VoIP Overview for Operators

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NANOG 34 –Seattle, Washington

May 2005

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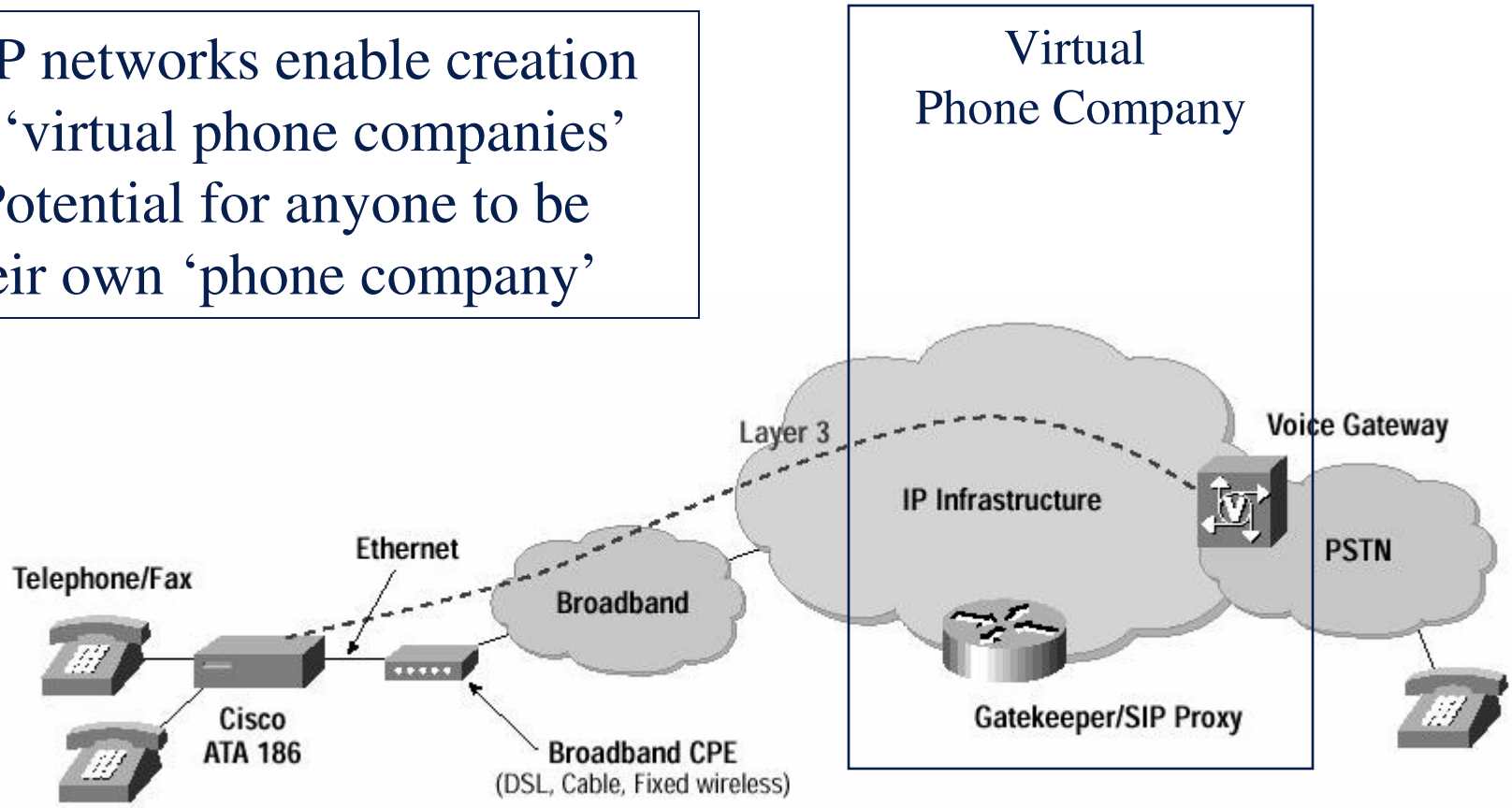
VoIP World

- IP networks enable creation of 'virtual phone companies'
- Potential for anyone to be their own 'phone company'



http://www.cisco.com/warp/public/cc/pd/as/180/186/prodlit/at186_ds.htm

Evolution of VoIP protocols

- H.323
  - ITU recommends for “ Packet based Multimedia communication systems”.
- MGCP –Media Gateway Control Protocol
  - IETF RFC 2075
- SIP –Session Initiation Protocol
  - IETF RFC 2543
- H.248 –Media Gateway Control (MEGACO)
  - IETF RFC 2885
  - Collaboration between ITU & IETF

