Considerations of the Fundamental Experiment of the Ad-hoc Network Operation

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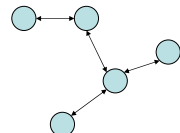

Agenda

- Backgrounds of MANET
  - ◆ Overview of MANET
  - ◆ Standardization and Implementation
- OLSR
- Test of implementation
  - ◆ Outline of OLSR
  - ◆ Environment
  - ◆ Results
- Issues of Operation
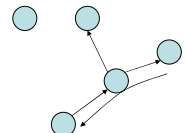

Overview of MANET [1/2]

- No infrastructure
  - ◆ option : Internet Connectivity
- Autonomously Constitution
  - ◆ MANET nodes have their own IP addresses
- Routing
  - ◆ IETF MANET Working Group
- Application
  - ◆ Sensor Network
  - ◆ Multi-hop Connection between Access Points

Overview of MANET [2/2]

- Proactive
  - Table-driven
  - Periodical Flooding

- Reactive
  - Hop-by-hop
  - On-demand Flooding

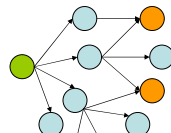| Source	Destination
xxx.xxx.xxx.xxx	yyy.yyy.yyy.yyy
xxx.xxx.xxx.xxx	zzz.zzz.zzz.zzz

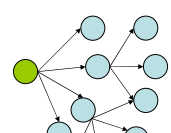| Source	Destination
xxx.xxx.xxx.xxx	yyy.yyy.yyy.yyy
xxx.xxx.xxx.xxx	zzz.zzz.zzz.zzz

Standardization & Implementation

- Proactive MANET Protocol (PMP)
  - ◆ OLSR – Experimental RFC 3626
  - ◆ TBRPF – Experimental RFC 3684
  - ➔ OLSRv2
- Reactive MANET Protocol (RMP)
  - ◆ AODV – Experimental RFC 3561
  - ◆ DSR
  - ➔ Dymo
- Implementation
  - ◆ Implementing on many architectures and OSs
    - ● X86, Power PC, ARM
    - ● Windows, Linux, Mac OS

OLSR

- OLSR : Optimized Link State Routing
  - ◆ Periodical neighbor sensing
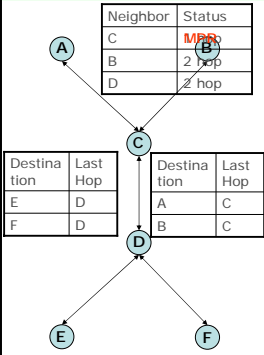 - ◆ Multi Point Relay (MPR)
    - ● Optimized broadcast

Normal Flooding   MPR Flooding

MPR (Multiple Point Relay)

Neighbor	Status
C	MPR
B	2 hop
D	2 hop

Destination	Last Hop
E	D
F	D

Destination	Last Hop
A	C
B	C

I. Each node maintains the local link periodically and establishes bi-directional links to 2-hop neighbor nodes.

II. Each node selects 1-hop neighbor nodes as MPRs that have the links to 2-hop neighbor nodes.

III. Each MPR node broadcasts TC messages that have the link information between each MPR node and each MPR selector.

Routing Table

Neighbor	Status
C	MPR
B	2 hop
D	2 hop

Neighbor Set
+

Destination	Last Hop
E	D
F	D

Topology Set
+
Dijkstra

=

Destination	Next Hop
B	C
C	C
D	C
E	C
F	C

Routing Table

Test of MANET Implementation [1/2]

- Purpose
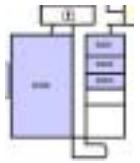 - Multi-hop communication
  - Overhead of nodes' relaying process

- Measurement
  - Tool : netperf (http://www.netperf.org/)
    - TCP Throughput
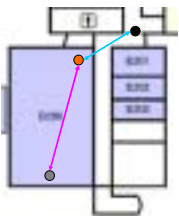   - TCP Request / Response

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Test of MANET Implementation [2/2]

- Environment
  - Implementation : OLSR daemon(http://www.olsrd.org/)
  - OS   : Fedora Core3
  - Mobility : None
  - Location : B206
  - Wireless LAN
    - Intel PRO/Wireless 2915ABG : Centrino
    - IEEE802.11g, Ad-hoc Mode
    - Channel : 1
      - Channel 7   : Laboratory Access Point
      - Channel 4, 11 : ITC Access Point
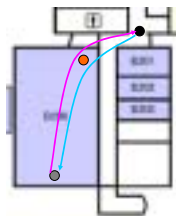

Results (1hop, TCP)

Route	Throughput
Grey->Orange	17.666
Orange->Grey	17.906
Black->Orange	16.344
Orange->Black	15.976

Mbit/sec

Route	Request/Response
Grey->Orange	968.954
Orange->Grey	1015.856
Black->Orange	909.87
Orange->Black	1005.592

Trans/sec

Results (2hop, TCP)

Route	Throughput
Grey->(Orange)->Black	6.026
Black->(Orange)->Grey	7.408

Mbit/sec

Route	Request/Response
Grey->(Orange)->Black	508.444
Black->(Orange)->Grey	481.43

Trans/sec

Consideration

	Throughput	Request/Response
1hop	16.973 Mbit/sec	975.068 Trans/sec
2hop	6.717 Mbit/sec	494.937 Trans/sec

■ Relaying overhead
➔ Multiple communication on the same channel
■ Smaller throughput on the several simultaneous communication over multi-hop network
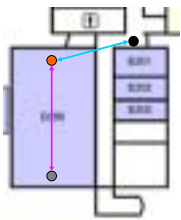➔ To improve the design of Link Layer and Physical Layer

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Issues of MANET Operation

■ Wireless conditions
◆ ESSID
◆ Channel
◆ WEP Key

■ <u>Providing protocol of these values</u>

◆ Location that has good RSSI
➔ We can not see the radio wave....
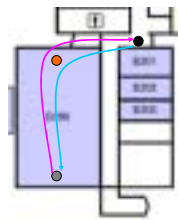

Throughput (1 hop, TCP)

Route	Throughput
Grey->Orange	17.666 14.778
Orange->Grey	17.906 16.876
Black->Orange	16.344 7.154
Orange->Black	15.976 5.354

Mbit/sec

Throughput (2hop, TCP)

Route	Throughput
Grey-> (Orange)->Black	6.026 2.922
Black-> (Orange)->Grey	7.408 1.916

Mbit/sec

Issues of MANET Operation

■ Routing Protocol
■ Destination hosts
■ Providing services
◆ There are no compatibility between RMP and PMP.
◆ In case of RMP, MANET nodes do not know the existence of the destination node.
◆ MANET nodes do not have the information of the other MANET nodes.

■ <u>Need for services on MANET like DNS or SLP</u>

Conclusion

■ MANET routing protocols are standardized.
■ To the next step, we have tested MANET on the real world, not simulation.
■ There are many problems to operate MANET actually.

■ Future Work
◆ Protocols that provide neighboring information and service.
◆ Applications on MANET.