A SURVEY OF P2P OVERLAYS IN VARIOUS NETWORKS

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***Abstract*—Overlay networks based on the P2P paradigm have been successfully employed to facilitate reliable data transport .They are used to improve the dependability of traffic flows between end-hosts without changing the underlying infrastructure. By observing connections between neighbours, the overlay can predict the statistical behaviour of the network and can thus select proper routes. In particular, if network capabilities are limited and failure recovery times are high, P2P routing overlays achieve significant performance improvements and better resource usage .This paper surveys P2P overlays in various networks such as ad hoc networks, sensor networks and WLANs. There has been much interest in emerging Peer-to-Peer (P2P) network overlays because they provide a good substrate for creating large-scale data sharing, content distribution and application-level multicast applications. These P2P networks try to provide a long list of features such as: selection of nearby peers, redundant storage, efficient search/location of data items, data permanence or guarantees, hierarchical naming, trust and authentication, and, anonymity. P2P networks potentially offer an efficient routing architecture that is self-organizing, massively scalable, and robust in the wide-area, combining fault tolerance, load balancing and explicit notion of locality.**

Keywords-Overlay Networks; P2P Overlays; Ad hoc networks; Sensor Networks; WLAN

I. INTRODUCTION

PEER-TO-PEER (P2P) overlay networks [3] are distributed systems in nature, without any hierarchical organization or centralized control. The P2P overlay network consists of all the participating peers as network nodes. There are links between any two nodes that know each other: i.e. if a participating peer knows the location of another peer in the P2P network, then there is a directed edge from the former node to the later in the overlay network. In P2P networks, clients provide resources, which may include bandwidth, storage space, and computing power. As nodes arrive and demand on the system increases, the total capacity of the system also increases. In contrast, in typical client–server architecture, clients share only their demands with the system, but not their resources. In this case, as more clients join the system, less resource are available to serve each client.

P2P overlay networks [1] are built at application layer which is on the top of the network topology. These overlays are used for indexing and peer discovery which makes the P2P system independent from the physical network topology. Contents are directly exchanged between the underlying Internet Protocol (IP) networks. Overlay networks based on the P2P paradigm have been successfully employed to facilitate reliable data transport. They are used to improve the dependability of traffic flows between end-hosts without changing the underlying infrastructure. The overlay can predict the statistical behaviour of the network by observing the connection between the neighbours and can thus select proper routes. The P2P routing overlays achieve high performance even in limited network capabilities.

There are two classes of P2P overlay networks: *Structured* and *Unstructured*. The *Structured* P2P overlay [2] network topology is a tightly controlled network. The contents are placed only at specified locations but not at random peers. Structured peer-to-peer overlay networks are sometimes referred as Distributed Hash Table (DHT), are scalable networks which supports Internet-scale applications. The applications of structured p2p overlays are construction of large-scale networks, decentralized applications, distributed storage, group communication, and content distribution. The advantage of this overlay is messages correctly reach the destination even if large number of nodes crashes.

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An *Unstructured* P2P overlay network has no prior knowledge about the topology of the network. Here the peers join the network without any specific rules (loose rules). A resource may take a long time for the search operation because most of the time there is no relation between the name of resources and their locations. The advantages of this overlay are: easy implementation, simplicity, keyword search and dynamic environments. The major drawback of this overlay is the scalability problem.

II. P2P OVERLAYS IN MOBILE AD- HOC NETWORKS

Ad hoc network [4] is a collection of autonomous devices that communicates using wireless links without any pre-existing infrastructure. The nodes of these networks are connected by multihop wireless paths. These are rapidly deploying and self configuring networks without any infrastructure. The communicating nodes may be out of range so that the participating nodes in the network must be able to relay traffic. Adaptive Quality of Service routing protocols are used in this network to maintain up-to-date local QoS information. The architecture is based on P2P routing overlays, which utilizes network observations and measurements as in Over QoS, which enables dependable routing between overlay devices.

The routing services offered by the overlay devices to the local neighbours are dynamic in nature, so the visibility and range of the P2P overlay is restricted and the neighbour nodes may change any time. The P2P overlay has a special feature that the geographic restrictions will not conflict with ad hoc routing mechanisms.

