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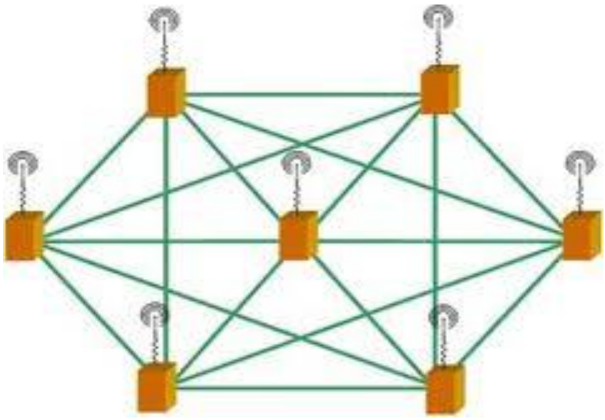
Autogenous Reconfigurable Wireless Mesh Network

J.H.Reena[1], K.Govardhan Reddy[2], P.V.S. Srinivas[3]
[1]*PG Scholar, Department of Computer Science and Engineering, TKR College of Engineering and Technology, Hyderabad, A.P-500 097, India*
[2]*Associate Professor, Department of Computer Science and Engineering, TKR College of Engineering and Technology, Hyderabad, A.P-500 097, India*
[3]*Professor& Head, Department of Computer Science and Engineering, TKR College of Engineering and Technology, Hyderabad, A.P-500 097, India*

Abstract: *Multi Hop Wireless mesh networks MNs) experience frequent link failures caused by channel interference, dynamic obstacles and/or applications' bandwidth demands. These failures cause severe performance degradation in WMNs or require expensive, manual network management for their real-time recovery. This paper presents an Autogenouss network Reconfiguration System (ARS) that enables a multi-radio WMN to autonomously recover from local link failures to preserve network performance. By using channel and radio diversities in WMNs, ARS generates necessary changes in local radio and channel assignments in order to recover from failures. Next, based on the thus-generated configuration changes, the system cooperatively reconfigures network settings among local mesh routers. ARS has been implemented and evaluated extensively on our IEEE 802.11-based WMN test-bed as well as through ns-2-based simulation. Our evaluation results show that ARS outperforms existing failure -recovery Schemes in improving channel-efficiency by more than 90% and in the ability of meeting the applications' bandwidth demands by an average of 200%.*

I. INTRODUCTION

Wireless mesh networks (WMNs) are evolve to develop to provide better services world widely and it also developed to deploye variety of applications, it coordinates network management system and intelligent transportation system. It has been evolving in various forms (e.g., using multi-radio/channel systems to meet the increasing capacity demands of the various applications.Even though link failures occurs.wmn overcomes such failures inorder to provide good communication services to the various applications Wireless communication technologies continue to undergo rapid advancement. The attractiveness of Wireless Mesh Networks (WMN)s, in general, can be attributed to their characteristics: the ability to dynamically self-organize and self-configure, coupled with the ability to maintain mesh connectivity, leads in effect to low set-up/installation costs, simpler maintenance tasks, and service coverage with high reliability and fault-tolerance. As a result, WMNs have found many useful applications in a broad range of domains. WMNs represent a key technology for future generation wireless networksIt Provides an accessible, comprehensive overview of the state-of-the-art technology of Wireless Mesh Networks and it Includes reader-friendly discussions for practitioners, directions for future research.A WMN is dynamically self-organised and self-configured, with the nodes in the network automatically establishing and maintaining mesh connectivity among themselves. This feature brings many advantages to WMNs such as low upfront cost, easy network maintenance, robustness, and reliable service coverage. Conventional nodes equipped with network interface cards (NICs) can directly communicate to the wireless mesh networks. Customers without wireless NIC can communicate with mesh network by connecting to wireless mesh routers, for e.g., through Ethernet. Thus, WMN will greatly help people to be online anywhere anytime. Moreover, the gateway and bridging functionalities of mesh routers enable the integration of WMNs with various existing networks such as cellular, wireless sensor, wireless-fidelity, world-wide interoperability for microwave access, Wi media networks.



WMN is a promising technology for numerous applications, e.g. Broadband home networking, community and neighborhood networking, enterprise networking, building automation, etc. It is gaining significant attention as a possible way for the cash strapped Internet service providers(ISPs),carriers, and others to roll out to robust and reliable wireless broadband service access in a way that needs minimal upfront investments. With the capability of self-organisation and self-configuration, WMNs can be deployed incrementally one node at a time as needed. As more and more nodes are installed, the reliability and connectivity for users increase accordingly.Deploying a WMN is not too difficult since all the required components are already present in form of Adhoc network routing protocols, IEEE 802.11 MAC protocol, etc. Several companies have already realized the potential of this technology and offer wireless mesh networking products. However, to make WMN be it all can be considerable research efforts are still needed. For example, the available MAC and routing protocols applied to WMNs do not have enough scalability: the throughput drops significantly as the number of nodes or hops in a network increases. Similar problems exist in other networking protocols. Consequently, all existing protocols from the application layer to transport, network MAC, physical layers need to be enhanced or re-invented.