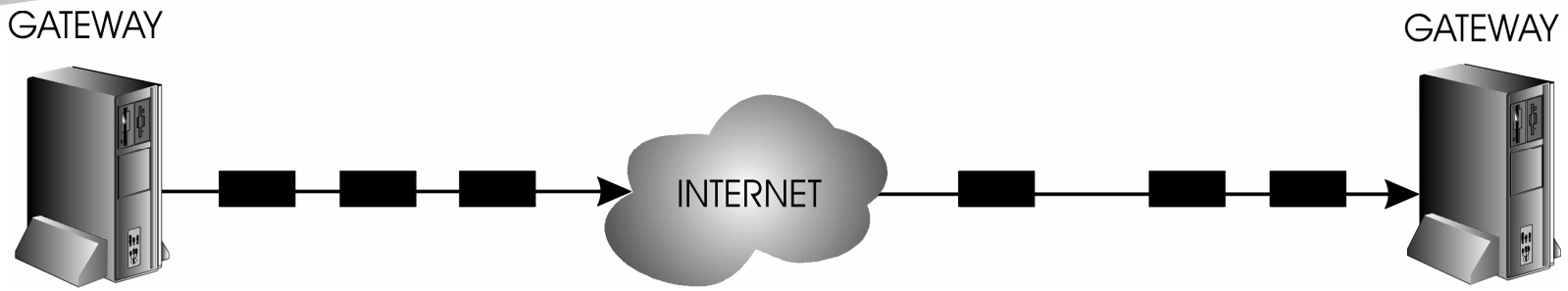
VoIP & Peering

- Issues that have different requirements & effects than traditional IP:
  - Latency
  - Jitter
  - Out-of-Order Delivery
  - Packet Loss
  - ENUM
  - Security
  - SPIT
  - PSTN on/off ramp

Latency

- Latency
  - Ideal should be maximum of 150ms (1-way), and ideally, maximum of 250ms for round trip
  - ITU-TG.114 recommends 150ms or less
  - Round trip latency of 500+ms (1/2 second) is virtually unusable for voice conversation
  - Components that make up latency:
    - Network
    - CODEC
    - Jitter buffer