Structured P2P overlay models are scalable and avoid flooding. Structured P2P protocol (Chord) is more efficient, that acts as a distributed data structure like Distributed Hash Table (DHT) with two main operations like Put (*key, value*) and Get (*key)*. *Key* is usually achieved by mapping the IP address of the node and *value* is the hashing function mapping key that related to some file etc.Even though it is more efficient, unstructured P2P overlays are easily implementable by Gnutella protocol. Using this protocol peers are selected at random and they are stored in a table. Gnutella protocol utilizes a set of descriptors. The descriptors like Ping, Pong, Query, Query Hit and Push are used to communicate between servents, they act as client or server or both at the same time.

A comparison of unstructured P2P overlays and structured P2P overlays[6], structuredP2P is tightly controlled and contents are placed not at random peers, but at specified locations that will make subsequent queries more efficient. Even though it is more popular, unstructured P2P overlays are thought to be the explicit structure and it support complex queries for mobile ad hoc networks. The Gnutella protocol of the unstructured P2P architecture achieves high hit rate and fault tolerant than Chord, which is a structured P2P framework.

TABLE I
COMPARISON OF P2P ARCHITECTURES IN AD HOC NETWORKS

Taxonomy	Unstructured	Structured
Architecture	Flat and Ad-Hoc network of servents. Flooding request & Peers download directly.	Uni-directional & Circular NodeID space.
Scalability	No	Yes
Reliability	Yes	No
Searching Mechanism	Blind Search	Index Search
Example	Gnutella	Chord

III. P2P OVERLAYS IN SERVICE ORIENTED WIRELESS NETWORKS

P2P overlays in service oriented networks [10] are mainly used to manage the QoS in IEEE 802.11 networks. The P2P overlays in these networks are developed with the goal of ensuring compatibility and interoperability with the IEEE 802.11e MAC standard [9]. Through the distributed mechanism acting at the application layer the overlay manages the bandwidth allocation among the participants. Whenever IEEE 802.11e functionalities are available the QoS support is achieved, by mapping bandwidth requests onto priority classes, and handling cross-layer control information exchange between the application and the MAC layer. The overlay also provides the capability of dynamically reacting to possible malfunctions and churn (i.e., the process of continuous node association and de-association caused mainly by mobility).

The P2P overlay is to satisfy the bandwidth request over the physical medium. As per the QoS point of view, the applications run on the host can be categorised as , applications with quantitative specifications of Qos, applications with qualitative specifications of QoS and best effort applications.

The overlay is an unstructured architecture, is maintained by passing signals among the nodes. This architecture is unbalanced in the presence of a centralised component. If it is hybrid, other nodes could manage a fraction of bandwidth. If it is distributed, all the nodes participating in the network will manage bandwidth.

The nodes can be identified uniquely by applying SHA1 Hashing algorithm to the IP address and a positive integer is adjoined with each host at the end of

outcome. After the creation of the overlay, a Bandwidth Mediation Point (BMP) must be selected, by passing the ID of each host through the overlay.

The ID with lowest value is elected as BMP. During the setup time the BMP owns all the Maximum Manageable Physical Bandwidth (MMPB) from all participating nodes. It forms a cluster like multihop fashion.

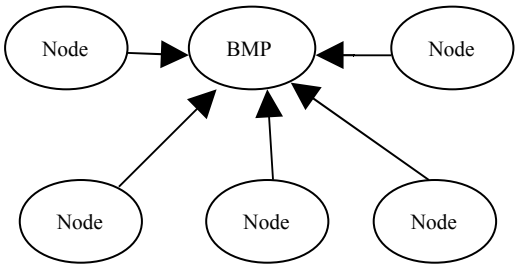

Figure 1.Unbalanced Architecture

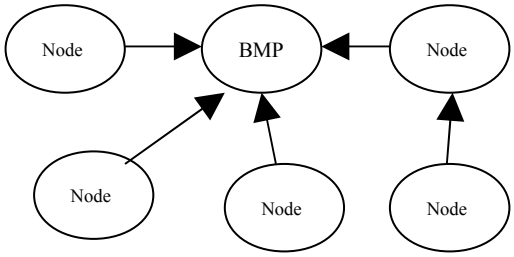

Figure 2.Hybrid Architecture

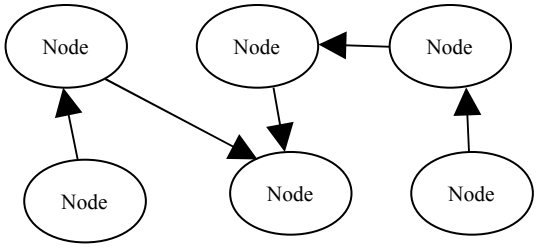

Figure 3.Balanced Architecture

In the overlay each node maintains the status and it checks its current status after getting a request from the application layer and the bandwidth not used by the current node will be distributed to other peers, according to the priority. After receiving the response message, the requesting peer becomes the owner of the bandwidth and updates its status appropriately.

