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Concept of Mobility Based Video-Telephony in Mobile Ad Hoc Network (Manet)

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Abstract: A Mobile Ad Hoc Network (MANET) is a collection of wireless mobile computers forming a temporary network, without any fixed base station. The network nodes communicate with one another over scarce wireless channels in a multi-hop fashion. The Ad Hoc network is adaptable to the highly dynamic topology resulted from the mobility of network nodes and the changing propagation conditions. In various applications, where a fixed backbone is not available, a readily deployable wireless network is needed. Mobile Ad Hoc networks are also a good alternative in rural areas or third world countries where basic communication infrastructure is not well established. This study describes the idea of Ad Hoc networking and scenarios where this technology will make an impact. How the environment of an Ad Hoc network is very different from the wired environment, and the effect this has on the design and operation of routing protocols for mobility based Video-Telephony in Ad Hoc networks is widely explained in this study.

Key words: Video telephony, MANET, QoS, VBS, BMT, Insignia

INTRODUCTION

Wireless networking is being used more and more in both fixed and mobile usage scenarios, whereas high quality multimedia (voice, video and data)[1] services over high-speed wireless local area networks (LANs) are becoming a reality. A multi hop mobile radio network, also called mobile Ad Hoc network (MANET) is a self-organizing and rapidly deployable network in which neither a wired backbone nor a centralized control exists.

Sending text messages among the groups, multicasting or broadcasting messages for necessary actions and audio or video telephony are the possible applications over MANET. Audio conferencing is a must when a person does not have enough time to write long messages. On the other hand video telephony is also necessary when visual demonstration is really helpful to explain something necessary. Thus video telephony over MANET with a satisfactory Quality of Service (QoS) must be commercially very much popular for its users.

Mobile computing and networking should not be confused with the portable computing and networking we have today. In mobile networking, computing activities are not disrupted when the user changes the computer's point of attachment to the Internet. Instead, all the needed reconnection occurs automatically and no interactively.

In cellular networks, communications between two mobile nodes completely rely on the wired backbone and fixed base stations. In a MANET no such infrastructure exists, and the network topology may dynamically change in an unpredictable manner since nodes are free to move. This study describes the idea of video telephony in MANET. A description of a number of different issues related to Medium Access Control (MAC), routing, and QoS in Mobile Ad Hoc Network.

VIDEO-TELEPHONY IN MANET

Video-telephony or video conferencing: Conduct a conference between two or more participants at different sites by using computer networks to transmit audio and video data. For example, a point-to-point (two-person) video conferencing system works much like a video telephone. Each participant has a video camera, microphone and speakers mounted on his or her computer. As the two participants speak to one another, their voices are carried over the network and delivered to the other's speakersand whatever images appear in front of the video camera appear in a window on the other participant's monitor. Multipoint videoconferencing allows three or more participants to sit in a virtual conference room and communicate as if they were sitting right next to each other.

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Technology for video-telephony: For many tactical operations, communication between mobile nodes (such as robotic vehicles) requires high performance sensing channels capable of transmitting high quality video signals over unstructured mobile networks. This necessitates a peer-to-peer network assembly of wireless multi hop ad-hoc routing. In addition, recent advances in Wireless LAN (WLAN) technologies such as the IEEE 802.11 standard has provided new opportunities to develop an experimental platform to design and assess ad-hoc networks for transmission of multimedia information in realistic environments[2,3]. The IEEE 802.11 standard defines the carrier sense multiple access protocol combined with collision avoidance (CSMA/CA)[4]. This protocol can support WLAN in two different modes: infrastructure and ad-hoc. In the infrastructure mode, mobile nodes should communicate with each other via an Access Point (AP) that is based on a centralized protocol known as Point Coordination Function (PCF). For ad-hoc operation however, the standard specifies another access protocol called Distributed Coordination Function (DCF). The most important challenge in providing video communication in ad-hoc network environments[5] would be to maximize the perceived quality-of-service (QoS).

