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The IXP landscape in the SEE region

Initial Findings

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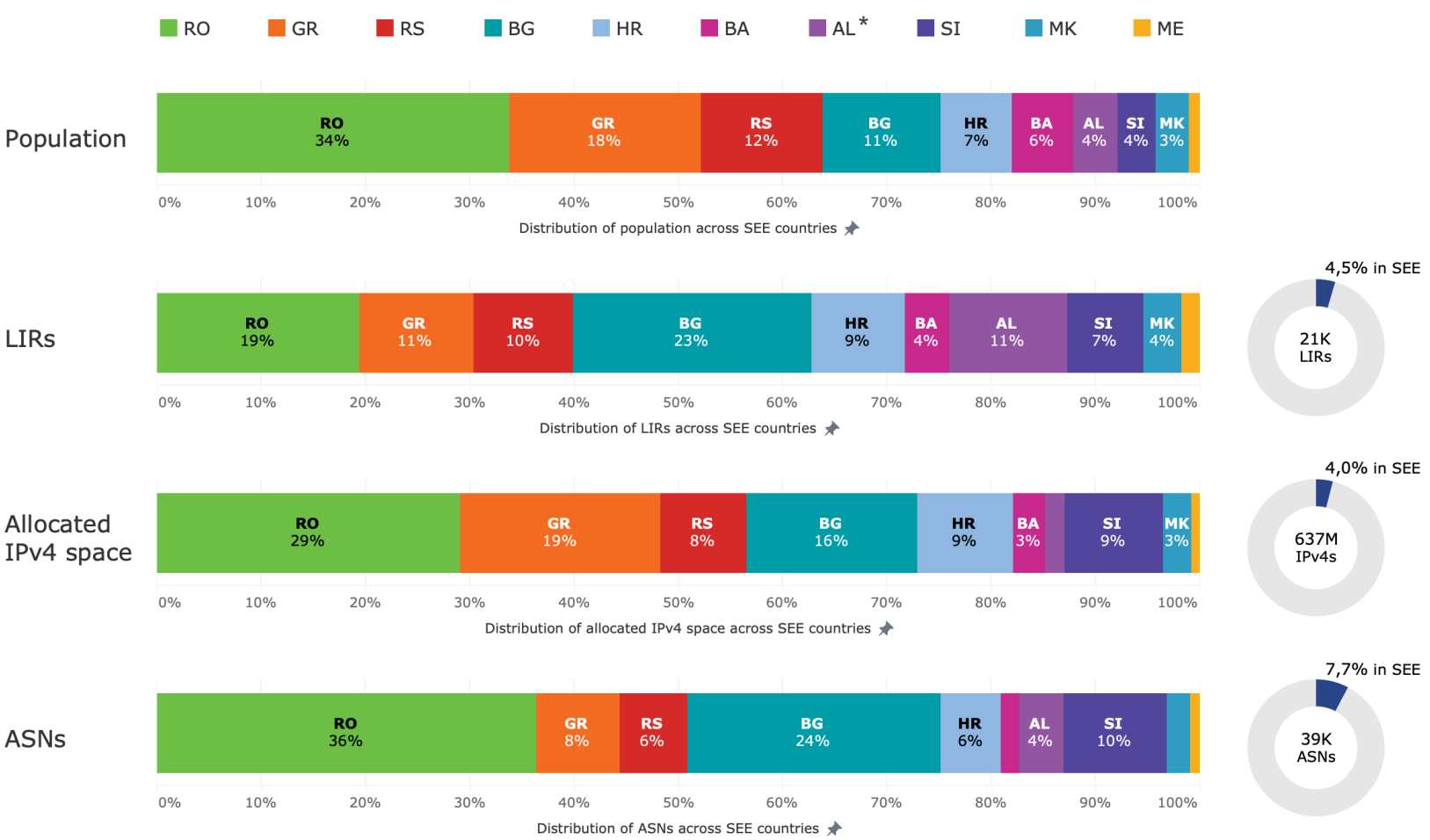
Report Introduction

- **Purpose:**
  - Assess the evolution and state of the IXP ecosystem in the SEE region to identify trends, challenges, and opportunities
- **Goals:**
  - Identify areas of growth or stagnation
  - Highlight internal and external challenges
  - Propose recommendations for enhancing connectivity and supporting national digital strategies

