International Journal of Research
ISSN: 2348-6848 Vol-3, Special Issue-1
National Conference on Advanced Computing Technologies
Held on 21st July 2015 at Hyderabad city organized by **Global Research Academy,** Hyderabad, Telangana, India.

A Critical Study on the Impact of Mobility, Multicast Transmission and Infrastructure on Network Capacity for Cellular and Ad Hoc Networks

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ABSTRACT: *We study the multicast capacity under a network model featuring both node's mobility and infrastructure support. Combinations between mobility and infrastructure, as well as multicast transmission and infrastructure, have already been showed effective ways to increase it. In this work, we jointly consider the impact of the above three factors on network capacity. We assume that m static base stations and n mobile users are placed in an ad hoc network. A general mobility model is adopted, such that each user moves within a bounded distance from its home-point with an arbitrary pattern. In addition, each mobile node serves as a source of multicast transmission, which results in a total number of n multicast transmissions. We focus on the situations in which base stations actually benefit the capacity improvement, and find that multicast capacity in a mobile hybrid network falls into several regimes. For each regime, reachable upper and lower bounds are derived. Our work contains theoretical analysis of multicast capacity in hybrid networks and provides guidelines for the design of real hybrid system combing cellular and ad hoc networks.*

■ **KEYWORDS***:* Mobile Ad hoc Network; Generalized Random Geometric Graph (GRGG).; Maximum Concurrent Flow (MCF); Vehicular Ad hoc Networks (VANETs); Wireless Routing Protocol (WRP); Signal Stability Routing (SSR)

INTRODUCTION

The term MANET (Mobile Ad hoc Network) refers to a multihop packet based wireless network composed of a set of mobile nodes that can communicate and move at the same time, without using any kind of fixed wired infrastructure. MANET is actually self organizing and adaptive networks that can be formed and deformed on-the-fly without the need of any centralized administration.

Otherwise, a stand for "Mobile Ad Hoc Network" A MANET is a type of ad hoc network that can change locations and configure itself on the fly. Because MANETS are mobile, they use wireless connections to connect to various networks. This can be a standard Wi-Fi connection, or another medium, such as a cellular or satellite transmission.[1]

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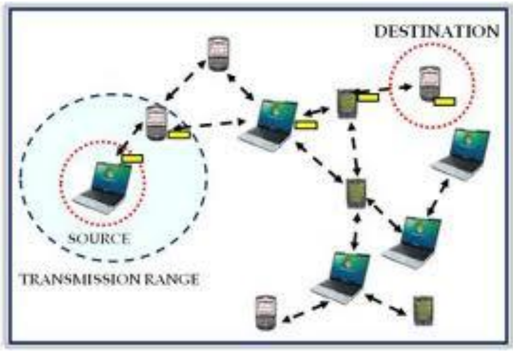


Figure 1: Structure of MANET

The purpose of the MANET working group is to standardize IP routing protocol functionality suitable for wireless routing application within both static and dynamic topologies with increased dynamics due to node motion and other factors. Approaches are intended to be relatively lightweight in nature, suitable for multiple hardware and wireless environments, and address scenarios where MANETs are deployed at the edges of an IP infrastructure. Hybrid mesh infrastructures (e.g., a mixture of fixed and mobile routers) should also be supported by MANET specifications and management features. Using mature components from previous work on experimental reactive and proactive protocols, the WG will develop two Standards track routing protocol specifications:

- Reactive MANET Protocol(RMP)
- ProactiveMANETProtocol(PMP)[2]

If significant commonality between RMRP and PMRP protocol modules is observed, the WG may decide to go with a converged approach. Both IPv4 and IPv6 will be supported. Routing security requirements and issues will also be addressed.
The MANET WG will also develop a scoped forwarding protocol that can efficiently flood data packets to all participating MANET nodes. The primary purpose of this mechanism is a simplified best effort multicast forwarding function. The use of this protocol is intended to be applied ONLY within MANET routing areas and the WG effort will be limited to routing layer design issues.
The MANET WG will pay attention to the OSPF-MANET protocol work within the OSPF WG and IRTF work that is addressing research topics related to MANET environments.[3]

Characteristics of MANET's:

- In MANET, each node acts as both host and router. That is it is autonomous in behavior.
- Multi-hop radio relaying- When a source node and destination node for a message is out of the radio range, the MANETs are capable of multi-hop routing.
- Distributed nature of operation for security, routing and host configuration. A centralized firewall is absent here.
- The nodes can join or leave the network anytime, making the network topology dynamic in nature.
- Mobile nodes are characterized with less memory, power and light weight features.
- The reliability, efficiency, stability and capacity of wireless links are often inferior when compared with wired links. This shows the fluctuating link bandwidth of wireless links.
- Mobile and spontaneous behavior which demands minimum human intervention to configure the network.

- All nodes have identical features with similar responsibilities and capabilities and hence it forms a completely symmetric environment.
- High user density and large level of user mobility.
- Nodal connectivity is intermittent.[4]

1. Infrastructure-based Networks:

- ❖ Fixed backbone
- ❖ Nodes communicate with access point
- ❖ Suitable for areas where APs are provided [5]

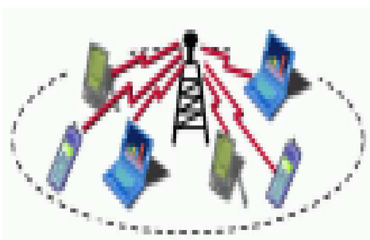


Figure 2: Infrastructure-based Networks

2. Infrastructure-less Networks

- ❖ Without any backbone and access point
- ❖ Every station is simultaneously router

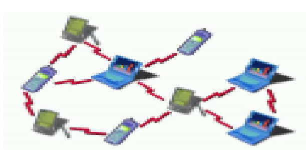


Figure 3: Infrastructure-lessNetwork

3. Nodes:

- ❖ limited resources.
- ❖ dynamic topology.
- ❖ Address assignment.[6]

4. Wireless channels:

- ❖ relatively high error rate
- ❖ high variability in the quality
- ❖ low bandwidth
- ❖ broadcast nature
- ❖ security aspect

Types of MANET:

There are different types of MANETs including:

- In VANETs – Intelligent vehicular ad hoc networks make use of artificial intelligence to tackle unexpected situations like vehicle collision and accidents.
- Vehicular ad hoc networks (VANETs) – Enables effective communication with another vehicle or helps to communicate with roadside equipments.
- Internet Based Mobile Ad hoc Networks (iMANET) – helps to link fixed as well as mobile nodes.[7]

Types of routing protocols in the MANET:

Two types of routing protocols:

2. Table-Driven Routing Protocols
   - Destination-Sequenced Distance-Vector Routing (DSDV)
   - Cluster head Gateway Switch Routing (CGSR)
   - The Wireless Routing Protocol (WRP)
3. Source-Initiated On-Demand Routing Protocols
   - Ad-Hoc On-Demand Distance Vector Routing (AODV)
   - Dynamic Source Routing (DSR)
   - Temporally-Ordered Routing Algorithm (TORA)
   - Associativity-Based Routing (ABR)

- Signal Stability Routing (SSR)[8]

Advantages of MANET's:

- Wireless communication
- Mobility
- Do not need infrastructure
- but can use it, if available
- small, light equipment[9]

LITERATURE SURVEY

When n identical randomly located nodes, each capable of transmitting at W bits per second and using a fixed range, form a wireless network, the throughput λ(n) obtainable by each node for a randomly chosen destination is Θ(W/√(nlogn)) bits per second under a noninterference protocol. If the nodes are optimally placed in a disk of unit area, traffic patterns are optimally assigned, and each transmission's range is optimally chosen, the bit-distance product that can be transported by the network per second is Θ(W√An) bit-meters per second. Thus even under optimal circumstances, the throughput is only Θ(W/√n) bits per second for each node for a destination nonvanishingly far away. Similar results also hold under an alternate physical model where a required signal-to-interference ratio is specified for successful receptions. Fundamentally, it is the need for every node all over the domain to share whatever portion of the channel it is utilizing with nodes in its local neighborhood that is the reason for the constriction in capacity. Splitting the channel into several subchannels does not change any of the results. Some implications may be worth considering by designers. Since the throughput furnished to each user diminishes to zero as the number of users is increased, perhaps networks connecting smaller numbers of users, or featuring connections mostly with nearby neighbors, may be more likely to be find acceptance.[10]