Architecture of virtual base station (VBS) selection: A VBS is a mobile terminal (zone_MT) in one particular zone become in charge of all the zone_MTs in the transmission range or a subset of them. VBS architecture requires a mobile node is elected from a set of nominees to act as a mobile base station within its zone. Based on our VBS routing protocol, a mobile station that wishes to send a packet to another mobile node in the network sends the packet to its VBS, which forwards it to the proper next hop. We also propose a novel routing scheme based on the VBS architecture, namely, the Virtual Base Stations Proactive-Reactive (VBSPR) routing protocol. VBS-PR promises to achieve considerable gains in terms of increasing the capacity of the wireless Ad Hoc network, reducing the call setup times and end-to-end delays and increasing the routing efficiency. Optimal routing through the terminals of MANET requires lots of computations as it is an NP-hard problem and the change of path due to mobility of the terminals will hamper the QoS of video transmission[6]. That is why; we choose VBS-PR for supporting QoS in video telephony services can operate as a purely on-demand scheme and utilize the wireless mobile infrastructure to increase efficiency.

VBSID	
Seq # (for identifting the duplicates)	
Age (for discarding the old brodcast)	
Neigbor VBS ID$_{1..n}$ (The ID of the neighbors forwarded by the BMT)	**DelayI...n (Roundtrip delay)**
Zone_MTID$_{1..n}$ (The MTs supervised by the VBS)	

Fig 1: The fields for hello packets

Virtual base station (VBS) selection schema: In our scheme, some of the MTs, based on an agreed-upon policy, become in charge of all the MTs in their neighborhood or a subset of them. This can be achieved by electing one to be a Virtual Base Station (VBS). If a VBS moves or stops acknowledging its presence via its so-called hello packets for a period of time, a new one is elected. The fields for hello packets exchanged between the VBSs are depicted in Fig. 1.

A number of issues have to be solved. The first issue is the way in which the VBSs are to be chosen. Electing a single VBS from a set of nominees should be done in an efficient way. Another issue to be addressed is the handing of responsibilities of a VBS over from one VBS to another. Every MT (zone_MT/VBS) has a sequence number that reflects the changes that occur to that MTand a my_VBS variable, which is used to store the VBS in charge of that MT. If an MT has a VBS, its my_VBS variable will be set to the ID number of that VBS, else if the MT is itself a VBS, then the my_VBS variable will be set to 0, otherwise it will be set to B1. Hello messages sent by VBSs contain their current knowledge of the Ad Hoc network, i.e., the whole Ad Hoc network. A VBS accumulates information about all other VBSs and their lists of MTs and sends this information in its periodic hello messages. On the other hand, unlike VBSs, zone_MTs accumulate information about the network from their neighbors between hello messagesand their network information is cleared afterwards. After being chosen as a VBS, a node stores information about all other nodes in the network. An MT is chosen by one or more MTs to act as their VBS based on an agreed-upon rule, viz., the MT with the smallest ID number.

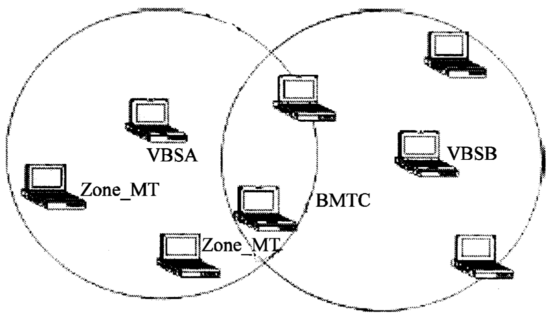

Fig 2: VBS with border mobile terminal

A noteworthy remark is that a node with a smaller ID number than another may be thought of as one that is more capable (in terms of processing speed, battery capacity, or any other criterion). To select an MT as a VBS, residual battery capacity (Normalized Power Value, NPV = instantaneous battery capacity of MT/ MAX_POWER)[7] is considered. If the current VBS has enough NPV, then it accepts merge request from other MT s. But if it is below THRESHOLD_1 then it rejects additional merge request. Again if it drops below THRESHOLD_2 then another VBS is selected from the MTs based on NPV. These threshold levels[8] are predetermined NPV. MTs announce their ID numbers and NPV with their periodic hello messages.

