



THE INTERNET IS FOR EVERYONE

Join us to keep the Internet open, thriving,
and benefitting people around the globe.

IXP Workshop & Technical Training

Port Moresby, Papua New Guinea

13 May 2016



What is the Internet Society?

The Internet Society (ISOC) is a cause-based organization that works with governments, industries, and others to ensure the technologies and policies that helped develop and evolve the Internet will continue into the future.

Our programs cultivate an Internet that is open to everyone, everywhere and aim to ensure that it will continue to be a tool for creativity, innovation, and economic growth.

MISSION: To promote the open development, evolution, and use of the Internet for the benefit of all people throughout the world.

VISION: The Internet is for everyone

Global Presence



118+

Chapters
Worldwide

80,000+

Members and
Supporters

143+

Organization
Members

5 (6)

Regional
Bureaus

21/38

Countries where
ISOC Staff Work
& Languages

ISOC | Who and What



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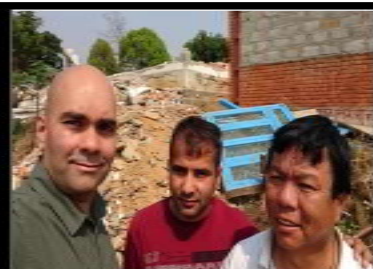
Why It Matters

Is enough to have Internet access, or must we also ensure that the access is open and unrestricted?

[Join us at RightsCon](#)

Deployment of W4C in Nepal in earthquake affected area of Gorkha District (Location of epicentre).

10 Villages connected, including 2 health centres and multiple schools.



Above: Rajiv Singh and Babu Ram Aryal
Below: ISOC sponsored Wi-Fi Area



I E T F®

Search



Chat Live with the
IETF Community

Kenya IXP Project II



International IXP Development | Associations & Forums

An Internet Exchange Point (IXP) is a network facility that enables the interconnection of more than two independent Autonomous Systems, primarily for the purpose of facilitating the exchange of Internet traffic



❖ **IX-Federation** | <http://www.ix-f.net/>

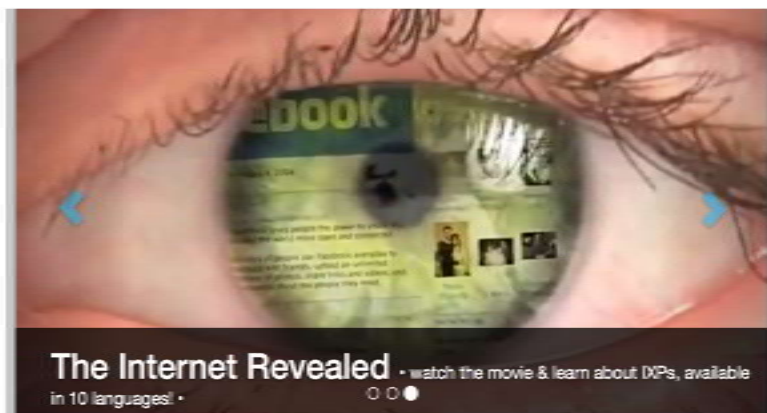
IXP Best Practices and Best Current Operational Practices

<https://www.euro-ix.net/ixps/set-up-ixp/ixp-bcops/>

IGF IXP Best Practices | <http://ow.ly/YYTFZ>

IXP Tech Infrastructure & Impact

- ❖ IXPs need not be expensive to be effective.
- ❖ LINX, now one of the largest IXPs in the world, started with 5 members and a donated switch.
- ❖ Bottom-up Community Development
- ❖ Technical Capacity Building
- ❖ Local traffic cheaper, latency decreases, quality better