The capacity of ad hoc wireless networks is constrained by the mutual interference of concurrent transmissions between nodes. We study a model of an ad hoc network where n nodes communicate in random source-destination pairs. These nodes are assumed to be mobile. We examine the per-session throughput for applications with loose delay constraints, such that the topology changes over the time-scale of packet delivery. Under this assumption, the per-user throughput can increase dramatically when nodes are mobile rather than fixed. This improvement can be achieved by exploiting a form of multiuser diversity via packet relaying.[11]

We provide a general framework for the analysis of the capacity scaling properties in mobile ad-hoc networks with heterogeneous nodes and spatial in homogeneities. Existing analytical studies strongly rely on the assumption that nodes are identical and uniformly visit the entire network space. Experimental data, however, have shown that the mobility pattern of individual nodes is typically restricted over the area, while the overall node density is often largely inhomogeneous, due to prevailing clustering behavior resulting from hot-spots. Such ubiquitous features of realistic mobility processes demand to reconsider the scaling laws for the per-user throughput achievable by the *store-carry-forward* communication paradigm which provides the foundation of many promising applications of delay tolerant networking. We show how the analysis of the asymptotic capacity of dense mobile ad-hoc networks can be transformed, under mild assumptions, into a *Maximum Concurrent Flow* (MCF) problem over an associated *Generalized Random Geometric Graph* (GRGG). Our methodology allows to identify the scaling laws for a general class of mobile wireless networks, and to precisely determine under which conditions the mobility of nodes can indeed be exploited to increase the per-node throughput. At last we propose a simple, asymptotically optimal, scheduling and routing scheme that achieves the maximum transport capacity of the network.[12]

This paper involves the study of the throughput capacity of hybrid wireless networks. A hybrid network is formed by placing a sparse network of base stations in an ad hoc network. These base stations are assumed to be connected by a high-bandwidth wired network and act as relays for wireless nodes. They are not data sources nor data receivers. Hybrid networks present a tradeoff between traditional cellular networks and pure ad hoc networks in that data may be forwarded in a multi hop fashion or through the infrastructure. It has been shown that the capacity of a random ad hoc network does not scale well with the number of nodes in the system. In this work, we consider two different routing strategies and study the scaling behavior of the throughput capacity of a hybrid network. Analytical expressions of the throughput capacity are obtained. For a hybrid network of n nodes and m base stations, the results show that if m grows asymptotically slower than √n, the benefit of adding base stations on capacity is insignificant. However, if m grows faster than √n, the throughput capacity increases linearly with the number of base stations, providing an effective improvement over a pure ad hoc network. Therefore, in order to achieve non negligible capacity gain, the investment in the wired infrastructure should be high enough.[13]

In this paper, we consider the transport capacity of ad hoc networks with a random flat topology under the present support of an infinite capacity infrastructure network. Such a network architecture allows ad hoc nodes to communicate with each other by purely using the remaining ad hoc nodes as their relays. In addition, ad hoc nodes can also utilize the existing infrastructure fully or partially by reaching any access point (or gateway) of the infrastructure network in a single or multi-hop fashion.[14] Using the same tools as in [1], we show that the per source node capacity of T(*W*/log(*N*)) can be achieved in a random network scenario with the following assumptions: (i) The number of ad hoc nodes per access point is bounded above, (ii) each wireless node, including the access points, is able to transmit at *W* bits/sec using a fixed transmission range, and (iii) *N* ad hoc nodes, excluding the access points, constitute a connected topology graph. This is a significant improvement over the capacity of random ad hoc networks with no infrastructure support which is found as T(*W*/v*N* log(*N*)) in [1]. Although better capacity figures may be obtained by complex network coding or exploiting mobility in the network, infrastructure approach provides a simpler mechanism that has more practical aspects. We also show that even when less stringent requirements are imposed on topology connectivity, a per source node capacity figure that is arbitrarily close to T(1) cannot be obtained. Nevertheless, under these weak conditions, we can further improve per node throughput significantly.[15]

