



Yucatán Research & Education (R&E) Networking – CUDI 2016 May 26, 2016

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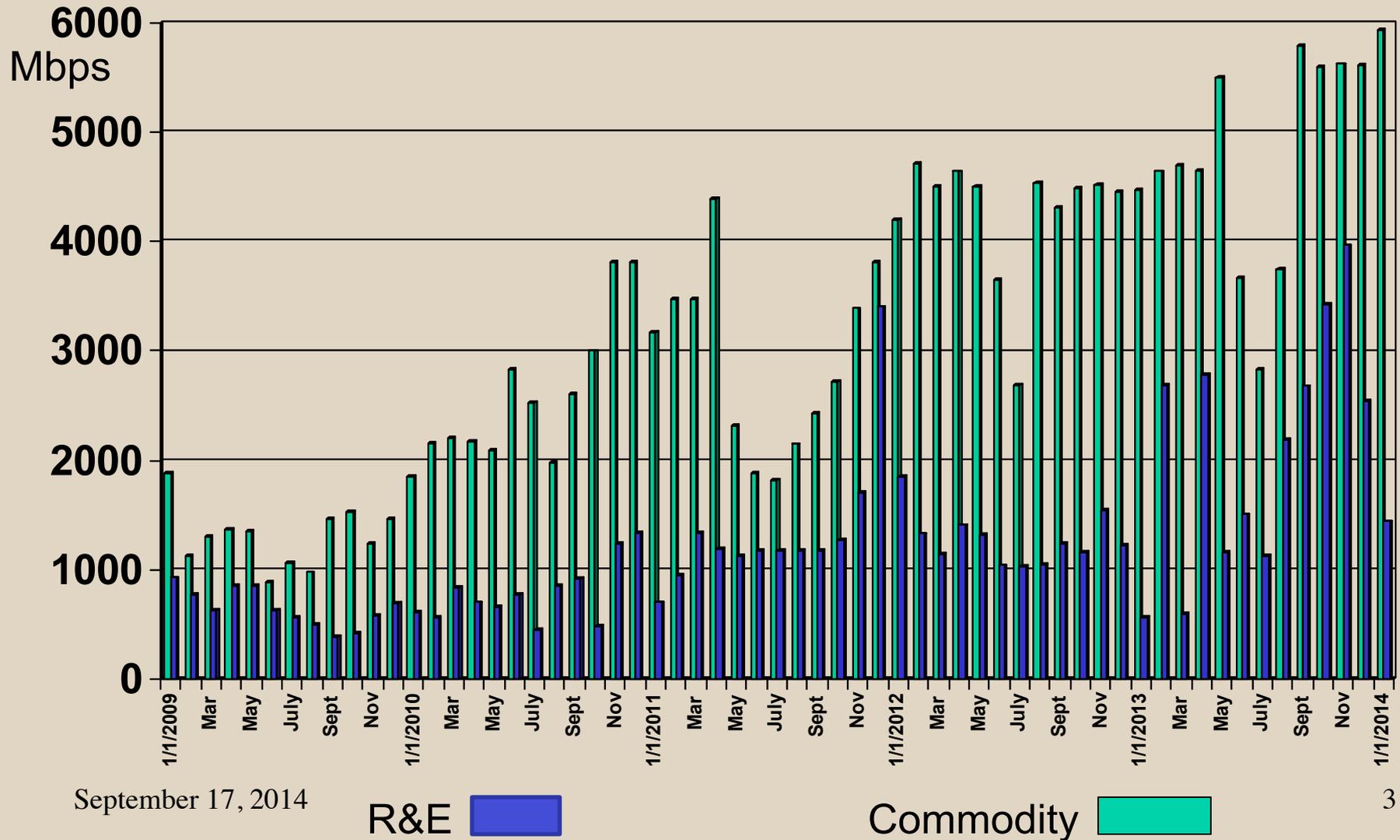
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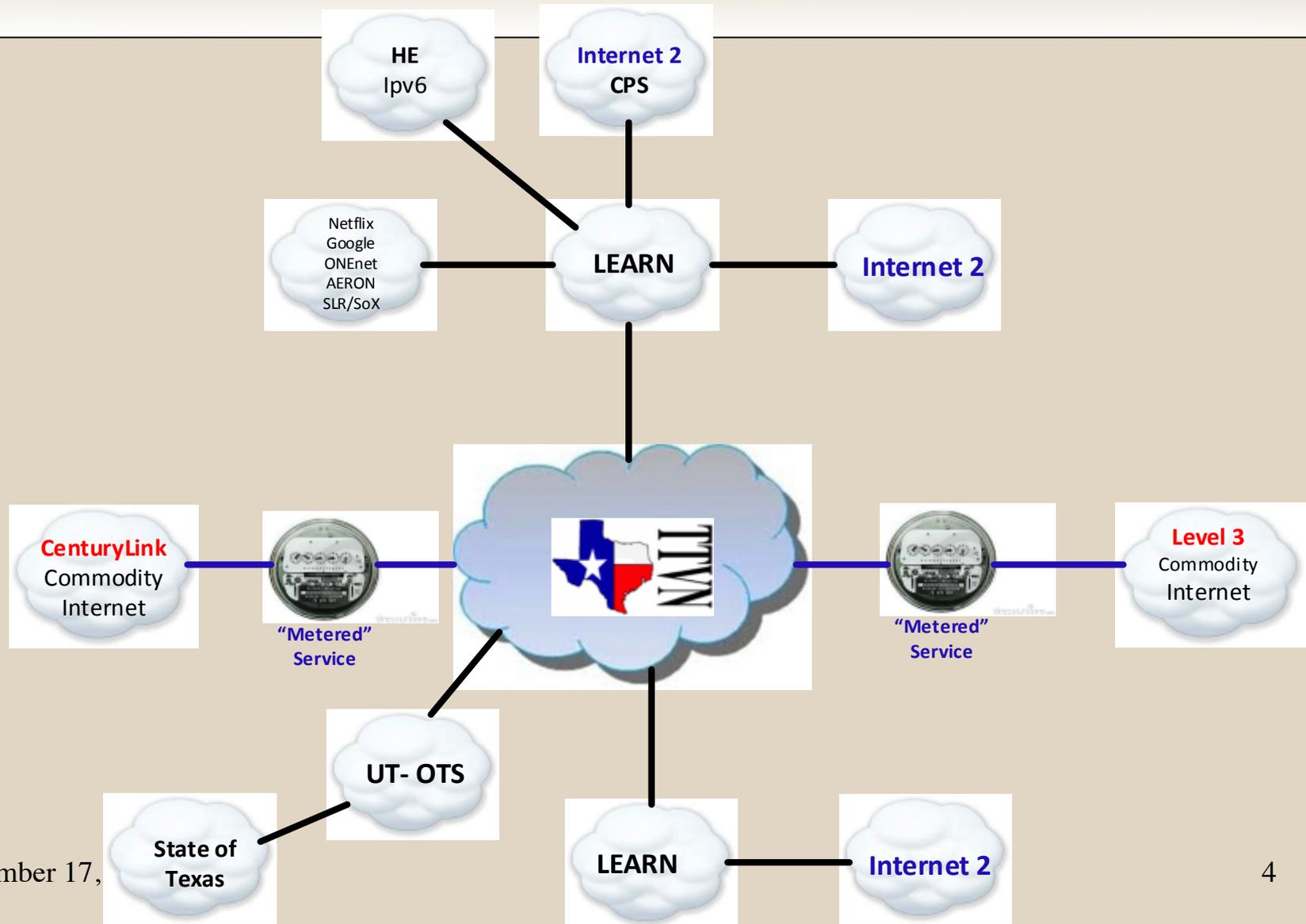
Outline