Jitter and Out-of-Order Delivery

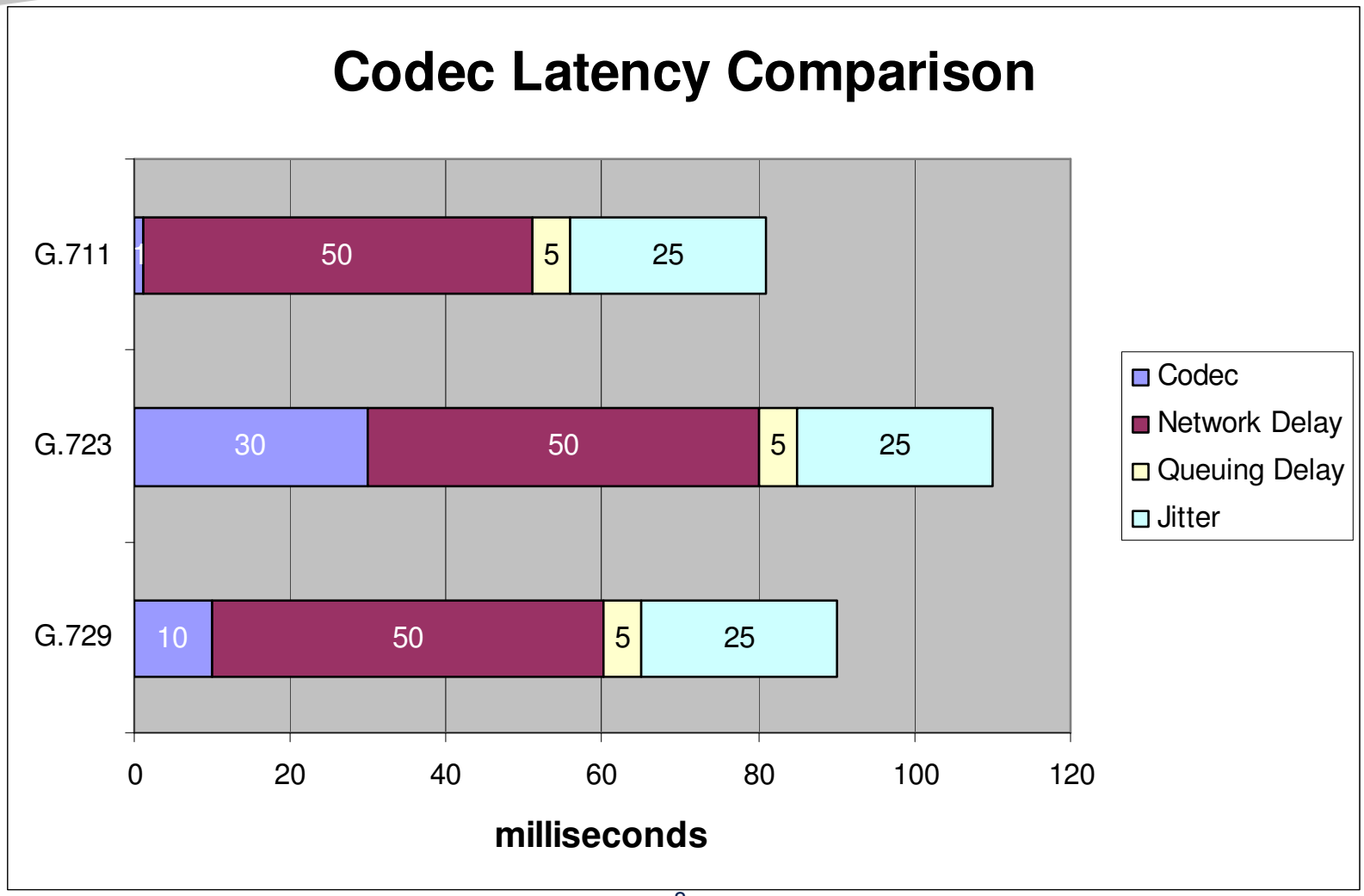


- Jitter is the degree of variability in loss and latency
- Jitter increases relative to the ratio of traffic burstiness to number of sources
- Out-of-Order Delivery is the portion of packets which arrive later than other, subsequently transmitted packets
- Voice, unlike data, is sensitive to the order sequence by which it arrives
- Traditional data techniques of buffering do not work and actually make the problem worse

Codec Mean Opinion Scores (MOS)

CODEC	Bit Rate	MOS	Delay
G.711 (PCM)	64Kbps	4.1	0.75ms
G.726 ADPCM	32Kbps	3.85	1ms
G.728 LD-CELP	16Kbps	3.61	3ms-5ms
G.729 CS-ACELP	8Kbps	3.92	10ms
G.729 x 2 Encodings	8Kbps	3.27	10ms
G.729 x 3 Encodings	8Kbps	2.68	10ms
G.729a CS-ACELP	8Kbps	3.7	10ms
G.723.1 MP-MLQ	6.3Kbps	3.9	30ms
G.723.1 ACELP	5.3Kbps	3.65	30ms

Latency calculation



Packet Loss

- CODEC used affects tolerance of packet loss
- E.g. – G.711 less tolerant than G.729
  - G.711 operates at 64Kbps
  - G.729 operates at 8Kbps
- What is ‘acceptable’?
  - 1%-3% is norm
    - Probably ok for G.729
    - May not work for G.711
  - 1%< may be for G.711
    - Probably unrealistic target/expectation on a consistent level

ENUM in a nutshell: RFC 3761

- take E.164 phone number
- turn it into a FQDN
- ask the DNS
- return list of URI's

+1 571 434 5651

1.5.6.5.4.3.4.1.7.5.1.e164.arpa.

sip:richard.shockey@neustar.biz

Simple ENUM/SIP Call Flow

ENUM Global Directory (DNS) Equates +1-202-555-1234 to sip:mark@carrier.net to enable Voice over IP using SIP

1. The caller simply dials the person's normal telephone number

2. Calling party proxy UAC queries DNS for location of end point

3. DNS returns NAPTR record containing SIP URL to Calling Party UA

DNS-Server

Response
sip:name@domain.com

Query
4.3.2.1.5.5.5.2.0.2.1.e164.arpa?

