Ad hoc networks technologies and protocols pdf

The special network refers to technologies that allow network communication on a special basis. Associated technologies include: Wireless Special Network Mobile Special Network Vehicular ad hoc Network Intelligent Automotive Special Network Protocols related to the special ad hoc network on demand Vector routing Ad Hoc Configuration Protocol Smart phone special network Special wireless distribution service Links - Morteza M. zanjireh; Hadi Larijani (May 2015), WSNs Centralized and Distributed Cluster Routing Algorithms Review, 2015 IEEE 81st Vehicular Technology Conference (VTC Spring), p. 1-6, doi:10.1109/VTCSpring.2015.7145650, ISBN 978-1-4799-8088-8, S2CID 23911051 This article of computer networks is a stub. You can help Wikipedia by expanding it.vte extracted from the Cenciarelli P, Gorla D and Salvo I (2019) Depleted channels, Acta Informatica, 56:5, (405-431), Publish Date online: 1-July-2019. 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Shi J, Salonidis T and Knightly E Hunger Mitigation through multi-channel coordination in CSMA multi-hop wireless networks Proceedings 7th ACM International Symposium on Mobile Special Network and Computing, (214-225) Decentralized Type Wireless Wireless Network Special Network (WANET) or Mobile Special Network (MANET) is a decentralized type of wireless network. The network is special because it does not rely on existing infrastructure, such as wire routers or access points in managed (infrastructure) wireless networks. Instead, each node participates in routing by paraphrasing data for other nodes, so identifying the data forwards is dynamically based on the network connection and routing algorithm in use. The Windows operating system has a special communication mode (setting up) that allows computers to communicate directly with each other without a router. Wireless mobile special networks are self-configuring, dynamic networks in which nodes can move freely. These wireless networks have no infrastructure installation and administration difficulties, allowing devices to build and join networks on the fly. A true MANET by definition requires multi-track routing, not just single-track or broadcast. Each device in MANET can move freely independently in any direction, and therefore often changes its links to other devices. Each of them must transmit traffic that is not related to its own use, and therefore be a router. The main task in creating MANET is to equip each device for the continuous maintenance of the information necessary for the correct route traffic. This becomes more difficult as the scale of MANET increases due to 1) the desire to route packages in/through any other node, 2) the percentage of overhead traffic required to maintain routing status in real time, 3) each site has its own goodput for the independent route and is unaware of other needs, and 4) all must have limited bandwidth, such as a piece of radio frequency spectrum. Such networks can operate on their own or may be connected to a wider Internet. They may contain one or more and different transivers between the nodes. This leads to very dynamic, autonomous topology. MANETs usually have a routed network environment on top of a special Link Layer network. MANETs consist of a peer-to-peer, self-forming, self-healing network. MANETs around 2000-2015 usually communicate on radio frequencies (30 MHz - 5 GHz). Story on Stanford Radio Package Institute Package Radio Wang, the site of the first three-way internet transmission. Initial large-scale trials of short-term digital radio, February 1998. The earliest wireless data network was called PRNET, a package radio network, a radio network, was sponsored by the Defense Advanced Research Projects Agency (DARPA) in the early 1970s. Bolt, Beranek and Newman Inc (BBN) and SRI International designed, built and experimented with these early systems. The experimenters were Robert Kahn, Jerry Burchfiel and Ray Tomlinson. Similar experiments were conducted in amateur radiossemen with the protocol x25. These early batch radio systems preceded the Internet, and were indeed part of the motivation behind the original Internet Protocol package. DarPA experiments later included the Survivable Radio Network (SURAN) project, which took place in the 1980s. The successor to these systems was on the ground in the mid-1990s for the U.S. Army, and then other countries, as a short-term digital radio. Another third wave of research began in the mid-1990s with the advent of low-cost radio cards 802.11 for personal computers. Modern wireless special networks are designed primarily for military utility. Problems with radio packages: (1) cumbersome elements, (2) slow data speeds, (3) unable to maintain links if mobility is high. The project didn't go much further until the early 1990s, when wireless special networks were born. Early work on MANET Growth Laptops and 802.11/Wi-Fi wireless networks have made MANETs a popular research topic since the mid-1990s. Many scientific papers evaluate protocols and their abilities, suggesting varying degrees of mobility within a limited space, usually with all nodes within a few transitions from each other. The various protocols are then evaluated on the basis of measures such as packet rate rate, overheads, routing protocol, end-to-end package delays, network bandwidth, scalability, etc. Perkins worked on a dynamic problem-solving. Toh worked on a new routing protocol, which was known as ABR - associative routing. Perkins eventually proposed the DSDV - a routing of the destination sequence vector that was based on the routing of the distributed distance vector. Toh's proposal was routed on