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VoD SERVICES USING HIERARCHICAL STRUCTURE

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Abstract:*In this paper we considered the method of describing the telecommunication system providing VoD services using hierarchical structure with optimization and security features. Today we have seen that many times, during the downloading process of various videos, there will be disturbance or hanging and failures due to the low bandwith and other technical problems. In this paper we are proposing some methodologies to remove such type of failures by using the concepts of optimization of bandwidth which describes the relationship between the structural elements at each hierarchical level of the multi-layer graph. Video Transferring is resource (like band-width) consuming task and it require an optimal configuration of the system. The proposed hierarchical structure makes it possible to consider the telecommunication system as a whole and avoid any failure in the local optimum when solving optimization problem as well as providing some security features. Also some techniques are proposed for band-width reduction.*
Keywords : *Video on Demand, Proxy nodes, Topology synthesis, Multi-Layer graph.*

I.INTRODUCTION:

Video on demand is a technology that provides entertainment on demand to all the subscribers of the service. Video on demand provides customers with informative and entertaining streams of multimedia and video information. Some of the services that can be offered by video on demand technology are:
Movies-on-demand: Movies, TV shows, special interest programs and music videos can be watched by home users at their convenience. E-commerce: Customers can shop from home for some of their favourite items such as books and software from various web sites. Interactive advertising: Customers can interact directly with full motion video advertisements and order theproduct on-line while they watch the advertisement. There are two distinct types of video on demand applications, each requiring different technology. Near-Video-on-demand: This technology delivers the same content using multiple video streams with staggered start times. For example, twelve video streams – each starting at ten minute intervals can deliver a single, two-hour video. Users wishing to watch the video may have to wait. The waiting time is no longer than ten minutes. In this technology many users share a single video stream. True-Video-on-demand:This technology provides the users with the requested content immediately. In response to a user request, the video server delivers the content in a video stream immediately, without any waiting time. Generally video streams are dedicated to users unless multiple users request a single content title at exactly the same time. Using this technology, it is possible to provide interactive control of the video stream to the users. For example, users can be provided with VCR controls such as play, fast forward, rewind, pause. True video-on-demand will be the focus of this report provided with VCR controls such as play, fast forward, rewind, pause. True video-on-demand will be the focus of this report.

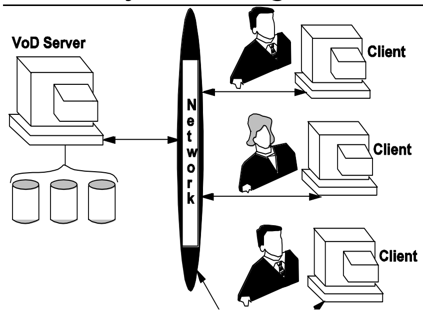

Fig.1 Video-On-Demand

The Video-on-demand (VoD) service is an integral part of the modem multi-service network and can be considered as a subset of IPTV service.

Internet Protocol television (IPTV)is a system through which television services are delivered using the Internet protocol suite over a packet-switched network such as the Internet, instead of being delivered through traditional terrestrial, satellite signal, and cable television formats.

IPTV services may be classified into three main groups:

live television, with or without interactivity related to the current TV show;

time-shifted television: catch-up TV (replays a TV show that was broadcast hours or days ago), start-over TV (replays the current TV show from its beginning);

video on demand (VOD): browse a catalog of videos, not related to TV programming.

System for delivering VoD service can be described as a set of servers that host video content. These servers are interconnected in a certain way (either directly or through intermediate nodes) and they also must have connections with the subscribers through subscriber access nodes.

Telecommunication systems are constructed hierarchically, on the basis of overlay networks, i. e. each lower level of the network provides transparent transfer of the network flow over the upper level. Thus, it is expedient to represent such networks as an ordered set of graphs, each of which describes the topology of a network at a particular hierarchical level. So, because of the complexity of such systems, it has been proposed to use multilayer graphs for their description, as shown at [1, 2].

II. HIERARCHICAL GRAPH DESCRIPTION

For video (VoD) transferring services system can be described as a set of servers that host video as well as provide security services as-

S= $\{s_i\}$set of subscribers of VoD service

VS= $\{vs_j\}$ - set of video-servers

IN= $\{in_i\}$ - set of intermediate nodes.

SA= $\{sa_i\}$ -- set of subscriber access nodes;

PN = $\{pn_i\}$ _ set of proxy nodes.

Description of a telecommunication system as a multi-layer graph is done in accordance with the following method:

a) Differentiate the set of levels in the telecommunication system being modeled.

b) Describe the topology of each level with the help of a classic graph.

c) Differentiate logic, functional and physical connections between the objects of different levels and describe them using the graphs.

d) Assign a set of characteristics to the corresponding parameters of the objects and inter-object relations interesting for the modeling, to the edges and vertices of the graph The application of this method makes it possible to receive a hierarchical graph that has the structure as shown on Fig.2 V is a set of vertices of the hierarchical graph G.