II. SYSTEM ANALYSIS

A) Existing System

First, resource-allocation algorithms provide various guidelines guidelines for initial network resource planning. However, even though their approach provides a comprehensive and optimal network configuration plan, they often require “global” configurationchanges, which are undesirable in case of frequent local link failures.

Next, a *greedy* channel-assignment algorithm can reduce the requirement of network changes by changing settings of only the faulty link(s). However, this greedy change might not be able to realize full improvements, which can only be achieved by considering configurations of neighboring mesh routers in addition to the faulty link(s).Third, fault-tolerant routing protocols, such as local re-routing [16] or multi-path routing [17], can be adopted to use network-level path diversity for avoiding the faulty links. However, they rely on detour paths or redundant transmissions, which may require more network resources than link-level network reconfiguration.

Disadvantages

1. Cannot avoid Propagation of Qos failures To Neighbouring Links
2. UnSuitable For Dynamic Network Reconfiguration

b) Proposed System

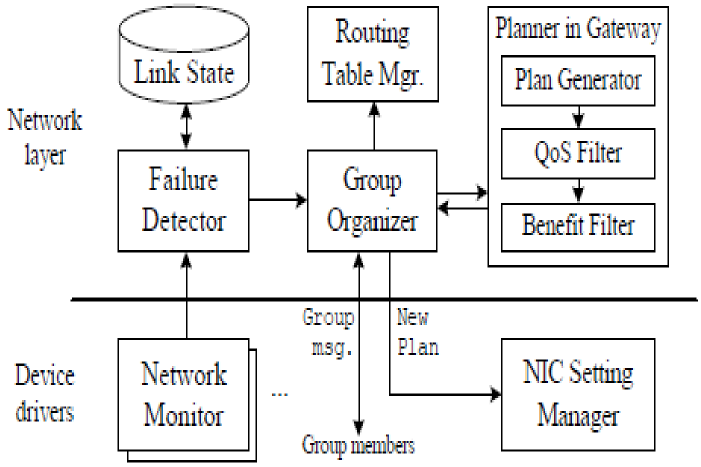
To overcome the above limitations, we propose an *Autogenous Reconfiguration System* (ARS) that allows a multi-radio WMN (mr-WMN) to autonomously reconfigure its local network settings—channel, radio, and route assignment—for real-time recovery from link failures.

In its core, ARS is equipped with a reconfiguration planning algorithm that identifies local configuration changes for the recovery, while minimizing changes of healthy network settings.ARS first searches for feasible local configuration changes available around a faulty area, based on current channel and radio associations. Then, by imposing current network settings as constraints, ARS identifies reconfiguration plans that require the minimum number of changes for the healthy network settings.it detects a long term failures, network –wide planning Algorithems can be Useda hybrid link-quality measurement technique, as we will explain Based on the measurement information, ARS detects link failures and/or generates QoS-aware network reconfiguration plans upon detection of a link failure.ARS has been implemented and evaluated extensively via experimentation on our multi-radio WMN test-bed as well as via ns2-based simulation. Our evaluation results show that ARS outperforms existing failure-recovery methods, such as static or greedy channel assignments, and local re-routing. First, ARS's planning algorithm effectively identifies reconfiguration plans that maximally satisfy the applications' QoS demands, accommodating twice more flows than static assignment. Next, ARS avoids the ripple effect via QoS-aware reconfiguration planning, unlike the greedy approach. Third, ARS's local reconfiguration improves network throughput and channel-efficiency by more than 26% and 92%, respectively,

Advantages

1. Public safety, environment monitoring and city wide wireless internet services
2. Avoid Propagation of Qos failures To Neighbouring Links
3. Provides effective reliability Quality service world widely by recovering from link failures and by providing dynamic Link Quality of Service and also by channel availability.

III ARS Architecture



ARS software architecture in each node

ARS is a distributed system that is easily deployable in IEEE802.11-based mr-WMNs. running in every mesh node; ARS supports self-reconfigurability via the following distinct features:
• *Localized reconfiguration*: Based on multiple channels and radio associations available, ARS generates reconfiguration plans that allow for changes of network configurations only in the vicinity where link failures occurred, while retaining configurations in areas remote from failure locations.
• *QoS-aware planning*: ARS effectively identifies QoS- satisfiable reconfiguration plans by (i) estimating the QoS- satisfiability of generated reconfiguration plans and (ii) deriving their expected benefits in [Type a quote from the document or the summary of an interesting point. You can position the text box anywhere in the document. Use the Text Box Tools tab to change the formatting of the pull quote text box.channel utilization.

