INEX

IXP Manager Introduction

AfIX, Mauritius
August 2019

Nick Hilliard

Chief Technical Officer
Internet Neutral Exchange Association
Company Limited by Guarantee

dublin

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IXP Manager Workshop

INEX Overview

- Founded in 1996
- 104 peering members
- ~320Gbit/s peak traffic
- Two infrastructures, 7 points of presence in Dublin
- Local IXP in Cork

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IXP Manager

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

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.

Current Status

- Full-time developer, Yann Robin, hired in Dec 2016
- IXP Manager v5 completed in May 2019
  - Mostly an infrastructure update
  - Migration from Zend Framework to Laravel completed
  - Important but invisible work
- Now adding new features
- Development model is mostly linear
- In production at ~75 IXPs worldwide

IXP Manager Workshop

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, SwissIX and Facebook
  - Additional sponsorship: APNIC, ZA-INX, STH-IX, GR-IX, Interlan, NaMeX, NIX
  - Other funding from: LONAP, 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

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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

Search for...

IXP CUSTOMER ACTIONS

- Customers
- Interfaces / Ports
- Patch Panels
- Users
- Contacts
- Colocated Equipment

IXP ADMIN ACTIONS

- Infrastructures
- Facilities
- Racks
- VLANs
- Switches
- Routers
- Console Servers
- Core Bundles
- IP Addresses

Dashboard

Overall Customer Numbers

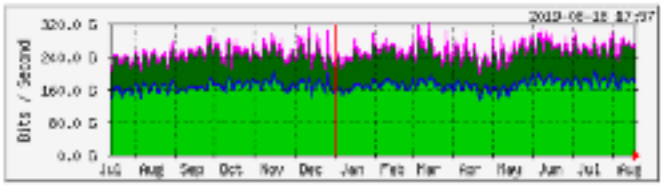
Customer Type	Count
Full	104
Associate	16
Internal	2
Pro-bono	6

Customers by Location

Location	Customers
Equinix DB2 (Kilcarbery)	77
Equinix DB1 (Citywest)	58
Interxion DUB1	38
Cork Internet Exchange	19
Equinix DB3 (NWBP)	17
BT Citywest	12
Interxion DUB2	6
Vodafone Willsborough	1

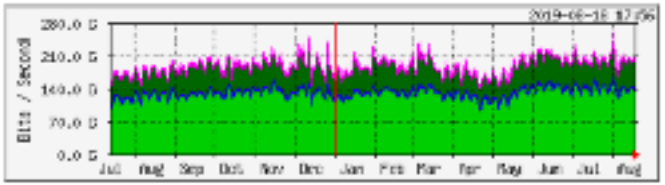
Day Week Month Year

INEX Aggregate Traffic



	Max	Average	Current
In	317.028 Gbits	168.602 Gbits	82.110 Gbits
Out	317.028 Gbits	168.851 Gbits	92.137 Gbits

INEX LAN1 Aggregate Traffic



	Max	Average	Current
In	254.873 Gbits	128.354 Gbits	75.202 Gbits
Out	256.106 Gbits	129.397 Gbits	76.730 Gbits

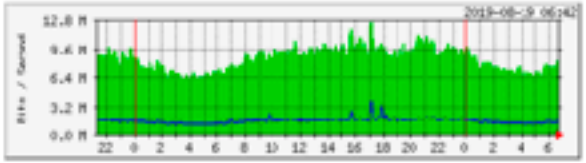
User Portal

- 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

Your INEX - IXP Manager Dashboard

Overview | Details | Ports | Cross Connects | Filtered Prefixes » | P2P » | Peering Manager » | Statistics » | Peer to Peer Traffic »

Aggregate Traffic Statistics



	Max	Average	Current
In	14.460 Mbits	8.331 Mbits	8.067 Mbits
Out	5.261 Mbits	1.477 Mbits	1.352 Mbits

Recent Members

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

Name	AS Number	Date Joined
Sirius	AS60501	2019-06-24
Convergenze	AS39120	2019-03-29
Titania Networks Limited	AS56911	2019-02-04
RETN	AS9002	2019-01-28
SIPSYNERGY	AS51409	2018-10-12