- Background
 - Research and Education (R&E) Networking in Texas
 - R&E Networking Lessons Learned
 - Internet2 Research and Education Network
- NSF IRNC Program, AmLight Mexico Pathways (AMP) 2014 IRNC Grant
- Preliminary Recommendations for Yucatán R&E Networking

TTVN – Five Year Peak Utilization



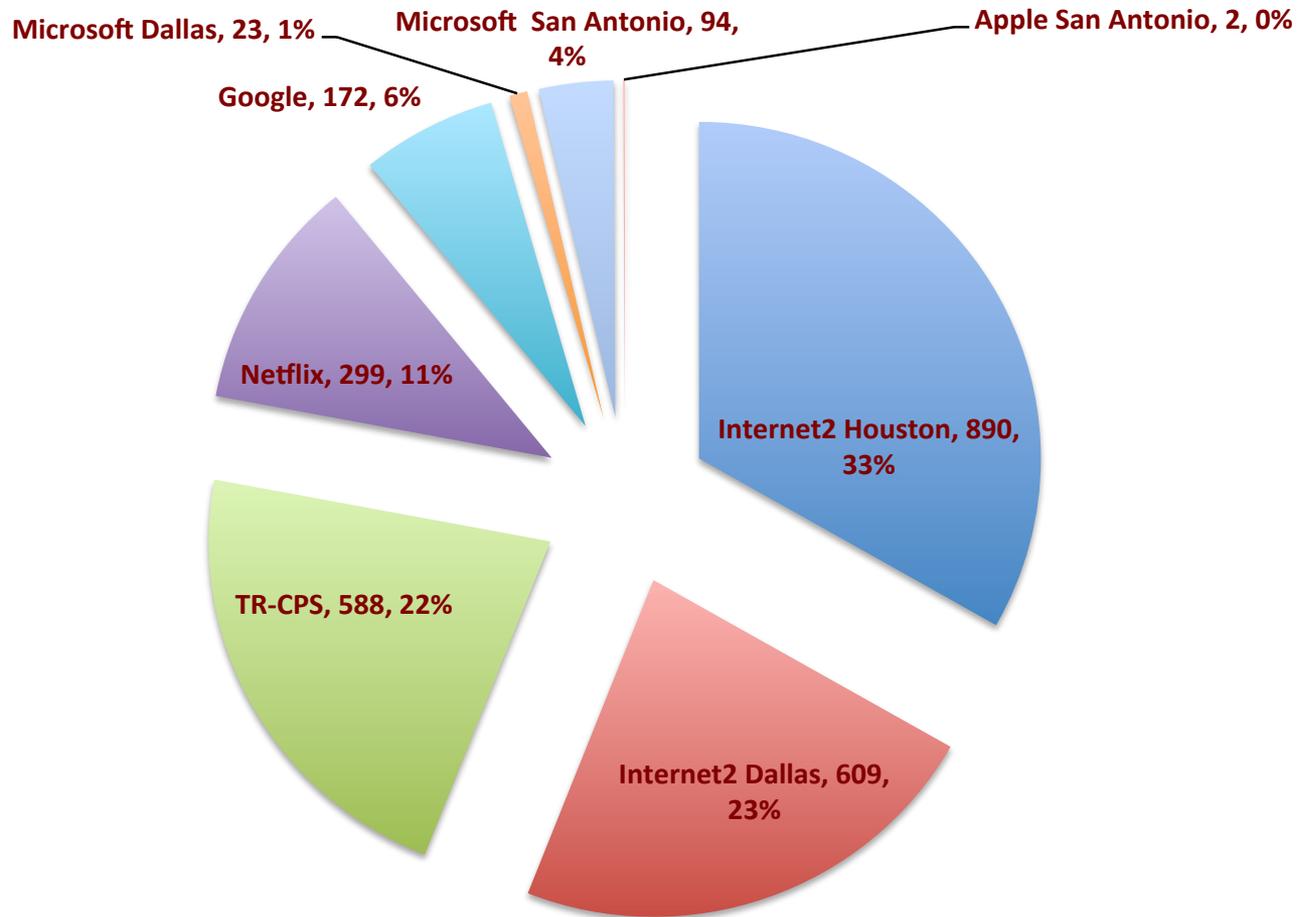
TTVN Network Peering



LEARN IP Utilization - Weeks 20-23 2014

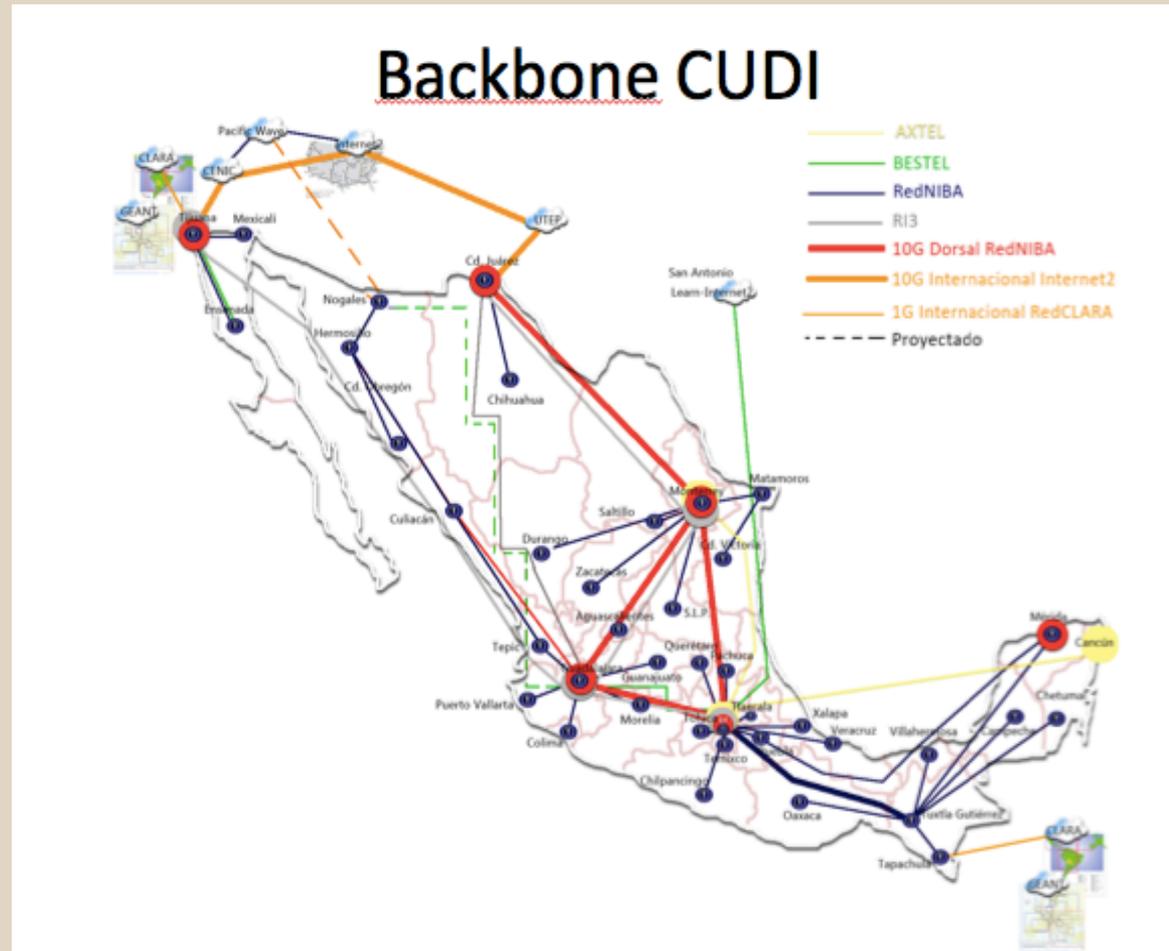


IP Usage IN+OUT over 30 days (Terabytes and %)



CUDI Backbone 2014

- CUDI Backbone now runs on the Comisión Federal de Electricidad (CFE) Telecom fiber optic network
- CFE Telecom fiber backbone is a modern Xtera Optical Ground Wire (OPGW) solution that is capable of 100 Gbps
- The CUDI 10 Gbps backbone currently interconnects Juárez to a triangle between Monterrey, Guadalajara, and Mexico City
- Current connections to the U.S. Internet2 network are in San Diego, El Paso, and San Antonio
- Current connection speed to Mérida is 1 Gbps



NSF Internet Research Network Connections (IRNC) Grants 2014



- NSF IRNC Grants 2014
 - Several types: (1) Backbone (link US R&E networks with peer international networks), (2) Open Exchange Point, (3) R&E Network Operations Centers, (4) Advanced Network Management tool development and application, and (4) Training.
