Mobitex Network Security

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Mobitex

- Background
- Network structure
- Security features

Mobitex background

- History of the Mobitex protocol
- Overview of network operators
- Overview of network users

ERICSSON

History of the Mobitex protocol

- Originated at "Televerket" in early 1980s
- Developed by Ericsson (Eritel)
- First operational network in 1986
- Packet-switched, national infrastructure
- Mobitex Technology AB
  - http://www.mobitex.com/

Overview of network operators

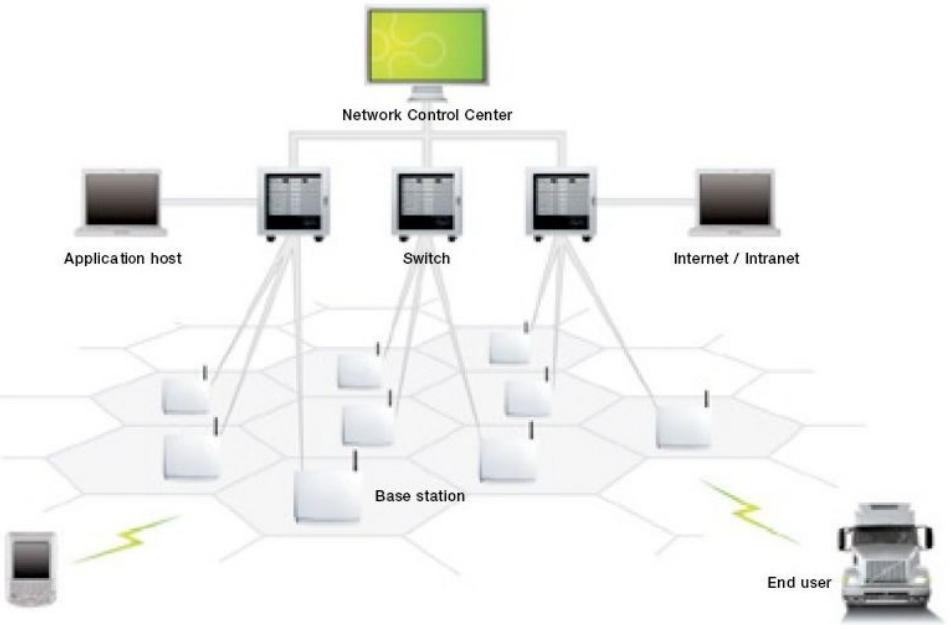
- 30+ networks worldwide today
- 20 public commercial networks
  - Velocita Wireless (AT&T, Cingular, RAM)
  - Rogers Wireless (Cantel)
- Mobitex Association
  - Operators, developers and manufacturers
  - http://www.mobitex.org/

Overview of network users

- Public Safety
- Field service support
- Transport / Logistics
- Card Payments (POS)
- New growth areas
  - Positioning / Resource Management
  - Metering / Remote control
  - Alarm systems

Mobitex network structure

- Mobitex network topography
- The Mobitex protocol suite



Mobitex network topography

- Backbone network connects NCC and one or more main exchanges (MHX)
- Area exchanges (MOX) connected to MHX
- Fixed terminals and mobile radio base stations (BAS) connected to MOX
- Mobile terminals can be restricted to an area or be allowed roaming (with tariff)
- Infrastructure linked by HDLC or X.25

The Mobitex protocol suite

- Roughly corresponds to OSI layers 1-4
  - Hey, so does TCP/IP!
- Everything revolves around MPAK packets with 24-bit src/dst MAN addresses
  - That's just like IP packets, I know this!
- Poor adoption of layer 4 standards
  - Most applications “roll their own”

The Mobitex protocol suite

- Layer 1 – Radio layer
  - 896-901Mhz Up / 935-940Mhz Down
    - 900Mhz band in Americas and Korea
    - 400Mhz band in Europe, Australia and Asia
    - 800Mhz band in China
  - Numbered 12.5khz bandwidth channels
  - 8kbaud GMSK modulation
  - Bit-scrambling to reduce same-bit strings
  - Radio frame header with base ID and flags

The Mobitex protocol suite

- Layer 2 – ROSI (RadiO Signalling Interface)
  - 20 bit interleaving of coded octets
  - (12,8) shortened hamming code
  - 144 bit data block with 16 bit CRC
  - Link header with frametype and length
  - Slotted ALOHA access mechanism with automatic repeat requesting (ARQ)
  - Network parameters broadcasted

The Mobitex protocol suite

- Layer 3 – The MPAK (Mobitex PAcKet)
  - Maximum 512 byte data payload length
  - Common components (header)
    - Sender and addressee MAN (not swapped in reply)
    - Traffic state flags – mailbox and delivery status
    - Subscription flags – POSACK, SENDLIST, etc.
    - Packet class and type designation
      - PSUBCOM / DTESERV packet classes
    - Optional address list appended