demand, i.e. routes are detected on the fly in real time as needed. ABR was introduced by IETF as RFCs. ABR was successfully implemented in Linux OS on Lucent WaveLAN 802.11a-enabled laptops, and therefore a practical special mobile network was proven. Another routing protocol, known as AODV, was subsequently introduced and then proven and implemented in 2005. In 2007, David Johnson and Dave Maltz proposed DSR, a dynamic source routing. Applications Decentralized nature of wireless special networks suitable for a variety of applications where central nodes can't rely and can improve network scalability compared to wireless, managed networks, the theoretical and practical limits of the overall potential of such networks have been defined. The minimal configuration and rapid deployment make special networks suitable for emergencies such as natural disasters or military conflicts. The presence of dynamic and adaptive routing protocols allows you to quickly form special networks. Wireless special networks can be further classified by their applications: Mobile Special Networks (MANETs) Mobile Special Network (MANET) is continuously self-configuring, self-organizing, infrastructure less than 22 network of mobile devices connected without wires. Sometimes it is known as on-the-fly networks or spontaneous networks. VANETs vaneTs are used to connect vehicles and roadside equipment. Intelligent Automotive Special Networks (InVANETs) are a kind of artificial intelligence that helps vehicles behave intelligently during collisions of vehicles with vehicles, accidents. Vehicles use radio waves to communicate with each other, creating communication networks instantly on the fly while vehicles move on the roads. Smartphone Special Networks (SPANs) SPAN uses existing hardware (primarily Wi-Fi and Bluetooth) and software (protocols) in commercially available smartphones to create peer-to-peer networks without relying on carrier cellular networks, wireless hotspots, or traditional network infrastructure. SPANs differ from traditional hubs and networks such as Wi-Fi Direct in that they support multi-hop relays and no notion of a group leader so that peers can join and leave of their choice without destroying the network. More recently, Apple's iPhone with version 8.4 iOS and above have been incorporated with a multi-tier special network, in iPhones, allowing millions of smartphones to create special networks without relying on cellular communication. It is said that this will change the world. iMANETs Internet Mobile Special Networks (iMANETs) is a type of wireless special network that supports Internet protocols such as TCP/UDP and IP. The network uses network level routing protocol to connect mobile nodes and create routes distributedly and automatically. Wireless Grid Networks Home article: Wireless Grid Network Network Networks take its name from topology as a result of the network. In a fully connected grid, each node is connected to each other, forming a grid. The partial grid, on the other hand, has a topology in which some nodes are not related to others, although the term is rarely used. Wireless special networks can take the form of grid networks or others. Wireless special network does not have a fixed topology, and its connection between nodes completely depends on the behavior of devices, their models of mobility, distance each Thus, wireless grid networks are a certain type of wireless special networks, with a particular focus on topology of the network. While some wireless grid networks (especially inside the home) have relatively infrequent mobility and therefore rare link breaks, other, more mobile grid networks require frequent routing adjustments to account for lost links. Army Tactical MANETs Military or Tactical MANETs are used by military units with a focus on data speed, real-time requirements, rapid redirection during mobility, data security, radio range, and integration with existing systems. Common radio wave forms include the U.S. Army's JTRS SRW and the waveRelay system. Special mobile communications works well to meet this need, especially without infrastructure, rapid deployment and operation. Military MANETs are used by military units with a focus on rapid deployment, without infrastructure, all wireless networks (without fixed radios), reliability (communication breaks are not a problem), security, range, and instantaneous operation. MANET can be used in army jumping mines, in platoons, where soldiers communicate in foreign terrain, giving them superiority on the battlefield. Tactical MANETs can be formed automatically during a mission and the network disappears when the mission is finished or decommissioned. It is sometimes referred to as a on the fly wireless tactical network. The Air Force's Special Networks (FANETs) unmanned aerial vehicles are made up of unmanned aerial vehicles that provide greater mobility and communicate with remote areas. An unmanned aerial vehicle, it's a plane with no pilot on board. Unmanned aerial vehicles can be controlled remotely (i.e. fly by pilot at a ground control station) or can fly autonomously based on programmed flight plans. Civilian use of UAVs includes 3D terrain modeling, parcel delivery (Amazon), etc., UAVs were also used by the U.S. Air Force to collect data and probe the situation without risking the pilot in an unfriendly environment. With wireless special network technology built into the UAV, multiple UAVs can communicate with each other and work as a team to complete the task and mission. If the UAV is destroyed by the enemy, its data can be quickly unloaded wirelessly to other neighboring UAVs. The UAV's special communications network is also sometimes