 - Five year grants
 - Backbone grants
 - Up to \$1.2 million/year for five years.
 - Expect two or three awards (no U.S. to Europe).
 - Will fund connections from U.S. to other countries, but does not fund infrastructure in other countries.
 - Must demonstrate science and engineering drivers
- AmLight Mexico Pathways (AMP) Team (Backbone Proposal)
 - Florida International University (FIU)
 - Julio Ibarra, PI, and Heidi Alvarez, co-PI, both FIU
 - LEARN
 - Steve Riter, co-PI, Chair LEARN Board and CIO UT El Paso
 - CENIC
 - Louis Fox, co-PI, CEO CENIC
 - CUDI
 - Carlos Casasús, co-PI, CEO CUDI
 - RedCLARA
 - Florencio Utreas, co-PI, Exec. Director RedCLARA

NSF Internet Research Network Connections (IRNC) AmLight Mexico Pathways (AMP) Proposal Goals

- 2015 – 2017 Goals
 - Establish cross-border connections to CUDI at 10 Gbps
 - Juárez to El Paso Internet2/LEARN
 - Nogales, Mexico to LA Internet2/CENIC/PacificWave
 - LA to San Diego to Tijuana to Ensenada
 - Connect to RedCLARA in Tapachula, Mexico, and route RedCLARA traffic on CUDI backbone
- 2018 – 2019 Goals
 - Increase cross-border connections to CUDI (see above) from 10 to 100 Gbps.
 - Deploy Internet2's Innovation Platform to at least four Mexican research institutions.