Introducing the Region



*Includes LIRs and internet resources allocated to entities operating in Kosovo

Region is Not Homogeneous

- Regulatory disparities (EU and non-EU)
- Market size (larger and smaller)
- Geographic location (landlocked and coastal)
- Intra-region connectivity (Ex-YU and rest)

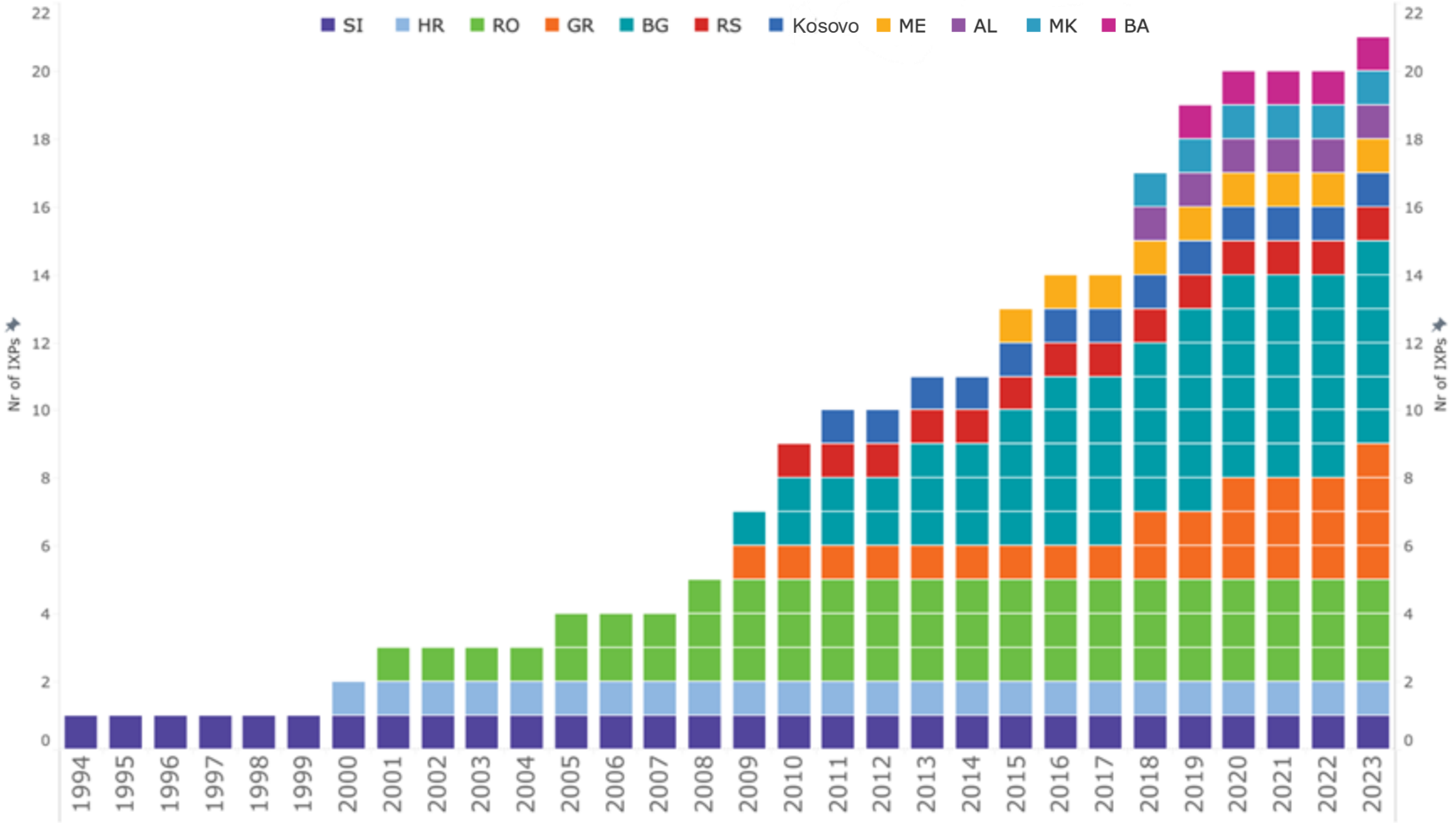
Initial Findings

The Role of IXPs in Digital Connectivity

- **Definition:**
  - A physical infrastructure where networks (ISPs, content providers, enterprises) exchange internet traffic directly, rather than through alternative ways
- **Benefits:**
  - Better quality of experience: faster speeds, higher availability, greater resilience
- **Economic Impact:**
  - Supports ecosystem digitization, promotes local content development, and reduces dependency on costly international transit
- **Security & Resiliency:**
  - Minimizes vulnerabilities associated with routing traffic through distant, international hubs

