Budapest University of Technology and Economics
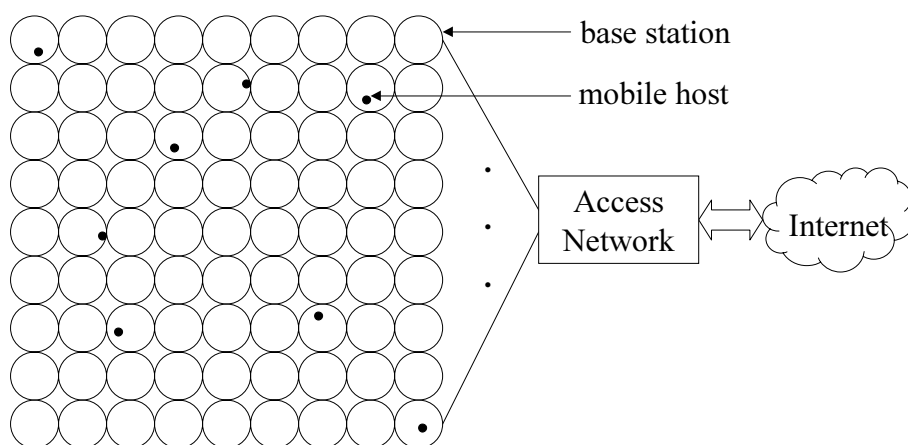
Ericsson Research Hungary

Cost Analysis of Paging in IP Micro-Mobility Networks

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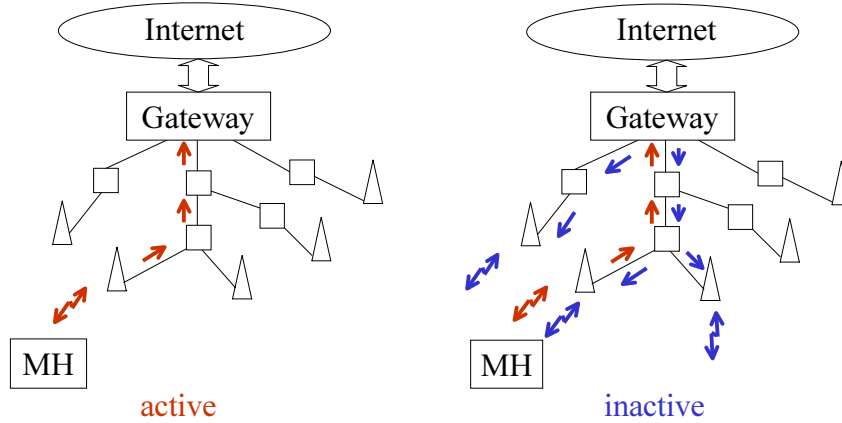

IP micro-mobility network

- base station
- mobile host

Access Network

Internet

Cost Analysis of Paging in IP Micro-Mobility Networks

Location tracking

(continuous location tracking or paging)

location update   **paging**
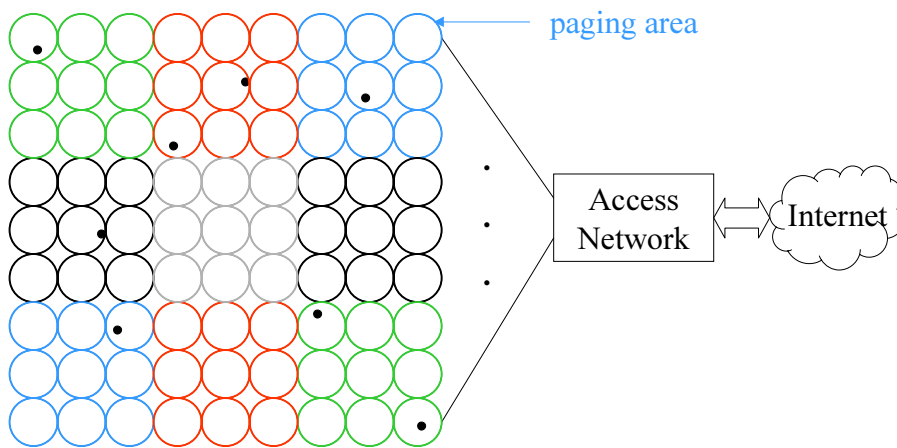

active   inactive

Cost Analysis of Paging in IP Micro-Mobility Networks

Location areas

paging area

Access Network   Internet

Cost Analysis of Paging in IP Micro-Mobility Networks

Problems

- decide when to be in active/inactive state
- (size of the paging area)
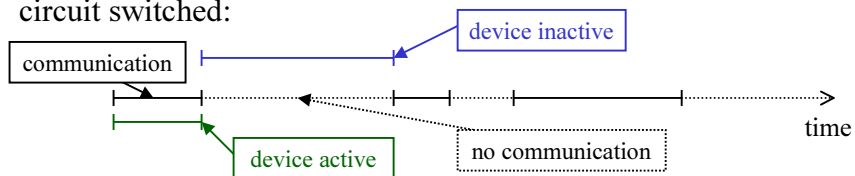- (shape of the paging area)