Proposed NSF-IRNC 2015-2017



Proposed NSF-IRNC 2018-2019



Preliminary Yucatán R&E Networking Recommendations



- **Mérida IXP** - Establish an Internet Exchange Point (IXP) in Mérida
- **Science and Technology Park Network** - Connect the Science and Technology Park to the IXP with dark fiber, and develop S&T Park network plan
- **CUDI Expansion & Bandwidth Increase** – Expand access to CUDI, increase bandwidth of the CUDI R&E circuit to Mexico City from 1 to 10 Gigabits per second (Gbps), protect research bandwidth, and increase commodity Internet connection bandwidth
- **Backup CUDI and Education Circuits** - Plan for a backup CUDI and Education 10 Gbps circuits over an alternate path
- **Upgrade Yucatan Red Estatal de Servicios Digitales** - Plan for moving the backbone of the statewide WiMax network to fiber, and provide 1 or 10 Gbps to research universities and research institutes via existing R&E fiber in Mérida
- **Additional Network Services** - Consider adding services such as VoIP, IPTV, and Emergency Notification for universities and K-12; and consider Next Generation 911
- **HPC Condominium Cluster** - Consider a “condominium cluster” model for high-performance computing in the Science and Technology Park

Establish an IXP in Mérida

- Not a new idea, you are in the planning stages.
- What is an IXP?
 - Physical location with network infrastructure to facilitate the exchange of Internet traffic between Internet Service Providers, large IT companies (e.g., Google, MS, Apple, Netflix, ...), and R&E Networks
 - Can reduce cost to participants, reduce latency, increase resilience, and eliminate the need for traffic to leave Mexico just to get to someone across the street on a different ISP
 - Operated by a single entity, either a commercial company (U.S. model) or a not-for-profit (Europe, Mexico, U.S. R&E Networks)
 - Cost to join and recurring fees related to port speeds
- The first IXP in Mexico was only recently established in Mexico City in April 2014
 - Consortium for Internet Traffic Exchange, AC (CITI)
 - Initial members of the non-profit, civil association: CUDI, KIO Networks, Megacable, Nextel, Redit, TransTelco, IUSACELL, Servnet, Grupo Hevi, and Maxcom
 - Located in high-availability KIO Network data center

IXP Mérida Considerations

- Convene a meeting of all the potential stakeholders to build support and assess participation
- Profit vs non-profit?
 - Most likely not-for-profit, but need to involve the stakeholders
 - Need a governance model for the not-for-profit: review CITI, euro-IX, IXPtookit, and Internet2 documentation
- Identify technical expertise and establish a technical committee for the IXP
- Location for IXP Mérida?
 - All the members need to agree on the location
 - Preferably, Tier 3/4 data center, but at a minimum quality power and cooling, UPS, generator backup, cooling backup, fire & break-in detection, 24 X 7 access for members, physically secure, etc.
 - Easy connection to potential member networks, access to fiber or rights-of-ways, & ability to build or easy access to antenna towers
- Develop detailed business plan
- Consider a dedicated circuit interconnecting the CITI IXP in Mexico City and the Mérida IXP
 - Perhaps negotiate with the Comisión Federal de Electricidad (CFE) for a 1 or 10 Gbps circuit
 - Could bring additional peering opportunities to Merida earlier
 - Probably need to be sensitive to local ISP implications

Science and Technology Park Network

- Dark Fiber from Mérida IXP to Science and Technology Park
 - In addition to commercial ISP availability in the park, purchase a long-term lease (IRU) for 10 to 20 years of at least one fiber pair connecting the IXP to S&T Park
 - Install Dense Wavelength Division Multiplexing (DWDM) Equipment on the fiber
- Establish Network Point-of-Presence (POP) in S&T Park
 - Institution agnostic, a truly shared facility.
 - Identify suitable POP location with fiber connectivity to all S&T Park buildings and adequate power, cooling, backup generator, and backup cooling
 - Develop a governance structure for S&T Park Networking

