Feb 2nd, 9:30 AM - 3:30 PM

Research poster: HTSMA: a hybrid temporal-spatial multi-channel assignment scheme in heterogeneous wireless mesh networks

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HTSMA: a Hybrid Temporal-Spatial Multi-Channel Assignment Scheme in Heterogeneous Wireless Mesh Networks

Authors: Yan Jin, Ju-Yeon Jo, Mei Yang, Yohwan Kim, Kungtai Jang, John Gowens

Overview of WMNs

Home Networking in Climate Change

Ubiquitous Sensor Network (USN) based Infrastructure in Climate Change

HTSMA is a conceptual network built over existing physical networks which make use of sensed data and provide knowledge services to anyone, anywhere and at anytime, and where the information is generated by using context awareness.

Initialzation of HTSMA

Communication Graph Formation Algorithm:

Phase I: Initialization
1. Switch to a predefined, common channel for each node (GW, CH)
2. Set the hop count of gateway (GW) to 0
3. Set (CH)_j = 0 for each channel (CH)_j
4. Set S(0)_j = 0 and broadcast a hello message with its radio range (pks) and (CH)_j

Phase II: Main Processing (at host id)
1. Initialize a circular channel list (CH)_j = 1
2. If (CH)_j is the same as the list mode (1)
   a. If (CH)_j is the same as the list mode (1)
   b. Initialize a channel list (CH)_j
3. Set (CH)_j = 1
4. If (CH)_j is the same as the list mode (1)
   a. Initialize a channel list (CH)_j
5. Update the associated channel (CH)_j with the current channel (CH)_j
6. If (CH)_j is the same as the list mode (1)
    a. Initialize a channel list (CH)_j

Proposed Algorithm-HTSMA

Hybrid Temporal-Spatial Multi-Channel Assignment (HTSMA) scheme

Neither a dedicated channel nor time synchronization is needed
Each host is equipped with single radio interface — feasible for small and low-cost devices
The gateway utilizes available channels fairly by switching channels in a round-robin fashion to collect the packets from other nodes — spatial property of HTSMA
Other nodes simultaneously utilize different orthogonal channels within their neighborhoods — temporal property of HTSMA

Mac-multichannel Why?

Increases network capacity

B = bandwidth of a channel

User bandwidth = B

Problem: Channel Assignment (CA)

Classification

Centralized

Graph Based

Network Flows

Distributed

Network Partitioning

Gateway Centered

Peer Channeled

Marina et al. 2005

Tang et al. 2005

Brzozowski et al. 2006

Pajatkar et al. 2008

Parnawa et al. 2004

Podda et al. 2005

Savvides et al. 2003

Existing problems

Utilization of a dedicated channel for the transmission of necessary control messages — waste of limited bandwidth resource
Utilization of time synchronization across all the nodes — excessive system overhead
Routing=CA is a NP problem
A distributed heuristic algorithm is feasible

Metric II: Saturation network throughput in a 500km area

Performance Evaluation

Three MAC CA schemes:
(1) conventional single-channel IEEE 802.11
(2) multi-channel synchronization-based MAC protocol MMAC [So et al. 2004]
(3) HTSMA

Three performance metrics:
(1) Aggregate network throughput
(2) Saturation network throughput — maximal throughput that a network can accommodate
(3) Collision ratio

Metric I: Aggregate network throughput in a 500m area

Metric III: Collision ratio in a 500m area

M(15pks,4) N(5pks,7)

W (15pks,5) (35pks,5)

Q (30pks,2)

RTR

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