Two approaches in P2P monitoring

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***Abstract*—With the increasing use of Peer-to-peer overlays the necessity of monitoring crucial informations for the applications take face. In special, the Peer-to-peer applications which could improve its autonomics characteristics with the use of the informations monitored are the ones subjected in the second part of this work. There, our work proposes a framework that can make available management informations about the overlay that can be used by these applications to improve some of its autonomic characteristics. On the first part, our work proposes to build a framework using P2P as tool to network management envisaging tow contributions by mean of an Aggregation Service and an Self-Configuring service.**

I. Introduction

Nowadays more and more applications that use the paradigm of collaboration through the use of p2p overlays are being developed and deployed. VoIP, file sharing, power processing share and more recently the multimedia content distribution including video, video on demand, and so on are simple examples of this kind of applications.

Each of this applications spawn its own p2p overlay. This is accomplished once the overlay is formed when the P2P software is started in the devices that make part on the application/service. Thus, neither every device aware to communicate through a network interface belongs to a specific overlay. However, those that belong to it exchange packets routing them among the devices using the underlying network infrastructure. In this sense, the same device (computer, for instance) can belong to many different overlays. Each one has its specific needs in terms of bandwidth, time constraints and audience among other characteristics.

In this context, as an example, the Bittorrent protocol is used to file sharing as well some some video on-demand applications, including commercial ones, are based on it [3]. It spawn a particular overlay for each file shared. In the Bittorrent language usage each overlay is called a *swarm*. The set of clients downloading and uploading a file creates a overlay where the entire system fairness is achieved through the main mechanism of management that is the rate of sharing in terms of uploading data (megabytes), also known as *tit-for-tat*. In it as much *chunks* a peer offer to uploading more chunks it is allowed to download. More informations about Bittorrent can be found on [3], [4].

Two instigating issues can be insighted from the notion of each P2P application spawns its own overlay. Peer-to-peer applications can be used to manage the underlying network infrastructure and different overlays sometimes have the same requirements for management.

There are some works on the direction of the former issue. Against the mainline which say the P2P applications are problems for the network management because the increasing traffic and the high bandwidth used, the works from [6], [2] are trying to use the new possibilities that the P2P networks presents to manage the underlying network infrastructure. One of the main possibilities behind that approach is the scale achieved with these applications. P2P network management applications can be installed in computer belonging to different administrative domains and because of that a real possibility of a global management can be noticed.

In the latter branch, the monitoring and offering management informations from the different P2P overlays to the "normal" P2P applications (VoIP, video on-demand distribution, file sharing, and so on) are not talked from our best knowledge from the specialized literature. Distance among nodes, upload and download bandwidth among nodes, online uptime, node load and others are metrics that can be used for many P2P applications to improve their skills in offering services. This metrics belonging the overlay layer can be monitored and offered to the P2P applications, and this is what this work proposes.

Also in the field of the P2P networks and applications, the Autonomic Computing characteristics must be applied. The Autonomic Computing looks for to make the applications less dependents from the humans in terms of management. To do that it states some main principles whose applying are being pursued since 2001, when Paul Horn coined it [7]. That principles are known as the Self-* (read as Self-star) and basically guide the applications to configure, optimize, heal and protect themselves as well be awareness from their necessities and from their environment taking the self-management as final

objective. More details from autonomic computing can be got from [5], [12], [8], [13], [10].

The proposed overlay assessing approach intends to help the P2P application to sketch the Autonomic Computing objectives making available a set of common informations mainly related to the capacity of self-configuring, but not limited to, and also for self-optimizing and self-healing.

Thus, this work pretends examine in deep the insights already mentioned intending to present a framework to create and monitor overlays in a way to make available informations necessary to the applications which run in a P2P mode. Thus in the Section II will be discussed and presented the ideas to implement mechanisms to deploy a common overlay in the way each P2P application will be able to request the management informations necessary to its best working. At the end, in the Section III will be presented some conclusions about this ideas.