Identify technical expertise and establish a technical committee



CUDI Expansion & Bandwidth Increases on CUDI and Education Circuits



- Expand CUDI access to all universities (public and private), research institutes, S&T Park, and eventually K-12.
- Increase speed of CUDI circuit from Mérida to Mexico City from 1 to 10 Gbps
- Ensure there is sufficient bandwidth reserved for researchers to move big data
- Provide CUDI peering at IXP
- Increase speed on the Education commodity Internet circuit to Mexico City

Backup CUDI & Education Commodity Internet Circuits



- Although the CFE Telecom fiber is not as susceptible to cuts since it is in Optical Ground Wire (OPGW) cables run between the tops of high-voltage electricity transmission poles, equipment can fail
- Study options for a backup circuit to CUDI
 - Alternate fiber path to CFE or submarine cable to Miami
 - Other dark fiber IRU
 - Commercial ISP backup



Upgrade Yucatán Red Estatal de Servicios Digitales



- As bandwidth demands continue to increase, you will want to develop a fiber backbone connecting the major WiMax nodes
 - This will also benefit the Yucatán public safety network and Yucatán Digital Services for the public
 - Plan to connect to universities and research institutes outside Mérida over fiber as well.
- Connect to universities and research institutes over existing fiber in Mérida at 1 or 10 Gbps depending on research and education needs

Additional Network Services

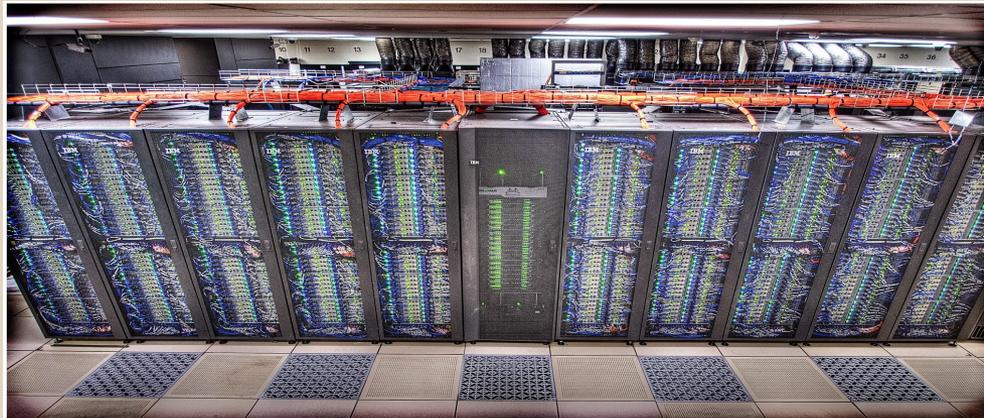
- Voice over IP (VoIP) telephone service, can serve research park, State of Yucatan and could expand out to all of CUDI if desired
- IPTV – Cable television over the network, distributed content engines reduce bandwidth requirement. Support entertainment, sports and educational content. Could send Gran Museo del Mundo Maya content to the United States.



- Emergency Notification
 - Since the Virginia Tech shootings in 2007, almost all U.S. universities provide an emergency notification service to their students, faculty, and staff. Updates of Hurricane activity to students and parents.
 - Most K-12 schools provide emergency notification
 - Standards allow for activation by Weather Service, Police or School Administrators.
- NG 911 – Next Generation 911 is an Internet Protocol (IP)-based service that allows voice, photos, videos, & text messages to flow from the public, through the 911 network, an on to emergency providers.

High-Performance Computing “Condominium Cluster”

- What is an “HPC Condominium Cluster?”
 - Intel-based HPC cluster, Infiniband interconnection, high-performance disk storage, & high-speed networking
 - System administration and data center operations provided by one entity
 - “Condominium” buyers receive high-priority access to the number of nodes they purchase for the life of the machine, and they contribute unused cycles to the overall good of all users.
- Texas A&M Example
 - We have purchased three HPC machines over the past nine years with this model
 - Most recently, the deal proposed was \$25K USD for two, 16-core nodes (price scales – four nodes for \$50K), 32 GigBytes memory/node, 3 PB shared mass storage by all users with 50GB guaranteed, minimum of three years of operation (typically we run the machines 4 to 5 years)



The Yucatan comes to TAMU

- 2014 – State of Yucatan hosts students at TAMU
- Summer program
 - English proficiency
 - GRE prep
 - Research



September 17, 2014