referred to as the IN kind of UAV sky network. U.S. Navy ships have traditionally used satellite communications and other marine radio stations to communicate with each other or with a land-based ground station. However, such links are limited by delays and limited bandwidth. Wireless special networks enable ship networks to be built at sea, providing high-speed wireless communications between ships, enhancing image and multimedia data sharing, and increasing combat coordination. Some defense companies like Rockwell Collins and Rohde and Schwartz) released production, which improves the communication between ships and ships. Wireless Touch Networks Sensors Are Useful Devices Devices To collect information related to a particular parameter, such as noise, temperature, humidity, pressure, etc., sensors are increasingly connected via wireless communication, allowing large-scale collection of sensor data. With a large sample of sensor data, analytics processing can be used to make sense of this data. Connecting wireless touch networks relies on the principles underlying wireless special networks, as sensors can now be deployed without any stationary radios, and they can now form networks on the fly. Smart Dust was one of the first projects implemented at U C Berkeley, where tiny radios were used to connect smart dust. Recently, mobile wireless touch networks (MWSNs) have also become an area of academic interest. Ad hoc home smart lighting SigBi is a low power-shaped wireless special network that is now finding its way into home automation. Its low power consumption, reliability and extended range inherent in grid networks can deliver several benefits to smart lighting in homes and offices. Management includes the adjustment of blacked-out lights, colored lights, as well as colors or scenes. Networks allow you to control a set or subset of lights through a smartphone or computer. The home automation market will exceed $16 billion by 2019. Special street lighting networks Wireless special smart network street lighting begin to develop. The concept is to use wireless control of urban street lights to improve energy efficiency as part of the architectural features of a smart city. Several street lights form a wireless special network. One gateway device can control up to 500 street lights. Using the device's gateway, you can turn on individual ON lights, off or dim them, and find out which individual light is faulty and needs maintenance. Robots' special network of robots are mechanical systems that control automation and perform responsibilities that seem difficult for humans. Efforts are being made to coordinate and control a group of robots to work together to achieve the task at hand. Centralized control is often based on a star approach, where robots take turns talking to a control station. However, with the help of wireless special networks, robots can form a communication network on the fly, i.e. robots can now talk to each other and collaborate in a distributed manner. With the help of a network of robots, robots can communicate with each other, share local information, and solve the problem in the most efficient and efficient way possible. Disaster Rescue Special Network Another civilian use of wireless special public safety network. During disasters (floods, storms, earthquakes, fires, etc.) need a fast and instant wireless connection. Especially in times of earthquakes, when radio towers have collapsed or have been destroyed, wireless special networks can be formed independently. Firefighters and rescue workers can use special networks to communicate and rescue the wounded. Wounded. radio connections with such features are available on the market. The hospital's ad hoc network Wireless special networks allow sensors, videos, tools and other devices to be deployed and interconnected wirelessly for clinic and hospital patient monitoring, doctor and nurse alert notifications, as well as make sense of such data quickly at fusion points so that life can be saved. Data monitoring and mining OFETS can be used to facilitate the collection of sensor data to collect data for various applications such as air pollution monitoring and the different types of architectures that can be used for such applications. A key characteristic of such applications is that nearby sensor nodes, while tracking an environmental function, typically register similar values. This redundancy of data due to the spatial correlation between sensor observations inspires methods of aggregation and data mining in the network. By measuring spatial correlation between data selected by different sensors, a wide range of specialized algorithms can be developed to develop more efficient spatial data analysis algorithms, as well as more efficient routing strategies. In addition, researchers developed performance models for MANET to apply queue theory. Problems with multiple books and works have identified technical and research problems faced by wireless special networks or MANETs. The benefits to users, the technical difficulties in implementation, and the side effect on radio frequency spectrum pollution can be summarized below: The benefits for users The obvious appeal of MANETs is that that the network is decentralized and the nodes/devices are mobile, that is, there is no fixed infrastructure that provides the possibility for numerous applications in various fields, such as environmental monitoring, Since the early 2000s interest in MANET has increased significantly, partly because mobility can increase network bandwidth, as evidenced by grossiser and Jie data along with the introduction of new technologies. One of the main advantages of a decentralized