E-911
Adapted from Material Created by Phil Campbell
Definitions from the Master Glossary maintained by NENA (National Emergency Number Association) at http://www.nena.org/standards/technical/master-glossary

ITS 441 - VoIP

Traditional E911 from Landline Phone

1. Resident calls E-911
2. Class 5 CO passes call to Tandem Office
   • Adds ANI data
3. Tandem office connects call to PSAP
   • TN/ESN table determines which PSAP
   • ESN: Emergency Service Number
   • Passes ANI data to PSAP (only ANI)
4. PSAP consults ALI database
   • ANI info sent to ALI
   • Returns address, ESN

Before The Call

The E911 Sequence
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   • ANI info sent to ALI
   • Returns address, ESN
Before the Call: MSAG
- Master Street Address Guide
- Maintained by government authorities
  - typically counties
- Maps street addresses into ESNs
  - ESNs can identify both the PSAP and/or the emergency agencies available to the caller.

Before the Call: OSS
- When a customer arranges phone service:
  - Customer tells telco his/her service address.
  - Telco assigns TN.
- The ILEC's OSS:
  1. Queries the MSAG to determine the customer's ESN based on address.
  2. Adds the TN, ESN to table in tandem switch.
  3. Adds TN, ESN & address to ALI db.

Works Very Well, If…
- Single Telco playing with the Data.
- Phone number uniquely determines location.
- Location is unchanging.
- PSAP doesn’t need to be relocated in large-scale emergency.

MLTS Issues
- MLTS = Multi-Line Telephone Systems
  - aka PBXs
- Stations have extensions
  - Assigned by MLTS administrator.
  - Changed at will - MACs
- Some, usually not all, may have associated DID.
- ANI? Often company's main billing number.
  - e.g. 593-1000 for OUT
- Main number not useful for 911 call back or location.
MLTS Solutions 1 – Stations w/ DID
• Change PBX programming to output calling station's DID number for ANI purposes.
  – via ISDN or CAMA
  » CAMA: Centralized Automatic Message Accounting (DTMF-based billing protocol)
  » may require special trunks for 911
• MLTS admin must update ALI for every station’s location

MLTS Solutions 2 – Stations w/o DID
• MLTS admin must create ERLs
  – Emergency Response Locations
• Each ERL has an ELIN
  – Emergency Location Information Number.
  – Dialable, must ring in ERL
• MLTS admin must update ALI for every ERL’s location & ELIN

Costs Galore for MLTS Operator
• PBX upgrades
• Cost of ISDN or CAMA trunks
• DIDs and/or ELINs from telco
• Additional labor
  – MACs become more expensive
• Possible auxiliary systems to deal with data
  – Mapping extensions into locations / ERLs
  – Uploading data to ALI

Costs for Telco
• Implementation of mechanism for MLTS to update ALI
Cellular Issues
• Obvious, yes?
• Call-back number no longer describes the physical location of the phone.
• But...
  – Service provider must know which cell caller is located in.

You Should Know
• NENA
  – National Emergency Number Association
• APCO
  – Assoc of Public-Safety Comm Officers
• NASNA
  – National Assoc of State 911 Administrators

Cellular Solution – Phase 0
• Requires:
  – Cellular caller to reach PSAP.
  – Somewhere, anywhere.
  – No ANI or call back required.
• More-or-less universal.

Cellular Solution – Phase 1
• Requires:
  – Cellular caller to reach PSAP.
  – PSAP to know which cell caller is in.
  – PSAP able to call back.
• Let’s note:
  – Analog ANI is 10 digits exactly.
  – SS7/ISDN can do more.
  – Many, many PSAPs have analog trunking.
Cellular Solution – Phase 1

- Telco sets up a series of pseudo-ANIs.
  - 740-xxx-xxxx means "cellular 911 caller"
- Telco sets up corresponding pseudo-ALIs.
  - "Cell served by tower at 18 S Court St NE antenna; callback number 613-555-2345"
- When call is made, the telco:
  - Sends pANI to PSAP
  - Modifies pALI in real time to include call back number.
- PSAP gets real callback number from ALI db.

Phase 1 Problems

- Cells can include multiple ESNs.
  - Sometimes even multiple states.
- Not useless, but…
  - Depends on caller for detailed location info.

