports
- Sflow Receivers
- Patch Panels
  - Patch Panel Port
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IXP ADMIN ACTIONS

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IXP STATISTICS

- Member Statistics - Graphs

Show 10 entries

Search:

Name	Rack	Colocation	Type	Ports Available	Installation Date	Action
DUB02.17.R01.01	INEX-PWT2-1	IE.DUB.DUB2.19.DDF1.U01	UTP / RJ45	22 / 24	2017-03-27	
DUB02.17.R01.01.U41	INEX-PWT2-1	IE.DUB.DUB2.19.ODFB.U77	SMF / SC	5 / 6 | 10 / 12	2017-03-27	
DUB02.17.R01.01.U43	INEX-PWT2-1	IE.DUB.DUB2.19.ODFA.U78	SMF / SC	3 / 6 | 6 / 12	2017-03-27	
IE.DUB.DUB1.19.R01.ODF05.U47.J	INEX-PWT1-1	IE.DUB.DUB1.19.R01.ODF05.U47.J	SMF / LC	9 / 12 | 18 / 24	2017-09-04	
IE.DUB.DUB1.19.R01.ODF05.U47.K	INEX-PWT1-1	IE.DUB.DUB1.19.R01.ODF05.U47.K	SMF / LC	12 / 12 | 24 / 24	2017-09-04	
IE.DUB.DUB1.2B.R03.01.U1-6.A	INEX-PWT1-1	IE.DUB.DUB1.19.R01.ODF04.U47	SMF / SC	1 / 6 | 2 / 12	2014-11-14	
IE.DUB.DUB1.2B.R03.01.U1-6.B	INEX-PWT1-1	IE.DUB.DUB1.19.R01.ODF04.U46	SMF / SC	2 / 6 | 4 / 12	2014-11-14	
IE.DUB.DUB1.2B.R03.01.U46	INEX-PWT1-1	IE.DUB.DUB1.2B.R03.01.U46	SMF / SC	0 / 12 | 0 / 24	2013-07-01	
IE.DUB.DUB1.2B.R03.01.U48	INEX-PWT1-1	IE.DUB.DUB1.2B.R03.01.U48	UTP / RJ45	13 / 24	2013-07-01	
L17-U47-C1	INEX-CIX-1	L17-U47-C1	SMF / LC	0 / 12 | 0 / 24	2016-04-01	

Showing 1 to 10 of 45 entries

Previous 1 2 3 4 5 Next

IXP Manager Workshop

Patch Panels

- IXP Manager's patch panel support includes
  - Fibre, UTP, different termination types
  - Simplex / duplex connections
  - Live-links to IXP port configurations
  - Simplex / duplex connections
  - Cross-connect history
  - Customer-visible and private notes
  - LOAs via email (PDF) with authentication via live-links
- Doesn't support circuits or linking cross-connects together

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Search for...

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Sflow Receivers
Patch Panels
Patch Panel Port
Users
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Colocated Equipment

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IRRDB Configuration
Route Server Prefixes

IXP STATISTICS

Member Statistics - Graphs

Ports for PP:[redacted] [Worker] (Colo Ref: PP:[redacted]) INEX-CWT1-1, Equinix DB1 (Citywest) [SMF/SC]

Search:

Name	Description / Switch / Port	Customer	Colocation Ref	Flags	Assigned at	State	Action
F1/F2 (1)	**Link to Vodafone Clonshaugh**	INEX	[redacted]	INT €	2013-04-17	Connected	Action 0
F3/F4 (2)	swi1-cwt1-1 :: Ethernet8	[redacted]	[redacted]	N-	2013-02-18	Connected	Action 0
F5/F6 (3)	swi1-cwt1-1 :: Ethernet9	[redacted]	[redacted]	N+	2013-03-29	Connected	Action 0
F7/F8 (4)	**Core**: Eunetworks Metro KCP1-CWT1 ([redacted])	INEX	[redacted]	INT N-	2017-05-08	Connected	Action 0
F9/F10 (5)	swi1-cwt1-1 :: Ethernet11	[redacted]			2009-11-20	Connected	Action 0
F11/F12 (6)		[redacted]	[redacted]	N-	2014-10-10	Connected	Action 0