Due to the highly distributed nature of P2P system, *kick-start* problem (first node problem) will occur and unique single point of entry to the architecture is not known. The wireless infrastructure, suffocated with priority of servicing problem.

The nodes connected in a P2P use only the allocated bandwidth that has been obtained through the overlay based mechanism. In the absence of MAC QoS support the bandwidth constraints are enforced using the algorithm to achieve a self limiting approach, leads to *loose QoS*.

IV.P2P OVERLAYS IN WIRELESS SENSOR NETWORKS

Wireless Sensor Networks are the key to gathering the information needed by smart environments. A sensor network is fast and easy to install and maintain. In sensor networks [7], the categories of devices are differentiated by bandwidth allocation and Bandwidth on Demand (BoD) schemes. Among all modern networks, the peer-to-peer overlay networking allows a redundant architecture that acts well against failure.

P2P networking has some problems such as lack of hierarchical organisation among hosts services and it hardly manage the bandwidth available at the physical level. Sensors are usually equipped with low computational resource and resource reservation policies are not applicable.

Assume a static sensor network: the topology of node mesh will not change during its lifetime. A proper routing algorithm, Ad hoc On Demand Distance Vector [5](AODV) delivers proper control information. A node can be added or removed with the network in the lifetime. The topology is constructed with “overlaid networks” [7], without any central point of coordination. The BMP is also considered as a node in pure P2P overlaid network. The snapshots are illustrated below.

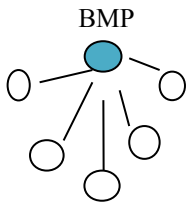

Figure 4.Client-Server Model

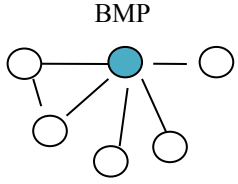

Figure 5.Hybrid Model

The bandwidth allocation service is offered by the Bandwidth Allocation middleware [8]. Moreover, the algorithm acts on the application layer independently of the actual Medium Access Control (MAC) resulting in a *"loose QoS,"* support, but without any real-time guarantee.

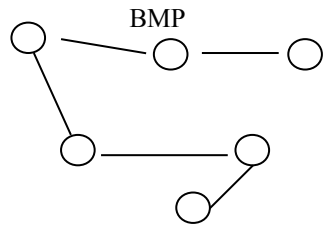

Figure 6.Pure P2P Model

The core of the algorithm is as follows. If a node asks for more bandwidth, it will generate a query to all the nodes. This architecture exchanges the bandwidth with the nodes. According to the availability of the bandwidth and the traffic, each node will send back some bandwidth. Then the p2p paradigm is applied both to the communication phase and to the bandwidth ownership relation. In the communication phase there is no central authority in the interaction of the sensors .The bandwidth ownership relation in which a centralized controller owns the bandwidth

When the algorithm starts, the kick-start phase is started. This phase establishes the first owner of the bandwidth resource and the bandwidth policies are not strictly related. Starvation and uncontrolled bandwidth usage is avoided in this approach.

V.COMPARISON OF THE OVERLAYS IN NETWORKS

In Mobile Ad Hoc Networks the P2P overlays are established to enhance the performance and dependability of multi-hop ad hoc communication, and identified basic application characteristics. In this network, unstructured p2p overlay achieves best hit rate and it is more flexible than structured p2p overlay. Blind search mechanism is used in this network. The QoS with real time is guaranteed. The performance of network can be analysed by the metrics such as total number of packets sent and received, routing load and throughput.

In Service Oriented Wireless LAN, a self-limiting approach is used if the MAC does not provide QoS support The real bandwidth usage of each node is checked using the bandwidth marshal. The bandwidth usage is the amount of resources actually obtained by relying on the overlay mechanism. By doing so, a host is enforced to use only the bandwidth obtained through the overlay-based mechanism. In this case the overall architecture is a distributed, without any central point of coordination. Node priorities are assigned and the nodes with high priority are given the service first. The nodes with low priorities waits for considerable amount of time and after that those nodes are considered as dead state. The real time guarantee is not provided in this network, because of loose QoS support.

