Three decades of Internet Exchanges.

What comes next?

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Delivering The World's Largest Data Center Platform

Europe

Amsterdam	Madrid
Athens	Marseille
Brussels	Paris
Copenhagen	Stockholm
Dublin	Vienna
Düsseldorf	Zagreb
Frankfurt	Zürich
London	

North America

Atlanta	New York
Austin	Northern Virginia
Boston	Phoenix
Charlotte	Portland
Chicago	Querétaro
Dallas	San Francisco
Houston	Seattle
Los Angeles	Silicon Valley
Miami	Toronto

Asia-Pacific

Chennai
Hong Kong
Melbourne
Osaka
Seoul
Singapore
Sydney
Tokyo

Africa

Abuja
Accra
Cape Town
Durban
Johannesburg
Lagos
Maputo
Mombasa
Nairobi

South America

Bogotá
Fortaleza
Rio de Janeiro
Santiago
São Paulo

Coverage

300+
Data centers

25+
Countries

50+
Metros

6
Continents

Control

24/7
Remote support
available

99.999%
Uptime – always on
and available

Capacity

1GW
Renewable
capacity

324MW
of available
capacity

Connectivity

1,300
Carriers globally

214,000
Cross connects

5,000+
Customers

Note: As of August 2023

Meet our team at EPF 2023

Sonja Ilijeska

Sales Director, Croatia

Osman Kolia

Senior Director, Strategy and Business Development

James Lockwood

Account Director, EMEA Core Network, Major Accounts

Andreas Polyrakis

Director, Business Development, Network Service Providers

Danielle Searle

Marketing and Events, Senior Associate

Mark Brand

National Interconnection Manager, Teraco

Yolandi Cloete

Platform Specialist, Teraco

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NAPAFRICA

Three decades of IXP evolution, at a glance

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Early days of IXPs in Europe
~1994 – 2003

LINX: 1994
as a non profit association

DE-CIX: 1995
by Eco - Association of
Internet Industry

Netnod: 1996
by TU-stiftelsen (internet-
related foundation)

VIX: 1996
by the Vienna Univ.
Computer Center

NIX.CZ: 1996
as a member's association

AMS-IX: [1994→]1997
as a member's association

euro-ix: 2001

Birth

- Birth around mid/end-90's
- Purpose: Offload (expensive/slow) transit traffic
- Usually initiated by academic networks and local ISPs
- Usually run by academia or a member's association
- Often just a switch or a router running as "best-effort"
- Mostly local ISPs (in some cases, ISP-club only)

Internet landscape

- Mostly for academia and fun
- Light business applications (web, email, …)
- E-commerce and e-shops appear

Growing up
~2004-2011

- By 2005, most countries had one IXP
- Change in customer mix: Large global CDNs, international providers, datacenter operators & hosters, clouds etc.
- Traffic levels rise, IXPs become critical for internet stability.
- Best effort not acceptable anymore. Introduction of SLAs, 24x7,
- Multiple POPs to cover the entire metro
- Remote peering, esp at large IXPs
- Commercialization, reselling

Internet landscape

- Starts becoming mission-critical for business.
- End users: peer2peer; streaming; social media
- Intolerance to downtime, packet loss or latency
- Traffic/content starts to localize. Local hosting & datacenters.
- CDNs; local caches; early edge computing
- Start of virtualization; then cloud

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Further evolution,
~2012-today:

- Tremendous surges in traffic
- Networks heavily depend on IXPs.
  - ☐ technical/commercial/legal evolution
  - ☐ further commercialization
- Need for diversity
- IXPs expanding towards the edge
- Stronger competition between IXPs

Internet landscape

- Cloud Computing
- FTTH & 5G
- Digital transformation
- Covid19
- More data. More content. More apps.
- Latency becomes increasingly important. Data and apps move closer to the edge
- Strong dependence on the internet

Evolution in other regions

North America

- Birth place of internet, earlier start
- USA is a huge, single market.
- Nation-wide ISPs connect in multiple IXPs
- DC-operated IXPs
- Competition within the same metro
- No IXP association
- European IXPs expanding in US

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- Growing markets
- ix.br, the largest IXP in the world
- Some peering taking place through USA