SYSTEM STUDY

FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

- ECONOMICAL FEASIBILITY
- TECHNICAL FEASIBILITY
- SOCIAL FEASIBILITY

ECONOMICAL FEASIBILITY

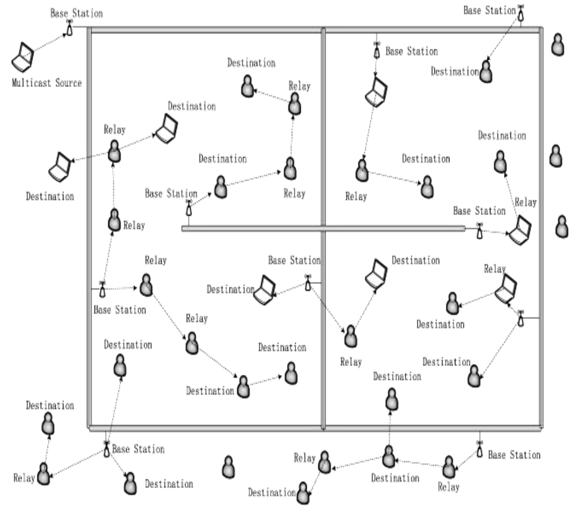
This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a gure high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.



SYSTEM DESIGN

SYSTEM ARCHITECTURE:

DATA FLOW DIAGRAM:

1. The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of input data to the system, various processing
   carried out on this data, and the output data is generated by this system.

Figure 4: System Architecture

   The data flow diagram (DFD) is one of the most important modeling tools. It is used to
   model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.
2. DFD shows how the information moves through the system and how it is modified by a series of

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transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output.

3. DFD is also known as bubble chart. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail.

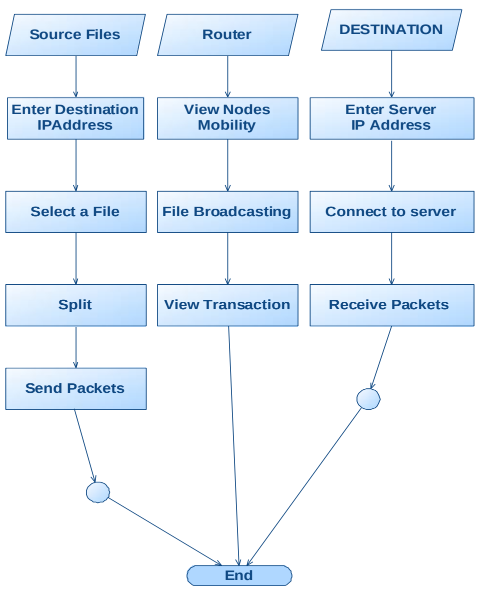

Figure 5: Data Flow Diagram

UML DIAGRAMS

UML stands for Unified Modeling Language. UML is a standardized general-purpose modeling language in the field of object-oriented software engineering. The standard is managed, and was created by, the Object Management Group.

The goal is for UML to become a common language for creating models of object oriented computer software. In its current form UML is comprised of two major components: a Meta-model and a notation. In the future, some form of method or process may also be added to; or associated with, UML.

The Unified Modeling Language is a standard language for specifying, Visualization, Constructing and documenting the artifacts of software system, as well as for business modeling and other non-software systems.

The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems.

The UML is a very important part of developing objects oriented software and the software development process. The UML uses mostly graphical notations to express the design of software projects.

GOALS:

The Primary goals in the design of the UML are as follows:

1. Provide users a ready-to-use, expressive visual modeling Language so that they can develop and exchange meaningful models.
2. Provide extendibility and specialization mechanisms to extend the core concepts.
3. Be independent of particular programming languages and development process.
4. Provide a formal basis for understanding the modeling language.
5. Encourage the growth of OO tools market.
6. Support higher level development concepts such as collaborations, frameworks, patterns and components.
7. Integrate best practices.

USE CASE DIAGRAM:

A use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted.

