TAC Memo – VoIP Interconnection

September 24, 2012

As part of the transition from TDM to VoIP, many service providers in the United States have considered the migration from TDM to IP Interconnections to be an essential part of the transition. As a working group, we have posited that delays in VoIP Interconnection are largely due to policy and commercial issues, not technology issues.

Outside of the United States, companies have been progressing towards a VoIP Interconnection model with a combination of bilateral agreements and federations of carriers following the IPX models. Consequently, the process, specifications and technology for successful interconnection is fairly mature. Unfortunately, various issues have contributed to a slower start in the United States. Today, some CLEC's and MSO's are implementing VoIP Interconnection through service level agreements within their communities of interest.

In the USF/ ICC Transformation Order and Further Notice of Proposed Rulemaking, the Commission wrote that "the duty to negotiate in good faith has been a longstanding element of interconnection requirements under the Communications Act and does not depend upon the network technology underlying the interconnection, whether TDM, IP, or otherwise."[1]

Additionally, the FCC noted that Network Owners may have incentives to refuse reasonable interconnect requests commenting that "the Commission previously has found that incumbent LECs have no economic incentive…to provide potential competitors with opportunities to interconnect with and make use of the incumbent LECs network and services."[2] The Commission also suggests that existing inter-carrier compensation regimes did not advance technology neutral interconnection as LEC's have a "more certain ability" to collect ICC under TDM.[3] The Commission has partially addressed this factor in the Second Order on Reconsideration[4] allowing LECs to "tariff a rate equal to their intrastate originating access rates when they originate intrastate toll VoIP traffic."

Through the comment period on the further notice, several positions have emerged:

- There is broad agreement among service providers on the end state. That end state can be described as a new public communications network consisting of interconnected managed IP networks that will ultimately replace the TDM network and accommodate additional forms of real time communications.

Unfortunately, the agreement seems to end there.

- There is significant disagreement whether there is a need to create a regulatory scheme for VoIP Interconnection. All commenters seem to prefer individual commercial negotiations to regulatory mandates if all participants are equally motivated to seek a fair and equitable agreement. *Unfortunately, there is a prevailing view that all parties are not equally motivated and, as such, believe regulatory intervention will be required.*

Joe Gillan of Gillan and Associates has summarized the key differences between large ILECs and other service providers documented in FCC Filings[5].

The large incumbent service providers have asserted:

- IP is an information service, not subject to 251/252 or good faith negotiations.

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[1] FCC 11-161A1 – "REPORT AND ORDER AND FURTHER NOTICE OF PROPOSED RULEMAKING," Paragraph 42, page 16.
[2] *Ibid* Paragraph 1337, page 451.
[3] *Ibid*, Paragraph 1340, page 453.
[4] FCC 12-47A1, "Second Order on Reconsideration," Adopted April 24, 2012, Section II
[5] "IP to IP Interconnection – The Regulatory Landscape", Joe Gillan, OPASTCO Summer Conference, July 16, 2012, slide 16

- VoIP should be considered to be similar to an Internet backbone service that has a demonstrated track record of successful interoperability.
- Internet backbone "peering and transit" contracts demonstrate that commercial negotiations will be successful and create the model for VoIP Interconnect
- Regulation of IP interconnection will encourage international regulation of the Internet

Others, including service providers and "trade groups (COMPTEL, NTCA, NCTA, OPATSCO), Wireless (excluding AT&T or Verizon) and State Commissions"[6] have taken the opposing view based on the concern that the market power of the largest service providers could create the opportunity to force unbalanced and unfair agreements. There is a strong belief that in order to ensure good faith negotiations between larger and smaller carriers and ensure the transition to VoIP Interconnection occurs in a timely manner, the FCC will ultimately have to create rules and processes to facilitate the transition.

- The Telecom Act is technology neutral and section 251(c) interconnection rights extend to (at the least) managed VoIP.
  - The Act provides for negotiation with safeguards: public disclosure, prohibitions on discrimination, opt-in rights and, where needed, arbitration. Some have asked for a date certain (5 years) to be established for VoIP Interconnection requests to be ubiquitous.

- ILEC's have used the argument that proprietary services provided to their subscribers over broadband connections will not count against their data caps since these services never leave their own network and therefore do not traverse the internet.
  - Commenters have reversed this argument to bolster their assertion that VoIP is a service that will traverse interconnected managed private networks and hence is not an Internet service.

