Mobile ad hoc network

From Wikipedia, the free encyclopedia

A **mobile ad hoc network** (**MANET**), also known as **wireless ad hoc network**[1] or **ad hoc wireless network**, is a continuously self-configuring, infrastructure-less network of mobile devices connected wirelessly.[2][3]

Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic.[4] Such networks may operate by themselves or may be connected to the larger Internet. They may contain one or multiple and different transceivers between nodes. This results in a highly dynamic, autonomous topology.[4]

MANETs are a kind of wireless ad hoc network (WANET) that usually has a routable networking environment on top of a Link Layer ad hoc network. MANETs consist of a peer-to-peer, self-forming, self-healing network. MANETs circa 2000–2015 typically communicate at radio frequencies (30 MHz – 5 GHz).

The growth of laptops and 802.11/Wi-Fi wireless networking have made MANETs a popular research topic since the mid-1990s. Many academic papers evaluate protocols and their abilities, assuming varying degrees of mobility within a bounded space, usually with all nodes within a few hops of each other. Different protocols are then evaluated based on measures such as the packet drop rate, the overhead introduced by the routing protocol, end-to-end packet delays, network throughput, ability to scale, etc.

Contents

Types

- Vehicular ad hoc networks[5] (VANETs) are used for communication between vehicles and roadside equipment. Intelligent vehicular ad hoc networks (InVANETs) are a kind of artificial intelligence that helps vehicles to behave in intelligent manners during vehicle-to-vehicle collisions, accidents.
- Smart phone ad hoc networks (SPANs) leverage the existing hardware (primarily Bluetooth and Wi-Fi) in

commercially available smart phones to create peer-to-peer networks without relying on cellular carrier networks, wireless access points, or traditional network infrastructure. SPANs differ from traditional hub and spoke networks, such as Wi-Fi Direct, in that they support multi-hop relays and there is no notion of a group leader so peers can join and leave at will without destroying the network.

- Internet-based mobile ad-hoc networks (iMANETs) is a type of wireless ad hoc network that supports Internet protocols such as TCP/UDP and IP. The network uses a network-layer routing protocol to link mobile nodes and establish routes distributedly and automatically.
- Hub-Spoke MANET – Multiple sub-MANETs may be connected in a classic Hub-Spoke VPN to create a geographically distributed MANET. In such type of networks normal ad hoc routing algorithms does not apply directly. One implementation of this is Persistent System's CloudRelay (http://www.persistentsystems.com/persistent-systems-cloud-relay/).
- Military or tactical MANETs are used by military units with emphasis on data rate, real-time requirement, fast re-routing during mobility, data security, radio range, and integration with existing systems.[6] Common radio waveforms include the US Army's JTRS SRW.
- Flying ad hoc networks (FANETs) are composed of unmanned aerial vehicle, allowing great mobility and providing connectivity to remote areas.[7]

Advantages and disadvantages in wireless communication networks

The obvious appeal of MANETs is that the network is decentralised and nodes/devices are mobile, that is to say there is no fixed infrastructure which provide the possibility for numerous applications in different areas such as environmental monitoring [1], [2], disaster relief [3]–[5] and military communications [3]. Since the early 2000s interest in MANETs has greatly increased which, in part, is due to the fact mobility can improve network capacity, shown by Grossglauser and Tse[8] along with the introduction of new technologies.

One main advantage to a decentralised network is that they are typically more robust than centralised networks due to the multi-hop fashion in which information is relayed. For example, in the cellular network setting, a drop in coverage occurs if a base station stops working, however the chance of a single point of failure in a MANET is reduced significantly since the data can take multiple paths. Since the MANET architecture evolves with time it has the potential to resolve issues such as isolation/disconnection from the network. Further advantages of MANETS over networks with a fixed topology include flexibility (an ad hoc network can be created anywhere with mobile devices), scalability (you can easily add more nodes to the network) and lower administration costs (no need to build an infrastructure first).[9][10]

