

# MadIX History and Status

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WISCONSIN  
UNIVERSITY OF WISCONSIN-MADISON

# Agenda

- Wisconsin Internet History
- Peering
- Peering Exchanges
- MadIX
- Other area exchanges



DoIT

DIVISION OF INFORMATION TECHNOLOGY

# Agenda

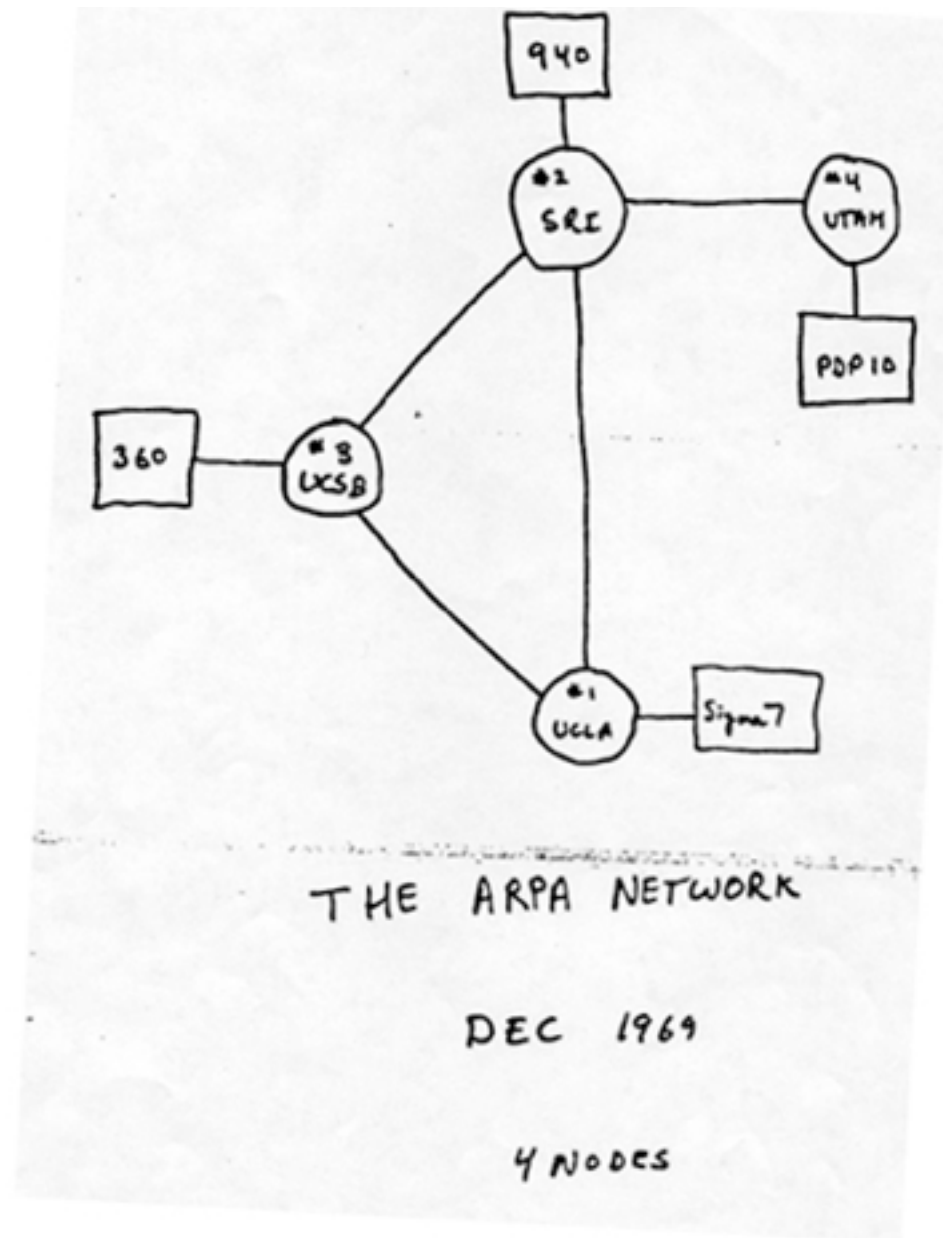
- **Wisconsin Internet History**
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**DoIT**