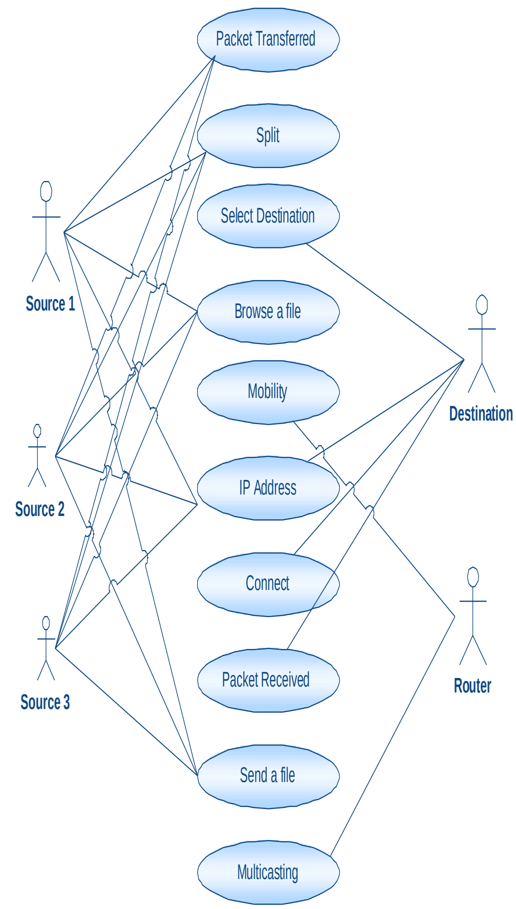

Figure 6: Use Case Diagram

CLASS DIAGRAM:

In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among the classes. It explains which class contains information.

SEQUENCE DIAGRAM:

A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

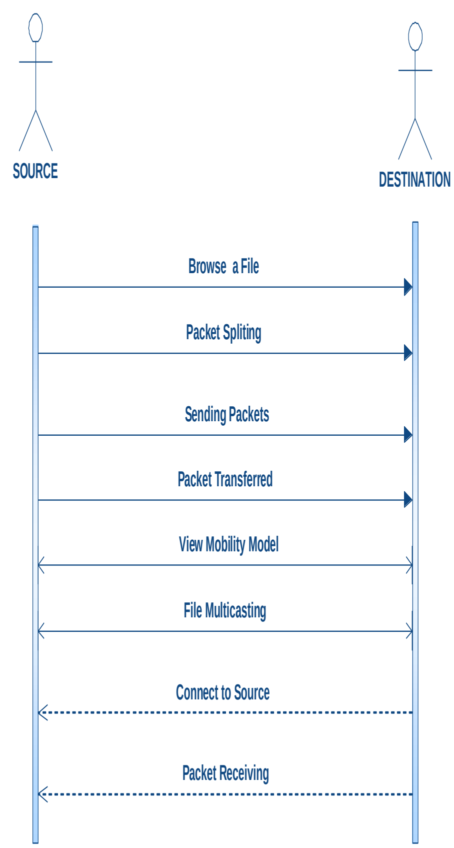

Figure 7: Class Diagram

ACTIVITY DIAGRAM:

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step

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workflows of components in a system. An activity diagram shows the overall flow of control.