Phase 1 Implementation

- Requires setting up the pANI, pALI etc.
- Process kicked off by PSAPs
  - Actually by the authorities that run them.
  - "OK, we're ready"
- Many PSAPs unready to receive the data.

Cellular Solution – Phase 2

- Calls for:
  - Cellular caller to reach PSAP
  - PSAP to know precise location of caller:
    - Within 50 m for 67% of calls
    - Within 150 m for 95% of calls
  - PSAP able to call back.
Two solutions for determining location

1. Handset-based
   - Phone determines its location, informs network.
     - GPS?
     - GPS-like based on tower transmissions?
   - Requires updating all phones!
   - Requires network upgrades.

2. Network-based
   - Network estimates location based on:
     - Relative signal strength
     - Relative time of arrival
     - Multipath signature
   - Requires very substantial upgrades.

Location Methods
- Choice left to service providers.
- Related to GSM/TDMA/CDMA choice.
- Equipment vendors jockey for one choice or another.

Current Status In US
- Here’s the FCC summary:
  - www.fcc.gov/_wirelessWirelessCore/911/911_1509720253.html
- Cell companies now mostly adhere to somewhat looser Phase II.
- PSAPs still old, old, old technology.
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Current Status In Ohio

• Ohio according to NENA
  – All counties have E911
  – 10 counties do not have wireless Phase I deployed
  – 6 counties are at Phase I
• Since Fall 2005
  – Wireless per line surcharge for E911
  – Currently $0.28 per line

VoIP Issues

• Variation on MLTS theme, but worse.
  – SOHO locations that reach PSTN through HQ could be on different continents
  – If Moves/Adds/Changes are easier...
• Much like cellular – no mapping between number and physical location.
• Need to account for three types of users:
  – mobile
    – e.g. Vonage softphone
  – “nomadic”
    – Can take router/gateway device anywhere.
  – fixed

In case you were wondering (I was)...

The Vonage vPhone a.k.a. “phone on a stick”

VoIP As PBX Replacement

• For phones in your building, just like PBX.
  – ELIN, ERL, DIDs, etc.
  – Consider 115 RTVC.
  – Xena, 591-4835 phones, Siemens phones
• Easy MACs strong point is problem.
  – Work-at-home makes it harder.
  – Stresses TN/E911 lookup, for sure.
  – Employees can move phones, even out of the building.
  – Can disable auto-discovery
Cable Companies as VoIP Providers

- Relatively simple problem – cable box fixes location of your phone.
- Needs “OSS” system to put data in ALI db and inform ILEC of the TN for TN/ESN mapping in routing tandem.
- Assumes cable telephone customers have old numbers and/or local numbers.

FCC’s VoIP Requirement 47CFR Part 9

- “Interconnected” VoIP providers must:
  - Deliver calls to correct PSAP
    - Must be standard feature
  - Send call-back number and (p)ALI info to PSAP
    - If PSAP is ready to receive it
  - Provide customers a way to upgrade location info “on the fly”
  - Notify customers of limitations of service
  - Within 120 days of adoption, i.e. 120 days from 5/19/05.

ILECs must:

- Cooperate by providing access to tandem switches, ALI Databases, etc.
- The FCC order clearly suggests that CLECs can provide E911 under contract to VoIP providers
- That seems to be what Vonage does
  - Excludes softphones, wireless phones.

Vonage, A Little Better

- Vonage must put data into routing tandem.
  - pANI/ESN
- Vonage must put data into ALI.
  - ALI, ESN, CBIN & pANI
  - Requires db access cooperation with ILEC.
- Address maps to ESN.
  - Customer must update address information online
  - Which ALI? Which MSAG?
  - Address = Town = County = MSAG = ESN
  - Address = Town = ILEC = ALI
Vonage, A Little Better

- This process is harder for nomadic users.
- How does Vonage know you’ve moved?
  - IP changed?
  - "Heartbeat" or "keep alive" messages?
- How do they know where you’ve gone?
  - You tell them.

IP Geo-Location ?!

- My desktop IP comes back as
  - 39.3095 LATITUDE, -82.081 LONGITUDE

3rd Party Companies

- Intrado and others
- Deal with MSAGs, ALIs, etc.
- Provide IP gateways to routing tandems.