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
Traditional E911 from Landline Phone

1. End Office
2. Tandem Office
3. PSAP
4. ALI db

ALI: Automatic Location Identification
ESN: Emergency Service Number
ANI: Automatic Number Identification
PSAP: Public Safety Answering Point

ITS 441 - VoIP

Tuesday, November 2, 2010
The E911 Sequence

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

1. MSAG
2. TN/ESN
3. ALI db

ILEC OSS

End Office

Tandem Office

PSAP
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 OU.

• Main number not useful for E911 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 613-5552345”

• 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.
Cellular Solution – Phase 2

• 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.
Cellular Solution – Phase 2

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/cgb/consumerfacts/wireless911srvc.html](http://www.fcc.gov/cgb/consumerfacts/wireless911srvc.html)
- Cell companies now mostly adhere to somewhat looser Phase II.
- PSAPs still old, old, old technology.
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 aka “phone on a stick”
VoIP As PBX Replacement

• For phones in your building, just like PBX.
  – ELIN, ERLs, DIDs etc.
  – Consider 115 RTVC.
    » Xena, 593-4835 phones, Siemens phones

• Easy MACs: strong point is problem.
  – Work-at-home makes it harder.
    » Stresses TN/ESN 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.
FCC’s VoIP Requirement

• 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, CBN, & 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 changes?
  – “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.