network is that they tend to be more reliable than centralized networks because of the multi-hop fashion in which information is transmitted. For example, in cellular network settings, coverage drops if the base station stops working, but the probability of a single manet failure point is significantly reduced because the data can take multiple paths. As the MANET architecture evolves over time, it can solve problems such as insulation/disconnection from the network. The additional benefits of MANETS to fixed-topology networks include flexibility (a dedicated network can be created anywhere with mobile devices), scalability (you can easily add more nodes to the network) and reduction administration (there is no need to build infrastructure in the first place). Summing up: High compliance No expensive infrastructure should be installed fast distribution of information around the sender No one point of failure. Multi-hop scalability Implementation Difficulty With Time Developing Network is clear that we should expect a change in network performance due to non-fixed architecture (no fixed connections). In addition, since the topology of the network detects interference and therefore connectivity, the mobility structure of devices on the network will affect network performance, which may cause the data to be resented many times (increased latency) and finally the distribution of network resources such as power remains unclear. Finally, finding a model that accurately represents human mobility while remaining mathematically compliant remains an open problem because of the wide range of factors that influence it. Some typical models include casual walking, casual flight patterns and taxation. Thus, all network entities can be mobile, so a very dynamic topology is needed. Network functions should be highly adaptive. There are no central entities, so operations must be managed in a fully distributed manner. Battery Limits Side Effects Use of unlicensed frequency spectrum, contributing to radio frequency spectrum contamination. Radio-receivers and modulation Wireless special networks can work on different types of radio stations. All radio stations use modulation to move information through a specific radio frequency bandwidth. Given the need to move large amounts of information over long distances quickly, the MANET radio channel ideally has greater bandwidth (e.g. radio frequency spectrum), lower frequencies and higher power. Given the desire to communicate with many other sites perfectly at the same time, many channels are needed. Given the radio frequency spectrum is common and regulated, there is less bandwidth available at lower frequencies. Processing many radio channels requires a lot of resources. Given the need for mobility, smaller sizes and lower energy consumption are very important. The choice of MANET radio and modulation has many trade-offs; many of them start with a certain frequency and bandwidth they can use. Radio can be UHF (300 - 3000 MHz), SHF (3 - 30 GHz), and EHF (30 - 300 GHz). Wi-Fi ad hoc uses unlicensed ISM 2.4 GHz radios. The higher the frequency, for example, 300 GHz, the absorption of the signal will be more dominant. Army tactical radio stations typically use a variety of UHF and SHF radio stations, including VHF to provide different communication modes. In the range of 800, 900, 1200, 1800 MHz are dominated by cellular radio stations. Some cellular radio stations use special communication to expand cellular communications in areas and devices that cannot be reached by a cellular base station. Next-generation Wi-Fi, known as 802.11ax provides low latency, high capacity (up to 10 Gbps) and low packet loss rate, offering 12 streams - 8 streams at 5 GHz and 4 streams at 2.4 GHz. IEEE 802.11ax uses 8x8 8x8 OFDMA, and 80 MHz channels. Thus, 802.11ax has the ability to form a high capacity wi-fi special networks. At 60 GHz, there is another form of Wi-Fi known as WiGi - wireless gigabit. This has the ability to offer up to 7Gbit/s bandwidth. WiGi is currently designed to work with 5G cellular networks. Around 2020, the general consensus is that the best modulation for moving information on higher-frequency waves will be Orthogonal_frequency-division_multiplexing, as used in 4G LTE, 5G and Wi-Fi. The Protocol Stack Problems affecting MANETs cover from different layers of the OSI protocol stack. The level of access to the media (MAC) should be improved to address the collisions and hidden problems of the terminal. The network layer routing protocol needs to be improved to address dynamically changing network topology and broken routes. The transport layer protocol should be improved to handle lost or broken connections. The session-level protocol should be about detecting servers and services. The main limitation with mobile nodes is that they have high mobility, resulting in links often broken down and restored. In addition, the bandwidth of the wireless channel is also limited, and the nodes run on a limited battery power, which will eventually be exhausted. These factors make the development of a mobile special network a challenge. The cross-layer design deviates from the traditional approach to network design, in which each layer of the stack will be performed independently. The modified power of the transmission will help this node dynamically change the range of its distribution on the physical layer. This is because the distance of distribution is always directly proportional to the transmission power. This information is passed from the physical layer to the network layer so that it can make optimal decisions in routing protocols. The main advantage of this protocol is that it allows