IXP Landscape

Data source: PeeringDB



Data source: PCH IXP directory

IXP Governance

- **Diverse Governance Models:**
  - Associations of ISPs, operator-neutral for-profit companies, university or government agencies
  - Large number of IXPs run by NRENs
  - Different levels of membership involvement
- **Impact on Growth:**
  - Governance and business models influence access to funding for critical equipment upgrades
  - Affects the ability to attract new members and shape growth strategy
  - Lack of focused personnel inhibiting growth potential

Market Dynamics

- **Incumbents' role:**
  - Incumbent ISPs often hold significant influence over local IXPs
  - Not all ISPs engage in open peering at the local IXP, limiting traffic exchange opportunities
- **Market Concentration:**
  - IXPs is typically more useful for small and medium sized ISPs
  - Larger ISPs may prefer private peering or rely on international hubs
- **Regional Investment Challenges:**
  - The lack of a sustainable cross-border market makes it harder to draw in major players or secure large-scale infrastructure investment (E-commerce, Media, Finance, Content)

Proximity to Major Data Hubs

- **Pros:**
  - Good access to a larger digital ecosystem
  - Low(-ish) latency
  - Low cost transit (for some countries)
- **Cons:**
  - Dependency on foreign hubs
  - Underdevelopment of local IXPs and peering
  - Export of capital from domestic economy
  - Lack of localisation

Regulatory Landscape

- **Establishment of the IXP:**
  - No special license required to establish or operate an IXP across the entire SEE region
- **IXP membership:**
  - Most IXPs do not require ISP licence to approve new membership
- **EU Regulation:**
  - **NIS 2 Directive:** The European Union's updated framework for cybersecurity, replacing the original NIS Directive (2016)
  - **Expanded Scope:** Includes stricter security requirements for essential entities, now including digital infrastructure (IXPs, DNS, and cloud computing services) as critical infrastructure