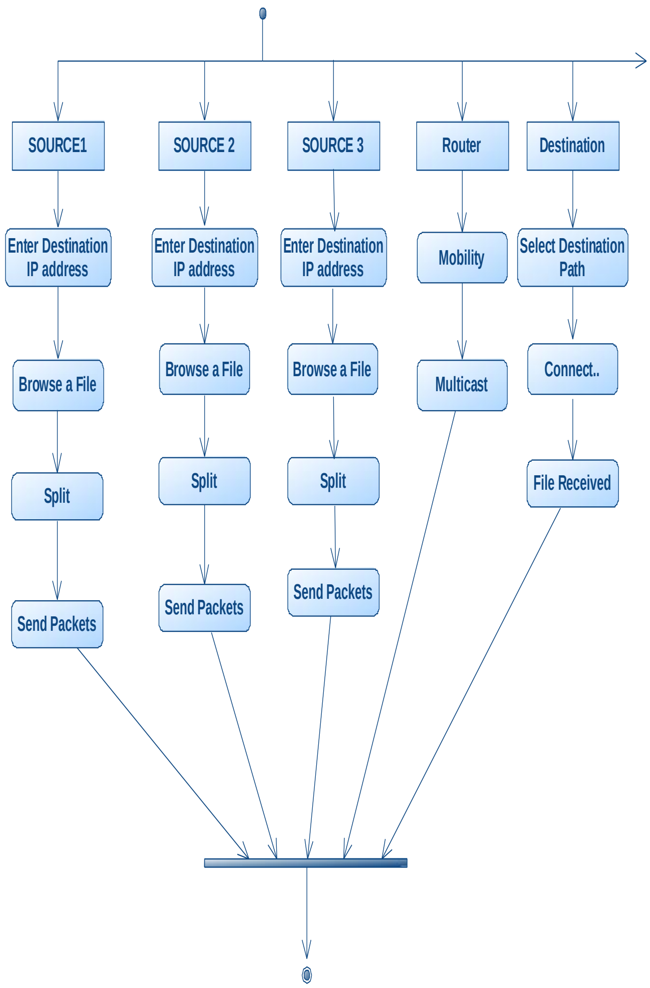

Figure 8: Activity Diagram

INPUT DESIGN

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system. The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things:

- What data should be given as input?
- How the data should be arranged or coded?
- The dialog to guide the operating personnel in providing input.
- Methods for preparing input validations and steps to follow when error occur.

OBJECTIVES

1. Input Design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process and show the correct direction to the management for getting correct information from the computerized system.

2. It is achieved by creating user-friendly screens for the data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in such a way that all the data manipulates can be performed. It also provides record viewing facilities.

3.When the data is entered it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that the user

will not be in maize of instant. Thus the objective of input design is to create an input layout that is easy to follow

OUTPUT DESIGN

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.

1. Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.

2.Select methods for presenting information.

3.Create document, report, or other formats that contain information produced by the system.

The output form of an information system should accomplish one or more of the following objectives.

- Convey information about past activities, current status or projections of the
- Future.
- Signal important events, opportunities, problems, or warnings.
- Trigger an action.
- Confirm an action.

SYSTEM ANALYSIS

EXISTING SYSTEM:

Many existing studies focus on the combinations of the above characteristics. Some aim to further increase the network performance, while others try to present a more realistic scenario. In, Liet al. explores the multicast capacity in a static hybrid network with infrastructure support. Establishing a multicast tree with the help of infrastructure and employing a hybrid routing scheme, they have showed that the achievable multicast capacity in a hybrid network. On the other hand, Huang, Wanget al. study the unicast capacity of mobile hybrid networks and jointly consider the influences of node's mobility and infrastructure support on it. A per-node capacity is for strong mobility, and for weak and trivial mobility.

DISADVANTAGES OF EXISTING SYSTEM:

In a many existing systems the scalability is failure of throughput capacity and some of the failures in the mobility nodes, and in networks infrastructure.

PROPOSED SYSTEM:

In this paper, we further study the multicast capacity scaling laws of a mobile hybrid network characterizing both mobility and infrastructure. In our model, each of the n users moves around a home-point within a bounded radius. An m wire-connected base station is placed in a wireless ad hoc network, of which the area scales with n. There are totally n_c clusters with radius r and the number of destinations in the multicast scheme is assumed as k. A multicast path can be generated with an infrastructure routing and a pure ad hoc routing, as well as a combination of both. Intuitively, in our hybrid routing scheme, we hope to circumvent the bottleneck of backbone transmission or wireless access for cellular networks and take the advantage of them, thus the capacity can be improved.

ADVANTAGES OF PROPOSED SYSTEM:

- Our work is the first one to consider the effect of a general mobility on multicast transmission. Furthermore, we study multicast capacity in a more realistic network model featuring both mobility and infrastructure support. As a result, our work generalizes both unicast and broadcast capacity results in MANETs and hybrid networks.
- We can prove that mobility is trivial and the network acts as a static one.

SYSTEM TESTING

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub assemblies, assemblies and/or a finished product It is the process of exercising software with the intent of ensuring that the

Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

TYPES OF TESTS

Unit testing

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

Integration testing

Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfaction, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

Functional test

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals. Functional testing is centered on the following items:

Valid Input : identified classes of valid input must be accepted.

