Mobile Wireless Network Tracing

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Motivation

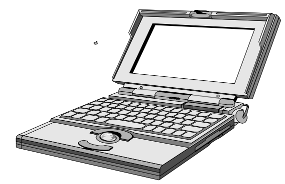
- Lack of trace data in:
  - wireless network behavior
  - mobility pattern
- Trace allows us to:
  - develop wireless and mobility models
  - drive simulation studies of larger systems
  - tuning and debugging
  - develop better policies:
    - Handoff: when, which network
    - Resource Allocation
    - Caching Management
    - Placement of Base Stations

Collaboration

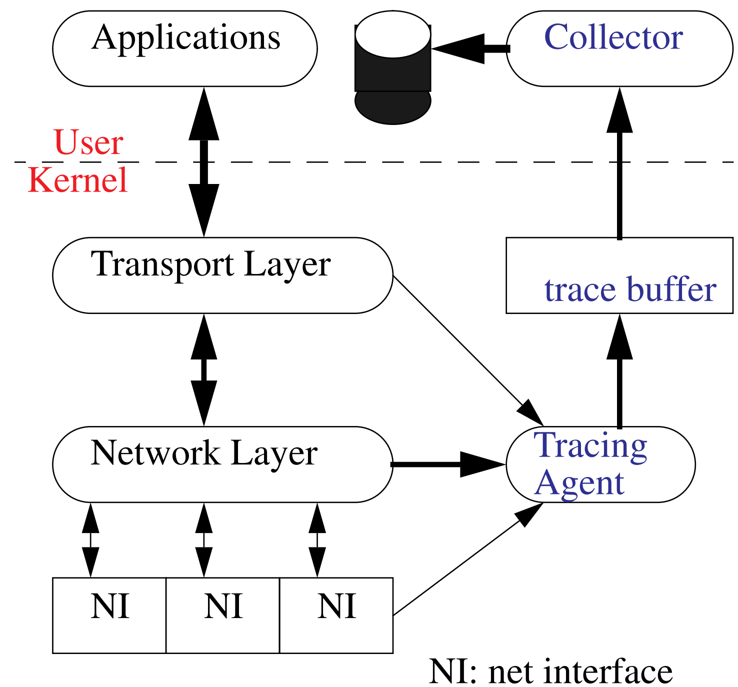
- Goals:
  - efficient and application-transparent tracing facility
  - extensible and self-described trace format
  - make tools and traces publicly available
  - provide a platform for future studies
- UCB:
  - develop trace collection tools and workloads
  - collect the traces
- CMU:
  - develop processing tools to distill traces into models
  - modulating workloads with traces or models

Trace Collection Architecture

- Tracing at the MH
  - more data available
  - users have control



- User-level Collector:
  - periodically extract data from the kernel trace buffer
  - write data to disk
- Kernel Tracing Agent:
  - application-transparent
  - efficient



Trace Format

- Extensibility and self-described:
  - data fields of each entry records not statically defined
  - record format is defined in the track header
- Trace Header:
  - `collecting agent, date, time, description`
- Track Header:
  - `track_id, time granularity, properties list`
  - encapsulate a single protocol or interface
  - variable size depending on the number of properties
- Entry:
  - `track_id, time, array of values`

Network Trace Data

- Packets:
  - `protocol,status`: from multiple network layers
  - `size, sequence`: throughput and loss rate
  - `MAC or IP address`: network interface
  - `send_time`: optionally time stamped the packet
  - `round_trip_time`: "ping" program

- Network Interfaces (devices):
  - `MAC address`: the only association to the packet trace
  - `signal level, signal quality, signal to noise...`
  - constant sample rate

