Hand-Over Strategies for LEO/MEO Satellite Systems

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Outline

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• Proposed solutions so far
• The DDBHP scheme
• Simulation Results
• Conclusions
• Further work
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Handover Management Issues

- Eliminate forced termination of calls
- Support an efficient network operation

Proposed Solutions

- Guard Channels
- Queuing of Handover requests (QH)
- Guaranteed Handover Procedure (GH)
Dynamic Doppler Based Handover Prioritization Scheme (DDBHP)

- The serving satellite is able to determine and monitor the MS position. This procedure:
  - is based on the measurement of Doppler shift (appropriate devices are included in all receivers)
  - involves no additional signaling

- Based on the Doppler shift and on mathematical calculations the serving satellite is able to derive:
  - the time remaining until the terminal exits the serving cell
  - the exact location at which the terminal will exit the cell (i.e. the destination cell)
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DDBHP
Understanding Geometry
Dynamic Doppler Based Handover Prioritization Scheme (DDBHP)

- DDBHP is based on a time threshold ($t_{TH}$) which defines an elevation angle under which the handover procedure is initiated.

- At call set-up:
  - if the time remaining until the terminal exits the serving cell is bigger than $t_{TH}$ then the call is accepted if a free channel exists.
  - otherwise a channel is needed in both the current and the subsequent cell in order to accept the new call.

- When the terminal reaches the point corresponding to $t_{TH}$:
  - if a channel exists in the destination cell it is reserved.
  - otherwise the request is queued.
Simulation Scenario

- Street of coverage
  - square cells
  - no cell overlap
  - earth rotation was not taken into consideration

- Three constellations were simulated:
  - Iridium-like (cell size: 500 Km, 10 channels/cell, 100 users/cell)
  - Globalstar-like (cell size: 1000 Km, 20 channels/cell, 100 users/cell)
  - Typical MEO (cell size: 2000 Km, 40 channels/cell, 100 users/cell)

- Poisson generated traffic
  - mean call duration of 180 secs
  - total load : 20%-80% of the cell capacity
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Simulation Results

Iridium-like system
Simulation Results

Globalstar-like system
Simulation Results

Typical MEO system

![Graphs showing simulation results for typical MEO system]
Simulation Results

Iridium-like system

![Graph showing simulation results for different hand-over strategies compared to the Iridium-like system, with labels for QH, GH, and DDBHP.]
Simulation Results

Globalstar-like system
Simulation Results

Typical MEO system

![Graph showing simulation results for Typical MEO system with labels QH, GH, and DDBHP against Load (Erlang).]
Conclusions

- DDBHP supports guaranteed handover at a lower network cost (i.e. zero $P_f$ is achieved at lower values of $P_b$)
- Inherently DDBHP is able to cope with cases that the destination cell is not in the opposite direction of the satellite movement (more realistic approach of satellite systems)
- DDBHP supports both beam and satellite handover

Further work

- Identification of the parameters affecting the protocol performance
- Analytical solution for the derivation of the best threshold
- Performance evaluation of DDBHP when cell overlap and earth rotation are considered