DIVISION OF INFORMATION TECHNOLOGY

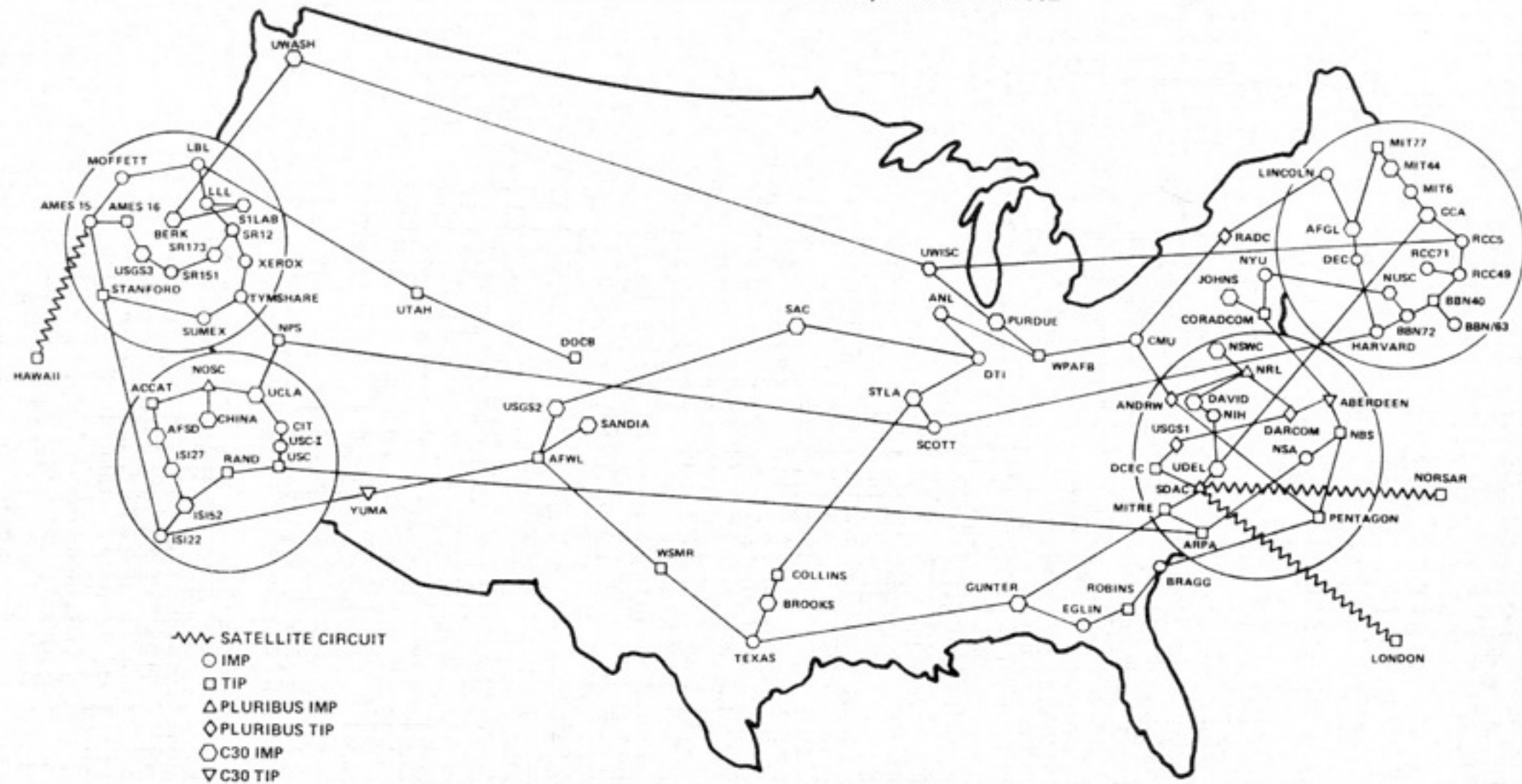
# ARPANet 1969





# ARPANet 1982

ARPANET GEOGRAPHIC MAP, FEBRUARY 1982



# WiscNet NSF Grant 1989

## COVER SHEET FOR PROPOSALS TO THE NATIONAL SCIENCE FOUNDATION

FOR CONSIDERATION BY NSF ORGANIZATION UNIT <small>(Indicate the most specific unit known, i.e. program, division, etc.)</small> <b>CISE DNCRI</b>		PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE <b>NSF 86-26</b>	
SUBMITTING INSTITUTION CODE <small>(if known)</small> <b>0038950000</b>	FOR RENEWAL <input type="checkbox"/> CONTINUING AWARD <input type="checkbox"/> ACCOMPLISHMENT BASED RENEWAL <input type="checkbox"/> REQUEST, LIST PREVIOUS AWARD NO.:	IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ___ NO <input checked="" type="checkbox"/> ; IF YES, LIST ACRONYM(S)	
NAME OF SUBMITTING ORGANIZATION TO WHICH AWARD SHOULD BE MADE (INCLUDE BRANCH/CAMPUS/OTHER COMPONENTS) <b>University of Wisconsin - Madison</b>			
ADDRESS OF ORGANIZATION (INCLUDE ZIP CODE) <b>750 University Avenue Room 442 Peterson Madison, WI 53706</b>			
IS SUBMITTING ORGANIZATION: <input type="checkbox"/> For-Profit Organization; <input type="checkbox"/> Small Business; <input type="checkbox"/> Minority Business; <input type="checkbox"/> Woman-Owned Business			
TITLE OF PROPOSED PROJECT <b>WISCNet - Wisconsin Higher Education Data Network</b>			
REQUESTED AMOUNT <b>\$589,000</b>	PROPOSED DURATION <b>3 years</b>	DESIRED STARTING DATE <b>12-01-89</b>	
CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW: <input type="checkbox"/> Animal Welfare <input type="checkbox"/> National Environmental Policy Act <input type="checkbox"/> International Cooperative Activity <input type="checkbox"/> Endangered Species <input type="checkbox"/> Research Involving Recombinant DNA Molecules <input type="checkbox"/> Research Opportunity Award <input type="checkbox"/> Human Subjects <input type="checkbox"/> Historical Sites <input type="checkbox"/> Facilitation Award for Handicapped <input type="checkbox"/> Marine Mammal Protection <input type="checkbox"/> Interdisciplinary <input type="checkbox"/> Proprietary and Privileged Information <input type="checkbox"/> Pollution Control			
PI/PD DEPARTMENT <b>Office of Information Technology</b>	PI/PD ORGANIZATION <b>UW - Madison</b>	PI/PD PHONE NO. & ELECTRONIC MAIL <b>(608) 262-8874 tad@vms.macc.wisc.edu</b>	
PI/PD NAME/TITLE <b>Pinkerton, Tad B - Director, OIT</b>	SOCIAL SECURITY NO.*	HIGHEST DEGREE & YEAR <b>Ph.D 1968</b>	SIGNATURE
ADDITIONAL PI/PD (TYPED) <b>Dori, Michael - Assistant Director, MACC</b>	---	<b>M.S. 1963</b>	
ADDITIONAL PI/PD (TYPED)			