<https://www.youtube.com/watch?v=QuBde4Sn3f0>



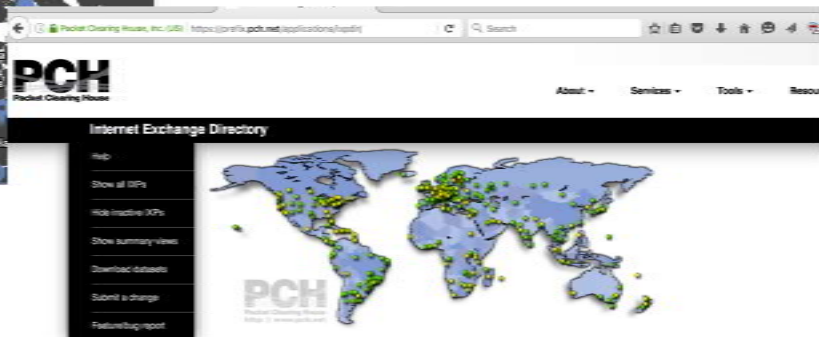
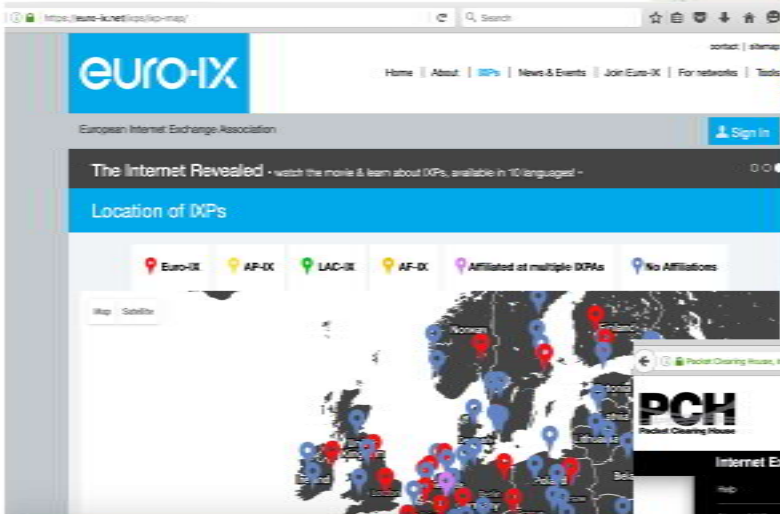
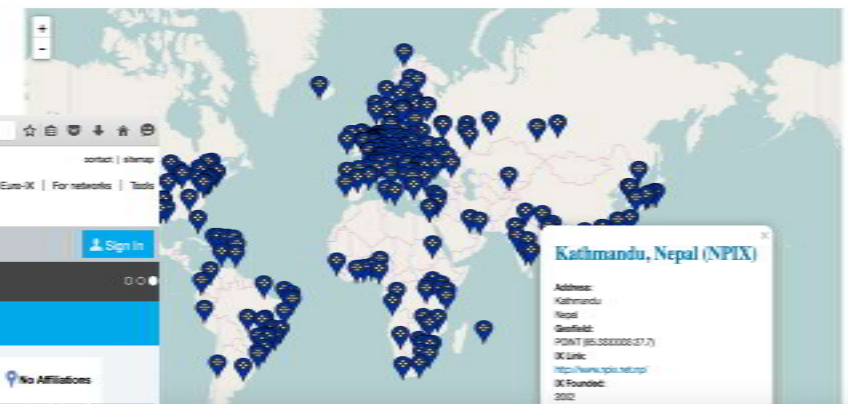
<https://www.youtube.com/watch?v=5oliP-p4zJM>

IXPs Global Landscape



IXPs | Global

Internet Exchange Point (IXP) Maps



Region	Country	City	Internet Exchange Name	Participants	Peers	Peers/Participant	Established	ASs
Asia/Pacific	Japan	Tokyo	Japan Internet Exchange in Japan	7	7	1	Aug 2000	27
Europe	Albania	Tirana	Albania IX	1	0	0	2001	0
Asia	Japan	Osaka	Japan's Internet Exchange	7	7	1	2000	10
Africa (2)	Luzon	Manila	MANIX	18	250	204	19th Dec 00	27
		Luzon	Anglo Internet Exchange	10	3000	10	17th Dec 00	27
	Luzon	Porto de Mactan	Internet Manila	18	0	0	18	27

The screenshot shows the euro-ix website interface. At the top, there's a navigation bar with the euro-ix logo, a search bar, and links for Home, About, IXPs, News & Events, Join Euro-IX, For networks, and Tools. Below the navigation bar, there's a section titled "The Internet Revealed" with a subtext "watch the movie & learn about IXPs, available in 10 languages!". The main content area is titled "List of IXPs" and displays statistics for Worldwide and Europe IXPs. It includes a filter box and tabs for Member, Sub-Member, Associate, and Remote. Below these are tabs for different regions: All, Euro-IX, APIX, AF-IX, LAC-IX, and North America. A table lists specific IXPs with columns for Name, City, Country, Country Code, and Affiliation.

https://euro-ix.net/ixps/list-ixps/

contact | sitemap

Home | About | IXPs | News & Events | Join Euro-IX | For networks | Tools

European Internet Exchange Association

Sign In

The Internet Revealed • watch the movie & learn about IXPs, available in 10 languages!