APAC & Middle East

- Following the European model, a few years behind
- Very diverse environment.
- Per country restrictions may apply (censorship, content filtering/restrictions, social media regulations/bans, telecom monopolies,...)
- Situation is improving
- Huge demand drives IXP growth, despite difficulties
- European IXPs expanding in the region

Africa

- The fastest growing continent in terms of GDP and population
- Huge Internet, telecoms & IXP growth
- European IXPs expanding in the region

What comes next

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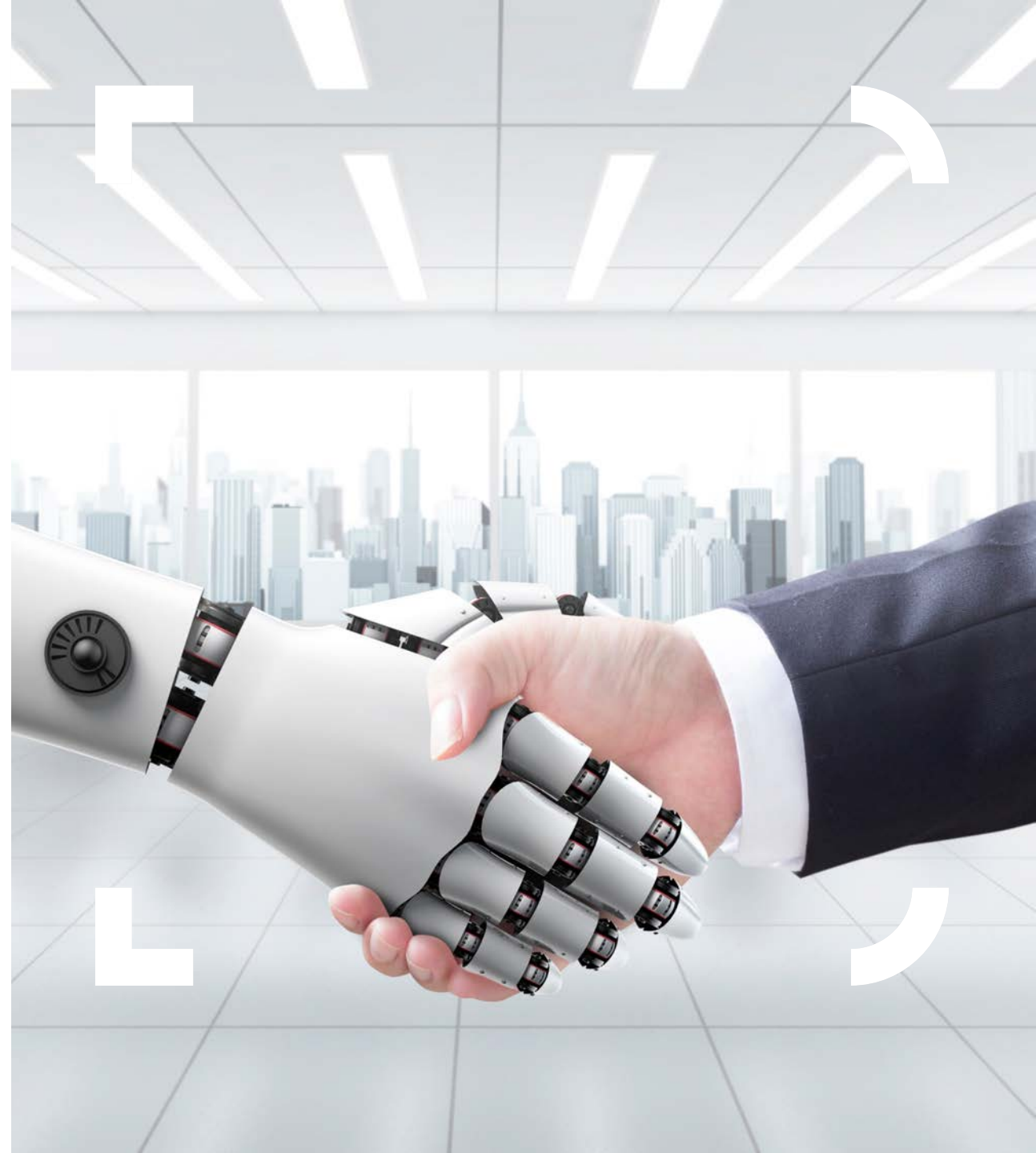
#1 The moving edge