Your Logo

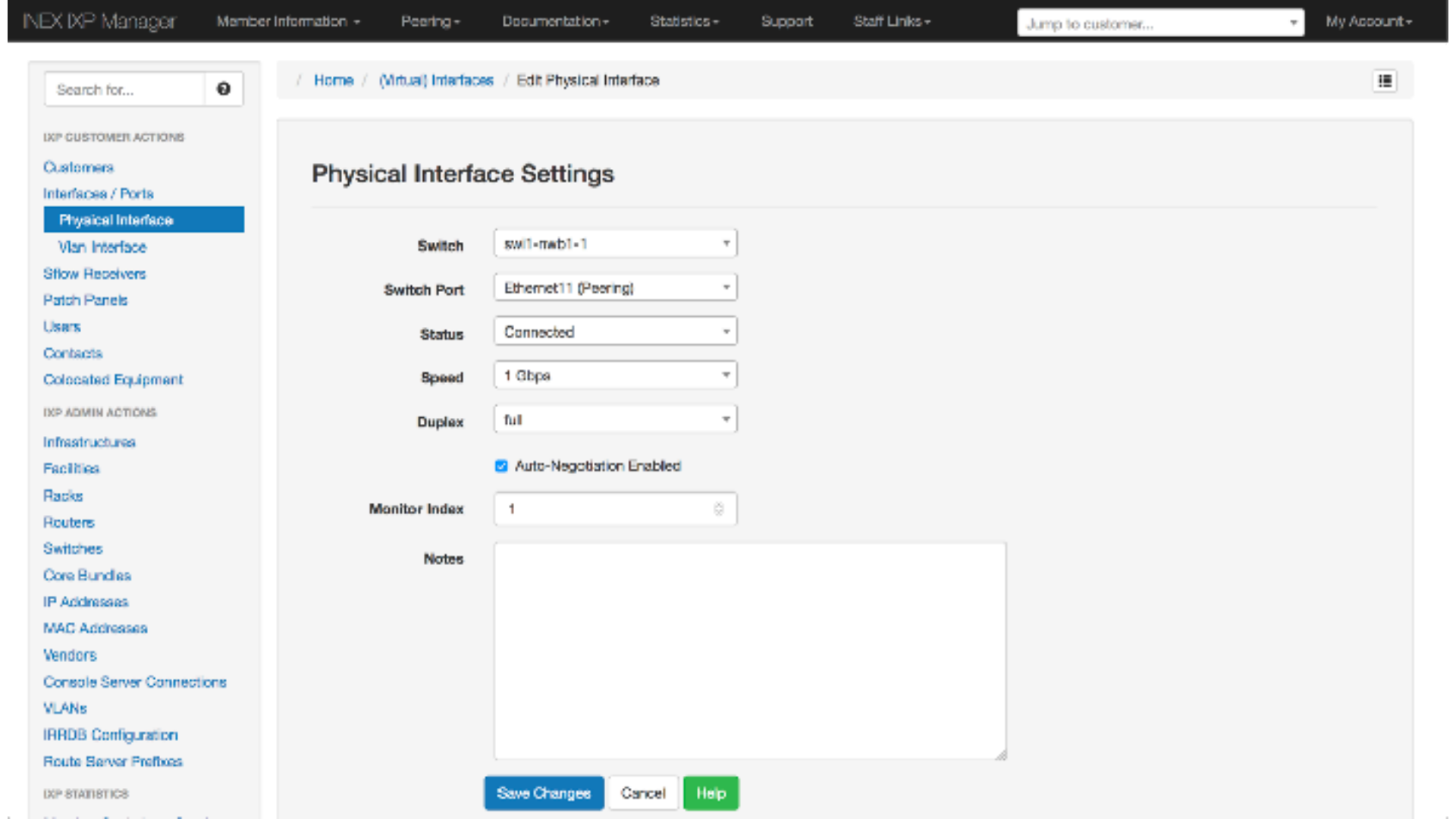
No logo uploaded which means it is not currently displayed on our public website. Please click here to add one now.