$G = \{£_1, £_2, £_3, £_4\}$

V = S U VS U IN U SA U PN

S Ω VS = ϕ , S Ω SA = ϕ , S Ω IN = ϕ, S Ω PN = ϕ, VS Ω SA = ϕ

Next section describe each level of graph G of the hierarchical structure-

-Cooperation between the service and subscribers (£3)
- Cooperation between the subscribers and the servers, and the servers with each other (£2)
- Entire physical topology of the network (£1).
- Cooperation between the subscribers and proxy nodes (£4).

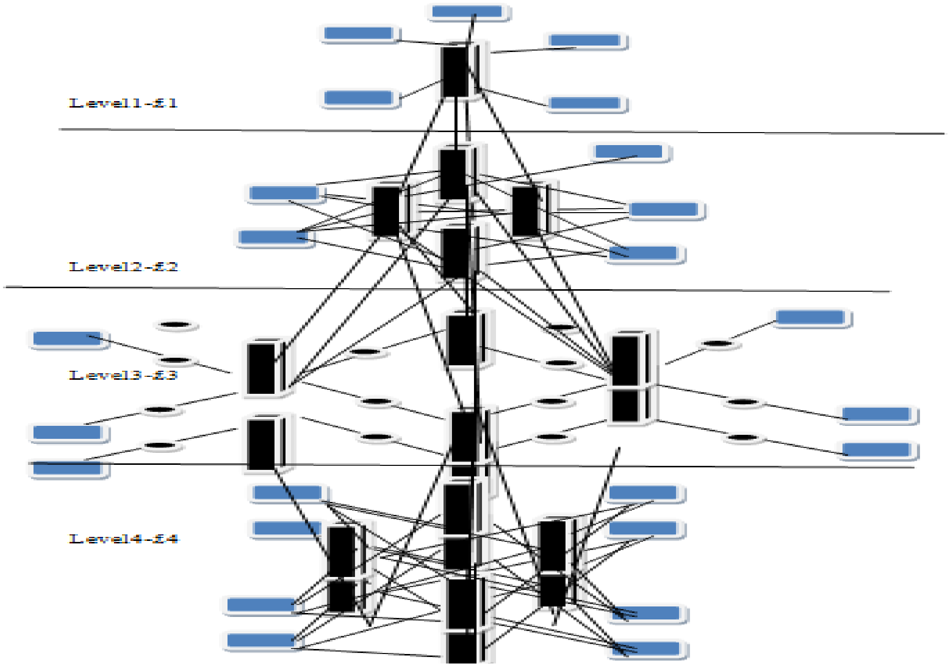

Fig.2. Hierarchical Structure for VoD services

On the level of interaction of the subscribers with the service, the graph will have the "star" topology since all the subscribers interact with the service. On the level of interaction of the subscribers with the servers and the servers between themselves, the topology will be almost mesh topology, because it is envisaged that each VoD server can interact with the other servers, and each subscriber can receive content from each server. This being said the subscribers have no connections between themselves, so there will be no edges between the graph vertices that
correspond to the subscribers. Finally, the bottom level describes the physical interaction between the VoD servers, subscribers and access nodes between themselves. The concept of the multi-layer graph implies the modeling of overlay networks. Consequently, each functional unit on each level has its corresponding counterpart on the other adjacent level E={eJ, ez, . . . ,eI4}' Such correspondence on the multi-layer graph is expressed by the edge joining the functional units (vertices) corresponding to each other on the adjacent levels of the multi-layer graph. Now it is possible to describe the flow model on the hierarchical graph [3]. The rule of flow conservation must be respected.

Generally, the flow conservation rules can be formulated in the following three statements.

- Amount of flow transferred between the pair of the interacting source-destination nodes along the chosen route is always unchanged.
- Sum of flows transferred by different routes between the pair of the interacting source-destination nodes equals to the amount of requirements emerging in the source node, and equals to the amount of requirements processed in the destination node.
- Sum of flows incoming to the node equals the sum of flows outgoing from the node if the node functions only as a transit node; or it differs by the amount equaling to the difference between the amounts of flows for which it is a source or a destination.

The next step is to define the constraints for each level of the multi-layer graph. General constraints for the network graph should be complimented by the constraints characteristic for the VoD systems. In this way, generally, the subscribers cannot function as transit nodes, i. e. they cannot generate traffic in the framework of the system being considered and transfer it to the other nodes.

The lowest level sub graph (£1) is a redundant graph including all intermediate nodes and access points. Its redundancy enables us to solve the problem of network topology synthesis on the redundant graph. Linear and linear-integer programming methods may be used here. This approach is known as node-link formulation of the topology synthesis problem and is described in [4]. Occupied bandwidth minimum can be used as the optimality criterion for the links used for the traffic transmission. In next section we will discuss about the band-width reduction techniques.