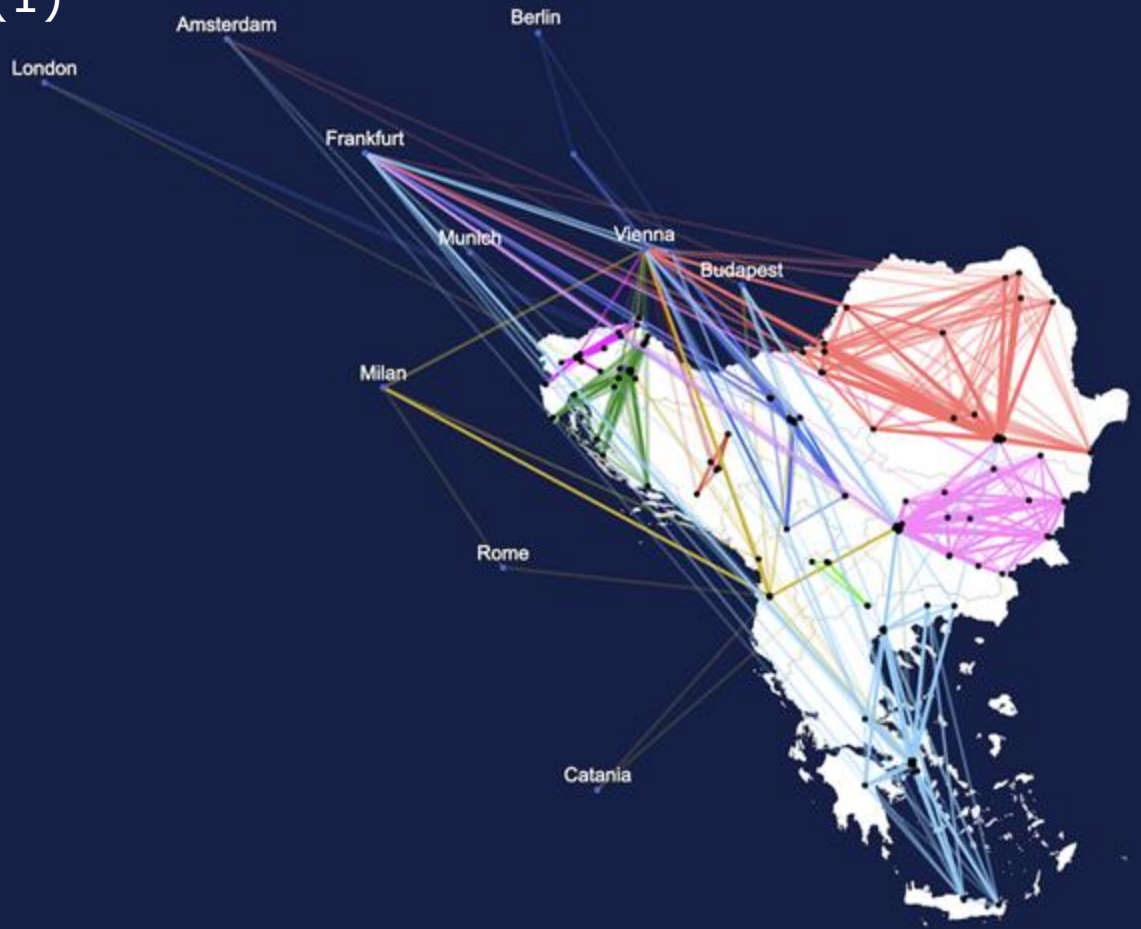
Criteria for Success

The Four Criteria for Success

1. Keeping local traffic local
2. Facilitating inter-region traffic
3. Attracting global hyperscalers and content providers
4. Supporting economy digitisation

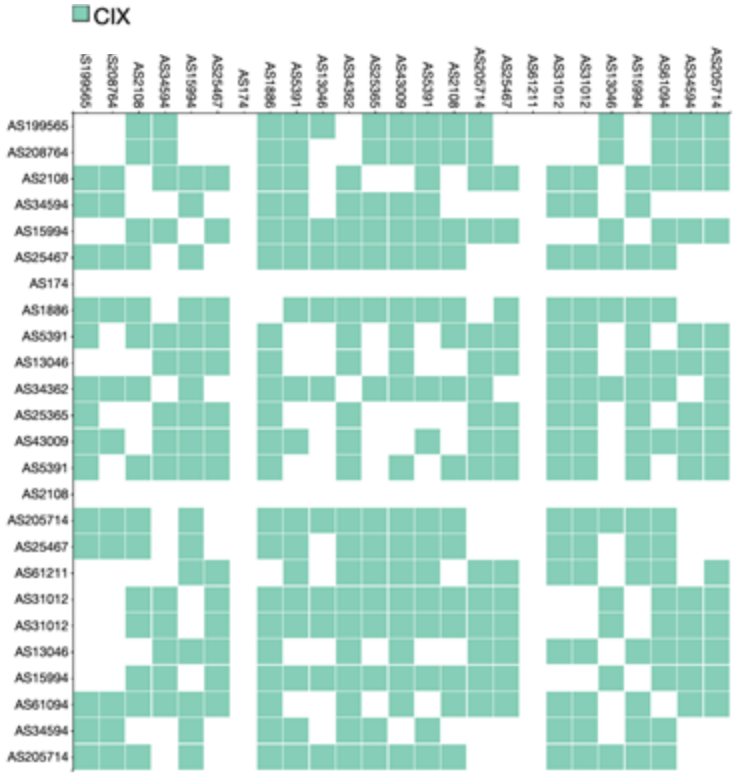
In-Country Connections (1)

Country	Total number of paths	Out-of-country number of paths	Out-of-country paths %
AL	72	19	26.39%
BA	28	3	10.71%
RS	455	31	6.81%
GR	754	27	3.58%
RO	1544	29	1.88%
SI	418	6	1.44%
HR	592	6	1.01%
BG	2031	15	0.74%
MK	25	0	0.00%