As we have considered this transition to an all IP network, we also have evaluated the factors that must be considered to effectively deliver real time communications content between IP networks. We acknowledge that there are broadly accepted best practices that have been implemented in Internet Peering that should be implemented as part of VoIP Interconnection. For example, standard language in Internet peering agreements provides for the exchange of traffic "originating and/or terminating" on networks of the two parties. Additionally, these agreements further state that "any peered network may not be used for "traffic dumping" or route of last resort."

The i3 Forum (and others) have been active in defining and documenting the considerations that are important when establishing VoIP agreements. These fall into several categories that lead to successful VoIP Interconnections.[7] These areas include Routing, Addressing, Security, Signaling, Media, Quality, Accounting/Charging and Testing. We have attached Appendix A that includes the detailed matrix.

We would like to close with a summary of our current view of VoIP Interconnection. We reiterate our finding that VoIP Interconnect is happening all over the world, at a rapid rate. VoIP Interconnection is growing in the USA due to efforts by MSOs and CLECs. This reinforces the point that deployment is technically feasible today but is largely being delayed due to commercial and policy considerations.

Despite our observation that the technology exists to interconnect today, we also acknowledge that other market forces now come into play. The TDM network is approaching the end of its designed lifespan. New interconnection opportunities could create the requirement for additional technical development and equipment deployment and create new commercial opportunities for providers. Finally, we reiterate that this change is uniquely transformative and creates the potential to eliminate rate centers and LATA's and will impact intercarrier compensation issues.

Potential Recommendations:

- The FCC has established a significant record on this issue in response to the further notice. The FCC should

[6] *IP to IP Interconnection*, Gillan, slide 19.

[7] Solutions for implementing IP-based interconnections for the international wholesale industry, from International Interconnect Forum for Services over IP (i3 Forum), Alessandro Forcina, Chairman WS Technical Issues, i3 Forum, ETSI Workshop on NGN Interconnection of Services Standardization, June 9, 2008

answer the critical question of whether section 251 requirements apply to VoIP Interconnection.

- In general, the Commission should refrain from imposing regulatory restrictions except where strictly necessary to ensure competitive neutrality and consumer protection.
  - Incumbent LECs assert that market forces will create a satisfactory agreement and should be left to the parties to resolve.
  - Other companies believe that there is a market failure, proven by the lack of progress in the United States vs. Europe or Asia and regulation will be required to ensure deployment.
- Regardless of the section 251 interpretation, the Commission should promote a technology-neutral position and allow for continuous innovation going forward.
- The Commission's assertion that the compensation regime is creating a reluctance to support IP Interconnection should be examined with the goal to remove any commercial barriers limiting deployment.
- **Canadian Market Example -** It may also be appropriate for the Commission to be aware of recent policy implemented by the CRTC for the Canadian market. The CRTC has created specific rules that establish criteria to trigger VoIP Interconnection requirements including:
  - Does the Requested Service Provider provide voice interconnection to an affiliate (or anyone else)?
  - Does the requested service provider provide interconnection for IP-enabled customers?
  - Do they provide VoIP Interconnection through a subsidiary?

Appendix A

Work in progress
9-3-2012

VoIP* Interconnection
Matrix of Considerations

Matrix of Considerations – 1

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Issue	Parties Involved	Possible Solutions	Rationalization & Implications
Services within scope	Service Providers (LEC, CLEC, IXC, OTT, ILD), State PUC's, FCC (NECA)	• VoIP & Video Telephony • Text / SMS • MMS • FAX, Modem – Still required but fading, especially modem • Location services – for at least PSAP interworking; can also enable ad-subsidized business models • Presence – supported by OTT & Enterprise communications today • Signaling transport & routing– e.g., TCAP services (800, prepaid, LNP/ WNP, mobile Location Services, SMS) can employ SIGTRAN, Diameter (IMS & mobile policy), RADIUS (WLAN authentication)	• IP interconnects enable services that TDM could not support • SS7 network replacement has at least signaling transport ramifications, & possible implications for TCAP services • Consumer "phones" will become IP devices to enable more services than just voice. (requires local power)
Physical Interconnect	Service Providers of all types, and regulatory bodies for arbitration	• Multiple choices, subject to SLA • Public or Private Choices • Layer 1, Layer 2, Layer 3 • Different technology options at Layers 1 and 2	• Agreements on a bilateral basis today