ARS Planning Algorithem and Implementation

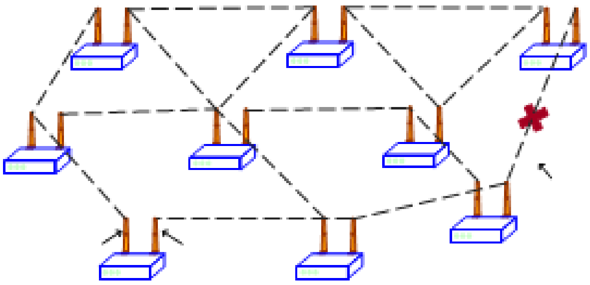
This Algorithm describes the operation of ARS. First, ARS in every mesh node monitors the quality of its outgoing wireless links at every t_m (e.g., 10 sec) and reports the results to a gateway via a management message. Second, once it detects a link failure(s), ARS in the detector node(s) triggers the formation of a group among local mesh routers that use a faulty channel, and one of the group members is elected as a leader using the well-known bully algorithm [29], for coordinating the reconfiguration. Third, the leader node sends a planning-request message to a gateway. Then, the gateway synchronizes the planning requests—if there are multiples requests—and generates a reconfiguration plan for the request. Fourth, the gateway sends a reconfiguration plan to the leader node and the group members. Finally, all nodes in the group execute the corresponding configuration changes, if any, and resolve the group. We assume that during the formation and reconfiguration, all messages are reliably delivered via a routing protocol and per-hop retransmission timer.
ARS Contains the Following Modules

1. **Multi Radio WMN**: A Network is assumed to consist of mesh nodes. IEEE 802.11 based wireless links and one control gateway. Each mesh node is equipped with n radios, and each radios channel and link assignments are initially made by using global channel/link assignment algorithms

2. **Link Failure Detection**: ARS in every mesh node monitors the quality of its outgoing wireless links at every tm and reports the results to a gateway via a management message, second once it detects a link failures, ARS in the detector node triggers the formation of a group among local mesh routers that use a faulty channel, and one of the group members is elected as a leader and coordinating the reconfiguration.

3. **Leader node:** The leader node sends a planning request message to a gateway. If any link is failure group members send request to the particular leader after that the leader node send request to the gateway.

4. **Network Planner**: It generates reconfiguration plans only in a gateway node. Network planner plans the diversity path for avoiding the faulty links .then the gateway synchronizes the planning requests – if there are multiple requests –and generates a reconfiguration plan for the request .fourth the gateway sends a reconfiguration plan to the leader node and the group members. Finally all the nodes in the group execute the corresponding configuration changes if any, and resolve the group



Wireless mesh architecture is quite different from a cellular or wireless LAN architecture. All nodes are equal so there is no centralized control and, therefore, each node must participate in networking as well as be a source or sink of traffic. Rather than a single hop to a base, multi-hopping amongst nodes is a common capability. All this brings the promise of great flexibility, particularly when we wish to create a new network, or expand an existing one.

Wireless mesh architecture is a first step towards providing high bandwidth network over a specific coverage area. Wireless mesh architecture's infrastructure is, in effect, a router network minus the cabling between nodes. It's built of peer radio devices that don't have to be cabled to a wired port like traditional WLAN access points (AP) do. Mesh architecture maintains the signal strength by breaking the long distances into a series of shorter hops. Intermediate nodes not only boost the signal, but cooperatively make forwarding decisions based on their knowledge of the network, i.e. performing routing.

WMNs consist of two types of nodes: mesh routers and mesh clients. Other than the routing capability for gateway repeater functions as in a conventional router, a wireless mesh router contains additional routing functions to support mesh networking. To further improve the flexibility of mesh networking, a mesh router is usually equipped with multiple wireless interfaces built on either the same or different wireless access technologies. Compared with a conventional wireless router, a wireless mesh router can achieve the same coverage with much lower transmission power through multi-hop communications. Optionally MAC: medium access control protocol in a mesh router is enhanced with better scalability in a multi-hop mesh environment.

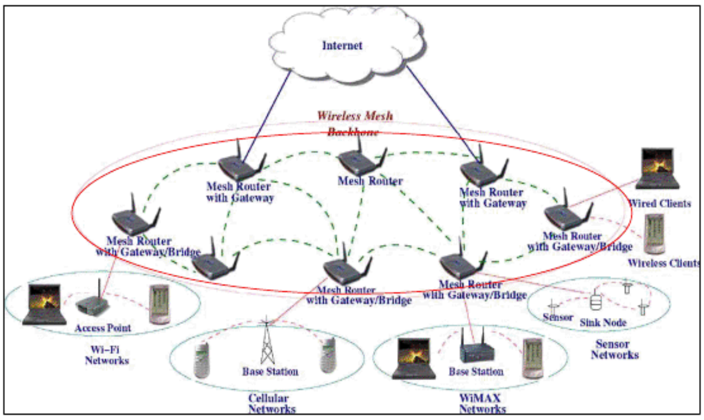
In spite all these differences, mesh and conventional wireless routers are usually built based on a similar hardware platform. Mesh routers can be built based on dedicated computer systems (embedded systems) and look compact. They can also be built on general-purpose computer systems (e.g., laptop, desktop

Pc Mesh clients also have necessary functions for mesh networking, and thus, can also work as a router. However, gateway or bridge functions do not exist in these nodes. In addition mesh clients usually have only one wireless interface. As a consequence, the hardware platform and the software for mesh clients can be much simpler than those for mesh routers. Mesh clients can have a higher variety of devices compared to mesh routers. They can be laptop, desktop PC, pocket PC, PDA, IP phone and many other devices. Many researchers have worked on proposing various architectures that are related to improving coverage and data rates in wireless networks. The architecture of WMNs can be classified into three main groups based on the functionality of nodes:

III. ACCESS/BACKBONE NETWORK

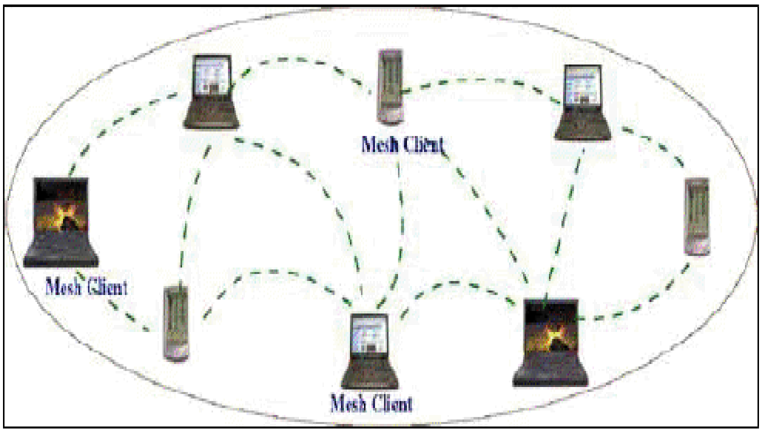
It is a mesh with hierarchy of node types that supports both intra as well as extra mesh traffic. In other words, the overlay routing network also has gateways to other, external networks such as internet. This type of

WMNs includes mesh routers forming an infrastructure for the clients that connect to them. The mesh routers form a mesh of self-configuring, self- healing links among themselves. With gateway functions, mesh routers can be connected to the internet. This approach, also referred to as infrastructure meshing provides backbone for conventional clients and enables integration of WMNs with existing wireless networks, through gateway/bridge functionalities in mesh routers. Conventional clients with Ethernet interface can be connected to mesh routers via Ethernet links. For conventional clients with the same radio technologies as mesh routers, they can directly communicate with the mesh routers. If different radio technologies are used, clients must communicate with the base stations that have Ethernet connections to mesh routers. Access/ backbone WMNs are the most commonly used type. For example, community and neighborhood networks can be built using infrastructure meshing. The mesh routers are placed on the roof tops of houses in a neighborhood, which serve as access points for users inside the homes and along the roads. Typically two types of radios are used in the routers, i.e. for backbone communication and for user communication, respectively. The mesh backbone communication can be established using long range communication techniques such as directional antennas.



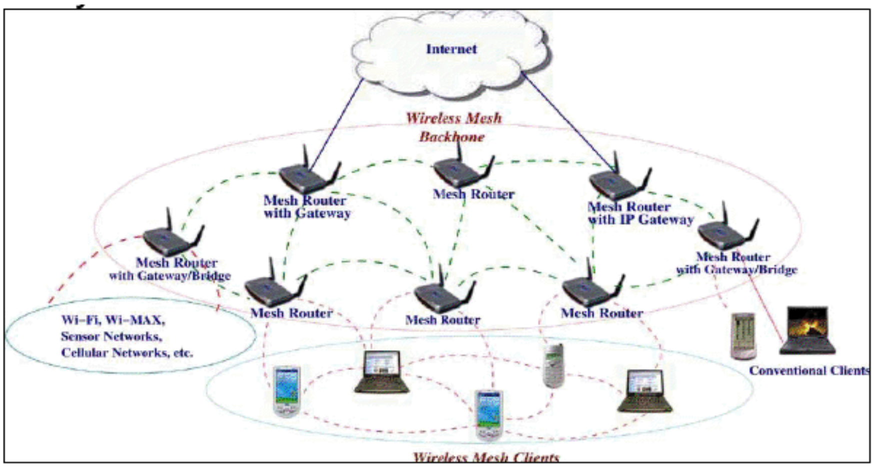
Client/Pure WMNs

All traffic in a pure mesh is intra-mesh, i.e. the mesh is isolated. Client meshing provides peer-to peer networks among client devices. In this type of architecture; client nodes constitute the actual network to perform routing and configuration functionalities as well as providing end-user applications to customers. Hence, a mesh router is not required for these types of networks. In Client WMNs a packet destined to a node in the network hops through multiple nodes to reach the destination. Client WMNs are usually formed using one type of radios on devices. Moreover, the requirements on end- user devices is increased when compared to infrastructure meshing, since, in client WMNs, the end-users must perform additional functions such routing and self-configuration.



Hybrid WMNs

This architecture is the combination of infrastructure and client meshing .Mesh clients can access the network through, mesh routers as well as directly meshing with other mesh clients. While the infrastructure provides connectivity to other networks such as internet, WIFI, Wi MAX, cellular, and sensor networks: the routing capabilities provide improved connectivity and coverage inside the WMN.



Multi hop wireless networks

An objective to develop WMNs is to extend the coverage range of current wireless networks without sacrificing the channel capacity. Another objective is to provide non-line-of-sight (NLOS) connectivity among the users without direct line-of-sight (LOS) links. To meet these requirements, the mesh style multi-hopping is indispensable, which achieves higher throughput without sacrificing effective radio range via shorter link distances, less interference between the nodes, and more efficient frequency re-use.