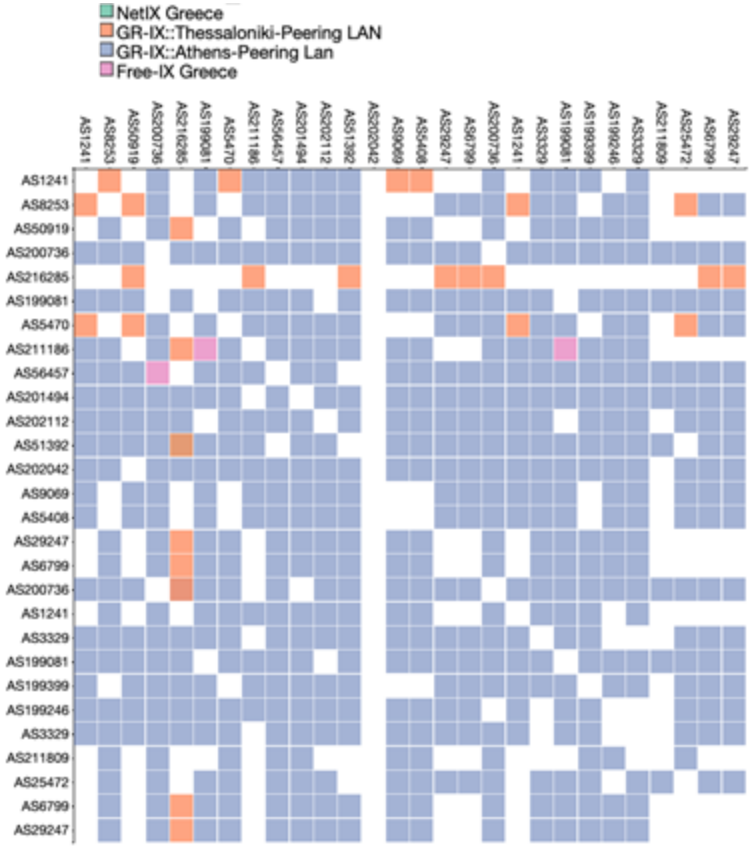


Data source: RIPE Atlas

In-Country Connections 1



In-Country Connections 2



Inter-region connections (2)

- Total IPv4 paths: 40,833
- Out-of-region paths: 8,507 (20.83%)
- In-region paths: 32,326 (79.17%)

Data source: RIPE Atlas

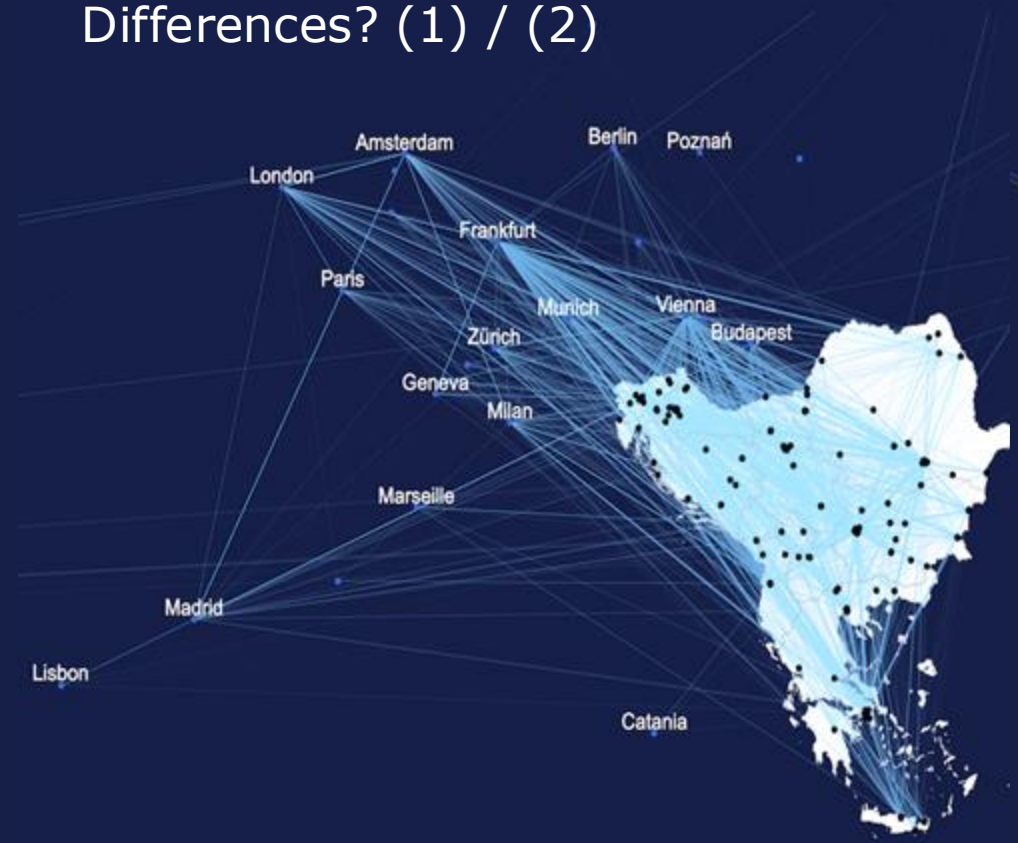
Inter-region connections (2)