access to information between the physical layer and the top layers (MAC and the network layer). Some elements of the software stack were designed to update the code on the spot, i.e. with nodes built into their physical environment and without having to return nodes to the lab. This software update relied on an epidemic way of disseminating information and had to be done both efficiently (multiple network broadcasts) and quickly. Routing in wireless special networks or MANETs is usually connected to three categories, namely (a) proactive routing, b) routing response and (c) hybrid routing. Proactive routing This type of protocol supports fresh lists of destinations and their routes, periodically distributing routing tables throughout the network. The main drawbacks of such algorithms are: The corresponding amount of data for Slow response to restructuring and failure. Example: Optimized Communication State Routing Protocol (OLSR) Routing distance vector As in corrected clean nodes support routing tables. Remote vector protocols are based on the calculation of the direction direction distance to any link on the network. The direction usually means the following hop address and exit interface. Distance is a measure of the cost to reach a particular node. The least expensive route between any two nodes is a route with a minimum distance. Each node supports the vector (table) of a minimum distance to each node. The cost of reaching your destination is calculated using different route metrics. RIP uses the number of destination conversions, while IGRP takes into account other information, such as site latency and available bandwidth. Jet routed This type of protocol finds a route based on user demand and traffic by flooding the network with Route Request or Discovery packages. The main drawbacks of such algorithms are: the time of high delay in finding a route. Excessive flooding can cause network clogging. However, clustering can be used to limit flooding. The delay incurred during the route detection is not significant compared to periodic exchanges of route updates by all nodes on the network. Example: Ad hoc On-Demand Distance Vector Routing (AODV) Flooding is a simple routing algorithm in which each incoming package is sent through all the outgoing links, in addition to where it has arrived. Flooding is used in systems such as Usenet and peer-to-peer file sharing, as well as in some routing protocols, including OSPF, DVMRP, and those used in wireless special networks. Hybrid routing This type of protocol combines the benefits of proactive and reactive routing. Routing is first set with some pre-emptively-looking routes, and then serves the demand from additionally activated nodes through reactive flooding. Choosing a method requires predestination for typical cases. The main drawbacks of such algorithms are: The advantage depends on the number of other activated nodes. The response to traffic demand depends on the gradient of traffic. Example: The Position-based zoning protocol uses information about the exact location of the nodes. This information is obtained, for example, through a GPS receiver. Based on the exact location, you can determine the best path between the original nodes and the destination nodes. Example: Location routing in mobile special networks (LAR) Technical requirements for the implementation of the Special Network consists of several nodes connected to links. Links are influenced by the site's resources (e.g. transmitter power, computing power, and memory) and behavioral properties (such as reliability), as well as communication properties (e.g. communication length and signal loss, interference, and noise). Since links can be connected or disabled at any time, a functioning network should be able to handle this dynamic preferably timely, efficient, reliable, reliable and scalable. The network should allow any two nodes to communicate by transmitting information through other nodes. A path is a series of links connecting two nodes. Various Different Methods use one or two paths between any two nodes. Flooding methods use all or most of the available paths. The main medium access management article: Media access management In most wireless special networks, nodes compete for access to the overall wireless environment, often leading to collisions (interference). Collisions can be handled through central planning or distributed access protocols. The use of a joint wireless connection increases the immunity to interference, while the destination node combines self-conference and other interference from the node to improve the decoding of desired signals. Software reprogramming large-scale special wireless networks can be deployed for long periods of time. During this time, requirements may change from the network or environment in which the nodes are deployed. This may require changing the app by performing on the sensor nodes, or giving the app a different set of options. It can be very difficult to manually reprogram nodes because of the scale (perhaps hundreds of nodes) and the built-in nature of the deployment, since the nodes can be located in places that are difficult to access physically. Therefore, the most relevant form of reprogramming is remote multi-shop reprogramming using a wireless environment that reprograms nodes as they are built into their sensing environment. Specialized protocols have been developed for built-in nodes that minimize process energy consumption, and reach the entire network with a high probability in the shortest possible time. Modeling One of the key challenges in wireless special networks is predicting the various possible situations that may arise. As a