

The Role of Satellite Services in Internet Event Notification

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Strawman Requirements for Event Notification

- $10^8 - 10^9$ events per day
- Wide area notification
 - continental United States
- Timely delivery of event notices
 - on the order of seconds
 - unreliable delivery
- Sensible economic model
- Aggregation as value-added service

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Wedging Ourselves into the Wrong End of the Design Space

- Synchronized distributed clocks
 - useful for a variety of distributed algorithms
 - endless source of doctoral theses
 - tight synchronization difficult
 - » NTP (Network Time Protocol)
 - tree-structured client/server architecture
 - achieves synchronization on the order of milliseconds
- GPS (Global Positioning System)
 - constellation of 24 satellites with continuous global coverage
 - supplies time, geolocation, and altitude worldwide
 - » two sites with same satellite in view can synchronize within tens of nanoseconds
 - » two sites with different satellites in view can synchronize within tens of microseconds
 - GPS receivers with serial interface available for << \$500
 - » single chip implementations available
 - » prices dropping rapidly

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Moral for Synchronized Distributed Clocks

- When your only tool is a hammer then every problem looks like a nail
- Effective solution required global satellite services
- Broadcast is effective for some problems

Claim: Effective wide-area event notification is easily achieved with satellite broadcast

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**Large Scale Digital Event Notification
Already Exists!**

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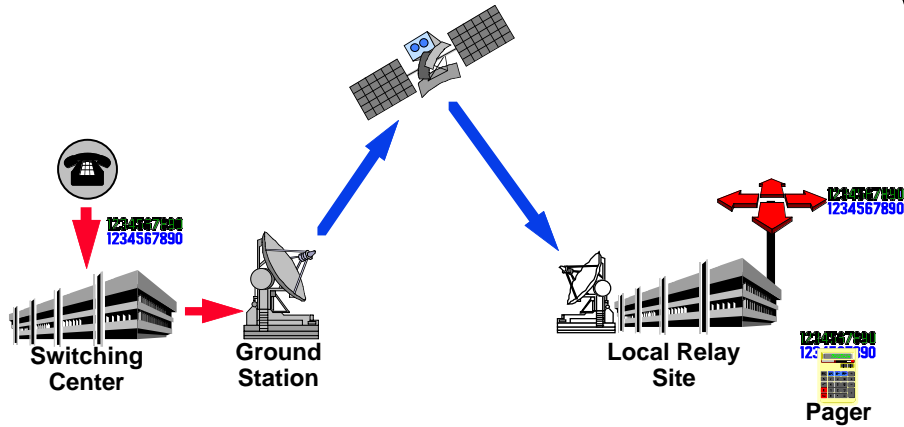
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Pagers

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Architecture of Nationwide Pager Networks



- Large number of calls (events) per day
- Digital
- Nationwide paging services rely on satellite broadcast
 - failure of Hughes Galaxy 4 disrupted 90% of nationwide paging services

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Paging Services as an Infrastructure for Event Notification

- Limited data
 - short digit string
 - short email message
 - » integration of paging with the Internet 3105551234@skytel.com
- Wide-area distribution
- Well understood economic model
 - monthly subscription + per message (event) fee
- Well understood interfaces
 - origin is touch tone telephone
 - receiver interface well documented
- Inexpensive end-user devices
 - pagers are so cheap that they are given to children
 - two chip implementation (receiver and microcontroller)

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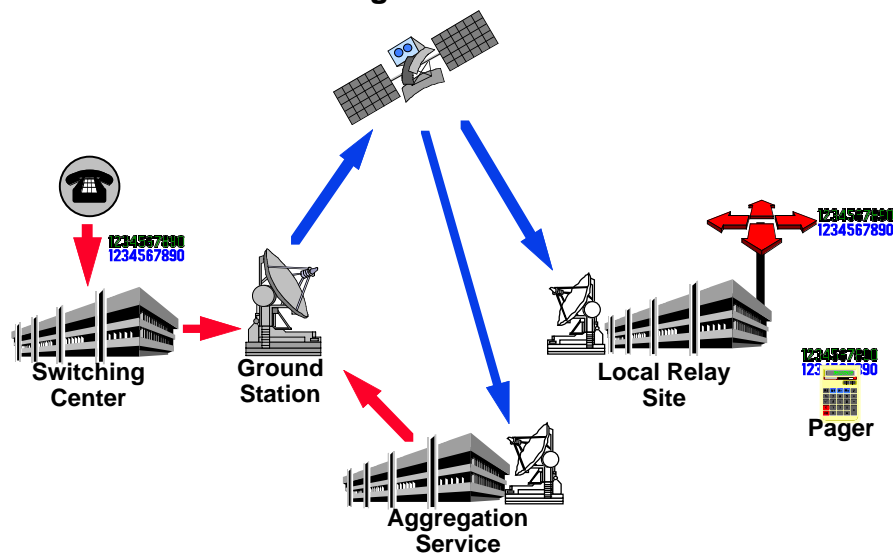
A Few Facts About Pager Protocols

- Paging speeds range from 1600 – 6400 bps
- Will support 5×10^9 individual devices
- 6×10^5 pagers per RF channel
 - each channel is 25 - 50 KHz wide
- unidirectional protocol is upward compatible with bidirectional protocol (Motorola FLEX & ReFLEX)
- will support alphanumeric messages on the order of 100's of bytes
- delivery times range from seconds to minutes
 - message length
 - system load
 - channel capacity

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Inserting Aggregation Services into the Pager Network



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Alternative Satellite Services

- DirectPC
 - asymmetric network
 - » 48 Mbs broadcast downlink
 - 28 Mbs effective downlink rate
 - » low bandwidth backchannel
 - typically 14 – 56 Kbs modem connection
 - subscribers “listen” to broadcast waiting for something interesting to come by
 - users submit requests via low bandwidth backchannel
 - requires 18 inch diameter dish antenna and a set-top box
 - implemented using Hughes Direct Broadcast satellites (aka DirectTV)
- GBS (Global Broadcast System)
 - military equivalent of a multimedia DirectPC
- Iridium

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Summary

- Satellite broadcast is the appropriate tool for the job
 - remember GPS
 - not all reasonable solutions lie entirely within our sphere of expertise
- A viable architecture for Internet event notification already exists — ***paggers***
 - Internet has a long history of adapting existing infrastructure to its own ends
- Sensible economic model
- Easy to insert value-added aggregation

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