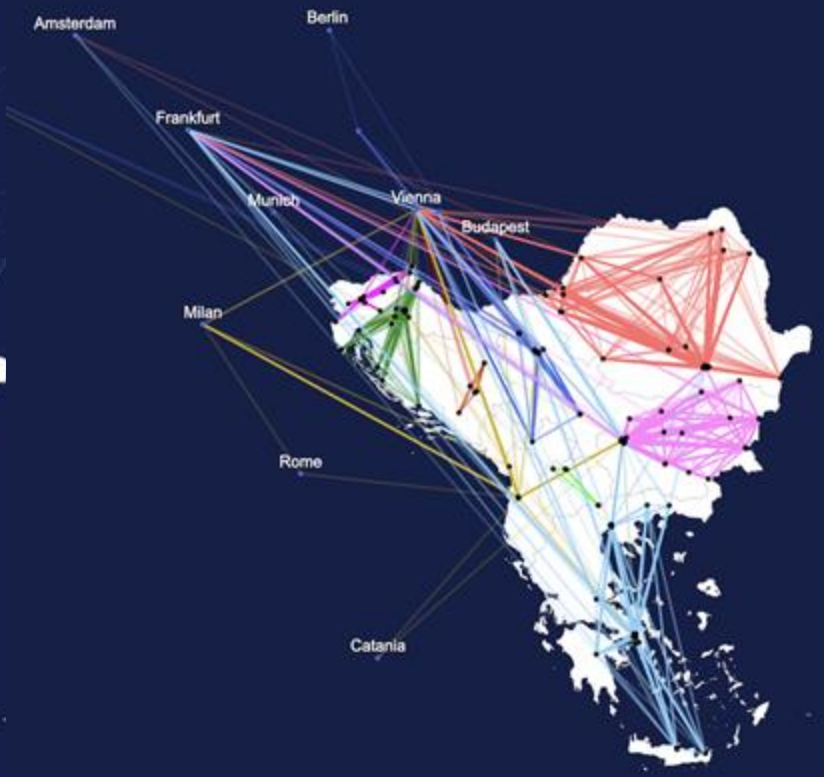
Number of in-region IPv4 paths	Regional IXP in the path
8645	NetIX Sofia
8640	InterLAN
8438	SOX
7944	BIX.BG
4526	CIX
4424	SIX
3567	GR-IX::Athens
2394	B-IX BG
2359	Balcan-IX
878	NetIX GR
702	GR-IX::Thessaloniki
543	RoNIX
455	MegaIX Sofia
318	IXP.mk
305	VarnaIX
258	T-CIX
36	BHNIX
21	ANIX
6	MIXP

- 40,833 total paths
- 15,439 (38%) via one or more IXPs
- 1,392 (3%) via IXP and out of region

Data source: RIPE Atlas

Differences? (1) / (2)