In Wireless Sensor Networks, the problem of bandwidth reservation and utilization problem can be solved using the algorithm. If the resources in the network are not needed for a long time it can be released from the network. This allows coordinated bandwidth usage also. The real time guarantee is not provided in this network, because of loose QoS support.

TABLE II
COMPARISON OF OVERLAYS IN NETWORKS

Features	Ad hoc Networks	Wireless Networks	Wireless Sensor Networks
Scalability	No	Yes	Yes
Reliability	Yes	Yes	Yes
QoS	Yes	Yes	Yes
Real time guarantee	Yes	No	No
Node Priorities	No	Yes	No

VI. CONCLUSION

This paper has presented various networks using P2P overlay networks that have been proposed by researchers. The best suited P2P overlay network can be selected based on the application and its required functionalities and performance metrics. P2P overlay can be selected based on the scalability, network routing performance, location service, file sharing, content distribution, and so on. In wireless LAN the scheme proposed coped with the bandwidth requests at the overlay level.

The overlay helped the IEEE 802.11e-compliant nodes, to translate them into corresponding priorities. The QoS requests and the roaming nodes have been investigated with satisfaction. In Ad Hoc networks, the concept of provider mediation is established in the overlay and enables a new service paradigm for future hybrid network architectures. In wireless sensor networks the BoD algorithm proposed allows obtains some QoS-like bandwidth reservation mechanism on a simple sensor network. Future work aims to integrate the overlay with cloud computing. In addition, different kinds of overlay (e.g., structured) could be investigated, in order to choose the most suitable one according to the high mobility scenarios and emergency.

Finally we conclude this survey, the P2P overlays in various networks, is best suited for wireless

networks, with its high scalability, reliability, and good quality of service. The nodes are served in a priority that is most efficient than other networks.

In the future, P2P overlays will be enhanced with the following extensions.1) Trust and reputation plays an important role for secured and trustworthy P2P overlay communications among the peers, 2) Application of P2P overlay networks in cloud computing, which needs multitenant architecture, 3) Economic and game theory, P2P overlay services can be used for resource sharing.

REFERENCES

1. D. Andersen, H. Balakrishnan, F. Kaashoek, and R. Morris, "Resilient Overlay Networks" in *Proceedings of 18. ACM Symposium on Operating Systems Principles*, pages 131–145,
October 2001.
2. M. Castro, P. Druschel, A. Ganesh, A. Rowstron and D. S. Wallach," Secure routing for structured peer-to-peer overlay networks," *Proc. USENIX SYMPOSIUM,* December 2002.
3. M. Castro, M. B. Jones, A.M. Kermarrec, and et al. "An Evaluation of Scalable Application level Multicast Built Using Peer-to-peer Overlays," in *Proceedings of 22. IEEE INFOCOM*, pages 1510–1520, March 2003.
4. T. Krop, M. Kappes, and M. Ollick," Establishing P2P-Overlays for Ad Hoc Networks Using Provider Subscription," in *GI Proceedings,* pages 207-210.
5. C. Perkins, E. Belding-Royer, and S. Das, "Ad hoc On-demand Distance Vector (AODV) routing," *IETF, RFC 3561*, July 2003.
6. E. Keong Lua, J. Crowcroft, M. Pias, R. Sharma and S. Lim,"A Survey and Comparison of Peer to Peer Overlay Network Schemes," *IEEE COMMUNICATIONS SURVEY AND TUTORIAL*, pages 1-22,March 2004.
7. L. Caviglione, F. Davoli , "A peer-to-peer bandwidth allocation scheme for sensor networks," presented at *Internat. Symp. on Performance Evaluation of Computer and Telecommun. Syst. (SPECTS04)*, San Jose, CA, July 2004.
8. L. Caviglione and F. Davoli, "Peer-to-Peer Middleware for Bandwidth Allocation in Sensor Networks," *IEEE Commun. Letters*, vol. 9, no. 3, pp. 285–87, Mar. 2005.
9. L. Caviglione, F. Davoli, and M. Polizzi, "An Overlay Scheme to Exploit IEEE 802.11e-based QoS," *Proc. IEEE WRECOM '07*, Rome, Italy, Sept.-Oct. 2007.
10. L. Caviglione and F. Davoli," Using P2P Overlays to provide QoS in Service Oriented Wireless Networks," *IEEE Wireless Communications,* pages 32-38, August 2009.

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