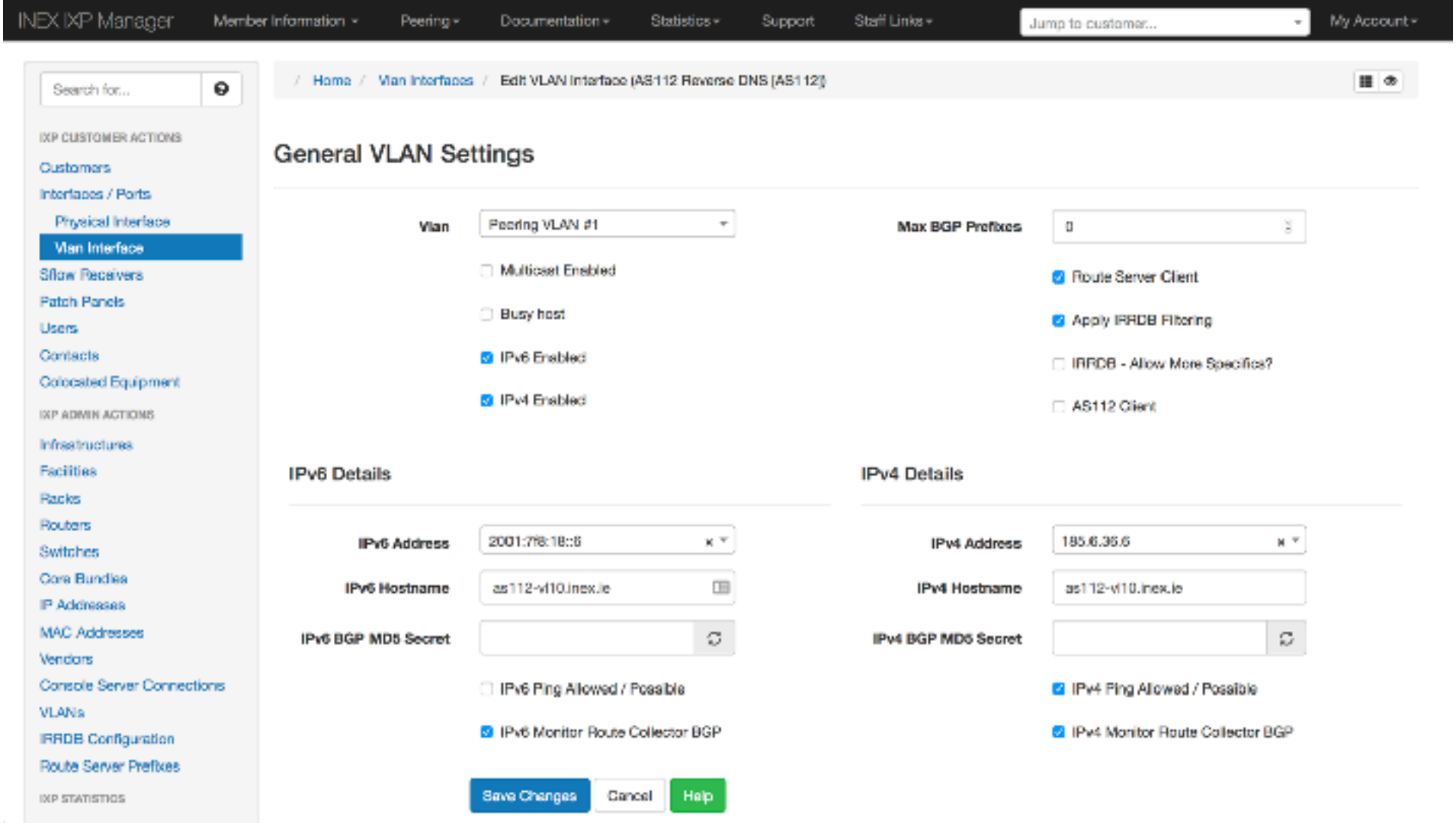
IXP Manager Workshop

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

INEX


INEX IXP Manager
Member Information
Peering
Documentation
Statistics
Support
Staff Links
Jump to customer...
My Account
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-mab1-1
Switch Port
Ethernet11 (Peering)
Status
Connected
Speed
1 Gbps
Duplex
full
Auto-Negotiation Enabled
Monitor Index
1
Notes
Save Changes
Cancel
Help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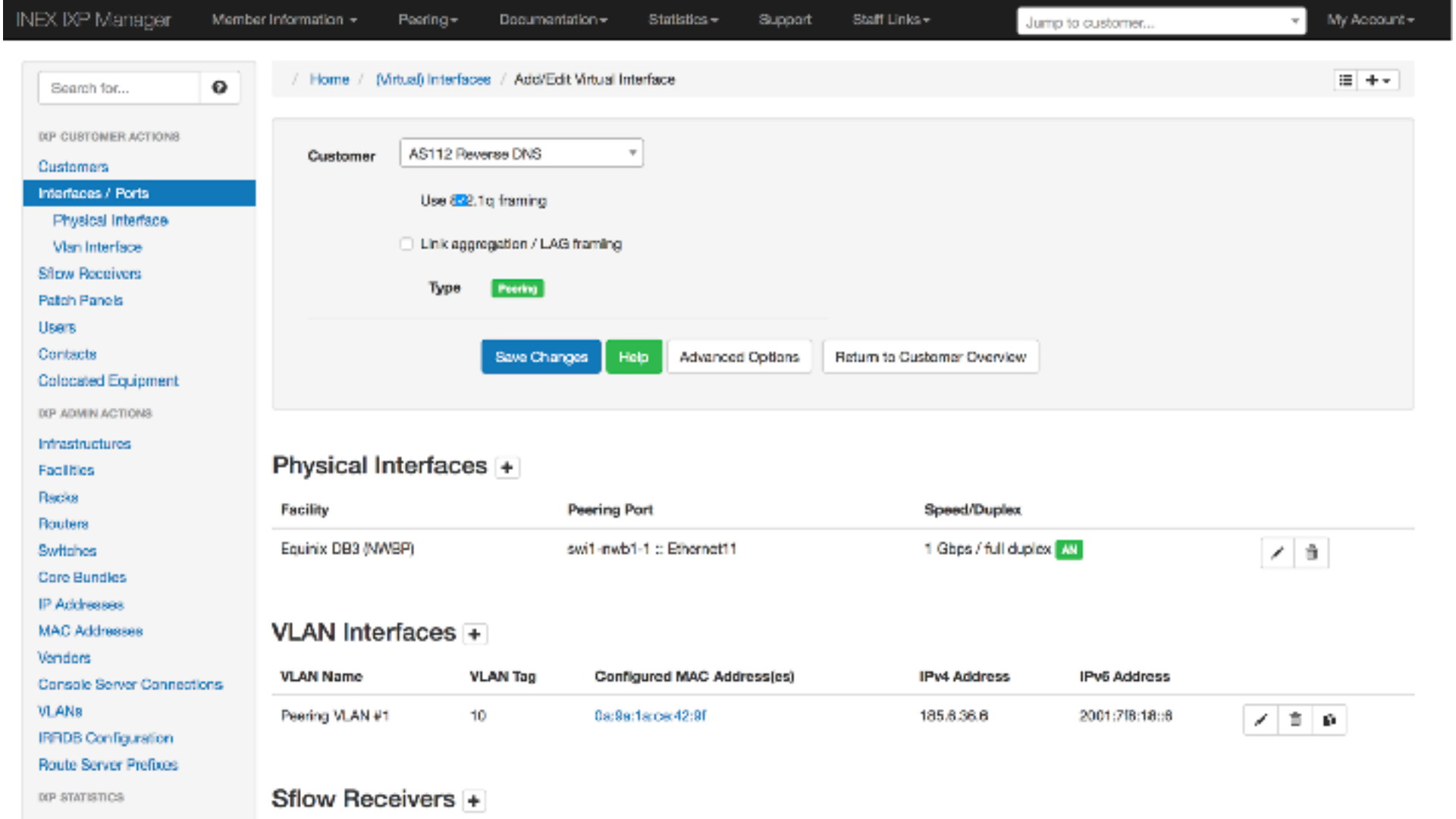
IXP STATISTICS
Home / Vlan Interfaces / Edit VLAN Interface (AS112 Reverse DNS (AS112))
General VLAN Settings
Vlan
Peering VLAN #1
Multicast Enabled
Busy host
IPv6 Enabled
IPv4 Enabled
Max BGP Prefixes
0
Route Server Client
Apply IRRDB Filtering
IRRDB - Allow More Specifics?
AS112 Client
IPv6 Details
IPv6 Address
2001:7f8:18::6
IPv6 Hostname
as112-v110.inex.ie
IPv6 BGP MD5 Secret
IPv6 Ping Allowed / Possible
IPv6 Monitor Route Collector BGP
IPv4 Details
IPv4 Address
185.6.36.6
IPv4 Hostname
as112-v110.inex.ie
IPv4 BGP MD5 Secret
IPv4 Ping Allowed / Possible
IPv4 Monitor Route Collector BGP
Save Changes
Cancel
Help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IXP STATISTICS
/ Home / (Virtual) Interfaces / Add/Edit Virtual Interface
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 (NWSP)
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