List of IXPs

525 IXPs Worldwide

120 Countries

350 Cities

218 IXPs in Europe

49 Countries

154 Cities

Filter

☒ Member ☐ Sub-Member ☐ Associate ☐ Remote

☒ All ☐ Euro-IX ☐ APIX ☐ AF-IX ☐ LAC-IX ☐ North America

NAME	CITY	COUNTRY	COUNTRY CODE	AFFILIATION
AMPATH - Florida International University/CIARA	▼ Miami	United States of America	US	
Academia Sinica Internet Exchange S	▼ Taipei	Taiwan	TW	

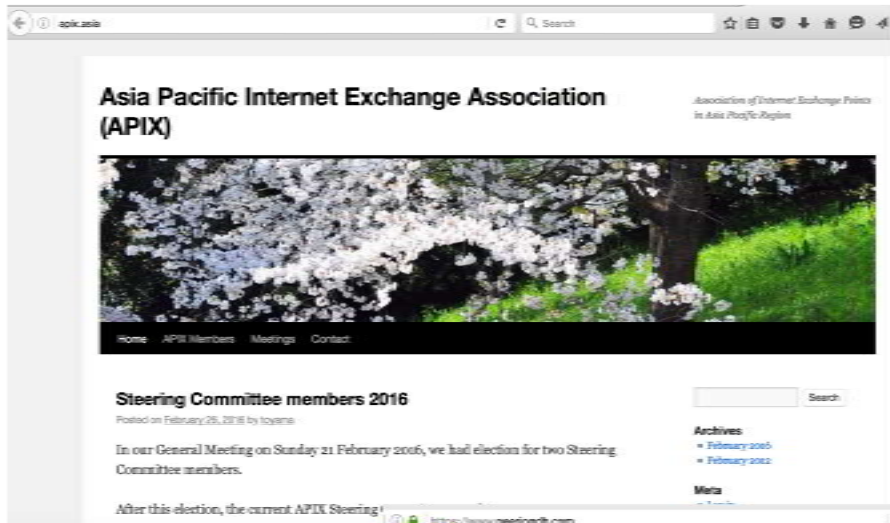
IXPs | IXP Associations & Peering DB

Af-ix.net

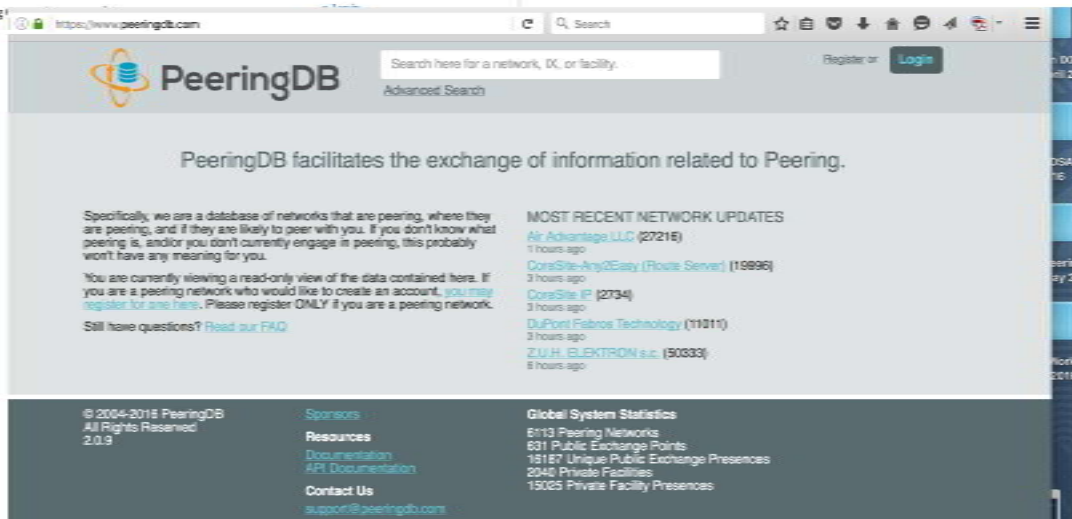
Ap-ix.net

Euro-ix.net

Lax-ix.org

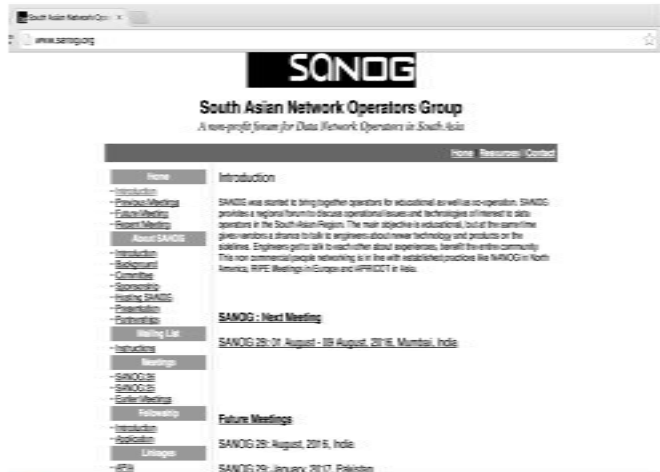


The screenshot shows the homepage of the Asia Pacific Internet Exchange Association (APIX). The header includes the APIX logo and navigation links: Home, APIX Members, Meetings, and Contact. Below the header is a large banner image of cherry blossoms. The main content area features a section titled "Steering Committee members 2016" with a sub-header "Posted on February 25, 2016 by Ioyana". The text below states: "In our General Meeting on Sunday 21 February 2016, we had election for two Steering Committee members." It also mentions "After this election, the current APIX Steering Committee members are:". On the right side, there is a search bar and an "Archives" section with links for "February 2016" and "February 2017".



The screenshot shows the homepage of PeeringDB. The header includes the PeeringDB logo and navigation links: Register or Login. Below the header is a search bar with the text "Search here for a network, IX, or facility." and an "Advanced Search" link. The main content area features a section titled "PeeringDB facilitates the exchange of information related to Peering." followed by a paragraph explaining the database's purpose. Below this is a section titled "MOST RECENT NETWORK UPDATES" with a list of recent updates, including "Air Advantage LLC (27216)", "CoreSite-Arc2Easy (Route Server) (119996)", "CoreSite IP (2734)", "DuPont Fabros Technology (11111)", and "Z.U.H. ELEKTRON s.r.l. (50333)". The footer includes copyright information: "© 2004-2016 PeeringDB All Rights Reserved 2.0.9", a "Sponsors" section, a "Resources" section with links for "Documentation" and "API Documentation", a "Contact Us" section with the email "support@peeringdb.com", and a "Global System Statistics" section with the following data: 6113 Peering Networks, 631 Public Exchange Points, 16167 Unique Public Exchange Presences, 2046 Private Facilities, and 15025 Private Facility Presences.