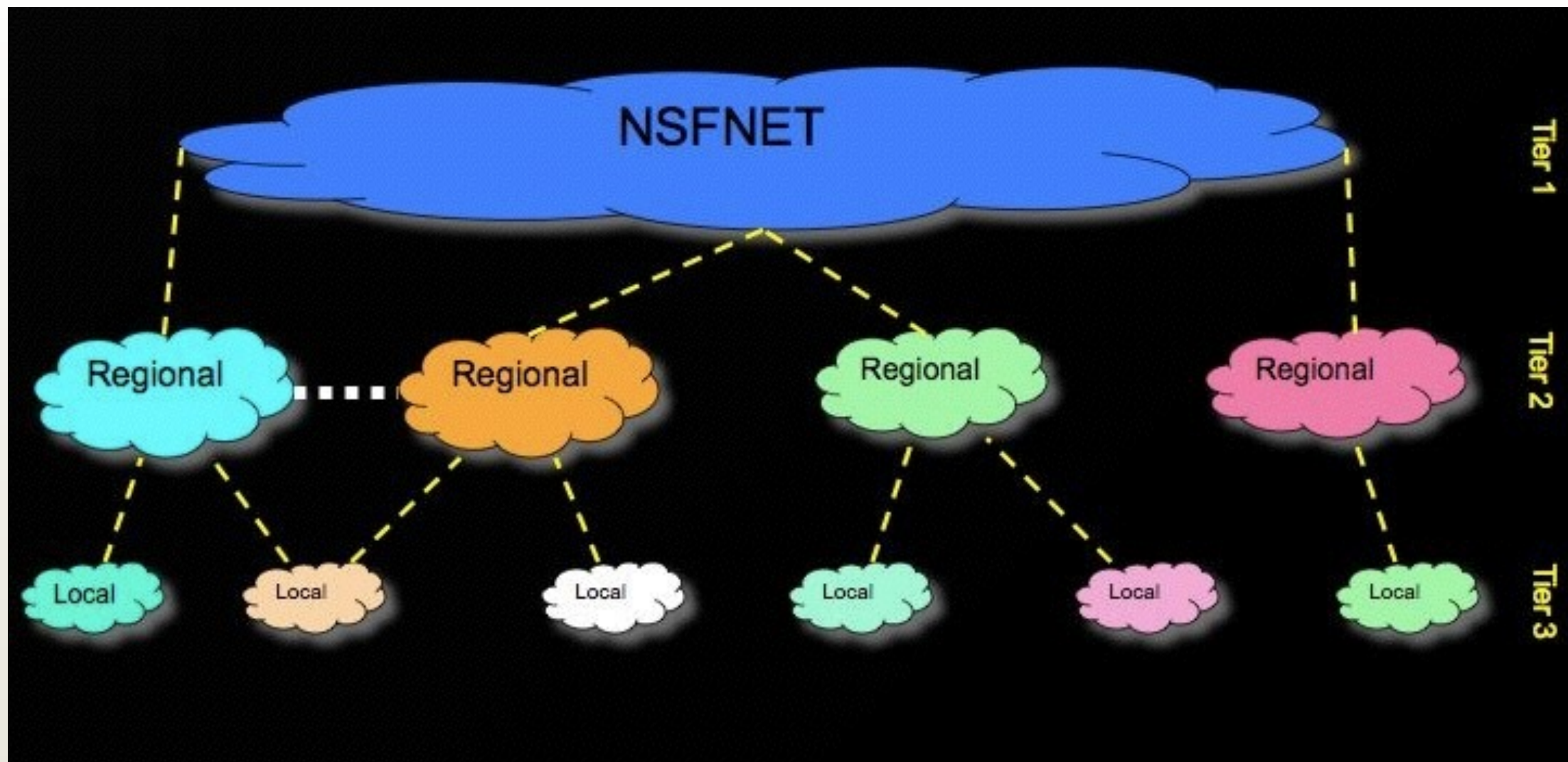




# NSFNet 1992



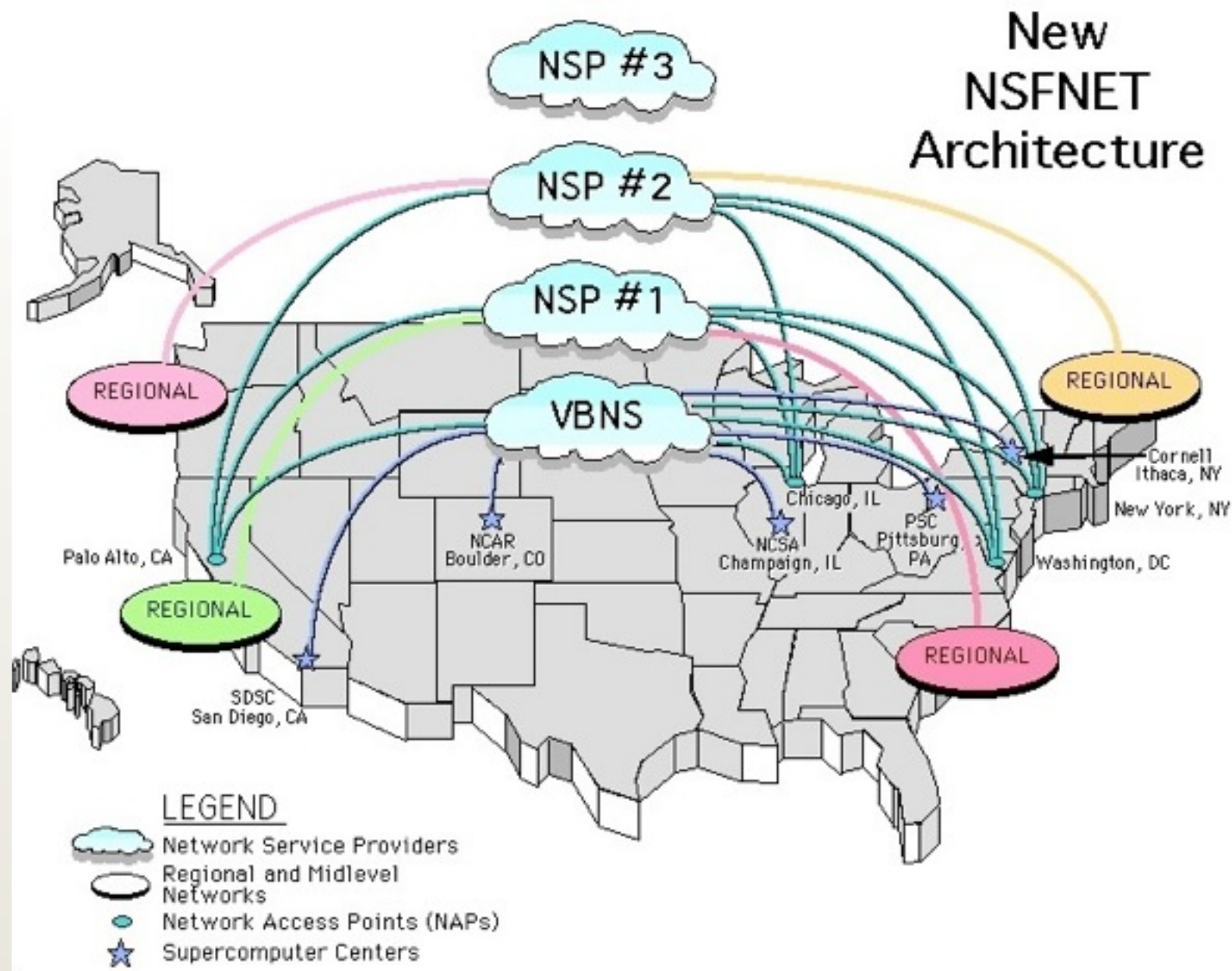
# NSFNet Hierarchy





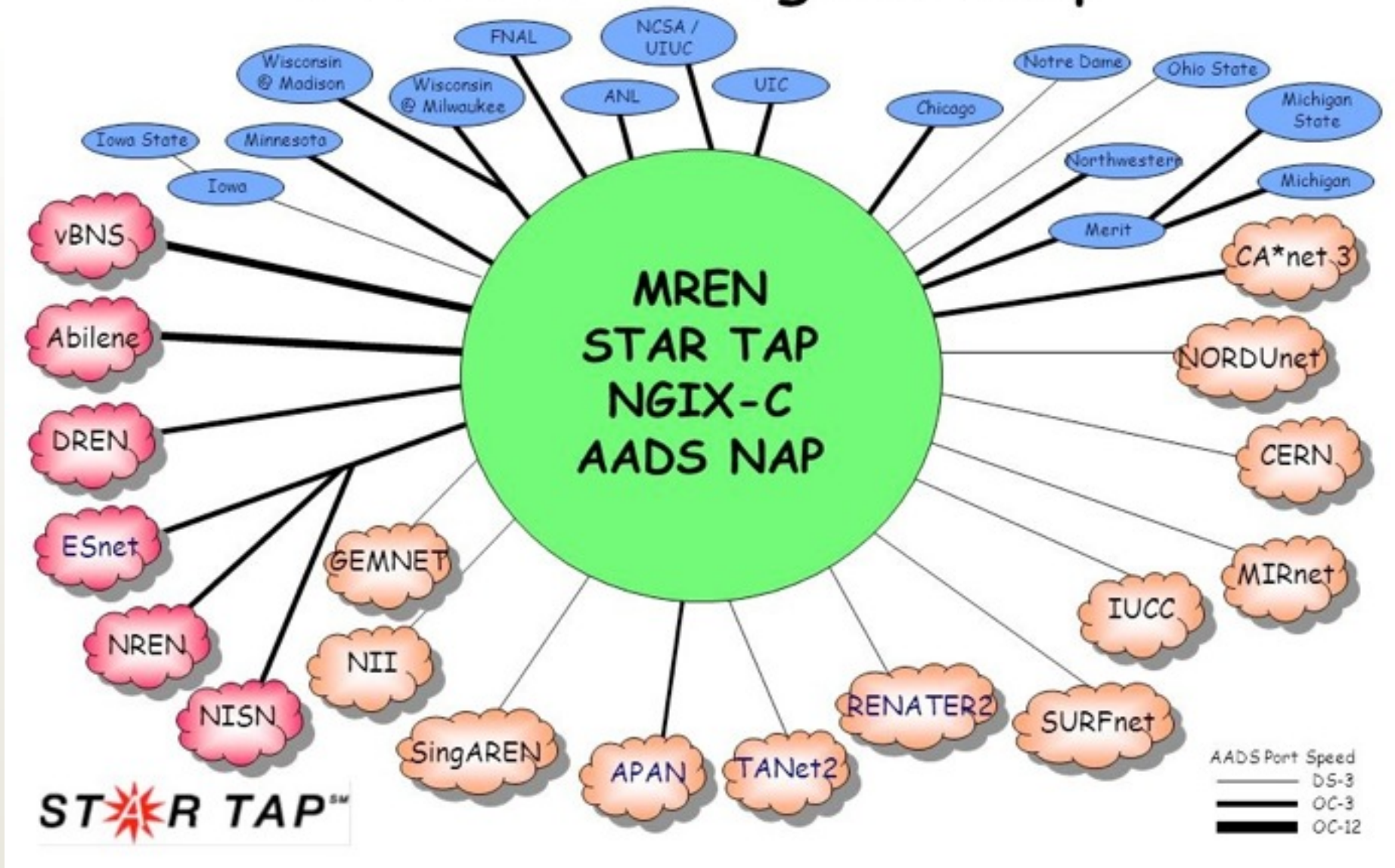


# NSFNet 1995



# Research Networking at the AADS NAP

## STAR TAP Logical Map





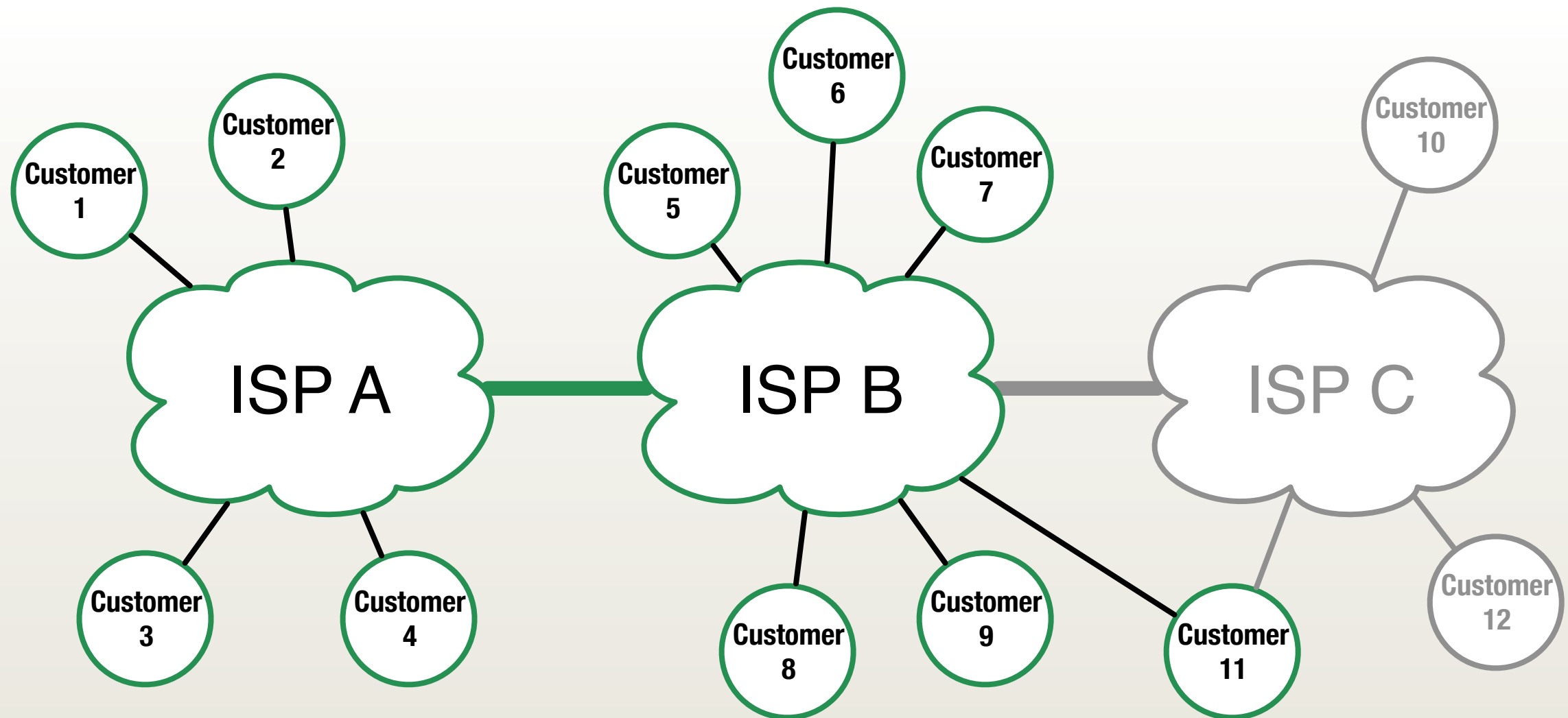


# Agenda

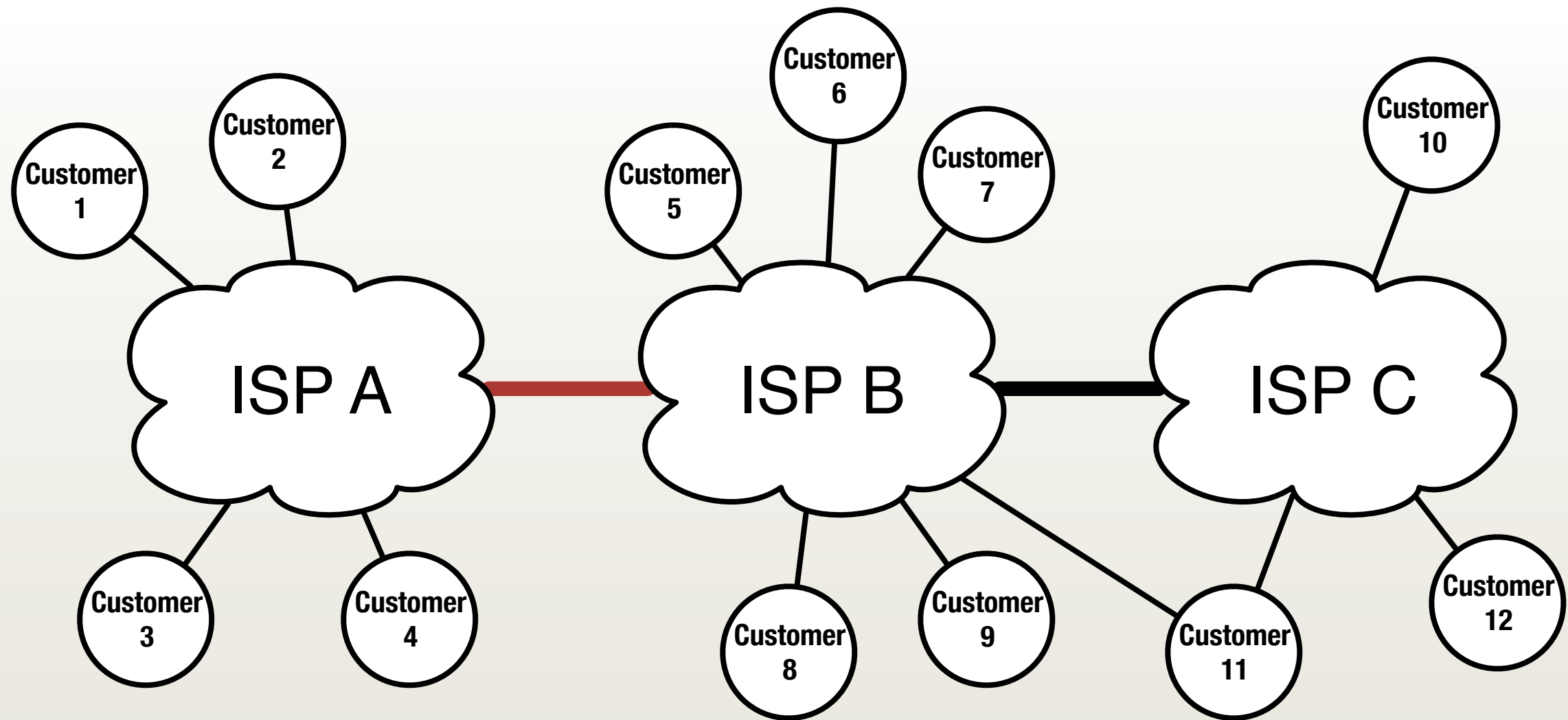
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# ISP A peers with ISP B



# ISP A transits ISP B



# Peering Definitions

- **Peering:** Two networks interconnecting for the purpose of exchanging traffic between their respective customers.
- **Transit:** A relationship with a network that allows you to cross their network to reach their peer networks.
- **Full Transit:** A relationship with a network that allows you to reach any other network participating in the Internet.