Support for adhoc -networking, and capability of self-forming, self-healing, self-organization

WMNs enhance network performance, because of flexible network architecture, easy deployment and configuration, fault-tolerance, and mesh-connectivity, i.e., multipoint-to-multipoint communications. Due to these features, WMNs have low upfront investment requirement, and the network can grow gradually as needed.

Mobility dependence on the type of mesh nodes

Mesh routers usually have minimal mobility, mesh- clients can be stationary or mobile nodes.

Multiple types of network access

In WMNs, both backhaul access to the internet and peer-to-peer (P2P) communications are supported. In addition, the integration of WMNs with other wireless networks and providing services to end-users of these networks can be accomplished through WMNs.

Dependence of power- consumption constraints on the type of mesh nodes

Mesh routers usually do not have strict constraints on power consumption. However, mesh clients may require power efficient protocols. As an example, mesh-capable sensor requires its communication protocols to be power efficient. Thus, the MAC or routing protocols optimized for mesh routers may not be appropriate for mesh clients such as sensors, because power efficiency is the primary concern for wireless sensor networks.

Compatibility and interoperability with existing wireless networks

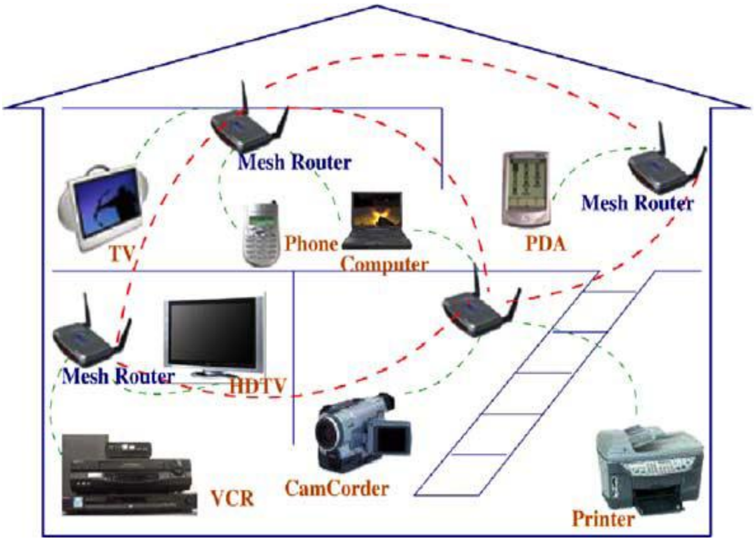
For example, WMNs built based on IEEE 802.11 technologies. It must be compatible with IEEE 802.11 standard in the sense of supporting both mesh-capable and conventional Wi-Fi clients. Such WMNs need to be interoperable with other wireless networks such as Wi-MAX, Zig-Bee, and cellular networks.

Application scenarios

Research and development of WMNs is motivated by several applications which clearly demonstrate the promising market while at the same time these applications cannot be supported directly by other wireless networks such as cellular networks, adhoc networks, wireless sensor networks, standard IEEE 802.11.

Broadband home networking

Currently broadband home networking is realized through IEEE 802.11WLANs.an obvious problem is that of the access points. Without a site survey, a home (even a small one) usually has many dead zones without service coverage. Solutions based on site survey are expensive and not practical for home networking, while installation of multiple access points is also expensive and not convenient because of Ethernet wiring for access points to backhaul network access modem. Moreover communications between end nodes less than two different access points have to go all the way back to the access hub. This is obviously not an efficient solution, especially for broadband networking. Mesh networking can resolve all these issues in home networking. The access points must be replaced by wireless mesh routers with mesh connectivity established among them. Therefore, the communication between these nodes becomes much more flexible and more robust to network faults and link failures. Dead zones can be eliminated by adding mesh routers, changing locations of mesh routers, or automatically adjusting power levels of mesh routers. Communication within home networks can be realized through mesh networking without going back to the access hub all the time. Thus, network congestion due to backhaul access can be avoided. In this application, wireless mesh routers have no constraints on power consumption and mobility. Thus, protocols proposed for mobile adhoc networks and wireless sensor networks are too cumbersome to achieve satisfactory performance in this application. On the other hand, Wi-Fi's are not capable of supporting adhoc- Multihop networking.



WMNs for Broadband Home Networking

Community and neighborhood networking

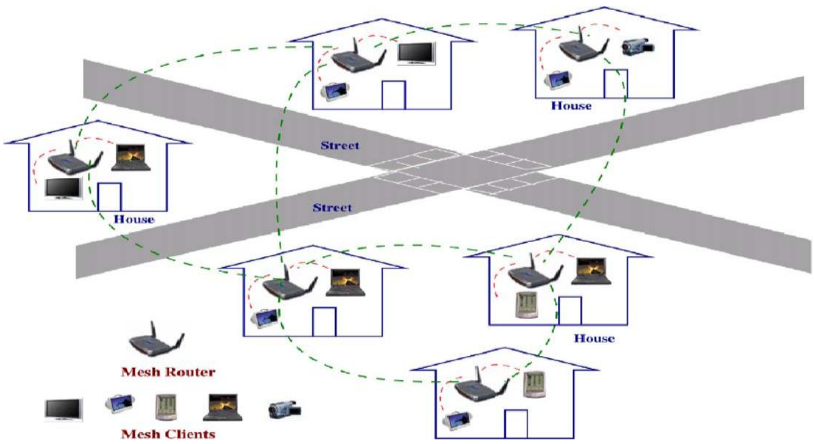
In a community the common architecture for network access is based on cable or DSL connected to the internet, and the last hop is wireless by connecting a wireless router to a cable or DSL modem. This type of network access has several drawbacks:

(1)Even if the information must be shared within a community or neighborhood, all traffic must flow through internet. This significantly reduces network resource utilization.

(2) Large percentage of areas in between houses is not covered by wireless services.

(3) An expensive but high band-width gateway between multiple homes and neighbors may not be shared and wireless services must be set up individually. As a result network service costs may increase.

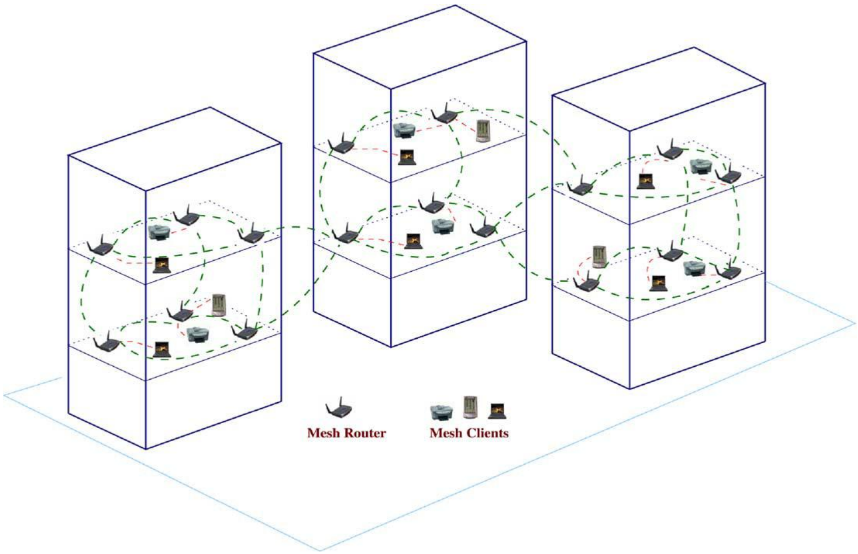
(4) Only a single path may be available for one home to access the internet or communicate with neighbors. WMNs mitigate the above disadvantages through flexible mesh connectivity between homes. WMNs can also enable many applications such as distributed file storage, distributed file access, and video streaming.



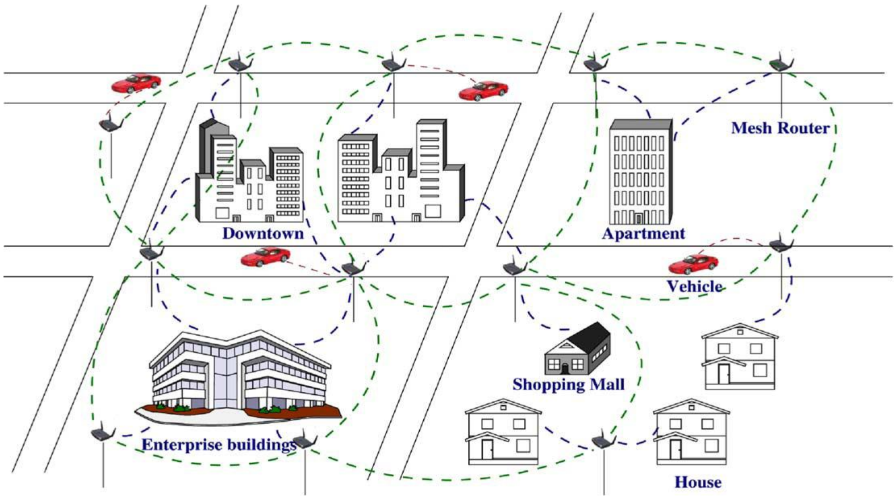
WMNs for Community neighborhood networking

Enterprise networking

This can be a small network within an office or a medium sized network for all offices in an entire building, or a large scale network among offices in multiple buildings. Currently, IEEE 802.11 networks are used widely in various offices. However these networks are still isolated islands. Connections among them have to be achieved through Ethernet connections, which is a key reason for the high cost of enterprise networks. In addition adding more backhaul access modems only increases capacity locally, but does not improve robustness to link failures, network congestion and other problems of the entire enterprise network. If the access points are replaced by mesh routers, Ethernet wires can be eliminated. Multiple backhaul access modems can be shared by all nodes in the entire network, and thus, improve the robustness and resource utilization of enterprise networks. WMNs can grow easily as the size of enterprise expands. WMNs for enterprise networking are much more complicated than at home because more nodes and more complicated network topologies are involved. The service model of enterprise network can be applied to many other public and commercial service networking scenarios such as airports, hotels, shopping malls,