Mobility Trace Data

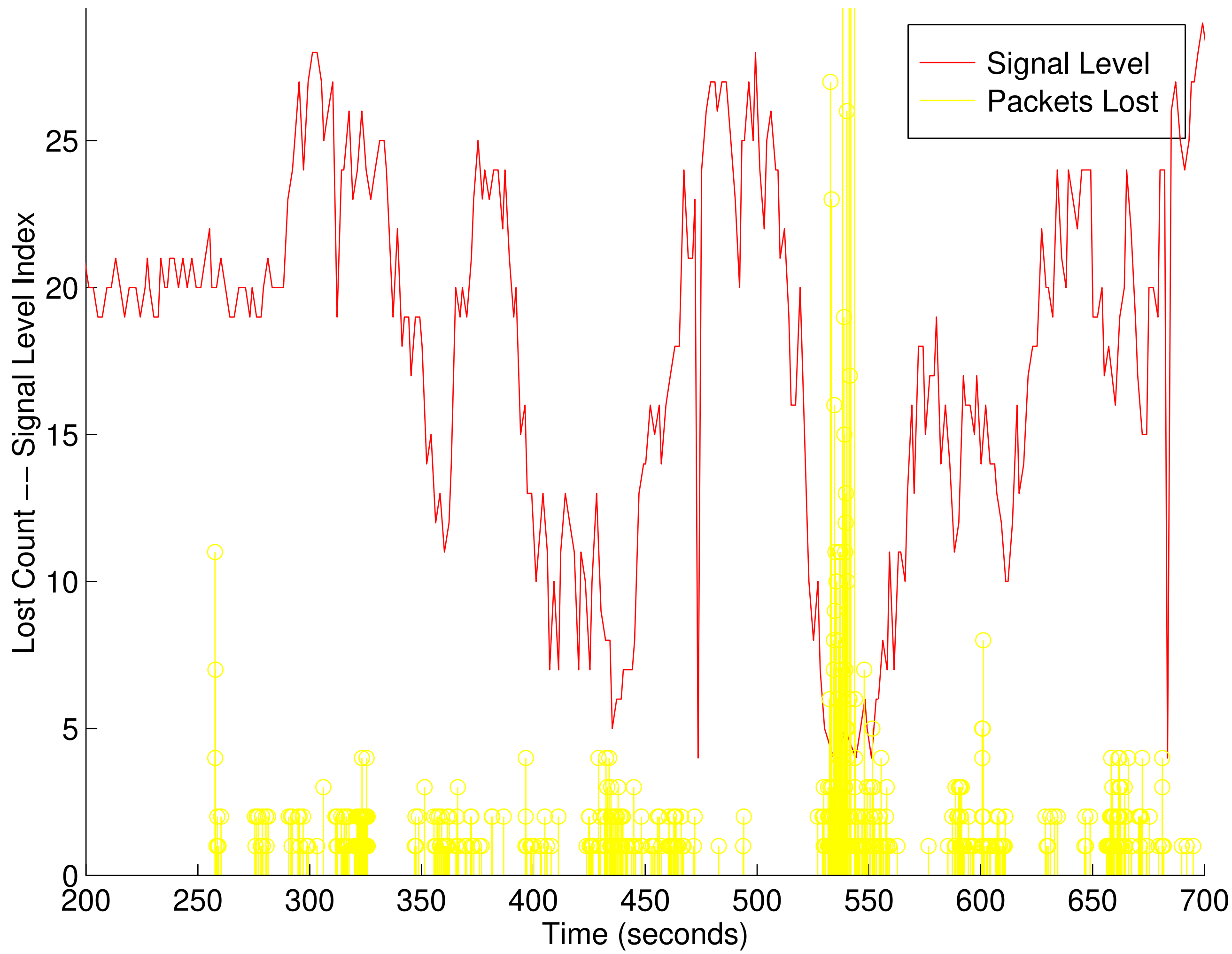
- Physical location:
  - `<time, x, y>`
  - XV displays *map*, records *coordinate of mouse click*
  - Post-processor can:
    - display the path
    - map the coordinates into cells
- Logical location:
  - BS currently servicing the MH
  - Beacon signals

Workloads

- Artificial Traffic Generator:
  - constant rate UDP or TCP stream
  - rate: 50% to 75% of the maximum bandwidth
  - can time stamp packet at source
  - source in same subnet, minimized wired network delay
- Ping: interval of 10 to 1000ms, measure RTT
- Real Applications:
  - Email: low bandwidth
  - FTP: high bandwidth
  - WWW, NFS: delay sensitive
  - VIC: high bandwidth, delay sensitive

Result

- 1 Mbps UDP stream, signal sampled every second



Open Issues

- Latency measurements:
  - Is round trip time good enough?
  - clock synchronization?
- Tracing at the BS?
- Trace facility and format flexible enough?
- Models to be derived from traces?
- Useful playback and analysis tools?