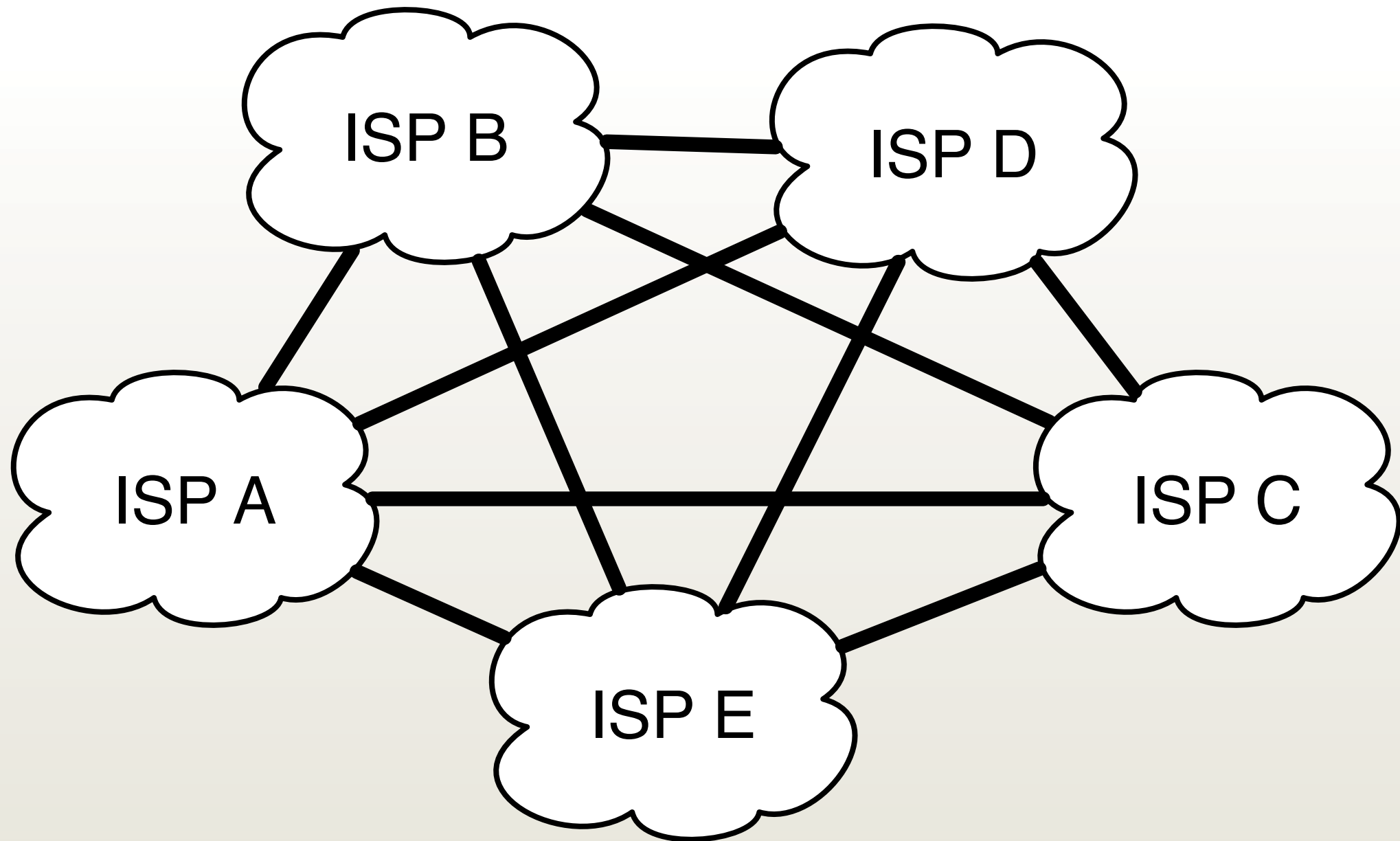


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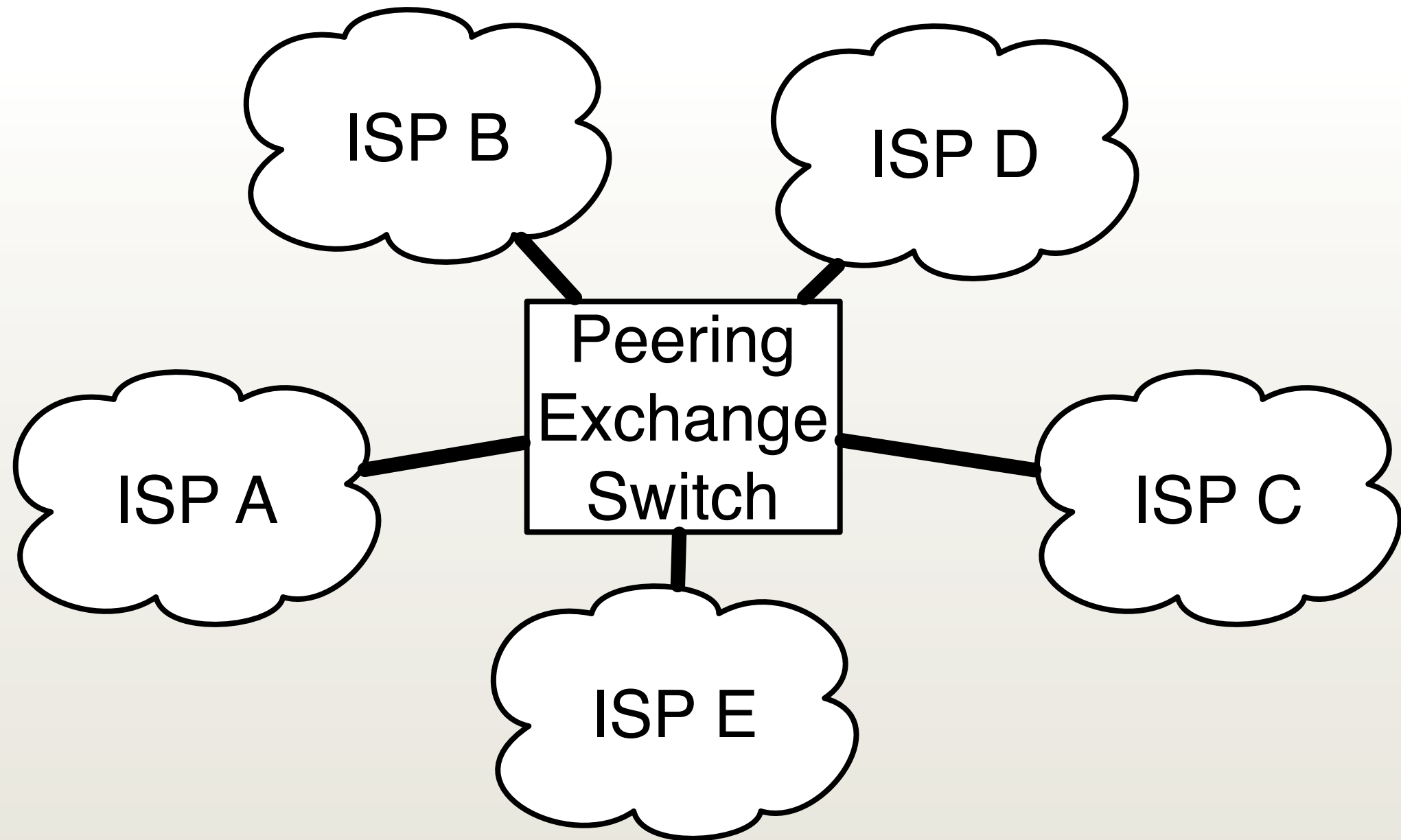