WMNs for enterprise networking



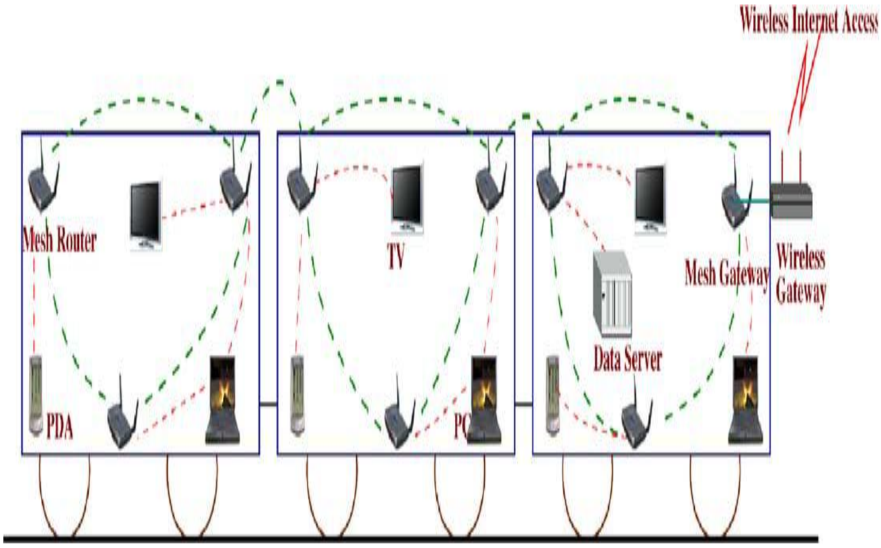
WMNs for metropolitan area networks

Metropolitan area networks

WMNs in metropolitan area have several advantages. The physical layer transmission rate of a node in WMNs is much higher than that in any cellular networks. For example, an IEEE 802.11g node can transmit at a rate of 54%Mbps.moreover; the communication between nodes in WMNs does not rely on a wired backbone. Compared to wired networks, e.g., cable or optic networks, wireless mesh MAN is an economic alternative to broadband networking, especially in underdeveloped regions. Wireless mesh MAN covers potentially a larger area than home, enterprise, building, or community networks. Thus, requirement on the network scalability by wireless mesh MAN is much higher than that by other applications.

Transportation systems

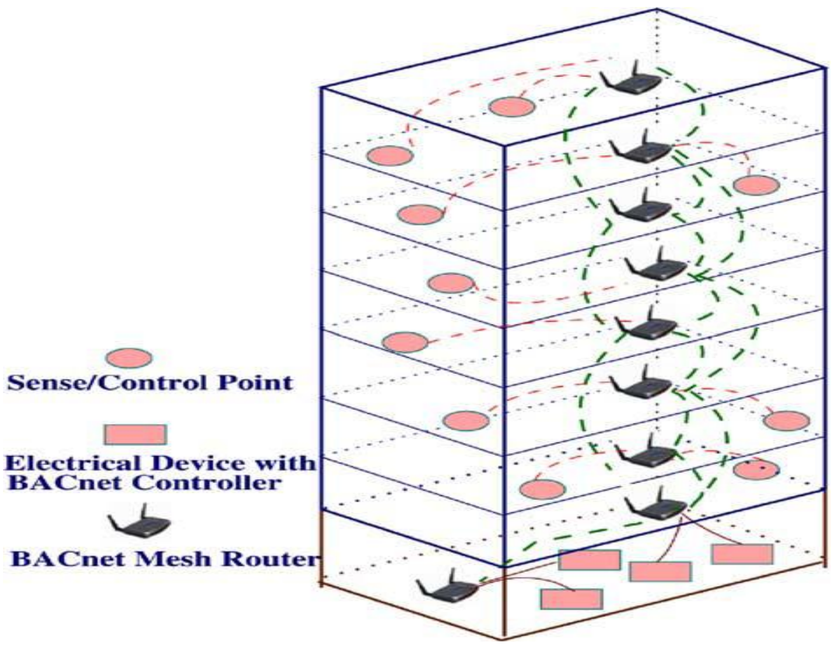
Instead of limiting IEEE 802.11 or 802.16 accesses to stations and stops, mesh networking technology can extend access into buses, ferries, and trains. Thus, convenient passenger information services, remote monitoring of in-vehicle security video and driver communications can be supported. To enable such mesh networking for a transportation system, two key techniques are needed: the high-speed backhaul from a vehicle (car, bus, or train) to the internet and mobile mesh networks within the vehicle.



WMNs for transportation systems

Building Automation

In a building, various electrical devices including power, light, elevator, air conditioner, etc., need to be controlled and monitored. Currently this task is accomplished through standard wired networks, which is very expensive due to the complexity in deployment and maintenance of a wired network. Recently Wi-Fi based networks have been adopted to reduce the cost of such networks. However, this effort has not achieved satisfactory performance yet, because deployment of Wi-Fi's for this application is still rather expensive due to wiring of Ethernet. If BACnet (building automation and control networks) access points are replaced by mesh routers, the deployment cost will be significantly reduced. The deployment process is also much simpler due to mesh connectivity among wireless routers.