Invalid Input : identified classes of invalid input must be rejected.

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Functions : identified functions must be exercised.

Output : identified classes of application outputs must be exercised.

Systems/Procedures: interfacing systems or procedures must be invoked.

Organization and preparation of functional tests is focused on requirements, key functions, or special test cases. In addition, systematic coverage pertaining to identify Business process flows; data fields, predefined processes, and successive processes must be considered for testing. Before functional testing is complete, additional tests are identified and the effective value of current tests is determined.

System Test

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

White Box Testing

White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

Black Box Testing

Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document. It is a testing in which the software under test is treated, as a black box .you cannot "see" into it. The test provides inputs and responds to outputs without considering how the software works.

Unit Testing:

Unit testing is usually conducted as part of a combined code and unit test phase of the software lifecycle, although it is not uncommon for coding and unit testing to be conducted as two distinct phases.

Test strategy and approach

Field testing will be performed manually and functional tests will be written in detail.

Test objectives

- All field entries must work properly.
- Pages must be activated from the identified link.
- The entry screen, messages and responses must not be delayed.

Features to be tested

- Verify that the entries are of the correct format
- No duplicate entries should be allowed
- All links should take the user to the correct page.

Integration Testing

Software integration testing is the incremental integration testing of two or more integrated software components on a single platform to produce failures caused by interface defects.

The task of the integration test is to check that components or software applications, e.g. components in a software system or – one step up – software applications at the company level – interact without error.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

Acceptance Testing

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

IMPLEMENTATION

MODULES

1. Scheduling policies
2. Heterogeneous networks
3. Transmission infrastructure

MODULES DESCRIPTION

SCHEDULING POLICIES

In this Module, the information about the current and past status of the network, and can schedule any radio transmission in the current and future time slots, similar. We say a packet is successfully delivered if and only if all destinations within the multicast session have received the packet. In each time slot, for each packet p that has not been successfully delivered and each of its unreached destinations, the scheduler needs to perform the following two functions:

1. **Capture**

The scheduler needs to decide whether to deliver packet to destination in the current time slot. If yes, the scheduler then needs to choose one relay node (possibly the source node itself) that has a copy of the packet at the beginning of the timeslot, and schedules radio transmissions to forward this packet to destination within the same timeslot, using possibly multi-hop transmissions. When this happens successfully, we say that the chosen relay node has successfully captured the destination of packet. We call this chosen relay node the last mobile relay for packet and destination. And we call the distance between the last mobile relay and the destination as the capture range.

2. **Duplication**

For a packet p that has not been successfully delivered, the scheduler needs to decide whether to duplicate packet p to other nodes that does not have the packet at the beginning of the time-slot. The scheduler also needs to decide which nodes to relay from and relay to, and how.

HETEROGENEOUS NETWORKS

In this Module, All transmissions can be carried out either in ad hoc mode or in infrastructure mode. We assume that the base stations have a same transmission bandwidth, denoted for each. The bandwidth for each mobile ad hoc node is denoted. Further, we evenly divide the bandwidth into two parts, one for uplink transmissions and the other for downlink transmissions, so that these different kinds of transmissions will not interfere with each other.

TRANSMISSION INFRASTRUCTURE

In this Module, A transmission in infrastructure mode is carried out in the following steps:

1) Uplink: A mobile node holding packet is selected, and transmits this packet to the nearest base station.

2) Infrastructure relay: Once a base station receives a packet from a mobile node, all the other base stations share this packet immediately, (i.e., the delay is considered to be zero) since all base stations are connected by wires.

3) Downlink: Each base station searches for all the packets needed in its own sub region, and transmit all of them to their destined mobile nodes. At this step, every base station will adopt TDMA schemes to delivered different packets for different multicast sessions.

RESULTS & CONCLUSION

This paper analyzes the multicast capacity in mobile ad hoc networks with infrastructure support. Hybrid routing schemes are proposed to achieve reachable upper and lower bounds in each of the regimes. It is worth pointing out that our work generalizes results in previous works on hybrid networks, impact of mobility and multicast transmissions, as well as any combinations of the above. Our results are instructive in the design of real hybrid system combining cellular and ad hoc networks.

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