# Private Peering





# Public Peering



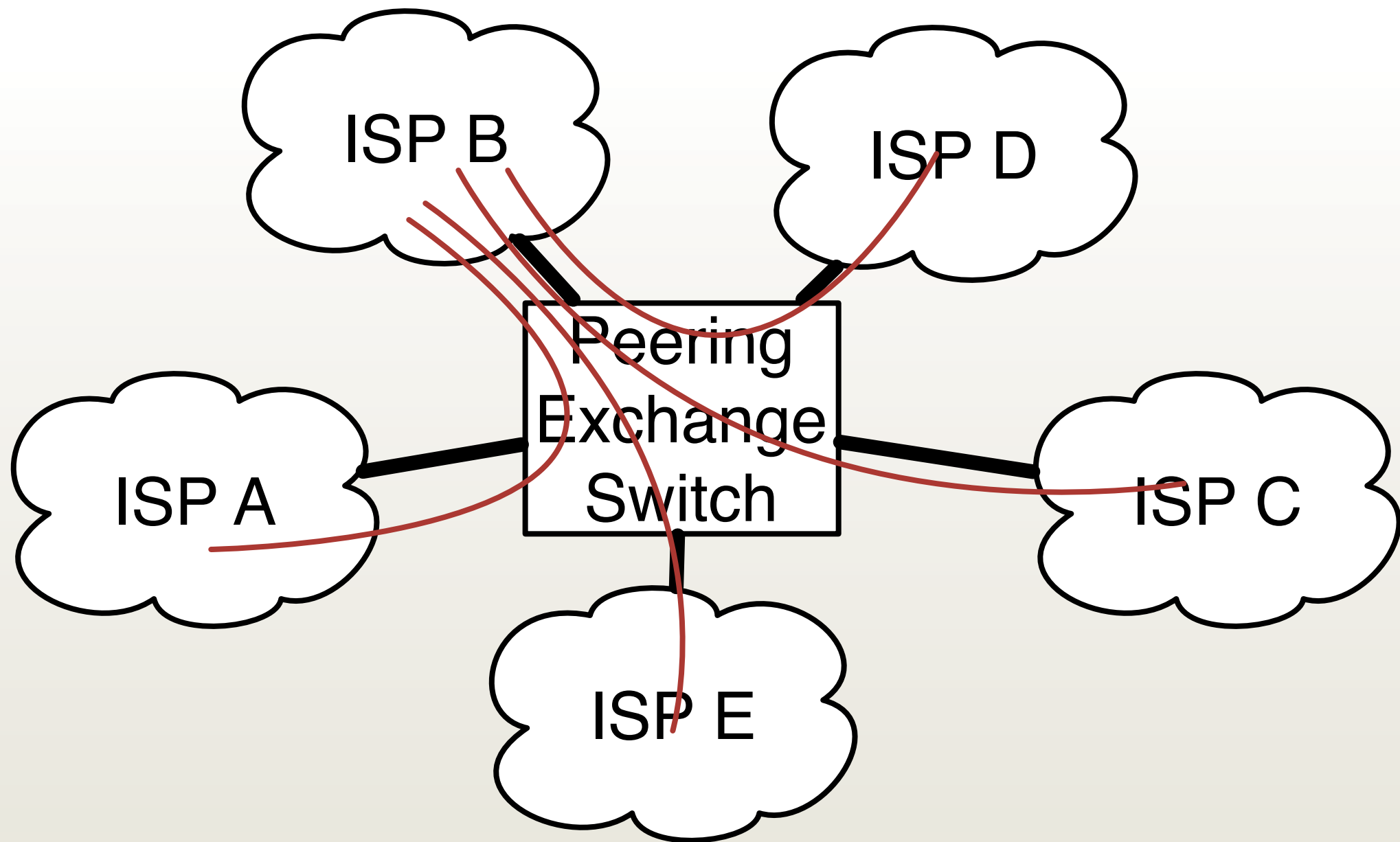


# More Peering Definitions

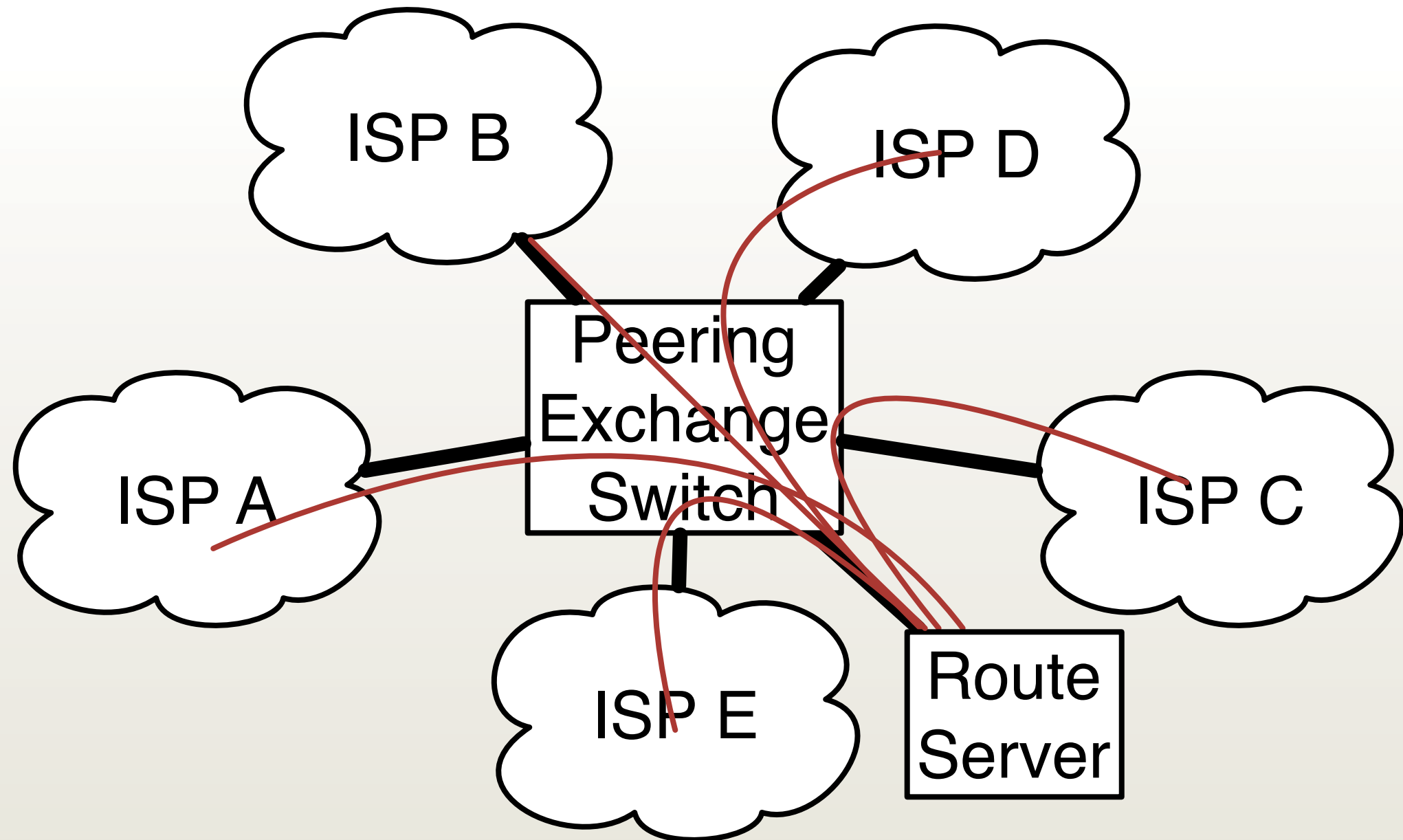
- **Public Exchange Switch:** A switch in a central location that allows networks to peer with any other network connected to the switch. Networks generally choose which other networks on the switch they will peer with.
- **Public Peering:** Peering with other networks via a public exchange switch
- **Private Peering:** Two networks peering through fiber or a circuit that directly connects their networks



# Bilateral Peering



# Route Server Peering

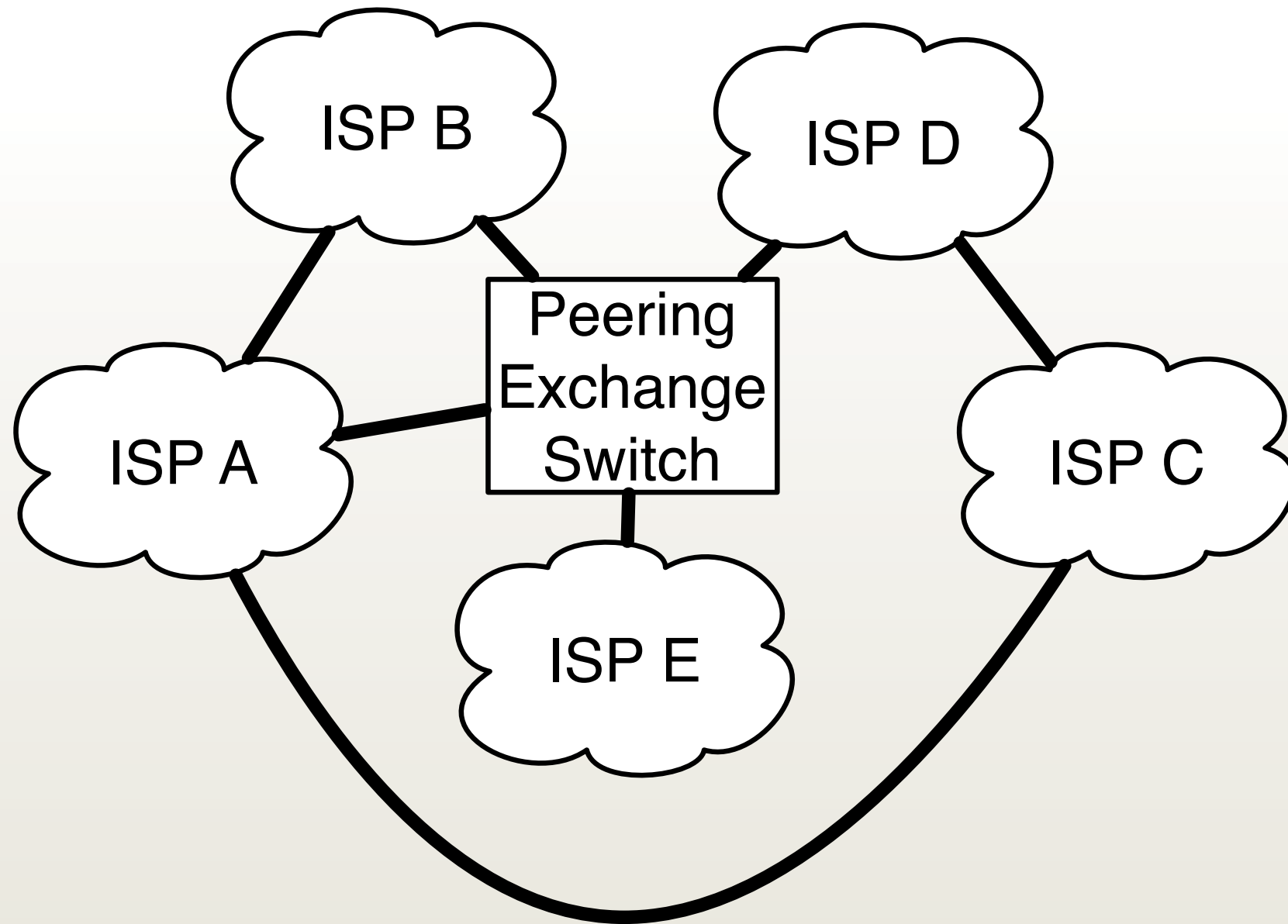


# More Peering Definitions

- **Bilateral Peering:** A peering agreement between two networks
- **Multilateral Peering:** A peering agreement between multiple networks that all agree to peer with each other under the same terms. Usually associated with a route server at a public exchange.



# Peering Options



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# Creation of MadIX

- Started in 1999 by University of Wisconsin
- Goal: Stop traffic across Madison going to the East or West coasts. Better performance, more capacity.
- Goal: Save on paid transit costs
- UW seen as neutral facilitator
- Each participant provides their transport to the exchange



# Creation of MadIX

- CSSC Building, 1210 W. Dayton Street
- FORE ATM switch
- ATM DS/3 and OC-3 services
- Initial participants: Berbee, Chorus, UW, WiscNet
- Early participants: TDS, SupraNet





# Evolution of MadIX

- Migration to Cat65xx platform
- Phase-out of ATM, migration to native Ethernet
- Gigabit Ethernet service
- 2007 – Expansion to 222 W. Washington
- 2009 – IPv6 support
- 2014 – 222 switch upgrade to Cat4500X