Region selection with VBS: Every MT (zone_MT/VBS) has a sequence number that reflects the changes that occur to that MT. An MT sends a merge-request message to another MT if the latter has a smaller ID number. The receiver of the merge-request responds with an accept-merge message, increments its sequence number by 1 to indicate that some change took placeand sets its my_VBS variable to 0. When the MT receives the accept-merge, it increments its sequence number by 1 and sets its my_VBS variable to the ID number of its VBS. If an MT hears from another MT whose ID number is smaller than that of its VBS, it sends a merge-request message to the former. When it receives an accept-merge message, it increments its sequence number by 1 and updates its my_VBS field. The MT then sends a dis-join message to its previous VBS. When the old VBS receives the dis-join, it removes the sender from its list of MTs, which it is in charge ofand it increments its sequence number by one. That is, this protocol puts more emphasis on a node becoming a VBS rather than supervised by a VBS. In this way a VBS with all its zone MTs forms a region.

Border mobile terminal (BMT): No two VBSs can hear each other = s transmissions directly, but rather through BMTs. Every BMT connects exactly two VBS i.e., its own VBS and another VBS within its wireless transmission range, or its own VBS and a BMT of another VBS. So, a VBS can be a BMT and an MT can be a BMT of more than one pairs if possible (availability of resource, capacity). VBS with Border Mobile Terminal are shown in Fig. 2.

INSIGNIA QoS framework and mobility: The primary design goal of the INSIGNIA QoS framework[9,10] is to support adaptive services that can provide base QoS (i.e., minimum bandwidth) assurances to real-time voice and video flows and data, allowing for enhanced levels (i.e., maximum bandwidth) of service to be delivered when resources become available. INSIGNIA is designed to adapt user sessions to the available level of service without explicit signaling between source-destination pairs. The routing protocols interact with resource management to discover and establish end-to-end QoS paths. In-band signaling refers to the control information being carried along with data packets. Using an in-band signaling approach, the INSIGNIA system can restore the flow state in response to topology changes within the interval of a few consecutive IP packets[11] when a standby route is available in cache. In MANETs, a soft state approach to state management at intermediate routing nodes is more flexible for the management of reservations. Soft state relies on the fact that a source sends data packets along an existing path. When an intermediate mobile router receives a new data packet and no reservation exists, admission control and resource reservation attempt to establish soft state. When a data packet arrives at a mobile router and there is an associated reservation, the reception of this data packet will refresh the existing soft state reservation over the next interval. If the soft state timer times out before a new packet arrives, the associated resources are released. The INSIGNIA signaling module controls the establishment, restoration, adaptationand destruction of adaptive QoS-aware paths between source-destination pairs. Packet forwarding classifies incoming packets as signaling or data packetsand forwards them to an appropriate module.

In hard-state resource management the guarantee of QoS between the source and destination pair remains fixed for the duration of the session. In INSIGNIA=s soft-state resource management, if a new packet is not received within the soft-state time interval then resources are released automatically and flow states are removed in a fully decentralized manner. Doing so will cause sudden termination of video transmission. So the source will explicitly dictate the hosts in the route to the destination to release reserved resources, through sending release packet when needed.