Mobility cost

- abstract value
    - time
    - bandwidth
    - energy
- mobility related signaling messages
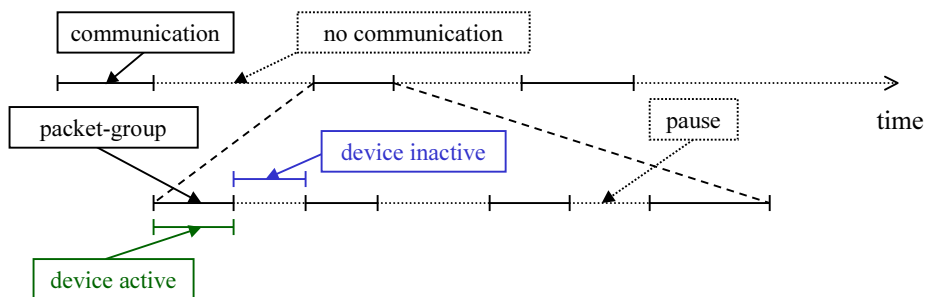
Traffic model

circuit switched:

communication

device inactive

device active

no communication

time

packet switched (2 level, on-off model):

communication

no communication

packet-group

device inactive

pause

time

device active

Traffic model

circuit switched:

device inactive

communication

device active

no communication

time

packet switched (2 level, on-off model):

communication

no communication

time

packet-group

device inactive

pause

device active

additional active time
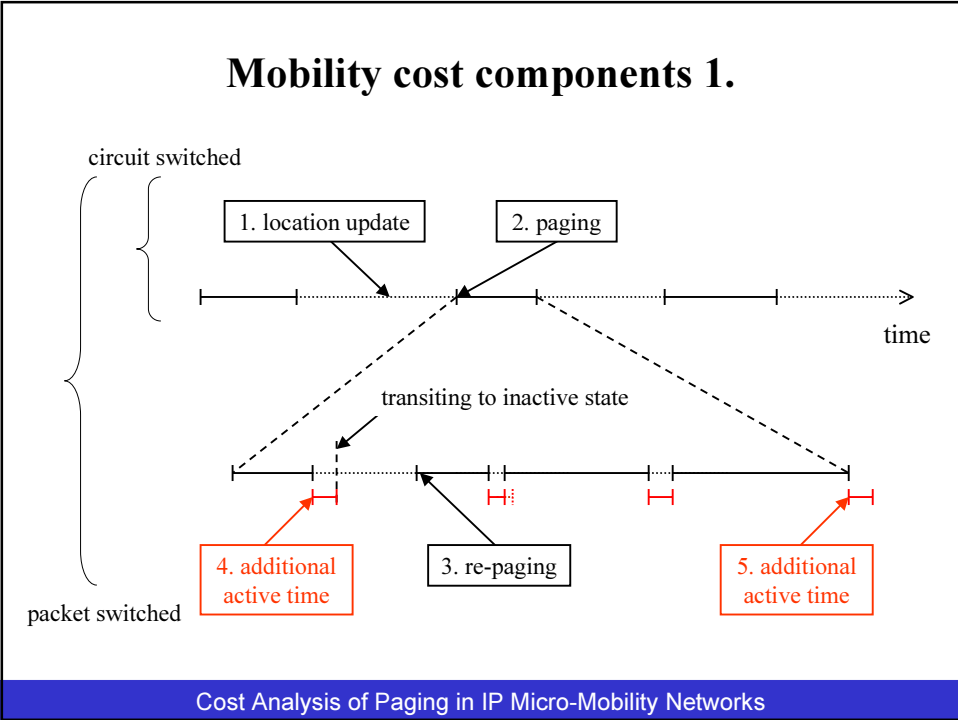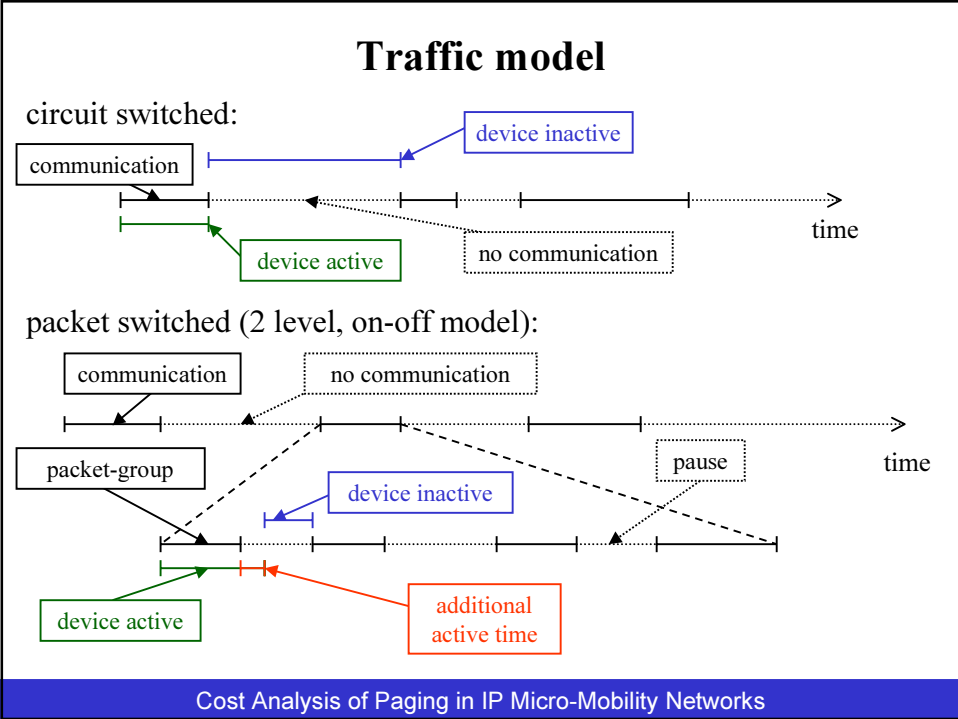
Mobility cost components 1.