- Data stored, processed and exchanged closer to the edge
  - □ Cloud computing
  - □ Edge computing (IoT, VR, ...)
  - □ AI
  - □ Data sovereignty

- IXPs expansions
  - □ in secondary cities
  - □ In developing countries & emerging markets
  - □ Even in highly regulated or monopolized markets

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#2 Need for diversity

- IXPs are critical infrastructure
  - □ Officially identified as such by NIS/NIS2!
- One per country / market is not enough
- Competition even in markets with well established players

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#3 Colonization

in country: 7 Overseas: 26 Powered-by: 8

DE·CIX

Experience and know how taken abroad

In 2012, DE-CIX took abroad its specific know-how and experience in establishing and operating Internet Exchanges and now operates interconnection platforms in the following metro markets: In New York, Dallas, Chicago, Richmond, Phoenix, Madrid, Barcelona, Lisbon, Marseille, Istanbul, Palermo, Oslo, Kristiansand, Esbjerk, Copenhagen, Helsinki, Prag, Warsaw, Bucharest, Kuala Lumpur, Johor Bahru, Singapore, Manila, Mumbai, Delhi, Kolkata, and Chennai. In addition, we cooperate with MSK-IX in Moscow and St. Petersburg, and have DE-CIX as a Service partner exchanges UAE-IX in Dubai, SEECIX in Athens, and Borneo-IX in Brunei as well as in three key markets in Africa: the Democratic Republic of the Congo (DRC), Libya, and Nigeria.

linx

in country: 4 Overseas: 3 Powered-by: 2

- 2012 – ConneXions reseller programme launched and first UK local exchange, IXManchester, opens. LINX tops 1000 connected member ports with first member connected at 100G(BT). LINX also becomes first IXP in the world to utilise Juniper PTX switching gear and Juniper MX routers.

- 2013 – LINX launches its second UK local exchange, IXScotland.

- 2014 – LINX launches its first overseas regional exchange, LINX NoVA. Shortly after, it is the first IXP in the world to be awarded Open-IX certification. LINX establishes its third UK exchange, IXCardiff, and an 11th London PoP at Digital Realty Chessington. LINX celebrates its 20th anniversary by hosting

amsix

in country: 1 Overseas: 13 Powered-by: 2

2012	Opening of AMS-IX Hong Kong, in collaboration with HGC
2013	CAR-IX becomes AMS-IX Caribbean
2014	Opening of AMS-IX Bay Area and AMS-IX Chicago
2016	Peak internet traffic at AMS-IX Amsterdam: 5 Tb/s
2017	Opening of AMS-IX India, in collaboration with Sify

#4 Interconnected IXPs | multiregional IXPs | Federations

- Initially, three schools
  - □ Disconnected peering LANs
  - □ Connected peering LANs
  - □ Stretched peering LANs
- Some IXPs gradually revise strategy
  - □ To follow competition
  - □ To connect secondary cities without self-standing critical mass
  - □ Market perception of "competing to carriers" changes
  - → But still many followers of the "disconnected peering LANs" approach
- Resellers and platforms are willing to cover gaps
- Synergies between IXPs, eg
  - □ LINX partnership with NAMEX,JPIX, NYIIX, ManxIX
  - □ DECIX partnership with BIX.BG, NIX.CZ, InterLAN
  - □ Federated IXP
  - □ Cross-IX

#5 Beyond traditional peering

Cloud Connectivity & Enterprises

- Direct audience: enterprises
- Indirect audience: ISPs
- Opportunity for IXPs
- New services such as MAPS
- Turn towards enterprises

- Older ideas (limited global adoption):
  - "trusted" peering LAN
  - TV/VOIP exchange
  - GRX exchange (mobile roaming)

- New ideas:
  - Data Exchange (eg amdex.eu)
  - ...

Digital Realty's approach

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Digital Realty's IXP approach

1　Recognize the value of IXPs

2　Focus on core business

3　Collaborate with IXPs for Internet Exchange services

4　Maintain neutrality

5　Help the Internet grow by fostering IXPs

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Thank you!
Questions?

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