# Networks222



# Metro Ring





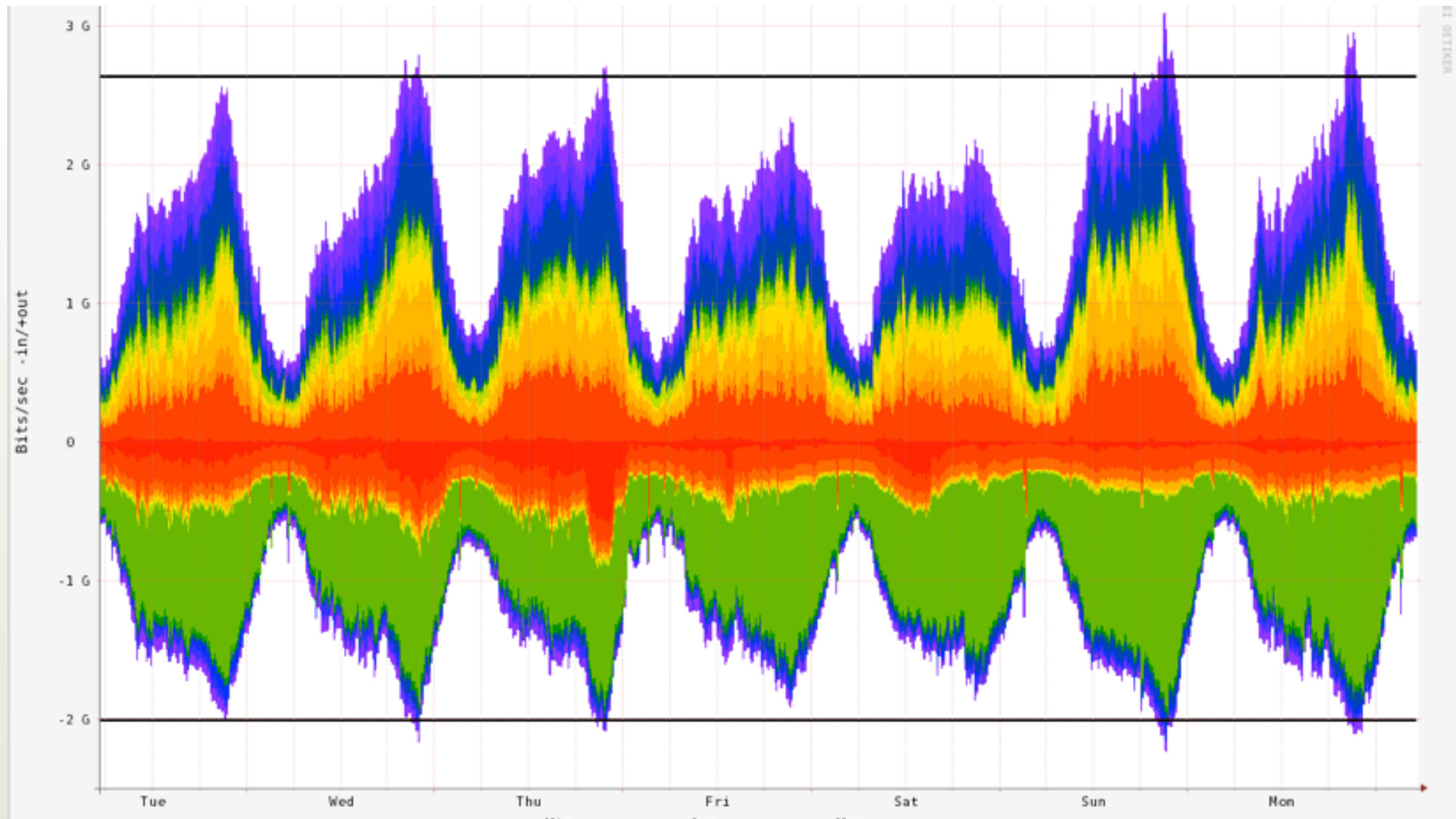
# MadIX Participants

Network	ASN
UW-Madison	59
WiscNet	2381
UWSysNet (soon)	3128
Badger Internet	26284
US Signal	26554
Sonic Foundry	22986
5NinesData	16842
CDW	3599
TDS Telecom	4181
Charter	20115

Network	ASN
SupraNet	4150
ResTechServices	46262
AirStream	11796
Netwurx	26785
Vernon Telecom	53849
Bug Tussel Wireless	33125
Hurricane Electric	6939
Hoyos Consulting	53597
Akamai	via 2381
Netflix	via 2381



# MadIX Total Traffic



# MadIX – Getting Connected

- Participants responsible for transport to the exchange
  - 222 W. Washington Street, Suite 12
  - 1210 W. Dayton Street
- GigE and 10GigE Ethernet, deprecating 100Mb
- Details: <http://go.wisc.edu/vm5fkw>



# PeeringDB.com

Public Exchange Point Detailed View			
<b>Common Name</b>	MadIX		
<b>Long Name</b>	Madison Internet Exchange		
<b>City</b>	Madison		
<b>Country</b>	US		
<b>Continental Region</b>	North America		
<b>Media Type</b>	Multiple		
<b>Protocols Supported</b>	Unicast IPv4 <input checked="" type="checkbox"/> Multicast <input checked="" type="checkbox"/> IPv6 <input checked="" type="checkbox"/>		
Contact Information			
<b>Company Website</b>	<a href="http://kb.wisc.edu/ns/page.php?id=6636">http://kb.wisc.edu/ns/page.php?id=6636</a>		
<b>Traffic Statistics Website</b>	<a href="http://stats.net.wisc.edu/madix.html">http://stats.net.wisc.edu/madix.html</a>		
<b>Technical E-Mail</b>	jeffb@doit.wisc.edu		
<b>Technical Phone</b>	+1-608-262-8336		
<b>Policy E-Mail</b>	jeffb@doit.wisc.edu		
<b>Policy Phone</b>	608-262-8336		
IP Address Blocks			
Type	Address Block	Reverse DNS Scan	
IPv4 Unicast	144.92.233.224/27	<a href="#">Link</a>	
IPv6 Unicast	2607:f388:0:2200::/64	Unsupported	
Local Facilities			
Facility Name	City	Country	Participant Count
<a href="#">Network 222</a>	Madison	US	7
<a href="#">University of Wisconsin-Madison</a>	Madison	US	2

List of Peers at this Exchange Point (Total: 13 )				
Peer Name	Local ASN	IP Address	IPs	Policy
<a href="#">5NINES, LLC</a>	16842	144.92.233.229	2	Open
<a href="#">Airstream Communications</a>	11796	144.92.233.238	1	Open
<a href="#">Berbee Information Networks Corporation</a>	3599	144.92.233.231	2	Open
<a href="#">Hoyos Consulting LLC</a>	53597	144.92.233.245	2	Open
<a href="#">Hurricane Electric</a>	6939	144.92.233.244	2	Open
<a href="#">Mad City Broadband</a>	5683	144.92.233.240	2	Open
<a href="#">Netwurx</a>	26785	144.92.233.239	1	Open
<a href="#">Spiralight Network LLC</a>	33125	144.92.233.242	1	Open
<a href="#">SupraNet Communications, Inc.</a>	4150	144.92.233.235	2	Open
<a href="#">TDS Telecom</a>	4181	144.92.233.233	2	Open
<a href="#">US Signal</a>	26554	144.92.233.227	1	Open
<a href="#">WiscNet</a>	2381	144.92.233.232	2	Open
<a href="#">Xenion Pty Ltd - Cacheboy Open Source CDN</a>	38281		1	Open





# PeeringDB.com

Company Information				Public Peering Exchange Points						
<b>Company Name</b>	TDS Telecom			<b>Exchange Point Name</b>	<b>ASN</b>	<b>IP Address</b>	<b>Mbit/sec</b>			
<b>Also Known As</b>	TDS			<a href="#">CoreSite - Any2 California</a>	4181	206.72.210.140	10000			
<b>Company Website</b>	<a href="http://www.tdstelecom.com">http://www.tdstelecom.com</a>			<a href="#">CoreSite - Any2 California</a>	4181	2001:504:13::140	10000			
<b>Primary ASN</b>	4181			<a href="#">Equinix Ashburn</a>	4181	206.126.236.64	10000			
<b>IRR Record</b>	ARIN::AS-TDS-TRANSIT			<a href="#">Equinix Ashburn</a>	4181	2001:504:0:2::4181:1	10000			
<b>Network Type</b>	Cable/DSL/ISP			<a href="#">Equinix Chicago</a>	4181	206.223.119.64	10000			
<b>Approx Prefixes</b>	400			<a href="#">Equinix Chicago</a>	4181	2001:504:0:4::4181:1	10000			
<b>Traffic Levels</b>	100+ Gbps			<a href="#">MadIX</a>	4181	144.92.233.233	1000			
<b>Traffic Ratios</b>	Mostly Inbound			<a href="#">MadIX</a>	4181	2607:f388:0:2200::7	1000			
<b>Geographic Scope</b>	North America			<a href="#">MICE</a>	4181	206.108.255.4	1000			
<b>Looking Glass URL</b>				<a href="#">MICE</a>	4181	2001:504:27::1055:0:1	1000			
<b>Route Server URL</b>				<a href="#">NYIIX</a>	4181	198.32.160.146	10000			
<b>Notes</b>	IPv4 Prefixes: recommend max-prefix 1000 IPv6 Prefixes: recommend max-prefix 25+			<a href="#">NYIIX</a>	4181	2001:504:1::a500:4181:1	10000			
<b>Protocols Supported</b>	Unicast IPv4 <input checked="" type="checkbox"/>	Multicast <input type="checkbox"/>	IPv6 <input checked="" type="checkbox"/>	1 2 of 2 Next > Last >>						
<b>Date Last Updated</b>	2014-06-06 19:43:58 UTC			Private Peering Facilities						
Peering Policy Information				Facility Name	ASN	City	Country	SONET	Ethr	ATM
<b>Peering Policy URL</b>	<a href="http://as4181.net/peering.html">http://as4181.net/peering.html</a>			<a href="#">350 E Cermak Rd. Chicago</a>	4181	Chicago	US	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>General Policy</b>	Open			<a href="#">CoreSite - DE2</a>	4181	Denver	US	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>Multiple Locations</b>	Preferred			<a href="#">CoreSite - LA1 - One Wilshire</a>	4181	Los Angeles	US	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>Ratio Requirement</b>	No			<a href="#">Equinix Chicago (CH1/CH2)</a>	4181	Chicago	US	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>Contract Requirement</b>	Not Required			<a href="#">Minnesota Gateway (Cologix)</a>	4181	Minneapolis	US	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Contact Information				<a href="#">Network 222</a>	4181	Madison	US	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Role	Contact Name	Telephone	E-Mail	<a href="#">Telx Atlanta</a>	4181	Atlanta	US	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Policy	Brad Fick	608-664-4667	peering@tdstelecom.com	<a href="#">Telx New York (111 8th)</a>	4181	New York	US	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
NOC	TDS NOC - Please Call in Emergency	608-664-4200	peering@tdstelecom.com							
Technical	Andy Koch	608-664-4694	peering@tdstelecom.com							
Technical	Kevin Roberts	608-664-4690	peering@tdstelecom.com							