II. Approaches

Our approach for the mentioned insights related with the use of P2P overlays will distinguish both applying for each one different treatments.

With the objective of improve the works which use P2P overlay as tools for network management we propose the construction of a framework which will deploy the main characteristics from that works adding new abilities such as the Aggregation Service and the Self-Configuration for the underlying network. This approach will use again the P2P as tool for network management. To use it, the organizations, which will be interested in managing the networks, need install the P2P software in their domains or distribute it for their customers inside their administrative domains.

The second approach proposes the construction of a middleware which will be responsible for monitoring some of the common informations that can be used by the P2P applications to improve its working. In this way the applications which will be implemented using this middleware will not be worried about the monitoring task, even the service executed be dependent on this monitoring, because the middleware will offer these informations. Examples of this informations can be the power processing and the up time of the peers, as well the relative distance among peers, and so on. These informations are important for a VoIP application, for instance, once the decision of which peer can be a super-peer to forward voice packets can be taken based on it. However, the power processing can be not so important for a file sharing application. For that kind of applications one of the most important informations is the distance among the peers, once the decision from which peer to download the file pieces can be taken based on it. Then, this approach will offer the capacity of separation between application and overlay.

A. P2P as a network management tool

The necessity of keeping the network working well even in high loaded, with different kind of needs and confuse environments, have made the network management a large discipline. From the well silted up and standardized protocols for network management like SNMP - Simple Network Management [1], and its updates (see more details on the RFC 1441 and RFC 2571), passing by RMON - Remote MONitoring (RFC 2021 and RFC 4502), Management by Delegation - MbD, mobile agents, management by policies using web services, until the most recent approaches the network applications and even the network infrastructure are changing.

A realizing change in the network usage happened when the firsts file sharing applications appeared. It had spread the collaboration concept through the usage of storage and communication capacities of the users, which means a increasing usage of distributed P2P applications. Recently, the P2P applications are being seen, by many network operators and carriers, as problems once the heavily necessity of bandwidth are bottlenecking the underlying communication links.

Some works are trying to use the increasing popularity of the P2P applications to make them allies in the management task. The work from [6] proposes the use of a hierarchical formation of peers collecting management informations and interacting with the SNMP agents installed in the devices managed by the P2P network they spawn. The authors have used the terms from MbD approach to name the peers (Top Level Manager - TLM, Middle Level Manager - MLM) that have specific functionalities. One specific network management problem treated on that work is the configuration management where the devices' configuration files can be searched around the P2P network, then downloaded, changed and after that applied to a specific device through the MLM peer closest the device to be managed. Other problem addressed is the shared network view among the network operators through the sharing of topology files. Among others, some examples of others works derived on this can be found in the literature [9], [11].

Similar work can be found in [2] which proposes a distributed, self-organizing, generic testing and QoS monitoring architecture for IP networks. The architecture is based on equal agents denoted as Distributed Network Agents (DNA), which form a management overlay for the service. The self-organization of the overlay is achieved by a Kademlia P2P network. The architecture intend to support the central network monitoring station. The main component from the DNA architecture that is the Mediator which runs in background and is responsible for the communication between the user and the individual test modules.

Even though the presented works are not a extended list of work in the P2P network management area we can realize that the main reason to use P2P overlays as tools for network management is the possibility of management of many different domains. Once a human manager, which can be connected through a peer with a specific administrative domain, can manage devices in a different domain, through the exchange of messages from these two peers belonging to these different domains, we can say the routing capabilities provided by the overlay, even when the peers are behind NAT or firewall, can provide a tool for scalable network management. Also, the

improved information exchange among the peers forming the management overlay help the cooperative management. This can be accomplished between human administrators belonging to different domains through the exchange of management policies. The network management using P2P overlays can take advantage of the overlay to offer high availability to the management service due the inner replication of the management service in the overlay as well can deploy load balancing to intensive processing management tasks, for instance, through the group formation among the peers involved.

Based on the reasons presented and the related works mentioned our propose wants to add two contributions in this field.

