

Simulation model of Mobile IP network

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Introduction



- Names:
 - On passport: Le Anh Tuan
 - On English documents: Anh Tuan Le or Tuan Le
 - Friendly English name: Alex
- Education Background
 - Bachelor of Electronic and Telecom Engineer
 - Hanoi University of Technology (1995-2000)
 - Master of Science in Network Systems
 - Swinburne University of Technology (2001-2003)
 - Currently studying Master of Engineering in Network Systems
 - Swinburne University of Technology (2003-)

Mobile IP Standard



- IETF Mobile IP working groups
- IP Mobility Support for IPv4
 - RFC 3344
- IP Mobility Support for IPv6
 - RFC 3775
- Extensions
 - Route optimisation
 - Hierarchical Mobile IP
 - Reverse tunnelling
 - AAA-NAI
 - Etc.



Mobile IP basic operation



- Mobile IP v4 – RFC-3344

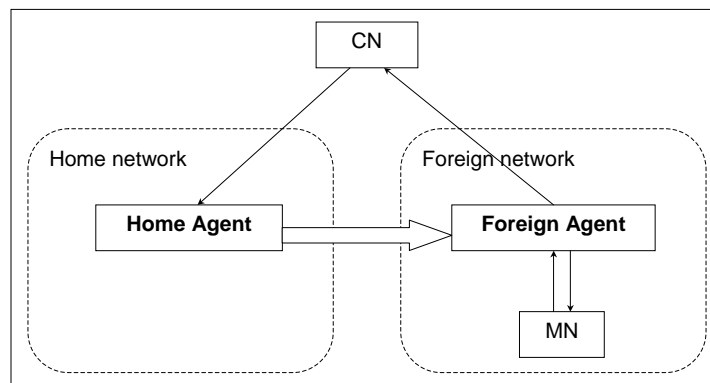


Figure 1 Mobile IP entities



Building simulation model



Purposes

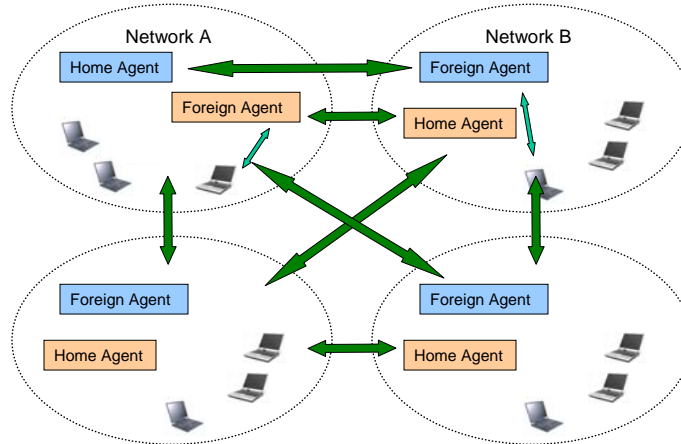
- Study the operation of the protocol standard
 - Functionalities of Mobile IP entities
 - Protocol parameters
 - Effects of different sets of configuration
- Scalability and performance in Large-scale Network
 - Location management performance
 - Effects of different mobility behaviours

Research Issues



- Protocol operation
 - What is the best parameter set for best performance under certain loads?
- Scalability
 - How well does Mobile IP scale to huge numbers of users?
 - Can Home Agents / Foreign Agents cope with the processing load and the amount of information?

Building simulation model



Simulation program



- Environment
 - Written in C++
 - Compiled and run on FreeBSD
- Configuration and Parameters
 - Input parameters and output data are written in text files.
 - Parameters:
 - Mobile IP configuration:
 - Timers
 - Network's parameters:
 - Link delays, Processing delays, Caching size
 - Population
 - Model parameters
 - User behaviours, Movement patterns
 - Trace file on/off

Trace files



- Keep records of every Mobile IP control messages
 - Time and timers
 - Types of message, sources, destinations
- Keep records of every Mobile Node
 - Operation events e.g. On/Off, Handoff, Return Home
- Analysis results are extracted from trace files:
 - Amount of control messages
 - Size of caches
 - Etc.

Validation and Results



- Simplest case
 - **N** number of Networks
 - Appearance rate of users of network **i** at others networks are all equal λ_i
 - Rate of handoff from network **i** to other networks are all equal **q**
 - Staying time exponentially distributed with mean t_i (Markov chain)

$$M = \sum_{n=0}^{\infty} (N-1) \cdot (\lambda_i + q) \cdot \left(\frac{N-2}{N} \right)^n \cdot t_i$$
$$= (N-1) \cdot (\lambda_i + q) \cdot \frac{N}{2} \cdot t_i$$

Validation and Results



- MN appearance rate: 1/second
- Registration lifetime: 180 seconds
- Mean updates interval: lifetime*3/4 = 135 seconds

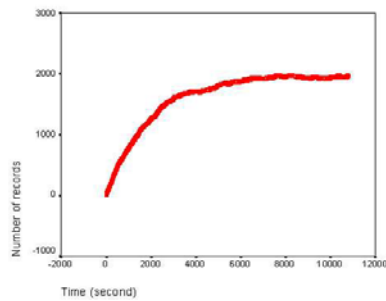
Statistical results from a network					
Number of Networks	Number of times MN connected at foreign networks	Mean staying time (second)	Number of processed messages	Number of handoffs	Steady state location cache size
2	10.791	2.000	Request: 412.339 Reply: 206.130 Advertisement: 21.693 Total: 640.162	N/A	≈ 2.000
3	21.851	1.333	Request: 828.756 Reply: 414.250 Advertisement: 21.209 Total: 1.264.215	8.786	≈ 4.000
4	32.362	1.000	Request: 1.239.184 Reply: 619.324 Advertisement: 21.702 Total: 1.880.210	26.094	≈ 7.000



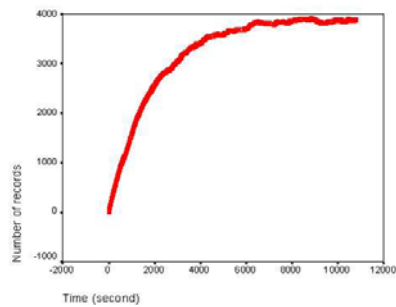
Validation and Results



Size Binding List



Size Binding List



Future work and challenges



- Near Future
 - Currently correcting the model and the simulation
 - Producing interesting information for a publication
- Long term future directions and Challenges
 - Identify scenarios that would match the real Mobile IP network in large-scale.
 - May involve extensions of basic Mobile IP
 - Future of Mobile IP
 - Complexity of the simulation and/or the standard itself
 - Comparison with other simulation tool e.g. Ns-2

Question and Suggestion