Showing 1 to 6 of 6 entries

IXP Resellers

- Many IXPs introducing reseller programs
- A “customer” can be both a reseller and an IXP participant
- Supported for fan-out ports
  - Resellers see their fanout ports
  - Resold members see their peering ports
  - Requires either physical fanout or else sub-interface fanout
- No reduction in functionality for resold members
- MRTG / P2P graphing all compatible
- Skin API documented at: http://git.io/he2RmQ

Graphing

- Three primary graphing interfaces available
- MRTG
  - Used for bits, packets, errors, discards
  - Simple but functional - allows abstraction of the switch interface name
  - Potential scalability issues on larger IXPs
- Smokeping
  - Measures RTT to all routers on the IXP
  - Mostly measures how busy the remote control plane is
  - Invaluable for debugging connectivity problems

Graphing

- Sflow
  - Custom-built interface to process sflow flow records
  - Used for peer-to-peer graphs and BGP peering matrix
  - Peer-to-peer are considered invaluable by IXP participants
  - Functionality depends on sflow support on the IXP switches
    - Hardware support for sflow is mixed but improving
    - Native support in all recent Broadcom and Mellanox chipsets
    - Some vendors don’t make this work properly at the user level
  - FreeBSD UFS found to work better than Linux ext3 for RRD store

Search for...

IXP CUSTOMER ACTIONS
Customers
Interfaces / Ports
Sflow Receivers
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IXP ADMIN ACTIONS
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IPv4/6 Addresses
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Console Server Connections
VLANs
IRRDB Configuration
Route Server Prefixes

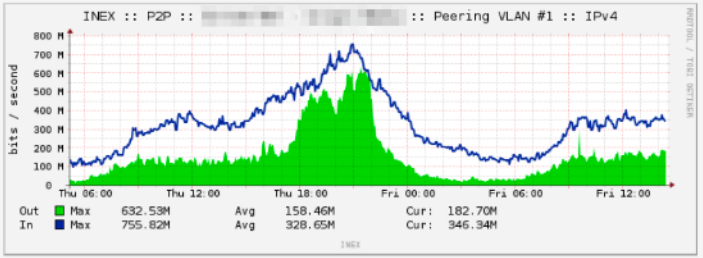
IXP STATISTICS
Member Statistics - Graphs

Traffic exchanged with: [redacted]

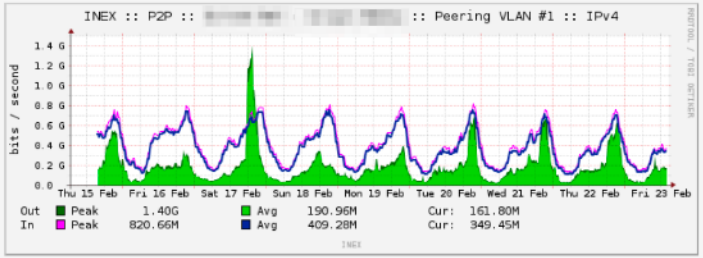
Return

LAN: Peering VLAN #1 | Graph Type: Bits | Protocol: IPv4 | Submit »

