European IXP Topography Project

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Background

- In the peering track at NANOG62 Sylvie LaPerrière presented a comparison between population density and existence of an IXP

- Authors thought we should try the same for Europe, but also try and do further analysis
  - The latter turned out to be a bit harder…

Scope

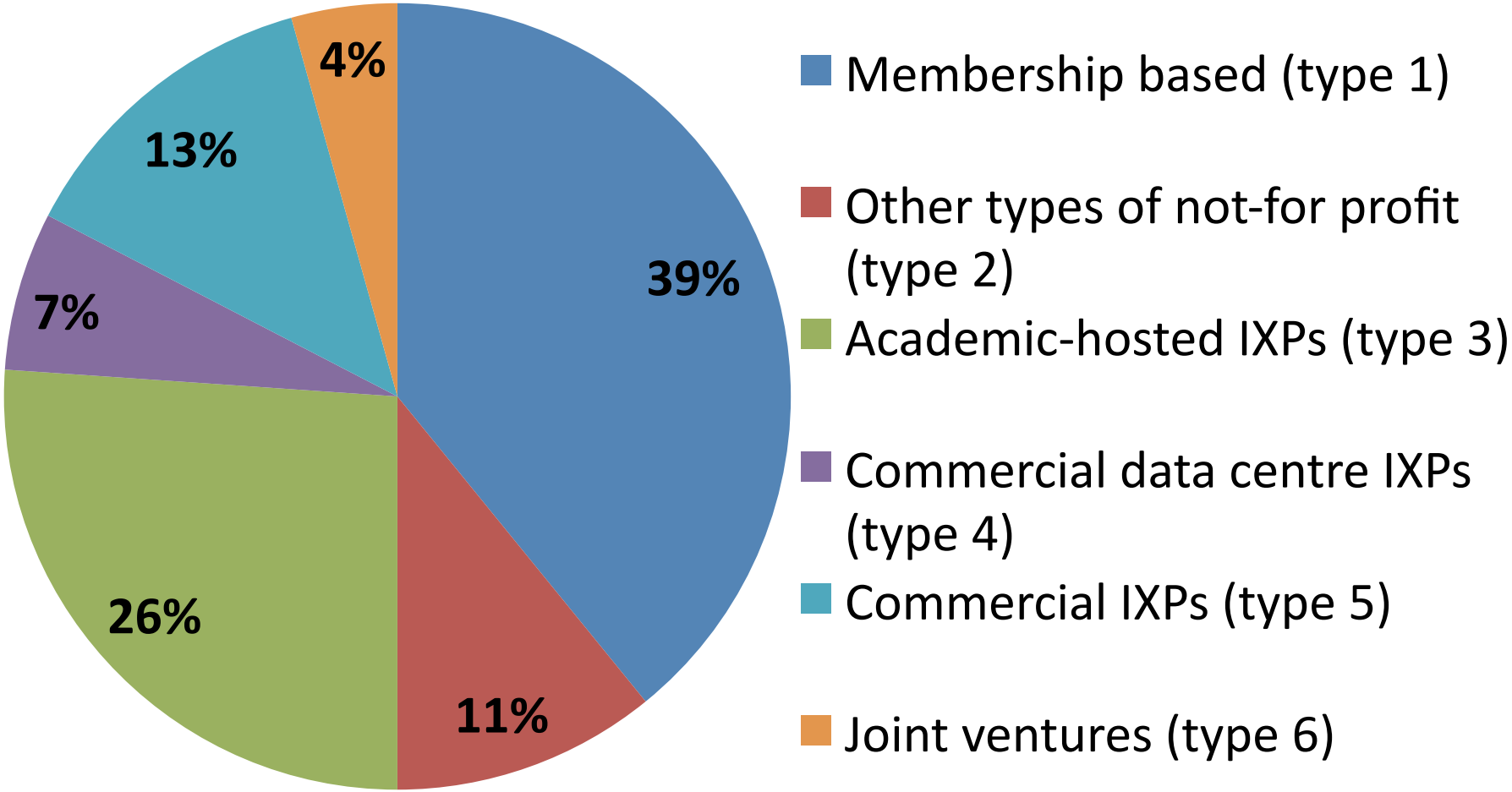
1. Analyze IXP proximity to major population centres
2. Develop classification system for IXPs
3. Combine 1 & 2 into a guide for European IXP scene
4. Draw conclusions and try and predict future market