result, modeling and modeling (MHS) using extensive radical parameters and that if analysis becomes an extremely important paradigm for use in special networks. One solution is to use modeling tools such as OPNET, NetSim or ns2. A comparative study of various simulators for VANETs shows that factors such as limited road topology, multi-road withering and roadside obstacles, traffic patterns, travel patterns, different speed and mobility, traffic lights, traffic congestion, driver behavior, etc., should be taken into account in the simulation process to reflect realistic conditions. In 2009, the U.S. Army Research Laboratory (ARL) and the Naval Research Laboratory (NRL) developed the Mobile Ad-Hoc Network test site, where algorithms and applications were subjected to representative wireless network conditions. The test site was based on a version of the MANE (Mobile Ad hoc Network Emulator) software originally developed by the NRL. ARL, NRL and Consulting - Engineering Next Networks (CENGN) later expanded the original test site to form eMANE, which provided a system capable of modeling network systems with complex, heterogeneous connections (i.e., multiple, different radio interfaces). [71] [71] The traditional model is a random geometric graph. Early work included modeling special mobile networks on rare and tightly connected topology. The nodes, first, are randomly dispersed in a confined physical space. Each node then has a predetermined fixed cell size (radio agent). It is reported that the node is connected to another node if the neighbor is within the radio range. The nodes are then moved (migrate) based on a random model, using a random walk or brourian movement. Different mobility and number of nodes give different lengths of route and, therefore, different number of multi-hams. A randomly constructed geometric graph drawn inside the square, these are graphs consisting of a set of nodes arranged in accordance with the point process in some usually limited subset of the n-dimensional plane, mutually connected according to the function of the mass probability of the bulls of their spatial separation (see, for example, the diagrams of the disk unit). Connections between nodes may have different weights to simulate the difference in channel intensity. You can then study networked observed data (such as connection, central role, or degree distribution) from the grapho theorist. You can further examine network protocols and algorithms to improve bandwidth and network fairness. Wireless special Security Most networks do not exercise any network access control, leaving these networks vulnerable to resource consumption attacks when a malicious node enters packages into the network to deplete the resources of the nodes that relay packages. To prevent or prevent such attacks, authentication mechanisms had to be used to ensure that only authorized nodes could enter traffic into the network. Even when authenticated, these networks are vulnerable to reset or delay packet attacks, resulting in the intermediate node dropping or delaying the package, rather than sending it quickly to the next transition. In a multi-tissue and dynamic environment, creating temporary 1:1 secure sessions using PKI with each other node is not possible (as is done with HTTPS, most VPNs, etc. on the transport layer). Instead, a common solution is to use pre-shared keys for symmetrical, authenticated encryption at the link level, such as MACsec using AES-256-GCM. With this method, each properly formatted package received, authenticated and then transferred for decryption or noting. This also means that the key (s) in each node must be changed more frequently and simultaneously (for example, to avoid reusing IV). The creation and management of trust management in MANETs faces challenges due to lack of resources and complex network interdependence. Managing trust in MANET should take into account the interaction between cognitive, social, information and communication networks and take into account resource constraints (e.g. computing power, energy, bandwidth, time) and dynamics (e.g. topology changes, node mobility, node failure, node, Channel conditions). Researchers at MANET have suggested that such complex interactions require a composite trust metric that reflects aspects of communications and social networks, as well as appropriate measurements of trust, trust distribution and trust management schemes. Continuous monitoring of each site within manet is necessary for trust and reliability, but is difficult because it is by definition continuous, 2) it requires input from the node itself and 3) from its closest peers. See also AmbientTalk, an experimental programming language for MANETs Backpressure routing cross-layer interaction and displaying services Delayed-tolerant Network Independent Basic Services (IBSS) List of Special Protocols Routing Mobile Wireless Touch Network Personal Network (PAN) Smart Meter Wi-Fi Direct Wireless Network Wireless Sensor Wireless Network Wireless Sensor Links - Toh, C. Wireless ATM - Special Networks, 1997, Kluwer Academic Press. ISBN 9780792398226. a b Chai Keong Toh Ad Hoc Mobile Wireless Networks, Prentice Hall Publishers, 2002. ISBN 978-0-13-007817-9 - b c. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks: Architectures and Protocols, Prentice Hall PTR, May 2004. ISBN 978-0-13-300706-0 - Wireless ATMs and special networks. Kluwer Academic Press. 1997. ISBN 9780792398226. Morteza M. zanjire; Hadi Larijani (May 2015). Overview of centralized and distributed cluster routing algorithms for the WSNs. IEEE 81 automotive technology conference: VTC2015-Spring. 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