"Call Setup"

Sip
Sip:name@domain.com

Dial
+1-202-555-1234

Sip Proxy

Sip Proxy

4. Calling party UA connects the call

New Concept : Private/Carrier/Infrastructure ENUM

- Private ENUM is generally regarded as one or more technologies (including DNS) that permit service providers to exchange phone number to URI data in a *private secure manner*.
- Service providers are looking for NGN signalling infrastructures
- Default PSTN termination no longer economically desirable
- Private ENUM is to be assumed as authoritative for all endpoints service providers choose to exchange data for. There is no need to OPT-OUT.
- The technology by which this data is accessed is currently not fixed
  - PULL Model; DNS, SIP, LDAP
  - PUSH Model; NPAC/LSMS, CD-ROM, FTP

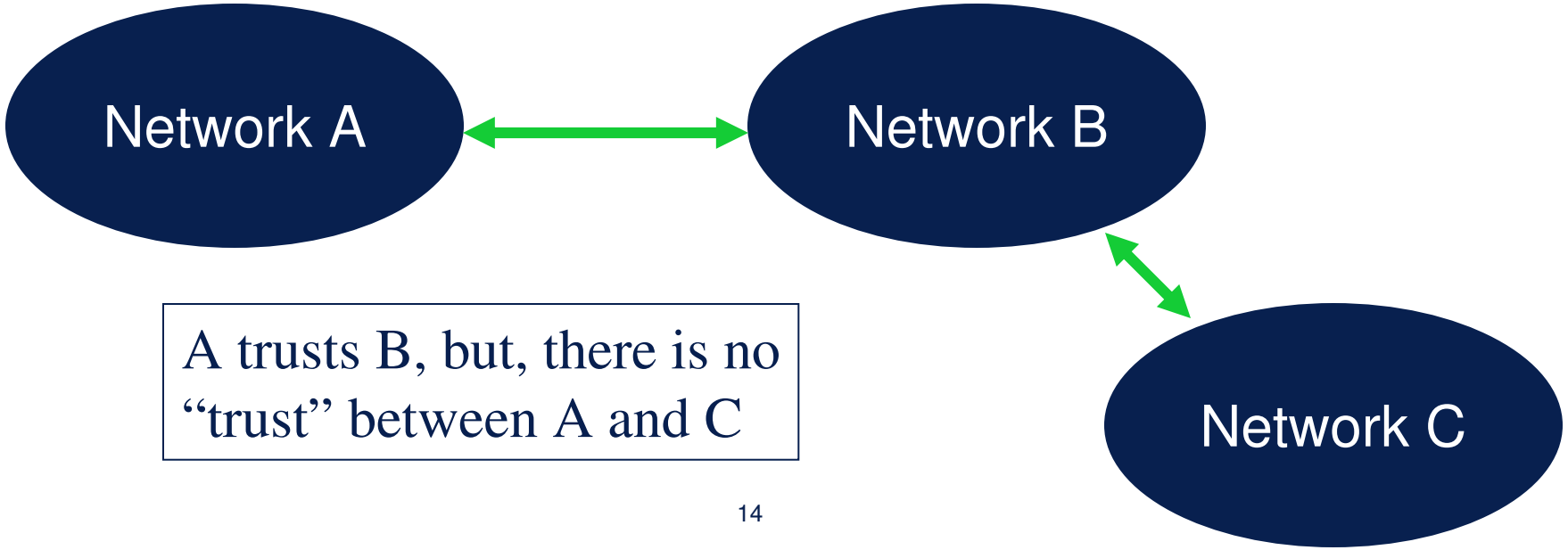
- Private and Public ENUM are Orthogonal to each other, they serve different markets for different reasons.

ENUM

- Probable that ‘private’ ENUM will be implemented before ‘public’ ENUM
- Public ENUM likely to have many political issues
- Enterprises will create private ENUM
- “Islands” will be created
- Synchronization and validity with DNS
- Authoritative ENUM is open issue