The Mobitex protocol suite

- Layer 3 – The MPAK (Mobitex PAcKet)
- PSUBCOM (Packet-switched SUBscriber COMmunication)
  - TEXT - ASCII / ISO-646 text formatted for printer/display
  - DATA - application data, optional encoding
  - STATUS - single byte status code (user defined meaning)
  - HPDATA - Higher Protocol Data, one-byte protocol ID
  - EXTPAK - used to exchange packets with “external” nets
- DTESERV (Data TErminal SERVice communication)
  - BORN, (IN)ACTIVE, DIE, LIVE, ROAM(ORD), GROUPLIST, INFO(REQ), TIME, AREALIST, ESNREQ, LOGINREQ, etc.

The Mobitex protocol suite

- Layer 4 – MTP/1 (Mobitex Transport Protocol)
  - Not limited to MPAK length
  - In-order delivery guaranteed
  - Error signaling and PDU identification
  - Reliable delivery of PDUs (optional)
  - Basically an UDP / TCP protocol analogue using HPDATA MPAKs as transport
  - Introduced in 1991, not used very often...

The Mobitex protocol suite

- Wired Layer 2 alternatives
  - MASC (Mobitex ASynchronous Communication)
    - Mainly used over V.24 or X.21bis to connect a Mobitex terminal to a computer application
  - MDOT (Mobitex Data Over TCP/IP)
    - "Internet application gateways" enable Ipv4 connected hosts to send/receive MPAKs
  - X.25
    - Standard profile for connecting fixed terminals to area exchanges (MOX)

Security features

- Privacy protection
- Subscriber identification
- Denial of service
- Network snooping
- Live Demo!

Mobitex Privacy protection

- ROSI (Layer 2) uses bit-scrambling to improve effectiveness of modulation
- Some may confuse this with privacy
- Scrambling generator trivial to reverse
  - rec.radio.scanner on 14 Mar 1997
    MsgId: <332A0580@geocities.com>
    From: arron5@geocities.com
    Subject: Fun mobitex stuff

Mobitex Privacy protection

- Mobitex protocol specification contains no provisions for privacy or integrity at all
- TEXT messages inherently clear text
- Lots of applications use HPDATA and don't bother with security or privacy
- Very much like IPv4 in that security must be implemented in the application layer

Mobitex Subscriber identification

- Subscriber identified by 24 bit MAN
- Issued to each subscriber by operator
- MAN is like an IPv4 address
  - Tied to a subscription, not a network location
- Location of each MAN stored in network
  - Compare IPv4 routing tables
- 3 different subscriber types

Mobitex Subscriber identification

- Terminal subscription (Fixed or Mobile)
  - Mobile terminal identified by 4-byte ESN
- Personal subscription
  - Transferable between terminals
  - Identified by 8-char password
- Host group subscription
  - Login to fixed terminals only
  - More than one active login at a time

Mobitex Subscriber identification

- Terminal subscription identified by ESN
- ESN calculated from terminal S/N
- ESN only req. to “activate” and “roam”
  - Sniff to spoof terminal at later time
    - Spoof logged in personal subscriptions
    - Real terminal may need to deactivate
  - Kill real terminal and hijack session
    - Spoof DIE message to deactivate real terminal
    - ESNREQ / ESNINFO can be sent at any time

Mobitex Subscriber identification

- All subscription data sent ***in the clear***
  - BORN
  - ACTIVE
  - ROAM
  - ESNINFO
  - LOGINREQ

Mobitex denial of service

- Wide-band jamming transmitters
  - Available off-the-shelf and as DIY kits
- "Rogue base station"
  - Implement wireless base using e.g. USRP
- Selective DOS targeting specific terminal
  - Spoof "DIE" DTESERV packets with dst MAN

Network snooping - prerequisites

- Radio that receives the correct frequency
- 8kbit GMSK - need FM discriminator tap
  - http://discriminator.nl/
  - Google is your friend...
- Software
  - Commercial software ($$$)
  - PDW (http://www.gsm-antennes.nl/PDW/)
  - Mine, as I'll show you next...
    - http://www.toolcrypt.org/index.html?mobitex

Demo of network snooping

Conclusions

- Mobitex wireless networks insecure
  - Compare IPv4 over unencrypted WiFi
- No confidentiality, serious problems with integrity and availability under attack
- Application developers and system owners need to address these issues
- Security needs to be built into apps
  - Authentication, message integrity, encryption

Q & A

- Questions?
- Experiences?
- Comments?
- Requests?