WMNs for building automation

Health and Medical systems

In a hospital or medical centre, monitoring and diagnosis data need to be processed and transmitted from one room to another for various purposes. Data transmission is usually broadband, since high resolution medical images and various periodical monitoring information can easily produce a constant and large volume of data.

Traditional wired networks can only provide limited network access to certain fixed medical devices. Wi-Fi based networks must rely on the existence of Ethernet connections, which may cause high system cost and complexity but without the abilities to eliminate dead spots. However, issues do not exist in WMNs.

Security surveillance system

As security is turning out to be very high concern, security surveillance systems become a necessity for enterprise buildings, shopping malls, grocery stores, etc. In order to deploy such systems at locations as needed, and WMNs are much more viable solution than wired networks to connect all devices. Since still images and videos are the major traffic flowing in the network, this application demands much higher network capacity than other applications.

In addition to the above applications, WMNs can also be applied to **Spontaneous (Emergency/disaster) networking and P2P communications.** For example, wireless networks for an emergency response team and fire fighters do not have in advance knowledge of where the network should be deployed. By simply placing wireless mesh routers in desired locations; a WMN can be quickly established. For a group of people holding devices with wireless networking capability, e.g. Laptops and PDAs, P2P communication anytime anywhere is an efficient solution for information sharing. WMNs are able to meet this demand. These applications illustrate that WMNs are a superset of adhoc networks, and thus accomplish all functions provided by adhoc networking.

Scalability

Multi-hop communication is common in WMNs. For Multi hop networking, it is well known that communication protocols suffer from scalability issues, i.e., when the size of the network increases, the network performance degrades significantly. Routing protocols may not be able to find a reliable routing path, transport protocols may lose connections, and MAC protocols may experience significant throughput reduction. As a typical example, current IEEE 802.11 MAC protocol and its derivatives cannot achieve a reasonable throughput as the number of hops increases to 4 or higher. The reason for low scalability is that the end-to-end reliability sharply drops as the scale of the network increases. In WMNs due to its adhoc architecture, the centralized multiple access schemes such as TDMA and CDMA are difficult to implement due to their complexities and a general requirement on timing synchronization for TDMA and CDMA. When a distributed multi-hop network is considered, accurate timing synchronization with the global network is difficult to achieve. Thus, distributed multiple access schemes such as CSMA/CA is more favorable. However, CSMA/CA has very low frequency spatial-reuse efficiency, which significantly limits the scalability of CSMA/CA- based multi-hop networks. To improve the scalability of WMNs, designing a hybrid multiple access schemes with CSMA/CA and TDMA or CDMA is an interesting and challenging research issue.

Mesh connectivity Many advantages of WMNs originate from mesh connectivity which is a critical requirement on protocol design, especially for MAC and routing protocols. Network self-organization and topology control algorithms are generally needed. Topology-aware MAC and routing protocols can significantly improve the performance of WMNs.

Broadband and QoS Different from other adhoc networks, most applications of WMNs are broadband services with various QoS requirements. Thus, in addition to end – to – end transmission delay and fairness, more performance metrics such as delay jitter, aggregate and per-node throughput, and packet loss ratios, must be considered by communication protocols.

Compatibility and Inter-operability It is a desired feature for WMNs to support network access for both conventional and mesh- clients. Thus, WMNs need to be backward compatible with conventional client nodes; otherwise the motivation of deploying WMNs will be significantly compromised. Integration of WMNs with other wireless networks requires certain mesh routers to have the capability of inter-operation among heterogeneous wireless networks.

Security Without a convincing security solution, WMNs will not be able to succeed due to lack of incentives by customers to subscribe to reliable services. Although many security schemes have been proposed for wireless LANs, they are still not ready for WMNs. For instance, there is no centralized trusted authority to distribute a public key in a WMN due to the distributed system architecture. The existing security schemes proposed for adhoc networks can be adopted for WMNs.

Ease of use: Protocols must be designed to enable the network to be as autonomous as possible, in the sense of power management, self-organization, dynamic topology control, robust to temporary link failure, and fast network-subscription/user-authentication procedure. In addition, network management tools need to develop to efficiently maintain the operation, monitor the performance, and configure the parameters of WMNs. These tools together with the autonomous mechanisms in protocols will enable rapid deployment of WMNs.

IV. CONCLUSION

This paper presented an Autogenously Reconfiguration System (ARS) that enables a multi-radio WMN to autonomously recover from wireless link failures. ARS generates an effective reconfiguration plan that requires only local network configuration changes by exploiting channel, radio, and path diversity. Furthermore, ARS effectively identifies reconfiguration plans that satisfy applications' QoS constraints, admitting up to two times more flows than static assignment, through QoS-aware planning. Next, ARS's on-line reconfigurability allows for real-time failure detection and network reconfiguration, thus improving channel-efficiency by 92%. Our experimental evaluation on a Linux-based implementation and *ns2*-based simulation has demonstrated the effectiveness of ARS in recovering from local link-failures and in satisfying applications' diverse QoS demands.

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