The use of an Aggregation Service which will be arranged by the peers selected from the management overlay and, although playing the role of front end to the human manager, they will be responsible to aggregate the advertisements from the peers which hold the real management services. The management services as a concept is software module which execute some management activity (monitoring and acting). In our case is assumed that each intermediary peer (middle lever managers) belonging to the management overlay will execute some management service, which could be the monitoring of well known infrastructure services such as DNS, DHCP, firewall and NAT ones, either using the already installed SNMP management legacy. But it also could be monitoring the web server memory level or else the more specific services such as monitoring QoS specific parameters in a video on-demand P2P transmission. Also, when the end users machines can take part of the management overlay the management service, which will be running on those peers, could be reserve end to end bandwidth for a VoIP communication. Our propose for the Aggregation Service is summarize the advertisements that each peer offering some management service must send to its Aggregator peer which will be an TLM peer in a higher lever overlay. Thus, a peer belonging to this level will be responsible for aggregate the services advertisements from many other peers as well keeping a monitoring information base, when possible, for those management services. This approach will allow the human manager search and access the specific management services needed in a faster way, once the search can be done in the overlay composed by the TLM peers. It is possible to observe this propose in the Figure 1.

It is possible to see in the Figure 1 that the management of many different administrative domains can be done through this approach once the aggregation manager's overlay can be seen as an overlay belonging to no one particular domain.

The second contribution is based on the first one. Once the so called Aggregation Service can be advertised and hold monitoring information about the management overlay as well some informations about the underlay network and the management system as a whole can use it to execute self-configuration. That self-configuration will concern with which peers in a moment can be the aggregation peers (monitoring churn is a responsibility of the aggregation management overlay) for instance. Thus the self-configuring requisite presented

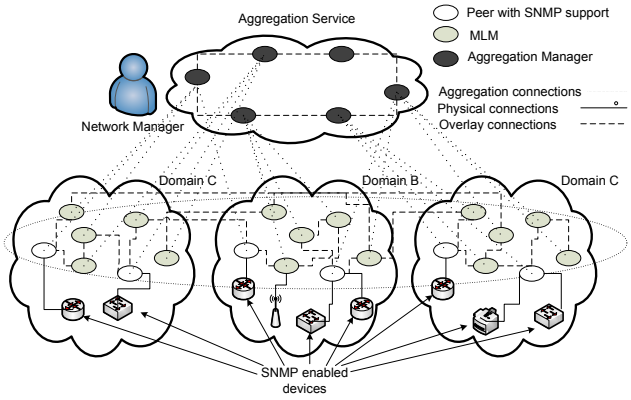

Fig. 1. P2P Network Management Overlay

here is related with the capacity of the peers execute some autonomic arrangement (without the human intervention) in the overlay or in the SNMP able devices according to the informations monitored and aggregated on the aggregation layer by the special aggregation peers. The Figure 2 shows the modular architecture proposed from this work.

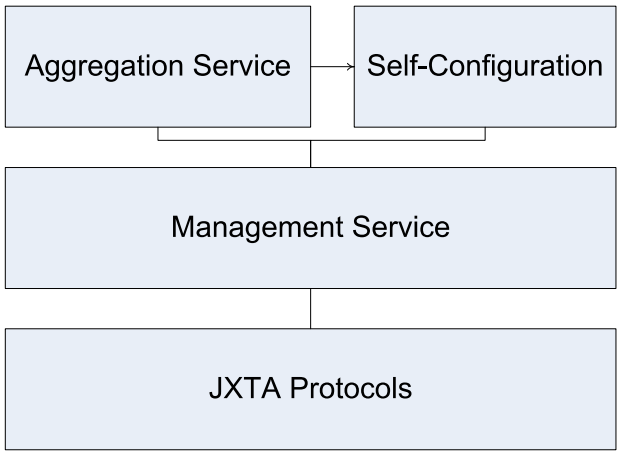

Fig. 2. Management P2P Framework Layers

B. Assesing overlays

Currently, each P2P application spawn its own P2P overlay. This second approach take face in this field. It was motived by the challenging question: If/when the overlay will be separated from the application, what happens? Considering the diversified necessity from the P2P applications is necessary to list a general set of informations which can be monitored from the overlays to be offered for the applications. Some of this informations are, but not limited to: distance among peers, power processing in each peer, storage space in each peer, number and distance among neighbors, bandwidth. This

is not a closed list, for what part of this propose is to research this set of informations.