III.BANDWIDTH REDUCTION TECHNIQUES

The key problem in deploying large-scale video on demand applications is economy rather than technology. In order to have an efficient and cost effective video-on-demand system it is important to reduce the bandwidth requirements as much as possible. This section explains some of the bandwidth reduction techniques and analyzes their suitability to video-on-demand services.

3.1 Multicasting:A typical video-on-demand system uses dedicated channels to service each user request. This increases the bandwidth requirements as more and more streams are requested. Multicasting is an approach whereby various customers can share a single movie stream resulting in reduced system cost per customer and improved system scalability. Multicasting has some limitations associated with it. For example, in order to share a single channel with a group of customers, all the customers have to request the video at the same time and watch it without any interaction (no pause, fast forward, rewind, etc). This defeats the purpose of a true and interactive video-on-demand system. There are certain multicasting techniques which can be used to provide interactive video-on-demand services.

3.2 Batching:In this approach, the requested video is intentionally delayed by some amount of time, called a batching interval, so that subsequent request for the same video arriving during the current batching interval may be serviced using a single I/O stream. This trades off reduced I/O stream requirements for increased latency. Therefore, large batching intervals would seem to be incompatible with the notion of a true VOD system. Batching can only be used with popular videos since unpopular videos are unlikely to receive multiple requests during the (short) delay interval.

3.3 Patching:In this approach, also called as a dynamic multicast, the multicasting stream is not static but can expand dynamically to accommodate new requests. For example, if there is a video being streamed through a local video server and there is a new request for the same video, then the video server starts caching the video data in its local disk. The server therefore needs an initial patching stream to transmit the leading portion of the video. When the leading portion of the video is transmitted, the rest of the video is transmitted from the data already buffered in the local disk. Using the patching technique, channels are used only briefly to broadcast the first few minutes of the video, instead of being held up for the entire duration of the playback. Patching can be seen as a multicasting technique for interactive video-on-demand systems where a single channel can be shared with multiple users. Patching also saves the storage costs as only a small amount of the video stream has to be buffered at the local disk (depending on the requests).

Patching is very effective in reducing the bandwidth and storage requirements if the number of interactive requests from the users is within a certain limit. Beyond that, patching looses its efficiency as it results in starting multiple patches of the same video and increases the bandwidth requirements.

3.4 Piggybacking: This approach tries to alter the playback rates of the on-going video streams by 5% (amount supposedly undetectable to human observers) in order to merge the respective video streams into a single stream which can then serve the entire group of requests. The idea is to display the leading stream at a slower rate, and the trailing stream at a faster rate. Then, assuming this interval is sufficiently small, the faster stream will eventually catch up with the slower stream. At this point the streams can be piggybacked or merged. There are different piggybacking policies that can be used to achieve maximum savings in bandwidth. The three basic types of piggybacking policies are simple merging policy, the odd-even policy and the greedy policy. The first two are elementary as they involve at most a single change of speed for each video stream. Therefore they can achieve a maximum of 50% improvement in the number of streams saved, because they pair of subsequent streams. The greedy policy changes the speed of the different streams in such a way that the streams are merged at the earliest possible time in order to achieve maximum savings in bandwidth.

There are some limitations associated with piggybacking. The first is that it takes a long time for two streams to merge. Therefore if the streams are very far apart, it is possible that they will never merge at all. The second drawback is that, unless the VOD server is powerful enough to make the video rate changes on the fly, it will have to store at least two versions of each video, doubling the storage requirements. The quality of service may also be affected when the playback rates are altered. Piggybacking assumes that the number of interactive requests is not very high. This is because, each interactive request causes the merged stream to start a new stream. This is therefore not a recommended option due to the level of interaction present in an interactive video-on-demand service.

Volatile storage:In this approach, every single video title that is transferred to a video server is cached in the server's local disk completely. Apart from its local storage, each video server has a volatile storage where the video content is stored for a short period of time. This procedure enables any future requests to be served from the local server without any additional video streams required from the distant server (the only exception is when a future request is for a part of the video which is still not present in the local volatile storage). There are no restrictions in the number of interactive requests as all the requests are satisfied from the local video server. The only drawback with this approach is that it increases the storage cost as additional volatile storage is required at each video server connected to an exchange.

Ideally, this approach can be combined with patching to achieve a hybrid solution which will be cost effective in terms of storage and bandwidth costs. The storage costs and network costs have to be compared and a topology has to be designed accordingly.

IV.CONCLUSION:

VoD service sets many requirements towards the parameters of the network that provides the services. In order to meet the Quality requirements for VoD service, minimize the cost of equipment for maximize the income of the telecommunication services provider, it is necessary to solve the optimization problem. Bandwidth Reduction Techniques are used to solve the optimization problem. Next, Consequently to solve the design problem for each of the network levels separately, when the results (services) of the design on one level become the input data for the remaining network levels, will not consider the system as a whole, but only provides an optimal result for each sublevel, which can lead to local optimums but not optimally solve the problem as a whole. This drawback can be eliminated by way of applying the some mathematical model of hierarchical graph during the planning and designing of the VoD services systems.

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