circuit switched

1. location update

2. paging

time

transiting to inactive state

4. additional active time

3. re-paging

5. additional active time

packet switched

Mobilty cost components 2.

$T\ T_d\ T_p\ T_{off}$: distributions $\quad T_a$: constant $\quad m$: size of PA $\quad C_p\ C_m\ C_a$: costs

$$\tau_d = E(T_d) \longleftarrow \begin{array}{c}\text{mean length of}\\ \text{communication}\\ \text{periods}\end{array} \qquad \frac{1}{f(m)\tau} \longleftarrow \text{intesity of changing PAs}$$

$$\gamma_d = \frac{1}{E(T_d)+E(T_{off})} \longleftarrow \text{intesity of communication periods} \quad \beta_d\ \beta_s \longleftarrow \begin{array}{c}\text{probability}\\ \text{of direction}\end{array}$$

- 1. cost of changing PAs outside session
- 2. cost of first paging
- 3. cost of re-paging
- 4. cost of active time outside communication periods

$$(1-\gamma_d\tau_d)\frac{C_m}{f(m)\tau} \ + \ (1-\gamma_d\tau_d)mC_p\gamma_d\beta_d \ + \ \gamma_d\tau_d\gamma_p e^{-\frac{T_a}{\tau_p}}\beta_s mC_p \ + \ \gamma_d T_a C_a \ +$$

$$+ \ \gamma_d T_d \gamma_p C_a \frac{\tau_p-(\tau_p+T_a)e^{-\frac{T_a}{\tau_p}}}{1-e^{-\frac{T_a}{\tau_p}}} \longleftarrow \begin{array}{c}\text{• 5. cost of active time inside}\\ \text{communication periods}\end{array}$$

Parameters

Mean time of staying at one base station:	180 s
Base stations in a paging area:	9 BS, 3x3 alignment
Mean length of communicating periods:	1500 s
Mean length of pauses:	3 s - 50 s, Exponential and Pareto
Length of additional active time:	0 s - 50 s
Cost of paging:	1
Cost of location update:	1
Cost of additional active time:	0.2 / s
Incoming - outgoing packets rate:	60 % : 40 %

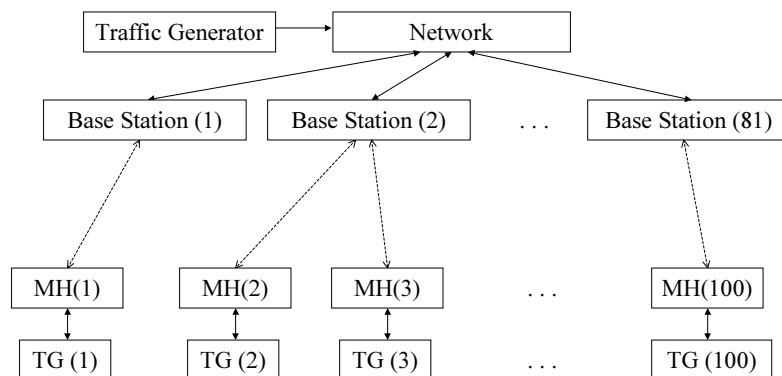Cost Analysis of Paging in IP Micro-Mobility Networks

