Damage Prevention Existing Technologies Distribution Sector

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Challenges for Damage Prevention

- Damage prevention for Distribution Sector means sensing in dense, noisy, and highly populated environments
- Any approach needs to minimize excavation frequency and size
- Implementation must be economically feasible
- Monitoring/Prevention systems need to be available 24/7
- Sensing systems need to have minimal false positives

Challenges for Damage Prevention (cont.)

- Technology should have NO negative impact to gas operations (e.g. interference with CP system)
- Any warning communications need to be reliable and secure
- Sensing systems need to filter out benign conditions
- Construction equipment generate a wide variety of frequency signatures that are further complicated by different soil types and mechanisms of wave propagation
- Straight runs of pipe are limited in footage which can make application of some systems uneconomical

Relevant Technologies/Practices

- Maps/Electronic Maps/Global Positioning Systems
- One-Call Procedures
- Standby “observers”
- Pipe Location Technologies
  - GPR
  - Electromagnetic
  - Acoustic PE Locator
  - E-line conductive locator
  - Vacuum Excavation
- Real- Time Sensing Network - GasNet™ (near commercial)

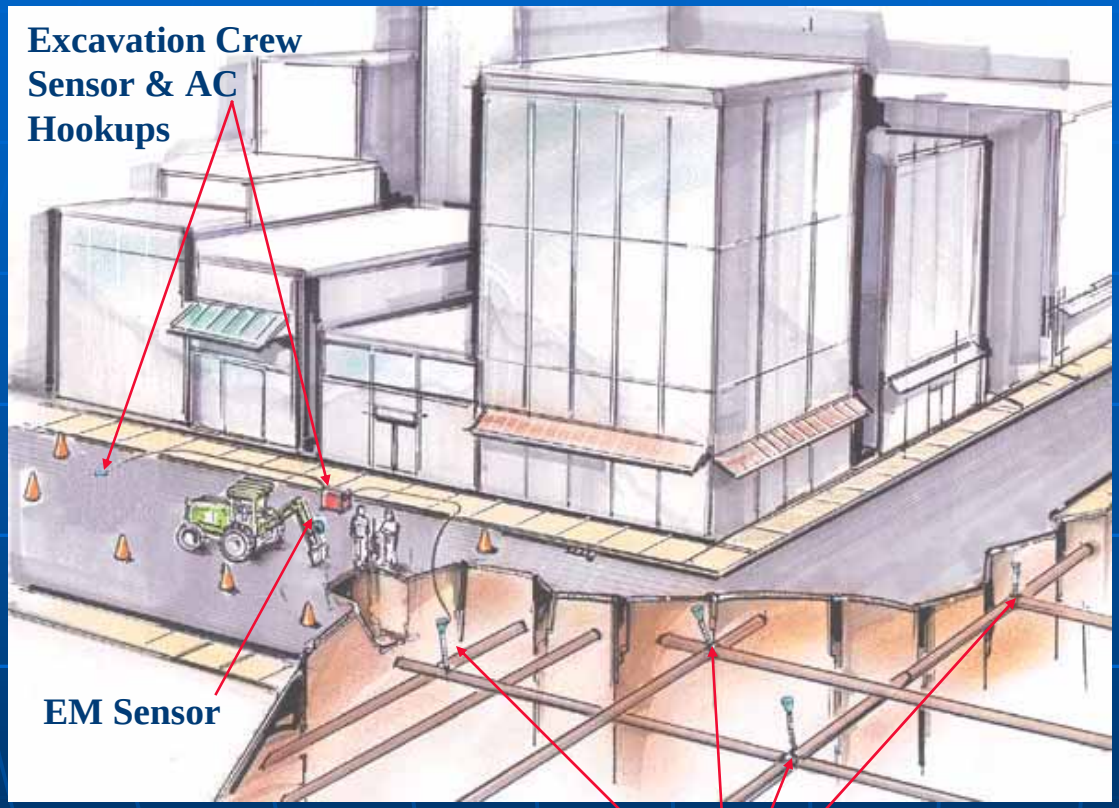
Highlight on Commercially Available GPR Systems