Data source: RIPE Atlas

Presence of ISPs at regional IXPs

		SIX	CIX	BHNIX	SOX	MIXP	InterLAN	RoNIX	BALCAN-IX	BIX.BG	NetIX	B-IX (Balkan-IX)	MegaIX Sofia	Varna IX	T-CIX	ANIX	IXP.mk	GR-IX: Athens	GR-IX: Thessaloniki	SEECIX	THESS-IX	NetIX Greece	KOSIX
		Slovenia	Croatia	Bosnia& Herzegovina	Serbia	Montenegro	Romania			Bulgaria						Albania	N. Macedonia	Greece					Kosovo
AS5603		200G																					
AS3212		200G																					
AS34779	SI	200G	10G							10G													
AS21283		40G																					
AS9119		10G	10G		10G					10G							10G						
AS5391	HR		30G														10G						
AS15994			80G																				
AS205714			200G																				
AS44306			80G																				
AS25144	BA																						
AS9146				20G																			
AS42560																							
AS20875																							
AS8400	RS				400G						20G				1G								
AS31042			20G		400G		10G		10G	20G	20G												
AS15958					200G																		
AS9125					40G																		
AS44143					X																		
AS43940	ME					X																	
AS15397						X																	
AS8585						X																	
AS8708	RO						100G																
AS9050							10G		40G		10G												
AS12302								10G															
AS8953							100G	100G															
AS8866	BG									20G	100G	10G		10G					1G				
AS8717										200G	20G	20G		10G									
AS29244										100G				1G									
AS42313	AL																						
AS50973																1G							
AS206262	AL*																						10G
AS21246																							10G
AS33983																							10G
AS29170																							10G
AS6821	MK																10G						
AS43612																	10G						
AS34772											100G						1G						
AS41557																	10G						
AS34547																	10G						
AS6799	GR																	800G	20G				
AS3329																		600G	200G				
AS25472																		200G	10G	10G			
AS1241																		200G	10G				

Data source: IHR, PeeringDB, RIPEStat

Cloud, CDN and OTT leaders in IXP participation

	SI	HR	RS	RO			BG					AL	MK	GR			
	SIX	CIX	SOX	InterLAN	RoNIX	BALCAN-IX	BIX.BG	NetIX	B-IX (Balkan-IX)	MegaIX Sofia	T-CIX	ANIX	IXP.mk	GR-IX: Athens	GR-IX: Thessaloniki	SEECIX	NetIX Greece
Akamai				200G			40G	100G									
Amazon							200G							200G			
Anexia				10G				10G						10G			
BelCloud				20G			40G							10G	1G		
Blizzard Entertainment				10G				10G									
ByteDance			200G	100G				100G									
CacheFly				10G	10G												
Cloudflare		40G	40G	100G	10G	10G	20G	200G	100G	10G	10G		20G	400G	10G	10G	100G
Delta Cloud							300G	100G									
Digital Realty														30G		20G	
Edgoo	10G																
Fastly							200G										
Google			80G	200G	40G		600G	400G	20G	20G	20G						
Hetzner Online			100G					200G									
Huawei					20G												
Hurricane Electric	100G	30G	100G	100G	100G	10G	100G	100G	100G	100G	10G	10G	10G	100G	10G	20G	100G
i3D.net				100G		10G											
M247			10G	20G	10G	60G		10G									
Mainstream			40G														
Meta			400G	200G	200G	200G	200G	420G	400G	20G	20G	30G					
Microsoft		40G		20G		200G	200G	100G		10G				200G		20G	
Netflix				100G	100G							10G*					
OVHcloud								100G									
Riot Games							10G	10G	10G	10G				10G			
Softnet	10G	10G	10G				10G						10G				
Sony														10G			
Valve			200G	100G				100G									
Voxility				20G	10G	20G		10G									
Yahoo!						10G	20G	10G									

Data source: PeeringDB

Digitalisation of the Local Economy

Data source: PeeringDB

Takeaways

Call for action - Better regional peering

- **More Attractive to Global Players**
  - Companies can/may serve multiple countries from a single hub
- **Stronger Security**
  - Less distance = fewer risks for data in transit
- **Lower Latency**
  - Crucial for gaming, fintech, and real-time apps
- **Greater Resiliency**
  - Less dependence on hubs like Frankfurt or Vienna
  - IXPs may contribute to an enhanced security posture that would benefit their members
- **Cost Savings**
  - Reduced transit needs can lower overall costs and decrease the outflow of capital

Questions & Comments

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THANK YOU!