With these positives follow some obvious draw backs in network performance. With a time evolving network it is clear we should expect variations in network performance due to no fixed architecture (no fixed connections). Furthermore, since network topology determines interference and thus connectivity, the mobility pattern of devices within the network will impact on network performance,[8] possibly resulting in data having to be resent a lot of times (increased delay) and finally allocation of network resources such as power remains unclear. Finally, finding a model that accurately represents human mobility whilst remaining mathematically tractable remains an open problem due to the large range of factors that influence it.[11] Some typical models used include the random walk, random waypoint and levy flight models.[12][13] [14][15]

Applications

Mobile ad hoc networks can be used in many applications, ranging from sensors for environment, vehicular ad hoc communications, road safety, health, home, peer-to-peer messaging, disaster rescue operations, air/land/navy defense, weapons, robots, etc. See the application section in wireless ad hoc networks.

Simulations

There are several ways to study MANETs. One solution is the use of simulation tools like OPNET, NetSim, NS2, OMNeT++ and NS3. A comparative study[16] of various simulators for VANETs reveal that factors such as constrained road topology, multi-path fading and roadside obstacles, traffic flow models, trip models, varying vehicular speed and mobility, traffic lights, traffic congestion, drivers' behavior, etc., have to be taken into consideration in the simulation process to reflect realistic conditions.

Data monitoring and mining

MANETS can be used for facilitating the collection of sensor data for data mining for a variety of applications such as air pollution monitoring and different types of architectures can be used for such applications.[17] It should be noted that a key characteristic of such applications is that nearby sensor nodes monitoring an environmental feature typically register similar values. This kind of data redundancy due to the spatial correlation between sensor observations inspires the techniques for in-network data aggregation and mining. By measuring the spatial correlation between data sampled by different sensors, a wide class of specialized algorithms can be developed to develop more efficient spatial data mining algorithms as well as more efficient routing strategies.[18] Also, researchers have developed performance models[19][20] for MANET to apply queueing theory.

See also

- AmbientTalk, an experimental programming language for MANETs
- Backpressure routing
- Delay-tolerant networking
- List of ad hoc routing protocols
- Mobile wireless sensor network
- Smart meter
- Wireless community network
- Wireless mesh network
- Wireless sensor networks

References

1. "Wireless ATM & Ad Hoc Networks" (https://books.google.com/books/about/Wireless_ATM_and_Ad_Hoc_Networks.html?id=0hMfAQAAIAAJ&redir_esc=y&hl=en). Kluwer Academic Press. 1997.
2. Morteza M. Zanjireh; Hadi Larijani (May 2015). *A Survey on Centralised and Distributed Clustering Routing Algorithms for WSNs* (https://www.researchgate.net/profile/Morteza_Mohammadi_Zanjireh/publi

cation/274638337_A_Survey_on_Centralised_and_Distributed_Clustering_Routing_Algorithms_for_WSNs/links/552444b80cf2b123c5173968/A-Survey-on-Centralised-and-Distributed-Clustering-Routing-Algorithms-for-WSNs.pdf) (PDF). Conference: IEEE 81st Vehicular Technology Conference: VTC2015-Spring. Glasgow, Scotland. pp. 1–6. doi:10.1109/VTCSpring.2015.7145650 (https://doi.org/10.1109%2FVTCSpring.2015.7145650).

