Multiple Call Opportunities
Alice Calls Bob How? One Way:

- Alice’s UA can set up a SIP trapezoid.
  - Corners: Alice’s phone, Acme SIP Proxy, Hugecorp SIP Proxy, Bob’s phone.
  - Requires:
    » Alice knows how to put bob@hugecorp.com into her phone
    » hugecorp.com sip addresses be in DNS
Alice Calls Bob How? Another Way:

- Alice’s UA can use the PSTN.
  - SIP call to Acme SIP gateway.
  - PSTN call to Hugecorp SIP GW
  - SIP call from Hugecorp SIP GW to Bob’s UA.
- Requires:
  » Alice knows Bob’s PSTN phone #
  » Bob has DID # or Hugecorp has an operator.
Wait, we have phone numbers…

• We have a nice system of international phone numbers
• One way to design a wide-area VoIP system:
  – Use the dialed phone number to figure out how to make the call
  – This system is called ENUM
• But first, a reminder…. 
E.164

• E.164 is the ITU standard for int’l dialable telephone numbers.
• Format:
  – “+” “CountryCode” “NationalNumber”
  – Countries may have substructure within the national number format.
  – Dashes and parentheses are for visual appearance only, are never dialed.
• Examples:
  – +1 (740)593-4890 for the ITS office
  – +44 771-159-4628 -- a number in the UK
    » (don’t call it, I have no idea who owns it)
Enum

• Relates E.164 numbers to IETF URIs.
  – Among other things, see RFCs 2916 and 3761.
• In its simplest form:
  1. Remove non-digits
  2. Insert dots between the digits
  3. Reverse the order
  4. Append e164.arpa
• Our UK number becomes:
  8.2.6.4.9.5.1.1.7.7.4.4.e164.arpa
Now What?

• Let’s call Nemox.net in Innsbruck, Austria
• E.164: +43 5 0234-0
• Enum: 0.4.3.2.0.5.3.4.e164.arpa
• DNS gives: sip:nemox.net@sip.nemox.net
• DNS of sip.nemox.net is: 83.137.41.34

• In short, we started with a phone number and found out what we need to make a SIP phone call.
But Wait, There’s More

• DNS can give us multiple records when we send in the .arpa lookup request.
• E.g.: send in:
  – 0.4.3.2.0.5.3.4.e164.arpa
• And get out:
  – mailto:info@nemox.net
  – sip:nemox.net@sip.nemox.net
  – http://nemox.net/
• Prioritized alternatives for this number.
Nice in Theory, But…

• This is a collaboration of sort between the IETF and the ITU; it is a slow process!
• Only a few countries have started ENUM registrations for public numbers.
• Users need to have their carriers establish registries for their numbers
• Try enumquery.com
Back to Alice and Bob

• Alice’s Proxy would:
  – Convert Bob’s number (let’s say it’s 313-567-1234) to 4.3.2.1.7.6.5.3.1.3.1.e164.arpa
  – Hit DNS
  – It might return something like this:
    » sip:bob@hugecorp.com
    » tel:+13135671234
    » In effect, this says try sip first, then the PSTN.
  – Set up the call.
Calling Carol

![VoIP Network Diagram]

- Internet
- PSTN
- Third Party Service
- Acme Company
- DNS
- SIP Proxy
- Alice
- Carol
- SIP GW
Calling Carol

• In principle, a third party could operate a SIP gateway to the PSTN.

• Non-trivial in practice:
  – PSTN calls aren’t free - billing needed.
    » Implies several gateways are best (close to the called number is better).
  – Equipment must be bought, maintained.
  – DNS updated as necessary.
  – Several such gateway services exist in conjunction with public SIP servers.
PXB Replacement

Diagram showing the integration of Acme Company's network with the Internet and PSTN.
PXB Replacement

• Surely the most common use of SIP.
• In practice:
  – No ENUM mapping.
  – External callers only know phone numbers.
  – Internal users only know phone numbers and extension numbers.
  – Internal users may not register as users, just as phones.
  – Configuration varies vastly!
  – Telephony features vary vastly!
Some Enterprise Possibilities: SOHO
Some Enterprise Possibilities: SOHO

• If we use our corporate WAN (VPN) for transport, we can extend our ‘sip space’ to any location.

• In the config drawn, all voice traffic goes to the PSTN at HQ.
  – 911 is problematic.
  – Local calls to/from SOHO location are also through HQ – not so good.
Some Enterprise Possibilities: Branch Office
Some Enterprise Possibilities: Branch Office

• A branch office can have its own SIP gateway and/or proxy. This allows local traffic to hit the PSTN locally.

• Can have many corporate locations:
  – Route traffic on WAN instead of PSTN.
Service Provision via SIP
Service Provision via SIP

• Your service provider can deliver traffic via SIP.
• In this drawing, the SIP ‘triangle’ consists of the AT&T SIP GW, the Acme SIP proxy, and one of the Acme agent phones.