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# MICE

- Midwest Internet Cooperative Exchange
- 511 11th Ave S, Minneapolis, MN
- Organized as a 501C non-profit
- Members donate \$, time, and equipment
- <http://www.micemn.net/>



# MICE History

- Steve Howard, Paul Bunyan Telephone, and Jay Hanke, Mankato Networks talked about workarounds to the “Chicago Problem”
- The only viable solution was to create an Internet Exchange Point in the upper Midwest
- After leaving the meeting, a LinkedIn group was created and invitations were sent out to our connections
- An informal meeting was scheduled July 29 and a steering committee was appointed (Dave Farmer, Mike Horwath, Jay Hanke).
- The steering committee created an Operations and Technical committee.
- FWR Communications (now Cologix) donated space and power in The Minnesota Gateway (the "511 building") in downtown Minneapolis.
- CNS and ipHouse donated use of switching hardware.
- The exchange had 7 peering members by March 2011 plus connectivity to the Northern Lights GigaPOP.
- By October 2011, there were 25+ peering members.
- Over 50 directly connected networks are peering now - September 8, 2014



# MICE Services

- **Bilateral peering** – Traffic exchanged directly between two members of the exchange over the shared exchange fabric.
- **Multilateral peering** – Traffic exchanged directly between members wishing to peer directly with any carrier.
- **Direct CDN access** – Initially Akamai, working on Limelight, Google, and Netflix.



# MICE Participants

Network	ASN
Northern Lights GigaPoP	57
CDW/Berbee	3599
Supranet	4150
TDS	4181
Onvoy Voice Services	5715
Hurricane Electric	6939
Integra Telecom	7385
ipHouse	7753
VISI	8015
US Internet	10242
Mammoth	10835
Airstream	11796
Enventis	12042
MDU Ethernet	13573
South Dakota Networks	13576
Advanced Integrated Tech	13746
Paul Bunyan Communications	14371
Jaguar Communications	15011
702 Communications	15267
Arvig	16904
Charter	20115
MyTelepath	20338
Akamai	20940
Implex	21709

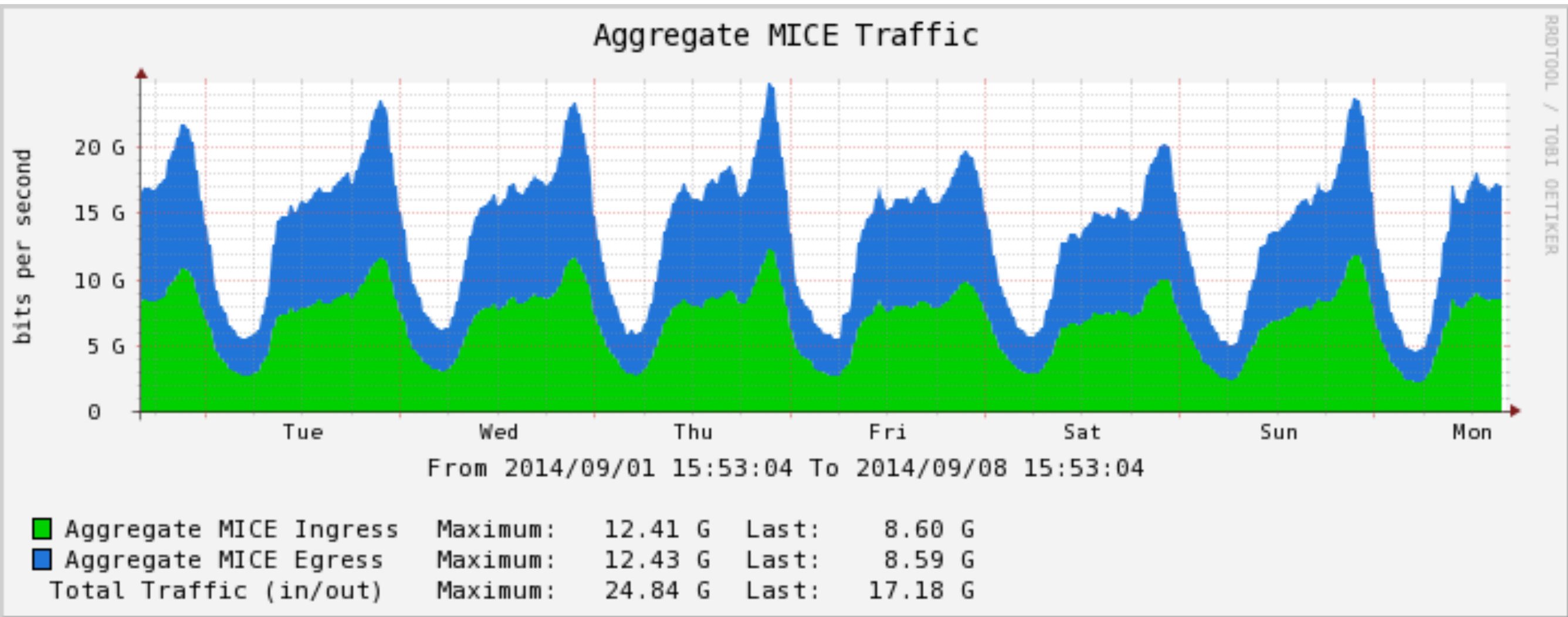
Network	ASN
Halstad Telephone Company	21730
Nextera	22402
Savage Communications	23260
Broadband Visions	25615
Atomic Data	25694
NU-Telecom	25852
Dakota Carrier Network	26794
Emergent Networks	29762
Genesis Wireless/RevNetData	30032
Cooperative Network Services	32609
Minnesota VoIP	32621
Wikstrom Telephone Company	33362
Stellar Association	36374
Acentek	40328
HCMC	40413
Arcustech	40442
Windomnet (City of Windom)	46692
Compudyne	47096
Radio Link Internet	53301
Vaultas	53480
ClaimLynx	62708
Code42	62715
Monticello Fibernet (City of	393466





# MICE Traffic

RRDTOOL / TOBI OETIKER





# MKEI-X

- Milwaukee Internet Exchange
- Established 2011
- 324 E. Wisconsin Avenue
  - Suite 433 – Netwurx
  - Suite 825 – TSR Solutions
- Ethernet – 10/100/1000 copper and SFP
- No fees
- <http://www.mkeix.net/>





# MKEI-X Participants

Network	ASN
5NinesData	16842
Netwurx	26785
Ethoplex	30162
E-Vergent Wireless	13337
Hoyos Consulting	53597
SupraNet	4150
TSR Solutions	18719
Business Only BB	30373



# TP-IX

- TP-IX: Twin Ports Internet Exchange
- 227 West 1st Street, Duluth, MN
- Operated by Paul Bunyan Communications
- No fee for 1000Mb port



# Thank You

- Questions?
- Contact info:
  - Jeff Bartig
  - [jeffb@doit.wisc.edu](mailto:jeffb@doit.wisc.edu)
- MadIX Info
  - <http://go.wisc.edu/vm5fkw>

