RTT TECHNOLOGY TOPIC
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Storage persistency

Introduction

In our June HOT TOPIC (The Circuit Switch to Session Transition) we identified session persistency as a component of **session value** (together with session immediacy, complexity and consistency).

In this month's HOT TOPIC we explore immediacy, consistency, complexity and persistency as components of **storage value**.

Differentiating short term and long term storage

We can divide storage into short term and long term storage. We can define short term storage as the memory needed to support real time operating systems (systems that respond to external asynchronous events in a **predictable** amount of time). Here, the emphasis is on read/write times, i.e. speed (immediacy) and consistency. Time constants are dictated by instruction cycle times (typically less than 100 ns) and operating system response times (typically less than 50 ms). Note that delay and delay variability need to be closely controlled to protect the 'real time' properties of the tasks being executed by the software.

The buffering used in IP routers can also be regarded as short term storage. We use buffering in an IP network to smooth offered traffic (effectively we are using memory bandwidth to improve delivery bandwidth utilisation). In this context, we can describe short term storage as the memory needed to support a 'real time' network (a network that responds to external asynchronous traffic in a **predictable** amount of time). The problem here is that an integral part of the IP network proposition is differentiated quality of service (prioritisation and queue management) and differentiated authentication procedures (secure and not so secure). This increases policy complexity. Policy complexity determines the amount of information that needs to be extracted from a packet header (sometimes described as deep packet examination). Complex decisions then have to be taken by the router, for example, how packets and/or packet streams in an IP flow should be treated and routed.

The general idea is that the router receives a packet, examines the destination address, determines the address of the next hop router and sends the packet on to the next hop. Performance is determined by the packet forwarding rate and the routing table size and is dependent on software and hardware - the efficiency of the buffering process, table storage, look up delay, the ability to move from read to write, ie speed and latency metrics (immediacy). If we add in data security, it may be necessary to examine the entire packet header and do a multiple table look up which will introduce delay and delay variability, i.e. classification delay (a lack of consistency).

To try and minimise delay, the router divides packet processing into several tasks. The data comes in from the physical layer and is demultiplexed in accordance with the MAC (medium access control) layer rule set, i.e. packets within frames within multi-frames. The packet is then sent for classification. A hardware co-processor may be used to improve look up performance. Performance is defined by the number of searches per second, the number of entries in the table and whether or not multi-protocol tables are used. Multi-protocol tables are needed if differentiated classes of service are supported. A software based standard processor based solution can take several hundred instruction cycles to classify a packet with QOS and/or security attributes. A co-processor can perform the task in a single clock cycle but lacks flexibility, i.e. it can only be used when the decisions to be taken are pre-defined and repetitive.

Either way, the quality needed from buffer bandwidth can be defined as immediacy, consistency and the ability to respond to complicated, complex and highly dynamic priority policies.

We might also choose to define store and forward as short term storage. We use store and forward in voice mail and SMS (and sometimes EMS and MMS) applications.

As with router buffer bandwidth, information is stored temporarily to help make the traffic easier to send. Here, we are not so concerned about immediacy though consistency of end to end delay is an important performance target.

Defining long term storage

Long term storage is where we store information for ourselves or for others with no particular time scale pre-defined as to when the information will be retrieved or read. This is sometimes described as persistent storage.

A good example of storage persistency (multi-media storage persistency) would be the Bayeux tapestry (1066). The Domesday Book - a follow on project by William the Conqueror in 1086 is another example, hand written on parchment - (a slow write cycle but a stable storage medium) and still in good shape (available to read in the UK public records office in Kew provided you understand ancient Latin).

Digital storage media is rather more changeable and probably much less persistent. There is a fine and very British case study of the problems encountered by the BBC and their contractor, Logica, when trying to recreate the ideals of the Domesday Book (a public record of private lives) 925 years later.

Go to www.atsf.co.uk/dottext/domesday.html for a blow by blow account of the vagaries of digital storage hardware and digital storage software in the early to mid 1980's.

Twenty years on, long term storage stability and long term compatibility remains a major issue. The stability issues are partly hardware, the loss of translucence in optical storage for example and partly software including long term access key management protocols.

Discussions on this subject can be found on the web site hosted by the digital preservation coalition www.dpconline.org.

Storage incompatibility creates application incompatibility. This is a problem because the user needs and expects service and application transparency. This is difficult to deliver when storage resources fail to talk to one another and/or to an external application.

Sun and Microsoft are both (separately) trying to address this in present product storage management software product lines. Sun's 'Jiro' product is intended to replicate what Java is doing for software - the write once read anywhere philosophy re-run as the store once store anywhere philosophy. The 'cost' of storage transparency is an additional management logic layer interposed between the presentation and transport layer in the OSI model. Additional case study information is available on the Jiro web site www.jiro.com or from the storage networks industry association (www.snia.org) and/or the distributed management task force (www.dmtf.org).

Summary

Wireless and wireline networks already make money out of storage - voice messaging uses storage resources, SMS - a store and forward service uses storage resources, down loadable ring tones use storage resources, backing up subscriber telephone address books in the network uses storage resources.

However, with persistent (long term) storage, stored information can gain value over time (storage asset value appreciation) provided we can maintain storage stability (memory volatility) and access capability. The increasing diversity of storage media (solid state and disk based) has created a number of interoperability issues partly, though not totally, addressed by existing vendors. Storage compatibility and application compatibility are an important network quality metric with a direct and indirect impact on delivered service quality (particularly service consistency).

Resources

Issues of persistent storage management - www.atsf.co.uk/dottext/domesday.html.

Digital media preservation - www.dpconline.org.

Jiro storage management software - www.jiro.com.

Storage Network Management - www.snia.org.

Distributed Network Management - www.dmtf.org.

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We aim to introduce new terminology and new ideas to clarify present and future technology and business issues.

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