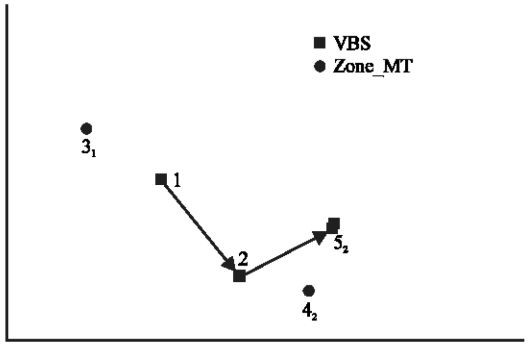

Fig 3: Sending a message from a VBS to a zone MT of another VBS

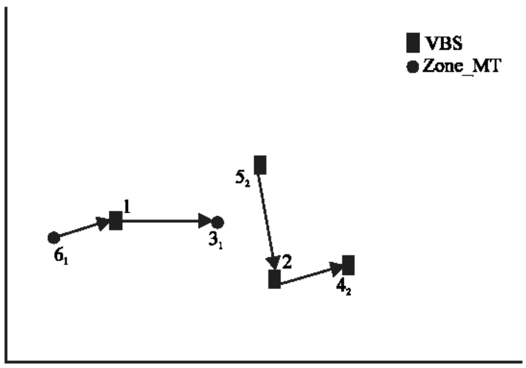

Fig 4: Sending a message from a zone MT to another zone MT of the same VBS

Proposed protocols

Protocol for BMT Fixation: When a new region (a new VBS) is created, the VBS will send a broadcast request to its zone_MTs to send their new region (a new VBS) is created, the VBS will send a broadcast request to its zone_MTs to send their status. Each MT sends the following information to its VBS: ID of the zone_MT, IDs of the VBSs, the zone_MT can hear required parameters from the replied status of the zone_MTs VBS will request the most suitable zone_MTs to become a BMT. The BMT=s will ask the two VBSs to make an entry in their adjacency table and its ID. The adjacency table of a VBS If c does not hear transmission from A (let) for a specified time, then it will inform B and B will delete the ID of A from its adjacency table. On the other hand, if c has moved far out of the range of either A or B then a new BMT will be selected repeating the above process.

If c is overloaded, that means if its currently available resources are not enough, then it can request other MTs to act as a BMT between A and B. If someone is found capable to act as BMT between A and B, then handoff is done. If the load is too high, then the primary BMT can request another MT to act as a secondary BMT. When the load is low, only the primary BMT works. The two VBSs are not aware of the secondary BMT. It is handled completely by the primary BMT (Fig. 4). The format of the BMT table for c is as follows (Table 1):

Table 1: Here the BMT will act as a gateway between VBS A and VBS B

ID of VBS A
ID of VBS B

Routing mechanism: A systematic framework[12] is needed to get the performance of different routing protocols for MANETs. Any frame from a host in a region is invariably handed to the VBS, which then broadcasts it. At this point, three scenarios can arise:

a. The destination is a host of the same region
b. The destination is in the neighboring region
c. The destination is not in neighboring region but connection possible.

For a. when the VBS=s broadcast is received by the destination MT, it can identify it by matching the destination address (ID) of the frame with its own ID.

For b. from the broadcast of VBS the assigned BMT for the destination gets the frame. It then forwards it to the destination region VBS, which in turn rebroadcast so that the destination MT gets it finally.

For c. once the source MT = s VBS gets the packet it uses its routing table to find neighbor is to be used for the route to destination. It then inserts that neighbor = s VBS address (ID) at the destination VBS address field of the data frame. After broadcast the BMT as usual identifies and forwards to the neighbor VBS. The same process is repeated until the destination region = s VBS is reached. This VBS learns that the destination MT is in its region from its list of maintained MTs. So a broadcast will do.

This protocol enhances the network performance, as the VBS is able to communicate with a number of its zone_MTs and BMTs simultaneously with much less collision.

MAC protocol and RTS/CTS frame: In the MAC layer we use one control channel for transmission of RTS/CTS messages for channel allocation. The MT will send a short RTS to the VBS and CTS reserves channel for MT. If collision occurs on the control channel, then it will wait a random time and send RTS again. B/W of all data channels are assumed equal. The phases of a single transmission from an MT to its VBS are as follows:

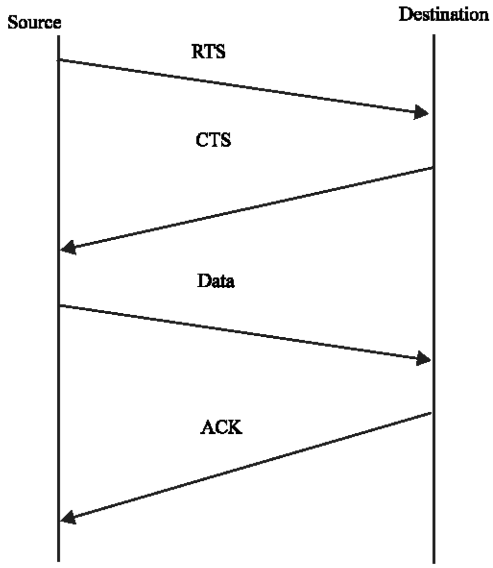

Fig. 5: Timing diagram for MAC layer

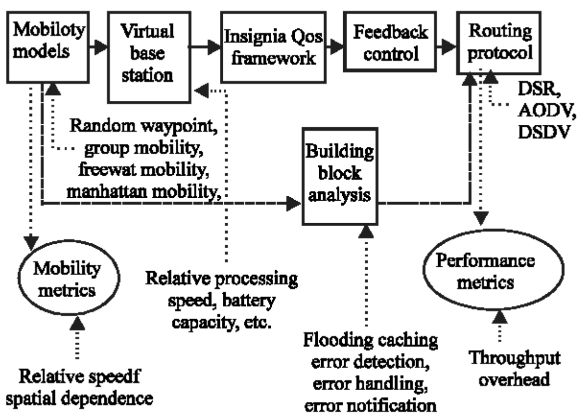

Fig 6: Proposed overall design for Video-Telephony in MANET

The overall design for video-telephony in MANET: The proposed overall design for Video-Telephony in MANET is given in Fig. 6.

CONCLUSION

This ideal of a highly distributed network not owned by any single party but available to all for common use is being pursued at the technical level through the development of dynamic routing protocols. Our route discovery and maintenance protocols involve only VBSs and BMTs so that other zone_ MTs do not exhaust their remaining battery power. Our proposed routing will be able to present bandwidth efficient mechanism, which is interacting with continuous flow of video data under high mobility condition. The future development will prefer efficient video conferencing with various mobility models.

REFERENCES

1. Dr. Petre Dini, 2003. AInternet Multimedia Traffic Pattrerns@ http://MMNS 2003, Conference Program.
2. Gharavi, H., K. Banand J. Cambiotis, RTCP-Based Frame-Synchronized FeedbackControl for IP-Video Communications over Multipath Fading Channels.@
3. Ahmed M. Safwat, Hossam S. Hassaneinand Hussein T. Mouftah, Structured Proactive and Reactive Routing for Wireless Mobile Ad Hoc Networks@, The Handbook of Ad Hoc Wireless Networks, CRC Press (The electrical engineering handbook series), ISBN 0-8493-1332-5.
4. Bharghavan, V., A. Demers, S. Shenker and L. Zhang., 1994. MACAW: A Media Access Protocol for Wireless LAN's.@ ACM SIGCOMM.
5. Hertrich, D., 2002. MPEG4 video transmission in wireless LANs: Basic QoS support on the data link layer@ of 802.11b. Minor Thesis, Technical University Berlin, http://www.daniel-hertrich.de/studienarbeit
6. Girod, B. and N. Farber, 2003. Feedback-Based Error Control for Mobile Video Transmission,@ THE PROCEEDINGS OF THE IEEE, pp: 1221-1234.
7. Ahmed Safwat, *et al.*, 2002. APower-Aware Fair Infrastructure Formation for Wireless Mobile Ad Hoc communications.@ Communications and Information Technology Ontario (CITO) Knowledge Network Conference 2002. Ottowa, Canada.
8. Lei Chen and Wendi Heinzelman, QoS-aware Routing Based on Bandwidth Estimation for Mobile Ad Hoc Networks.@
9. Seoung-Bum Lee, Gahng-Seop Ahn, Xiaowei Zhangand T. Andrew, 2000. INSIGNIA: An IP-Based Quality of Service Framework for Mobile Ad Hoc Networks.@ Campbel J. Parallel and Distributed Computing 60, 374_406.
10. Ghanta Ravikiran and Suresh Singh, Influence of Mobility Models on the Performance of Routing Protocols in Ad-Hoc Wireless Networks@
11. Lee, S.B. *et al.*, 2000. INSIGNIA: An IP-Based Quality of Service Framework for Mobile Ad Hoc Networks,@ J. Parallel and Distrib. Comp., Special issue on Wireless and Mobile Computing and Communications, pp: 374B406.
12. William Su, Sung-Ju Leeand Mario Gerla, 2001. Mobility prediction and routing in Ad Hoc wireless networks@, Int. J. Network Mgmt, pp: 11-3B30.