IXP Manager Workshop

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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IXP Manager Workshop

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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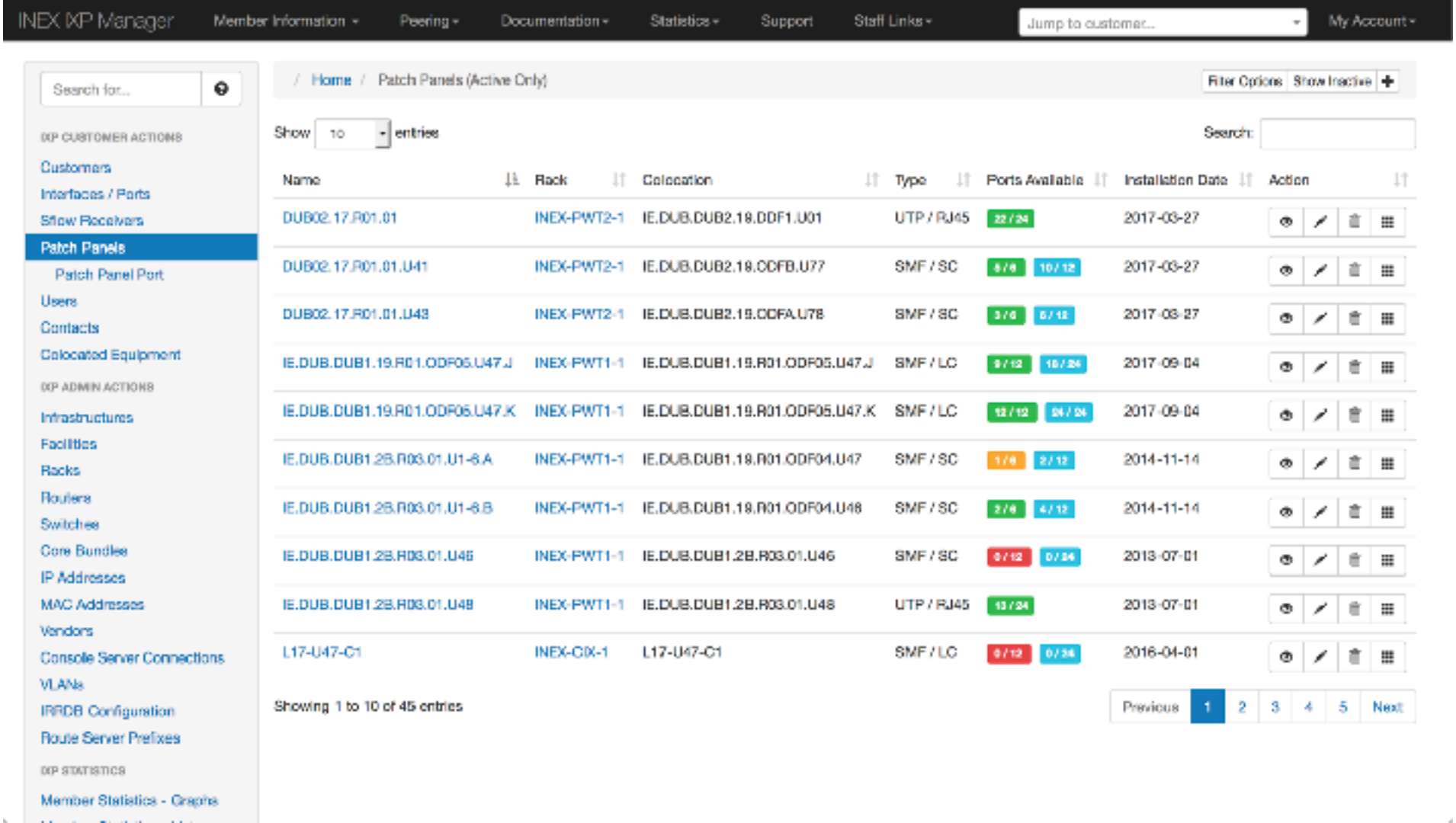
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Patch Panel Port
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Core Bundles
IP Addresses
MAC Addresses
Vendors
Console Server Connections
VLANs
IRRDB Configuration
Route Server Prefixes
IXP STATISTICS
Member Statistics - Graphs
Home / Patch Panels (Active Only)
Filter Options
Show Inactive
Show 10 entries
Search:
Name
Rack
Colocation
Type
Ports Available
Installation Date
Action
DUB02.17.R01.01
INEX-PWT2-1
IE.DUB.DUB2.18.ODF1.U01
UTP / RJ45
22 / 24
2017-03-27
DUB02.17.R01.01.U41
INEX-PWT2-1
IE.DUB.DUB2.18.CDFB.U77
SMF / SC
5 / 6
10 / 12
2017-03-27
DUB02.17.R01.01.U43
INEX-PWT2-1
IE.DUB.DUB2.18.CDFA.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.U48
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-COX-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...