3. Chai Keong Toh (2002). "Ad Hoc Mobile Wireless Networks: Protocols and Systems 1st Edition" (https://www.amazon.com/Hoc-Mobile-Wireless-Networks-Protocols/dp/0130078174). *Prentice Hall PTR*. Retrieved 2016-04-20.
4. Zanjireh, M. M.; Shahrabi, A.; Larijani, H. (1 March 2013). "ANCH: A New Clustering Algorithm for Wireless Sensor Networks" (https://www.researchgate.net/publication/257373717_ANCH_A_New_Clustering_Algorithm_for_Wireless_Sensor_Networks): 450–455. doi:10.1109/WAINA.2013.242 (https://doi.org/10.1109%2FWAINA.2013.242).
5. Martinez; Toh; Cano; Calafate; Manzoni (2010). "Emergency Services in Future Intelligent Transportation Systems Based on Vehicular Communication Networks" (http://ieeexplore.ieee.org/document/5609617/). *IEEE Intelligent Transportation Systems Magazine*.
6. Toh; Lee; Ramos (2002). "Next Generation Tactical Ad Hoc Mobile Wireless Networks" (https://www.researchgate.net/publication/228887934_Next-Generation_Tactical_Ad_Hoc_Mobile_Wireless_Networks). *TRW Systems Technology Journal*.
7. Antonio Guillen-Perez; Ramon Sanchez-Iborra; Maria-Dolores Cano; Juan Carlos Sanchez-Aarnoutse; Joan Garcia-Haro (2016). "WiFi networks on drones" (https://doi.org/10.1109/ITU-WT.2016.7805730). *ITU Kaleidoscope: ICTs for a Sustainable World (ITU WT)*.
8. Grossglauser, M; Tse, D (2001). *Mobility increases the capacity of ad-hoc wireless networks*. Twentieth Annual Joint Conference of the IEEE Computer and Communications Societies. **3**. IEEE Proceedings. pp. 1360–1369.
9. Helen, D; Arivazhagan, D (2014). "Applications, advantages and challenges of ad hoc networks". *JAIR*. **2** (8): 453–457.
10. Giordano, S (2002). "Mobile ad hoc networks". *Handbook of wireless networks and mobile computing*. pp. 325–346.
11. Gonzalez, Marta C; Hidalgo, Cesar A; Barabasi, Albert-Laszlo (2008). "Understanding individual human mobility patterns". *Nature*. **453** (7196): 779–782.
12. Brockmann, Dirk; Hufnagel, Lars; Geisel, Theo (2006). "The scaling laws of human travel". *Nature*. **439** (7075): 462–465.
13. Bettstetter, C; Resta, G; Santi, P (2003). "The node distribution of the random waypoint mobility model for wireless ad hoc networks". *IEEE Transactions on mobile computing*. **2** (3): 257–269.
14. Hyytia, E; Lassila, P; Virtamo, J (2006). "Spatial node distribution of the random waypoint mobility model with applications". *IEEE Transactions on mobile computing,*. **5** (6): 680–694.
15. Figueiredo, A; Gleria, I; Matsushita, R (2003). "On the origins of truncated Lévy flights". *Physics Letters A*. **315** (1): 51–60.
16. Martinez; Toh; Cano; et al. (2009). "A survey and comparative study of simulators for vehicular ad hoc networks (VANETs)" (http://onlinelibrary.wiley.com/doi/10.1002/wcm.859/abstract). *Wireless Communications Journal*. **11** (7): 813–828. doi:10.1002/wcm.859 (https://doi.org/10.1002%2Fwcm.859).
17. Ma, Y.; Richards, M.; Ghanem, M.; Guo, Y.; Hassard, J. (2008). "Air Pollution Monitoring and Mining Based on Sensor Grid in London". *Sensors*. **8** (6): 3601. doi:10.3390/s8063601 (https://doi.org/10.3390%2Fs8063601).
18. Ma, Y.; Guo, Y.; Tian, X.; Ghanem, M. (2011). "Distributed Clustering-Based Aggregation Algorithm for Spatial Correlated Sensor Networks". *IEEE Sensors Journal*. **11** (3): 641. doi:10.1109/JSEN.2010.2056916 (https://doi.org/10.1109%2FJSEN.2010.2056916).
19. Kleinrock, Leonard (1975). "Packet Switching in Radio Channels: Part I--Carrier Sense Multiple-Access

Modes and Their Throughput-Delay Characteristics" (http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1092768&tag=1).
20. Shi, Zhefu; Beard, Cory; Mitchell, Ken (2008). "Tunable traffic control for multihop CSMA networks" (http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4753376&tag=1).