IXP Development | Peering Events & Network Operator Group Meetings



Internet Ecosystem – Impact | IXPs

- **Internet Community Multiplier Effect**
- **Internet & Fibre Infrastructure Development**
- **Local technical community development & strengthening**
- **Train the trainer**
- **Network Operator Group (NOG) Development**
- **Mentoring Opportunities**
- **Economic Development & Investment | Additional Sustainable Infrastructure Projects**
- **Bottom-up Governance & Amplifier Across Local Ecosystem**

IXPs Best Practices & Regional



Challenges - IXPs

Collaboration and building trust. The establishment of an IXP requires the collaboration of many actors, many of whom are competitors that will be exchanging traffic at the IXP. **Neutral location and management.**

Best practices have shown that IXP location and management should be as neutral as possible and agreed upon by all IXP participants. Ideally, the location of an IXP and an IXP manager/operator should be independent of outside commercial or governmental influences. Unfortunately, some incumbents and/or governments want to control all aspects of an IXP. When this happens, the IXP often fails, as confidence and trust in its management and operations is lost.

Enabling environment. IXPs are sensitive to local constraints associated with the lack of an enabling Internet-connectivity environment, including investment and tax constraints, the high cost of local terrestrial fibre, and complicated rules for network deployment.

Best Practices - IXPs

Guiding Principles

Government actors can play an active and critical role in championing the development of IXPs and removing roadblocks to their growth and success. Guiding principles for policy makers and regulators include:

- **Support IXPs** and speed their development with information and communications technology (ICT) policy objectives that promote an enabling environment for interconnection via policy and regulatory frameworks.
- **Provide as much policy and regulatory transparency** as possible to encourage regional and international entities to participate in the local interconnection and peering environment.
- **Encourage competitive access to wired and wireless connections**, which will help lower the costs associated with connecting to an IXP.