IXP CUSTOMER ACTIONS

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Interfaces / Ports
Sflow Receivers
Patch Panels
Patch Panel Port
Users
Contacts
Colocated Equipment

IXP ADMIN ACTIONS

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Vendors
Console Server Connections
VLANs
IRRDB Configuration
Route Server Prefixes

IXP STATISTICS

Member Statistics - Graphs

Home / Patch Panel Port - PP:[redacted] [Worker]

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 C	2013-04-17	Connected	Action
F3/F4 (2)	swi1-cwt1-1 :: Ethernet8	[redacted]	[redacted]	N-	2013-02-18	Connected	Action
F5/F6 (3)	swi1-cwt1-1 :: Ethernet9	[redacted]	[redacted]	N+	2013-03-29	Connected	Action
F7/F8 (4)	**Core:** Eunetworks Metro KCP1-CWT1 [redacted]	INEX	[redacted]	INT N-	2017-05-09	Connected	Action
F9/F10 (5)	swi1-cwt1-1 :: Ethernet11	[redacted]			2009-11-20	Connected	Action
F11/F12 (6)		[redacted]	[redacted]	N-	2014-10-10	Connected	Action

Showing 1 to 6 of 6 entries

IXP Manager Workshop

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

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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
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Interfaces / Ports
Slow Receivers
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MAC Addresses
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Console Server Connections
VLANs
IRRDB Configuration
Route Server Prefixes

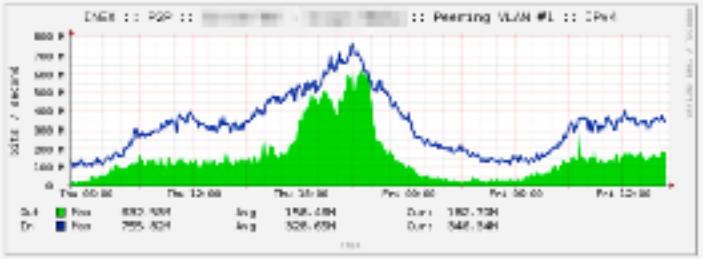
IXP STATISTICS
Member Statistics - Graphs

Traffic exchanged with: [redacted]