Matrix of Considerations – 2

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Issue	Parties Involved	Possible Solutions	Rationalization & Implications
Points of Interconnect	Service Providers of all types, and regulatory bodies for arbitration	• One size doesn't fit all • Depends on SP need for bilateral vs. multilateral connectivity • Keep high-volume (& often local) routes on bilateral POIs, but move to single POI affording multilateral connectivity for lower-volume routes • Locations depend on redundancy needs and competitive needs • Depends on cost of operating POI vs. cost of backhaul to POI • Different services need varying qualitative attributes from interconnects (e.g., secure, high QoS, low cost) • Where interconnects occur in a service provider's territory should be driven by commercial need & feasibility	• Commercially impractical to expect OTTs, some enterprises and CLECS to have other than local, physical interconnectivity. • Service Providers already provide Layer 2 and 3 interconnectivity for enterprises, which can be extended to carrier peers where TDM is used today. • Likely to be geographically local communications and need to minimize backhaul for latency-sensitive applications suggests need for more and geographically dispersed POIs • Should eliminate PSTN vestiges that create routing inefficiencies and unnecessary POIs/cost: LATA's, Rate Centers, IXC, LD and all tariffs, rules on call routing, etc.

Matrix of Considerations – 3

Work in progress 9-3-2012

Issue	Parties Involved	Possible Solutions	Rationalization & Implications
Signaling Formats	Service Providers of all types, and regulatory bodies for arbitration	• Signaling will vary with the service • Existing session border controller (SBC) & soft-switch technologies can effectively provide inter-working for VoIP and video-telephony call signaling; thus, there's no need to mandate a single default signaling protocol. SBCs are likely to be deployed at IP interconnects for security reasons. • Carrier ENUM with DNS can replace some of the TCAP services – e.g., for domain-based routing & number portability • SIGTRAN transport can replace SS7 for residual TCAP services	• ISUP signaling on SIGTRAN isn't advisable for VoIP, due to inability for signaling to carry media-plane, IP connection information • Domestic mobile service providers today use SIP-I or SIP-T for legacy VoIP interconnects; international mobile service providers may use BICC as well • Enterprises use SIP or H.323 for VoIP interconnects, with H.323 fading • Fixed service providers, along with IXC & ILD providers, use SIP and SIP-I for VoIP interconnects • IMS operators use SIP with a distinct profile, along with Diameter for authentication and service authorization and for network policy control • Legacy service providers of all types may use TCAP for AIN/IN/ CAMEL/WIN/MAP services hosted outside of their network

Matrix of Considerations – 4

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Issue	Parties Involved	Possible Solutions	Rationalization & Implications
Media Format	Service Providers of all types, and regulatory bodies for arbitration	• IP-to-IP interconnects will reduce the volume of media adaptation that's required today, since common codecs will often be negotiated via signaling (e.g., SDP negotiation) • Transcoding will most commonly be needed for calls between fixed and mobile networks, and between mobile networks using different wireless technologies • Existing session border controller, media server, and media gateway technology can effectively introduce transcoding into the media path, where this is needed; thus, there is no need to mandate a single default codec for each media type • Media Adaptation	• Voice media adaptations in scope for IP interconnects include transcoding, trans-rating, & RTP reframing. For video, trans-sizing may also be in scope. • G.711 is widely supported across fixed & enterprise networks • Mobile service providers use codecs designed for wireless and encumbered by intellectual property, such that equipment for fixed service providers & enterprises are less likely to support the codecs • Legacy mobile networks will have media gateways that support transcoding to G.711 • For IP interconnects, IMS networks will support transcoding at media servers or session border controller elements • Who performs transcoding will be negotiated.

Matrix of Considerations – 5

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Issue	Parties Involved	Possible Solutions	Rationalization & Implications

Number Portability	Service Providers of all types, NPAC, FCC oversight of NPAC	• Authoritative number portability database is today generally accessed using TCAP services. SS7 transport for TCAP can be replaced with SIGTRAN for continued use with IP interconnects.
		• Carrier ENUM with DNS can replace some TCAP services, including number portability
		  • E.g., CableLabs Peer Connect
		  • LNP Information incorporated into most Carrier's ENUM
		  • CC1 LLC is addressing implementation issues
			• Number portability implies that E. 164 numbers associated with subscribers may no longer have geographical significance; however, the number portability Db provides geographically significant routing information for routing of last resort to PSTN.
			• Usage of E.164 numbers is likely to persist
			• SIP URIs have been envisioned as replacing E.164 numbers, but such URIs have not seen wide deployment
			• URI's domain name – e.g., carrier.net – can be used for routing to the appropriate network
			• ENUM (RFC 6116) can be used to map an E.164 number to a domain for routing purposes