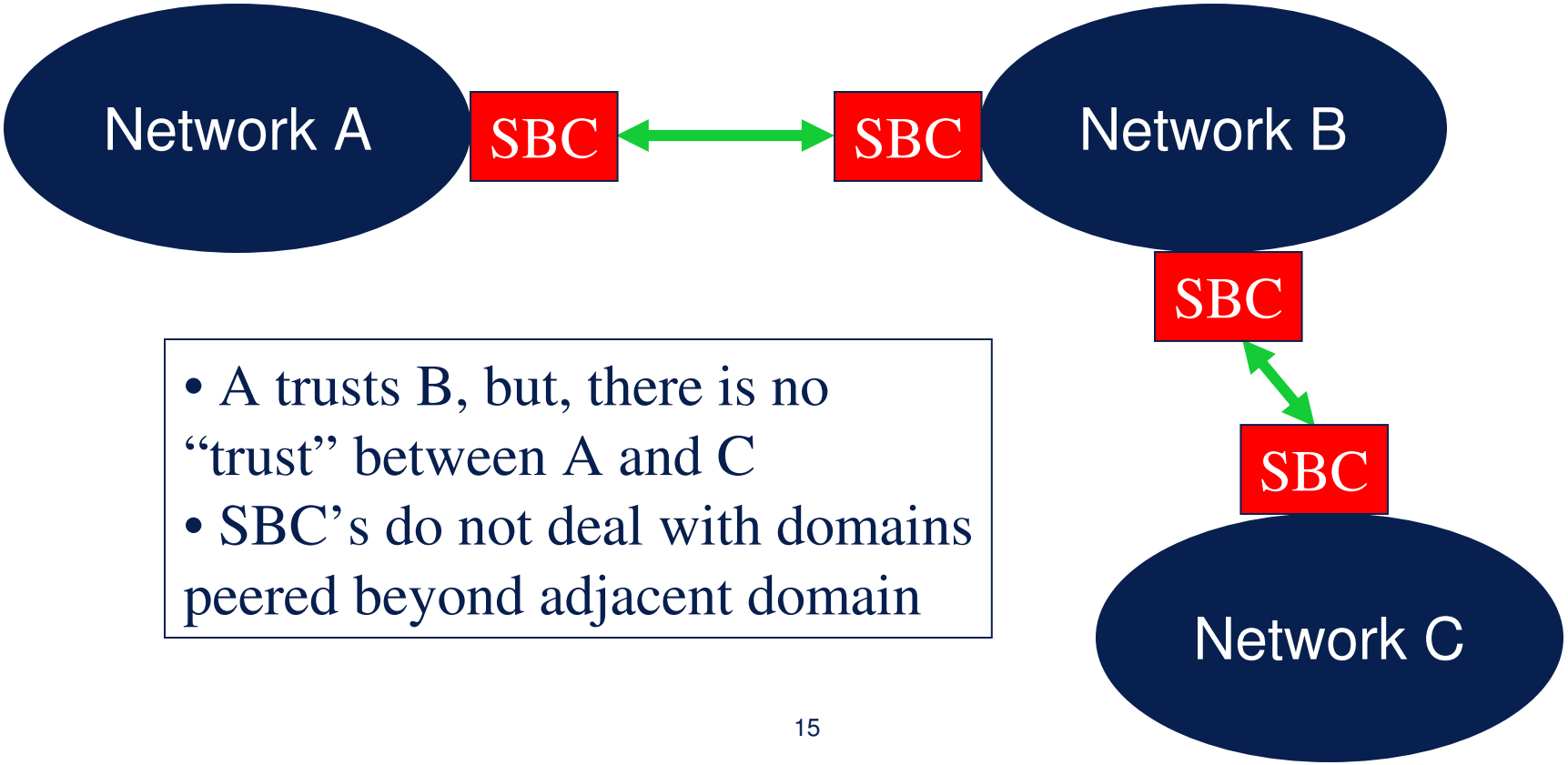
Security

- Many, many, many issues…for example:
- SPIT (Spam Over Internet Telephony)
- E.g. – “trust” between peering domains is problematic:



Security cont'd

- Current idea for establishing trust gives false sense of protection:



VoIP & Peering: Differentiation

- Differentiate peering?
  - Applications (VoIP/SIP) have differing requirements not served by conventional peering
  - New applications with new requirements (real-time)
    - E.g. – network gaming that combines voice, video and data
  - 'Quality' is needed for these new applications to varying degrees that have no precedent or agreement with many different potential methods
    - QoS
    - CoS
    - Private Peering (more?)
    - Others?
  - Security ***must*** be dealt with or we'll have a mess…

VoIP & Peering Future

- 2004 was breakthrough year
- Fact: Avaya & Nortel IP-PBX technology shipments surpassed traditional TDM based PBX shipments
- Government(s) are having ‘Sybil’ complex
- Law enforcement will be more involved
  - CALEA
  - Homeland Security
- Conflicting interests
  - CLECs, ILECs, MSOs, PTTs, ISPs, Content, etc.

VoIP & Peering Future

- Issues & challenges
  - Diametrical internal organizations and industries
  - Breaking the ‘Status Quo’
  - Mixture of innovation and tradition
- Evolving technology
  - SIP, CODECs, ENUM, etc.
  - Security
  - Identity

Questions & Answers

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