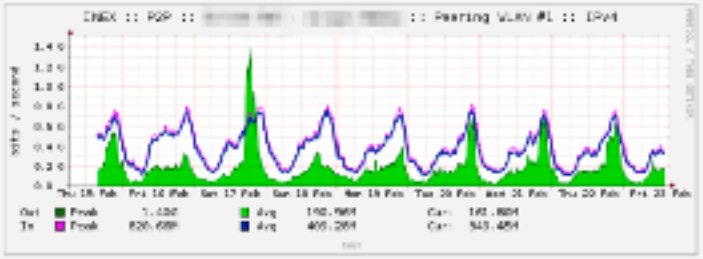
Return

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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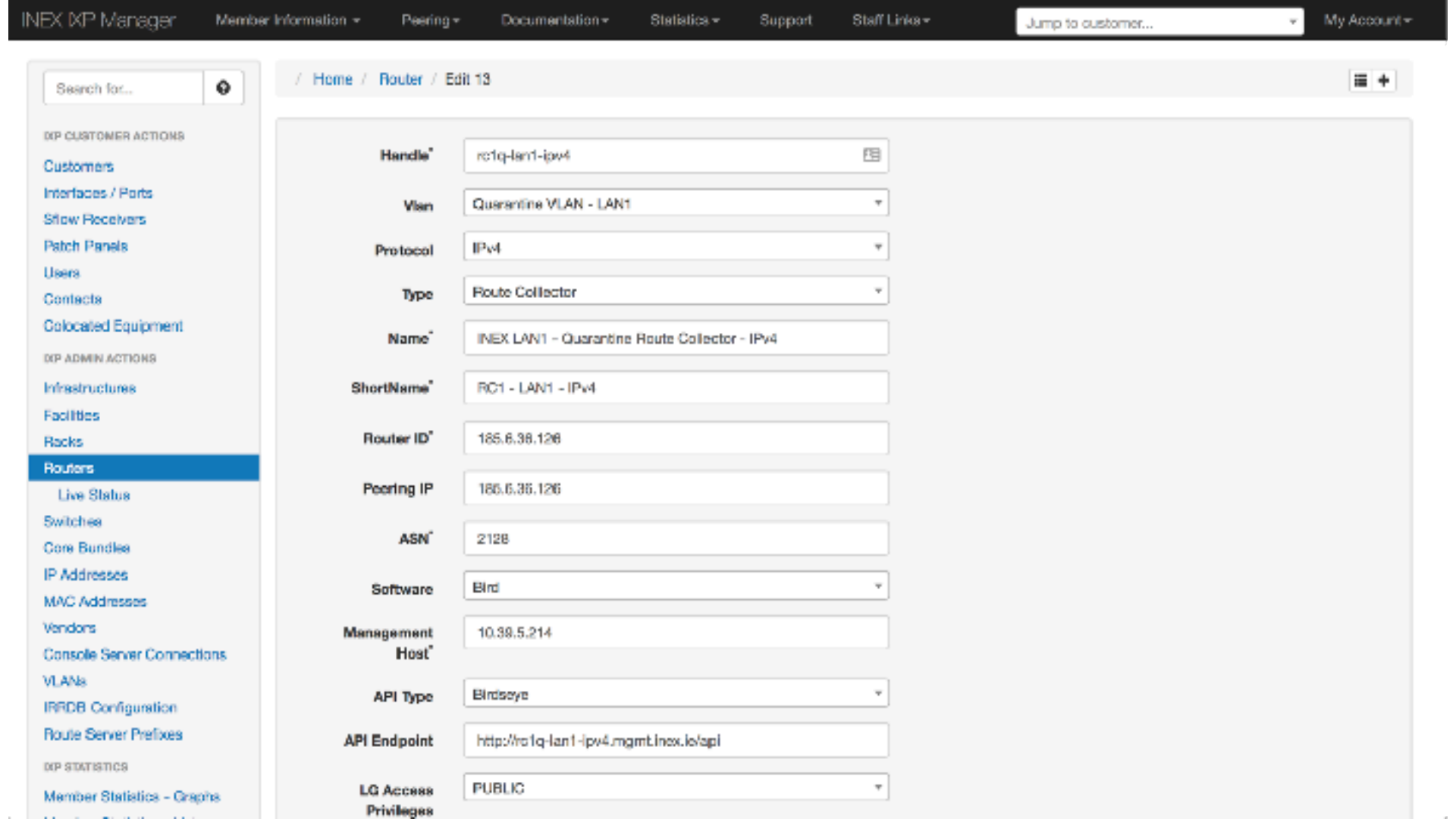
Skin Example: Routers

- 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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IXP STATISTICS
Member Statistics - Graphs
/ Home / Router / Edit 13
Handle*
rc1q-lan1-ipv4
Vlan
Quarantine VLAN - LAN1
Protocol
IPv4
Type
Route Collector
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*
10.30.5.214
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