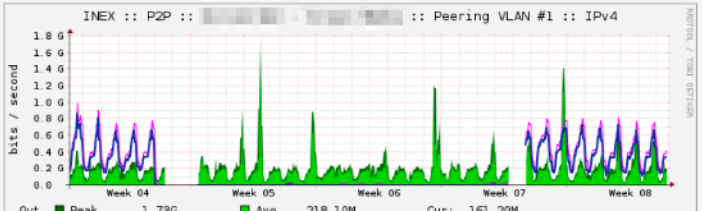
Day



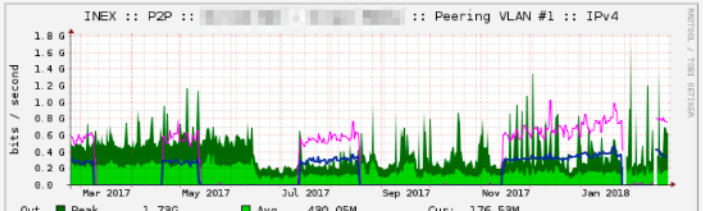
Week



Month



Year



IXP Manager Workshop

Route Servers

- Critical for all IXPs due to overhead of maintaining full-mesh bilateral peering
- Generates secure-by-default configurations
  - Strict prefix and ASN filtering enabled using IRRDB info
    - Can be disabled per customer. This is a really bad idea. Don't disable it.
  - MD5 and per-protocol max prefixes
- Default templating skin doesn't support RPKI
  - RPKI on route servers is more subtle than it looks
- Implementation is designed to discourage manual hacks (this is a feature)

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IRRDBs

- Used for Route server configuration generation
- Allows admin-defined IRRDB evaluation policies
  - Custom IRRDB policy can be configured per member
- Building complex prefix lists can cause performance problems
  - phase 1: pull IRRDB route objects to local DB using bgpq3
  - phase 2: build prefix lists from local DB
- Won’t work with Quagga for some ASNs
- Needs PHP-DS add-on module

IXP Manager Workshop

Templating and APIs

- Each IXP shares a common set of requirements but also has its own needs
- IXP Manager supports Skins and an API-based data exporter
- Skins
  - High complexity level
  - Written with PHP and Smarty
  - Intended for complex functionality, e.g. Route Server config
  - All functionality bundled with IXP Manager distribution
  - Can be extended on local installations, but care needed for future portability
  - Used for almost everything from User-Interface to “Routers” to graphing

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Skin Example: Routers

- An IXP Manager Router is an abstraction of a device which speaks BGP
  - Route server, route collector, AS112
- Trivially easy to create router instances for this functionality (INEX has 30)
- Integrates fully with Birds Eye Looking Glass
- Current skins support only BIRD
- Previous versions of IXP Manager also supported Quagga
  - Difficult to manage this because it lacks atomic config rewrite + reload
- Other options available:
  - OpenBGPD, GoBGP

Search for...

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- Sflow Receivers
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IXP ADMIN ACTIONS

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  - Live Status
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- IP Addresses
- MAC Addresses
- Vendors
- Console Server Connections
- VLANs
- IRRDB Configuration
- Route Server Prefixes

IXP STATISTICS

- Member Statistics - Graphs

/ Home / Router / Edit 13

Handle*	rc1q-lan1-ipv4
Vlan	Quarantine VLAN - LAN1
Protocol	IPv4
Type	Route Colllector
Name*	INEX LAN1 - Quarantine Route Collector - IPv4
ShortName*	RC1 - LAN1 - IPv4
Router ID*	185.6.36.126
Peering IP	185.6.36.126
ASN*	2128
Software	Bird
Management Host*	10.39.5.214
API Type	Birdseye
API Endpoint	http://rc1q-lan1-ipv4.mgmt.inex.ie/api
LG Access Privileges	PUBLIC

IXP Manager Workshop

Templating and APIs

- API Data Exporters
  - exports core database information in abstracted format
  - Supports JSON and YAML output
  - This can be fed into your favourite templating system
    - e.g. INEX uses Smarty and Jinja2/SaltStack
    - No issues with using your own favourite templating mechanism
  - Future portability assured with REST endpoint stability
  - INEX is likely to move some “core” functionality to this mechanism
  - Documentation is in progress for these APIs
  - IX-F / Euro-IX JSON data export schema works out of the box

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Summary

- Full stack IXP administration application
- Supports most things that IXPs need to do
- Suitable for most IXPs
- In active development with sponsorship from many organisations
- Community Supported
- Join mailing list at: www.ixpmanager.org/support.php
- It will make your life easier

THANK YOU

Thanks!

INEX