Best Practices - IXPs

Guiding Principles

- **Promote local investment opportunities** via tax holidays, and reduced duties on the equipment needed to build IXPs and operator networks (e.g., switches, routers, and servers). Provide clear guidance about local business rules and practices.
- **Foster relationships with IXPs to learn more** about local interconnection environments and the sustainability and technical management of an IXP.
- **Work with existing IXPs and expert organizations to avoid the mistakes** that other IXPs have made, obtain start-up assistance and equipment donations, and learn more about training and human-capacity development opportunities.
- **Refer to the Internet Society online Interconnection information for a general set of guiding principles** that enhance overall network interconnectivity (<http://www.internetsociety.org>) and our report on *Lifting barriers to Internet development in Africa: suggestions for improving connectivity*: <http://www.internetsociety.org/doc/lifting-barriers-internet-development-africa-suggestions-improving-connectivity/>

Best Practices - IXPs

Below are best practices from some of the practical work we have done with partners around the world:

- **Local Champion(s):** A champion is needed to help develop the IXP and build a community.
- **Neutrality:** As noted above, a neutral location and management of the IXP is critical to sustainability. All organizations at the IXP should agree on location and IXP management.
- **Simple Management Structure:** Many very large IXPs have been established on a basis of a simple management structure, a governing board made up largely of customers, and a volunteer staff, with customer fees set to just cover costs ('not-for-profit').
- **Equal Partners:** All peers at an IXP should be treated equally. Founding partners should not vote in or out members or have a weighted vote.
- **Establish Operating Principles:** Establish operating principles and publish them.
- **Website:** It is critical to have a web-site that includes, at a minimum, basic location and contact information, peering policies, traffic statistics, peers at the IXP.

Best Practices - IXPs

Below are best practices from some of the practical work we have done with partners around the world:

Redundant Power Supply: Always have a redundant power supply and test switching over to it frequently.

Fibre to the IXP: Allow operators to bring their fibre to the IXP

Redundant POP: Establish a redundant Point of Presence (POP).

Numbering Resources: Work with your regional Internet registry (RIR) to obtain IP addresses for peering and IXP management, and obtain an ASN from the RIR.

Host Value-added Services: Host value-added services to increase the value of the IXP for peers (i.e., time servers, root server instances, CDN caches).

Staffing: **Some IXPs function with volunteers.** Others have part-time or permanent staff. Take a look at models that may work for you, recognizing your staffing may shift as the IXP grows.

Diverse players: Allow diversity at your IXP – banks, regional and international operators, content delivery networks, research and education networks, cloud-service providers (gaming, social media), and government networks.

IXPs : Cost, Legal & Dispute Resolution



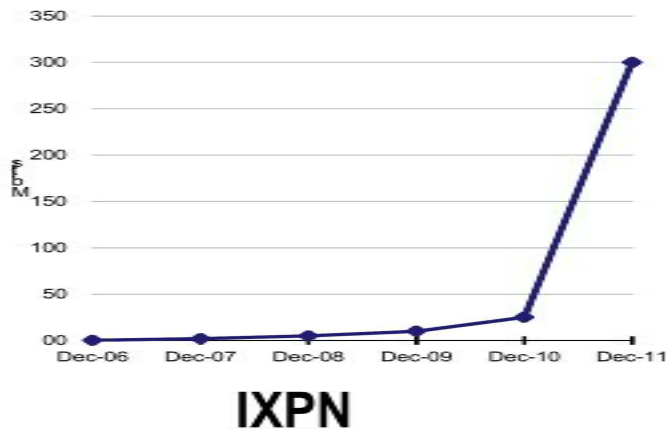
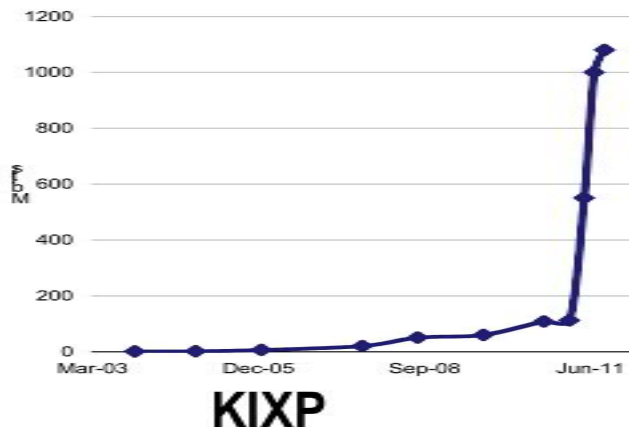
Measuring the Benefits and Impacts of IXPs: Kenya and Nigeria Case Study