IXPs in Europe

IXP Classification

1. **Membership-based IXPs**
   (i.e. where the members own the IXP)
2. **Other types of not-for-profit IXPs**
   (e.g. those owned by trusts such as Netnod, or other industry associations, such as DE-CIX or JINX)
3. **IXPs hosted in academic institutions or academic service organisations**
   (such as national academic or research networks)
4. **IXPs operated by commercial data centre organisations**
5. **A commercially owned IXP**
   (such as ECIX)
6. **Joint ventures of some combination of the above**
   (a fairly rare case)

Classification results



Mutual + Academic : 65%

Mutual + Academic + Other non-for-profit : 76%

Classification of the IXPs

#	IXP	City	Country	Type
1	ALB-IX	Tirana	Albania	5
2	AMS-IX	Amsterdam	Netherlands	1
3	BCIX	Berlin	Germany	1
4	BIX	Budapest	Hungary	1
5	BIX.BG	Sofia	Bulgaria	2
6	BNIX	Brussels	Belgium	3
7	CATNIX	Barcelona	Spain	3
8	CIX	Zagreb	Croatia	3
9	CIXP	Geneva	Switzerland	6
10	DE-CIX	Frankfurt am Main	Germany	2
11	DIX	Lyngby	Denmark	3
12	ECIX	Berlin	Germany	5
13	Equinix Zurich	Zurich	Switzerland	4
14	FICIX	Helsinki	Finland	1
15	France-IX	Paris	France	1

Classification of the IXPs

16	FVG-IX	Udine	Italy	4
17	GigaPix	Lisbon	Portugal	3
18	GN-IX	Groningen	Netherlands	3
19	GR-IX	Athens	Greece	3
20	INEX	Dublin	Ireland	1
21	InterLAN	Bucharest	Romania	1
22	IXLeeds	Leeds	United Kingdom	1
23	LINX	London	United Kingdom	1
24	LONAP	London	United Kingdom	1
25	LU-CIX	Luxembourg	Luxembourg	1
26	LyonIX	Lyon	France	1
27	MIX-IT	Milan	Italy	1
28	NaMeX	Rome	Italy	1
29	Netnod	Stockholm	Sweden	2
30	NIX	Oslo	Norway	3

Classification of the IXPs

31	NIX.CZ	Prague	Czech Republic	1
32	NL-ix	The Hague	Netherlands	5
33	PLIX	Warsaw	Poland	4
34	RIX	Reykjavik	Iceland	1
35	SFINX	Paris	France	3
36	SIX	Ljubljana	Slovenia	3
37	SOX	Belgrade	Serbia	2
38	SwissIX	Zurich	Switzerland	1
39	Thinx Poland	Warsaw	Poland	5
40	TIX Tuscany	Florence	Italy	2
41	TOP-IX	Torino	Italy	6
42	TOUIX	Toulouse	France	1
43	TPIX	Warsaw	Poland	5
44	TREX	Tampere	Finland	5
45	VIX	Vienna	Austria	3
46	VSIX	Padova	Italy	3

Major population centers

Rank	Urban Area	State	Population	IXP?	IXP names and notes
1	Paris	France	10 975 000	Y	France-IX plus several more
2	London	United Kingdom	10 149 000	Y	LINX, Lonap
3	Ruhr area	Germany	6 722 000	Y	ECIX is in Düsseldorf (which is adjacent)
4	Madrid	Spain	6 183 000	Y	ESPANIX
5	Milan	Italy	5 264 000	Y	MIX
6	Barcelona	Spain	4 656 000	Y	Catnix
7	Berlin	Germany	4 006 000	Y	BCIX, ECIX
8	Rome	Italy	3 798 000	Y	Namex
9	Naples	Italy	3 726 000	N	Largest urban area in Europe with no IXP!
10	Athens	Greece	3 515 000	Y	GR-IX
11	Lisbon	Portugal	2 669 000	Y	GigaPix
12	Rotterdam-The Hague	Netherlands	2 657 000	?	R-IX, but not sure if it is operational
13	Manchester	United Kingdom	2 560 000	Y	IXManchester
14	Birmingham (West Midlands)	United Kingdom	2 448 000	N	
15	Katowice (Silesian Metropolis)	Poland	2 231 000	Y	TIX, Thinx, PLIX?
16	Brussels	Belgium	2 072 000	Y	BNIX
17	Hamburg	Germany	2 057 000	Y	DE-IX, ECIX
18	Cologne-Bonn	Germany	2 003 000	N	
19	Bucharest	Romania	1 932 000	Y	InterLAN, Ronix
20	Munich	Germany	1 911 000	Y	DEC-IX, INXS