Matrix of Considerations – 6

Work in progress 9-3-2012

Issue	Parties Involved	Possible Solutions	Rationalization & Implications

Transit Services	Service Providers of all types, and regulatory bodies for arbitration	• One size will not fit all, as needs will vary per service, per retail service provider, and perhaps even per subscriber
		  • QoS required vs. best effort
		  • Bilateral vs. Multilateral connectivity & routing services
		  • Cascading payments vs. retail SPs' bilaterally handling termination fees
		  • Mere transport and routing vs. that plus value added services (e.g., transcoding, conferencing)
		• Rather than trying to anticipate in rule-making all the possible commercial needs related to transit service, commercial negotiations should be allowed to govern transport tariffs
		• GSMA provides blueprints for inter-service-provider SLAs in AA. 80 and AA.81
			• Even where Bill and Keep applies, transit / transport services must be paid for, where such are provided by a 3rd-party service provider
			• With completely flat networks – e.g., retail service providers directly routing to every other retail provider – we'd have an N^2 provisioning problem. Just as IXC and ILD providers address this problem today in the PSTN, IP transit providers must provide routing as well as transport.
			• U.S. voice transit service is already characterized by extremely competitive pricing

Matrix of Considerations – 7

Work in progress 9-3-2012

Issue	Parties Involved	Possible Solutions	Implications
Service Level Agreements and QoS	Service Providers, State PUC's, FCC (NECA), CLEC's, OTT, International	• Packet Labeling and Prioritization in the core MPLS • Dedicated QAM in Cable and FIOS EDGE networks • DSL DIFSERV DSCP bits RFC 1349 RFC 4594	• Best Practices to manage latency, reliability and security in VoIP networks
Transcoding and Media Adaptation	Various	• Two dimensions. TDM to IP and codec negotiation in VoIP	• Who is responsible for transcoding media? FNPRM questioning TDM to IP transcoding and who pays. In all IP peering, performing transcoding is negotiated between parties.
Business Drivers – ILECS - Move existing traffic from TDM to IP	ILECs, State PUCs, FCC, CLEC's OTT, International	• TDM Moving to Bill and Keep • Have to support IP interconnect if requested (per USF/ICC Order) • Defer to FNPRM to determine path and timing	• TDM capacity is paid for, but approaching end of support • Drives new competitors to buy TDM gear or contract I/C partners • Still seeing PRI/Enterprise growth; driving SIP Business Trunks? • Expensive to maintain parallel networks (opex, costs, unions) • SS7 will be retired with TDM
Business Drivers – Tier 2/3	Service Providers, State PUC's, FCC (NECA), CLEC's, OTT, International	• New regulations encourage cost reduction. • Quantify the net OPEX savings to service providers of IP to IP	• Tier 2/3 can spend less on interconnect

Matrix of Considerations – 8

Work in progress 9-3-2012

Issue	Parties Involved	Possible Solutions	Implications
Class 4 Services	Service Providers, State PUC's, FCC (NECA), CLEC's, OTT, International		• 8xx and calling card basic services • E-8xx/8xx+ (location based routing), secure calling, still viable ? • Enterprise interconnect (VPN etc.) • Transition to IP-PBX moving slowly, but gaining Momentum • Operator Services ? (does anyone care ?; leave on TDM ?) • Transition to next gen GETS ?
Calling Name Dialup V.34 Fax T.38 Short Codes Global Title Translations Elevator/Alarm Point of Sale CPE Power Public Safety	Service Providers, State PUC's, FCC (NECA), CLEC's, OTT, International	Calling Name information can be included in call signaling as is Calling Number in ISUP. Conversion gateways / equipment for protocol translation Other factors were addressed in TAC in 2011	• Cost of equipment
800/SMS NPAC LERG ENUM	Service Providers, State PUC's, FCC (NECA), CLEC's, OTT, International	Separate Database Work Item	• Privacy / security considerations of who has access to the info • Regulated databases and unregulated database interop