<i>Benefit</i>	<i>KIXP</i>	<i>IXPN</i>	<i>Summary</i>
Latency	Reduced from 200-600 ms to 2-10 ms	Reduced from 200-400 ms to 2-10 ms	Noticeable increase in performance for end users
Local traffic exchange	1 Gbit/s peak	300 Mbit/s peak	Savings on international transit of over \$1 million per year in each country
Content	Google network present locally, along with rehosting of domestic content	Same as in Kenya	Increase in usage and corresponding revenues for mobile data traffic
E-government	Kenya Revenue Authority gathers taxes online	Usage by education and research networks	Social benefits from e-government access to IXPs
Other benefits	An increasing amount of regional traffic exchanged at KIXP	Financial platforms hosted locally	Further economic benefits resulting from IXPs

- Reduced latency increasing performance and driving demand -- Especially for data-heavy applications, including video
- Direct savings on international transit (\$1.5M p.a. Kenya, \$1M Nigeria)
- Benefits facilitating e-government and education services -- e.g. Kenya Revenue Authority, West African Examination Council
- Catalyzing local hosting and content industry -- Repatriation of financial platforms in Nigeria, Data center investment in Kenya
- Increased mobile data market by an estimated \$6 million in Kenya; KIXP is attracting regional traffic

CDN Caches: Localizing International Content

- In addition to creating local hosting, local caching of Content Delivery Network content is a key opportunity.
- Implementation of Google/Akamai and other Caches and pops has had an impact on local traffic growth
- Localized CDN traffic represents more than 50% of traffic exchanged at KIXP and IXPN
- CDNs report that the existence of a robust IXP is a key decision factor in decision making on cache/pop locations



Cost, Legal & Dispute Resolution

- **Start-up Costs: Covered by Philip**
- **Donated equipment, racks, space**

Legal

- **Clear with PTA and Other Agencies: local, international**

Dispute Resolution

- **Take care not to impose heavy pre-regulation on IXP**
- **Potential “foundational document”**

Thank you for your attention!

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The Internet Society | www.internetsociety.org

Annex: Additional Background

IXP Workshop April 5-6, Tunis, Tunisia

The Internet Society | www.internetsociety.org

Resources | Studies & Surveys

- **ASEAN: Unleashing the Internet in SouthEast Asia**
<http://www.internetsociety.org/doc/unleashing-potential-internet-asean-economies>
- **Asia Pacific: Mobile Internet Survey** | <http://www.internetsociety.org/doc/mobile-internet-usage-trends-asia-pacific>
- **LAC IXP Study** | “Connectivity In Latin America and the Caribbean: The Role of Internet Exchange Points” <http://ow.ly/Jiw8s>
- **Bolivia IXP Study** | “Do Internet Exchange Points Really Matter? Evidence from Bolivia” <http://ow.ly/Jiw5X>
- **IXP Toolkit** | <http://www.internetsociety.org/ixptoolkitguide>
- **Africa IXP Study** | “Assessment of the Impact of Internet Exchange Points (IXPs) – Empirical Study of Kenya and Nigeria” <http://www.internetsociety.org/ixpimpact>
- **Lifting Barriers to Internet Development in Africa** | Suggestions for Improving Connectivity <http://ow.ly/Jiwhx>
- **Rwanda Content Study** | “Promoting Local Content Hosting to Develop the Internet Ecosystem” <http://ow.ly/JiwAE>

Resources | Videos

- IXP: Africa | AfPIF - Peering & IXPs: It Starts with a Handshake - <https://www.youtube.com/watch?v=5oliP-p4zJM>
- IXP Toolkit | Videos from Africa & Canada – IXP Development - <http://ixptoolkit.org/content/ixp-videos-0>
- W4C: Mexico | Guerrero – Building the Internet in Guerrero - <https://www.youtube.com/watch?v=RNOjPQoxSCQ>
- W4C: India | Digital Empowerment Foundation – Building the Internet through Community Wireless Networks – Ocean in a Drop - <https://vimeo.com/147451465>