Major population centers

21	Frankfurt	Germany	1 856 000	Y	DEC-IX
22	Leeds-Bradford	United Kingdom	1 787 000	Y	IXLeeds
23	Vienna	Austria	1 739 000	Y	VIX
24	Budapest	Hungary	1 724 000	Y	BIX
25	Warsaw	Poland	1 716 000	Y	PLIX, TPIX, WIX, Thinx, KIX
26	Amsterdam	Netherlands	1 600 000	Y	AMS-IX, NL-IX, ECIX
27	Valencia	Spain	1 561 000	N	
28	Lyon	France	1 542 000	Y	LyonIX
29	Turin	Italy	1 499 000	Y	Topix
30	Porto	Portugal	1 496 000	Y	GigaPix
31	Stockholm	Sweden	1 456 000	Y	Netnod
32	Marseille	France	1 369 000	Y	France-IX
33	Stuttgart	Germany	1 354 000	Y	Stuttgart-IX
34	Prague	Czech Republic	1 264 000	Y	NIX-CZ
35	Copenhagen	Denmark	1 231 000	Y	Netnod, DIX
36	Helsinki	Finland	1 203 000	Y	Ficix
37	Sofia	Bulgaria	1 185 000	Y	NetIX
38	Glasgow	United Kingdom	1 182 000	N	
39	Dublin	Ireland	1 158 000	Y	INEX
40	Seville	Spain	1 100 000	N	

Major population centers

41	Lille	France, Belgium	1 016 000	N	
42	Antwerp	Belgium	990 000	Y	NL-IX
43	Nice	France	962 000	Y	NicIX (operated by Rezopole, same as LyonIX)
44	Łódź	Poland	939 000	Y	Thinx
45	Toulouse	France	880 000	Y	TOUIX
46	Liverpool	United Kingdom	864 000	N	
47	South Hampshire	United Kingdom	856 000	N	
48	Bordeaux	France	845 000	N	
49	Thessaloniki	Greece	840 000	N	
50	Florence	Italy	821 000	Y	TIX
51	Newcastle upon Tyne (Tyneside)	United Kingdom	780 000	N	
52	Gdańsk (Tricity)	Poland	775 000	Y	Thinx
53	Kraków	Poland	760 000	Y	CIX, K-IX
54=	Bilbao	Spain	750 000	N	
54=	Riga	Latvia	750 000	Y	LIX
56	Palermo	Italy	731 000	N	
57	Nottingham	United Kingdom	730 000	N	
58	Catania	Italy	720 000	N	
59=	Malaga	Spain	700 000	N	
59=	Las Palmas	Spain	700 000	N	
59=	Zaragoza	Spain	700 000	N	
59=	Zagreb	Croatia	700 000	Y	CIX
59=	Dresden	Germany	700 000	N	
59=	Hannover	Germany	700 000	N	

Major regions without an IXP

1. The Ruhr area of Germany
2. Naples in Italy
3. Birmingham in the UK
4. Large cities in the biggest European countries (France, Germany, Italy, Spain and the UK)
5. Spanish cities (except Barcelona & Madrid)

Possible reasons

- Telecom network topology
- Market conditions
- Proximity to other/existing IXPs

Areas Missing IXPs

Urban area	Closest IXP	Distance
Naples	NaMeX, Rome	225km
Birmingham	LINX & LoNAP, London	203km
	IXManchester, Manchester	138km
Cologne-Bonn	ECIX&OCIX Düsseldorf	54km
	DE-CIX Frankfurt	177km
Valencia	CATNIX, Barcelona	377km
	ESPANIX, Madrid	331km
Glasgow	IXScotland, Edinburgh	74km

Five largest urban areas missing an IXP

Comparison to US study

- All but one of the 19 largest CSAs in the US have an IXP
  - 11 are major peering hubs
- The smallest of the 19 would be the 11th largest in Europe
- Europe seems to have a denser mesh of IXPs while lacking IXPs in more large population centers

Suggested developments

- Investigate IXP proximity to regional GDP
  - On the to-do list
- Correlation to neutral datacenter availability
  - Data set might be hard to acquire

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- https://www.linx.net/archive/topography/IXP-topography-project.pdf
- https://www.netnod.se/sites/default/files/IXP-topography-project.pdf