Further reading

- Satyajeet, D.; Deshmukh, A. R.; Dorle, S. S. (January 2016). "Article: Heterogeneous Approaches for Cluster based Routing Protocol in Vehicular Ad Hoc Network (VANET)" (http://www.ijcaonline.org/research/volume134/number12/satyajeet-2016-ijca-908080.pdf) (PDF). *International Journal of Computer Applications, Published by Foundation of Computer Science (FCS), New York, USA*. **134** (12): 1–8. doi:10.5120/ijca2016908080 (https://doi.org/10.5120%2Fijca2016908080).
- Royer, E.; Chai Keong Toh (April 1999). "A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks". *IEEE Personal Communications*. **6** (2): 46–55. doi:10.1109/98.760423 (https://doi.org/10.1109%2F98.760423).
- Mauve, M.; Widmer, J.; Hartenstein, H. (December 2001). "A Survey on Position-Based Routing in Mobile Ad Hoc Networks". *IEEE Network*. **1** (6): 30–39. doi:10.1109/65.967595 (https://doi.org/10.1109%2F65.967595).
- Djenouri, D.; Kheladi, L.; Badache, N. (October 2005). "A Survey of Security Issues in Mobile Ad hoc and Sensor Networks" (http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=1593277). *IEEE Communications Surveys and Tutorials*. **7** (4).
- Maihöfer, C. (April 2004). "A Survey on Geocast Routing Protocols" (http://www.comsoc.org/livepubs/surveys/public/2004/apr/maihofer.html). *IEEE Communications Surveys and Tutorials*. **6** (2).
- Jhaveri, Rutvij H.; Patel, Narendra M. (2015). "A Sequence Number Based Bait Detection Scheme to Thwart Grayhole Attack in Mobile Ad-hoc Networks" (https://link.springer.com/article/10.1007/s11276-015-0945-9). *Wireless Networks-The Journal of Mobile Communication, Computation and Information*. **21** (8): 2781–2798. doi:10.1007/s11276-015-0945-9 (https://doi.org/10.1007%2Fs11276-015-0945-9).
- Cano, Jose; Cano, Juan-Carlos; Toh, Chai-Keong; Calafate, Carlos T.; Manzoni, Pietro (2010). "EasyMANET: an extensible and configurable platform for service provisioning in MANET environments" (http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5673087&tag=1). *IEEE Communications Magazine*. **48** (12): 159–167. doi:10.1109/mcom.2010.5673087 (https://doi.org/10.1109%2Fmcom.2010.5673087).
- Shabbir, Abdul; Kumar, Anasuri Sunil (January 2012). "An Efficient Authentication Protocol for Security in MANETs" (http://interscience.in/IJCCT_Vol3Iss1/IJCCT_Paper_12.pdf) (PDF). *IJCCT*. **3** (1): 71–74.
- Kahn, Robert E. (January 1977). "The Organization of Computer Resources into a Packet Radio Network". *IEEE Transactions on Communications*. COM-25 (1): 169–178. doi:10.1109/tcom.1977.1093714 (https://doi.org/10.1109%2Ftcom.1977.1093714).
- Jubin, J.; Tornow, J. D. (January 1987). "The DARPA Packet Radio Network Protocols". *Proceedings of the IEEE*. **75** (1). doi:10.1109/proc.1987.13702 (https://doi.org/10.1109%2Fproc.1987.13702).
- Schacham, N.; Westcott, J. (January 1987). "Future directions in packet radio architectures and protocols". *Proceedings of the IEEE*. **75** (1): 83–99. doi:10.1109/PROC.1987.13707 (https://doi.org/10.1109%2FPROC.1987.13707).

External links

- IETF MANET group (https://datatracker.ietf.org/wg/manet/about/)
- IEEE Award for pioneering wireless ad hoc networks (https://www.ieee.org/about/awards/bios/tomiyasu_recipients.html)
- NIST MANET and Sensor Network Security project (http://csrc.nist.gov/manet/)
- Wireless Ad Hoc Networks Bibliography (http://w3.antd.nist.gov/wctg/manet/manet_bibliog.html)
- Hybrid Ad Hoc Mesh Networks in Military (http://www.meshdynamics.com/military-mesh-networks.html)
- IEEE Intelligent Transportation Systems Society – for VANETs (http://ewh.ieee.org/tc/its/)
- Smart Multi-Grid Wifi Mesh (http://www.meshdynamics.com/documents/smart-multi-grid-network.pdf): Integrated wifi mesh network provides metering, traffic safety, wifi access to communities in US.

Retrieved from "https://en.wikipedia.org/w/index.php?title=Mobile_ad_hoc_network&oldid=812485882"

- Contact Wikipedia
- Developers
- Cookie statement