Analytical results
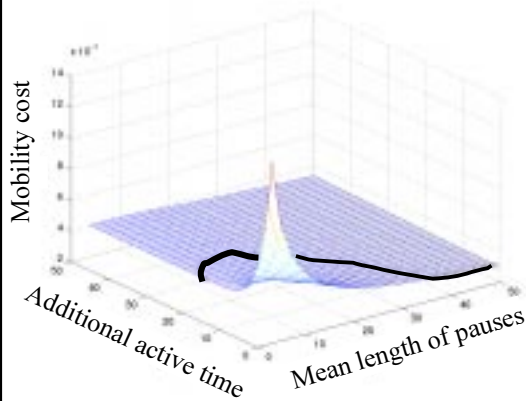
- length of packet-groups and pauses are Exponential

- the optimal additional active time depends on the mean value of pauses

Simulator

Plasma: discrete, event triggered, object oriented simulator

Simulation results

Exponential

Pareto

Dynamically setting the additional active time

- fixed additional active time
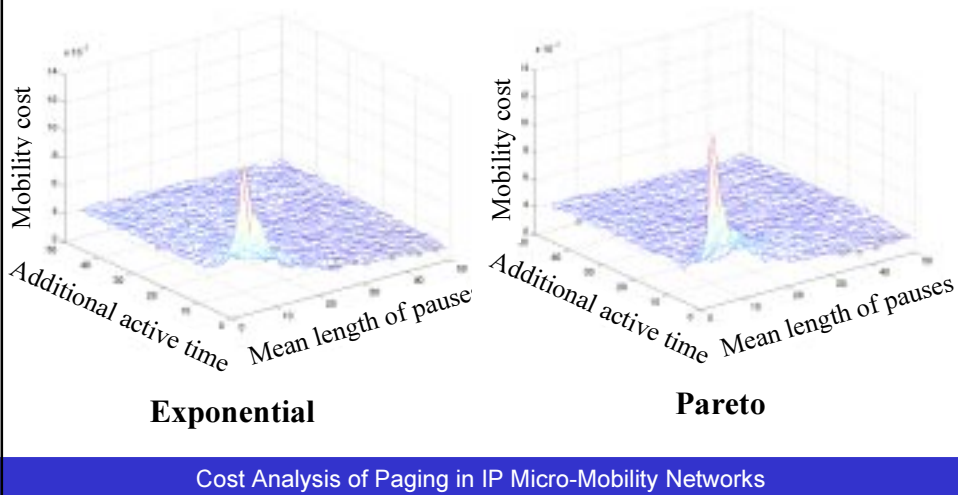
- measuring the pauses
- dynamically setting the additional active time
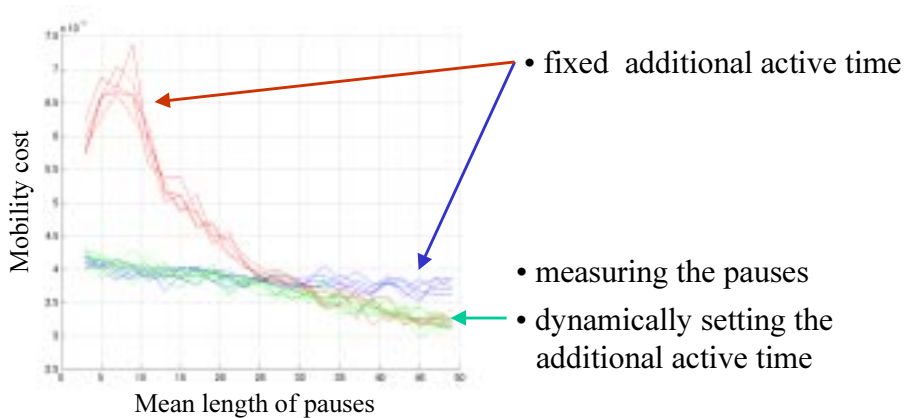
Conclusion

• Mobility cost is independent of the exact shape of the packet inter-arrival process.

• Mobility cost depends only on the mean packet inter-arrival time.

• We developed an adaptive algorythm, which decreases mobility related signalling.

Future work

• analytical study on additional active time

• investigate other paging methods

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