Some words are necessary to explain the main classes of P2P overlays. Some of the them are based on distributed hash tables (DHT), and because of that are known as the structured P2P networks. They establish a coupling among a large common space identifier (generally formed by numbers composed by 128 bits) between node identifiers (known as nodeIDs) and the objects looked for (known as keys). Then, as an example, in our propose of use P2P as management tool is it possible to use a structured overlay where the aggregated management services advertisements would looked for by its names that will be searched as keys in the Aggregation Service overlay with the help of the DHT used. The second class for P2P overlays are the unstructured ones. On that there is not a common space identifier and the nodes join the overlay without previous topology's knowledge. The peers are organized in a random graph in flat or hierarchical manner (e.g. Super-nodes layer) and the network uses flooding to query information, but with a limited scope, random walks or spanning ring Time-To-Live search on the graph to query content stored by the peers. It means the data objects are not assigned with a key from the space identifier; in other words there is not coupling between topology and data objects. As an example, in our previous propose we can think the Management Services advertisements as well the monitoring informations kept in that layer as a hybrid between structured and unstructured P2P overlay classes since the aggregation peers can be seen as super-peers to the management overlay.

Considering the challenge and the existing overlays the propose from this part of the work is to build a middleware, which can be integrated in the former propose as a future work, that will dispose that informations. How to dispose the informations is also a research objective, once it can be done through internal mechanisms such as offering the informations using public interfaces from the middleware, or using a kind of data base (XML, the aggregation service already explained, MIB and so on). What matter is the middleware must to treat the different P2P topologies (CHORD - circle, CAN - 3D cube, and so on; for the structured overlays for example) on which the P2P applications relies on. Concluding, the proposed architecture for this middleware will play a role of an integrator among the P2P overlays to monitor and expose informations to the P2P applications can execute self-management.

The Figure 3 shows the proposed architecture having in the bottom layer the overlays which can be monitored. In the middle layer is the software module integrating and monitoring those overlays keeping attention on the information needed by the P2P applications which are in the top layer.

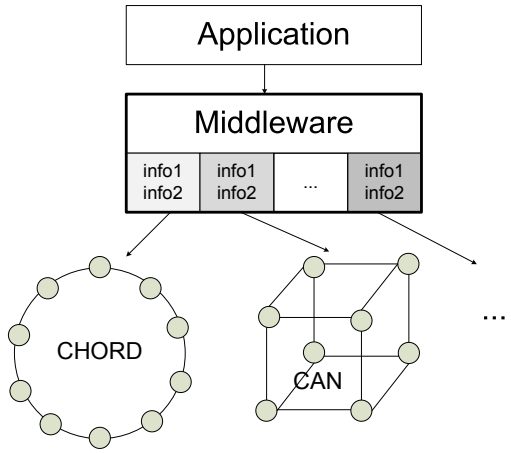

Fig. 3. Architecture to monitoring overlays

III. Conclusions

Peer-to-peer applications have spread the concept of collaboration into the domain of computer networks. This kind of applications have special needs in terms of operational working. Is important to have a common framework to make able the necessary management informations from the overlays be used by the P2P applications. The proposes presented here can contribute in two fronts in the P2P research area. Using P2P as tool for network management through an improvement from already done works meaning the implementation of an Aggregation Service and the Self-Configuring in an super-peers overlay from the management overlay is one of them. As a second contribution we presented a propose to separate the P2P application from its inner specific P2P overlay offering an environment to expose the informations monitored from it and necessary to the application activities' execution.

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