- S & S Noggin'
- GSSI/Vermeer
- Mala Easy Locator
- PipeHawk
- Wittentech
- U.S. Radar
- Others

Limitations of Some Commercially Available GPR Systems

- Difficult for User to Interpret
- Price to purchase
- Limitations in certain soil types and at certain pipe depths
- FCC Bandwidth restrictions
- User acceptance
  - Weight, portability
  - Desire for “magic bullet”

GasNet ™: Real-Time Sensing Network



Pressure, Flow, …, Gauges

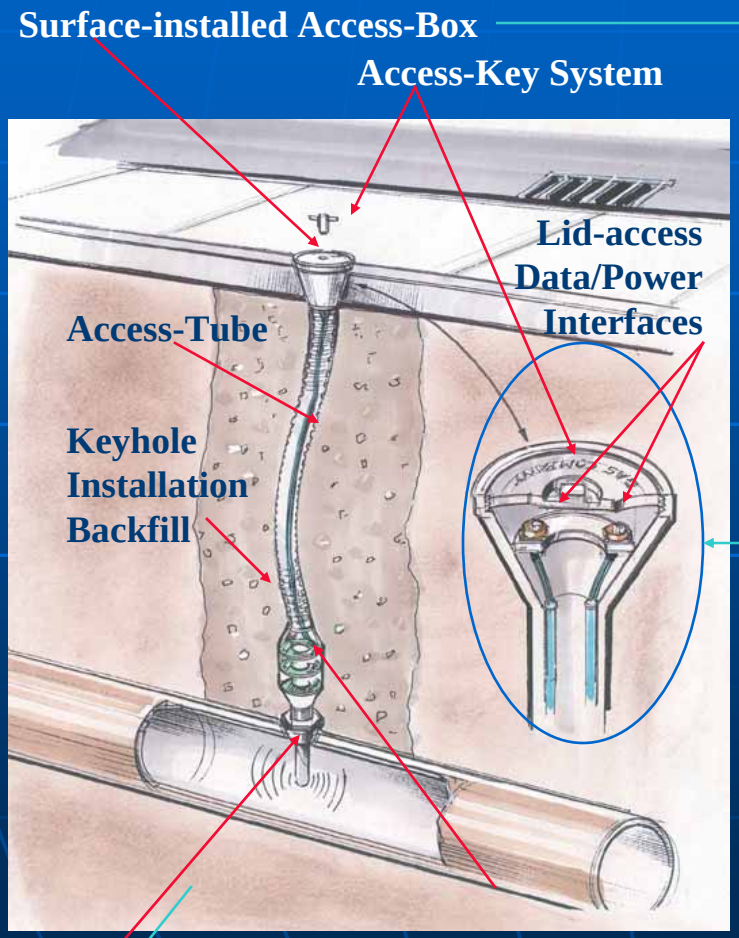
GASNET™ Sensor Nodes

GASNET™ Node Installations

Urban Network Map

Faulty-Line Detection

GasNet ™: Real-Time Sensing Network (cont.)



Confidence in Using Technologies

- Maps/Electronic Interfaces are gaining momentum and will soon be “taken for granted”
- Commercially available GPR is available as a service and as a product
  - GPR Product users need time and training which limits confidence
  - Applications are for difficult locate jobs; those who persist find the niche & gain confidence
- GasNet™ is pre-commercial but has generated excitement for gas operators at multiple companies in alpha and beta field tests

Industry's Application of Technology

- GPR and traditional pipe location methods are used broadly for confirmation of maps
  - *GPR can be used for finding a "clear lane" in a sub-structure with multiple utilities/multiple material types*
    - *Alternative – test holing*
- Traditional locating technologies are used extensively for locating and marking lateral location of metal pipe

What Technology Needs, if addressed could provide significant advancement?

- Reliable, user-friendly and affordable pipe location
- Real-time warning of threatening activities near pipelines
- Automated Warning systems integrated into construction equipment or other sources of damage

Summary

- Gas industry technology developers have identified significant challenges for damage prevention
- Existing technologies have some application and confidence is built with experience over time
- Miniaturization, wireless communication and electronics' capabilities have made real-time sensing possible
- Several technology needs are evident particularly in pipe location