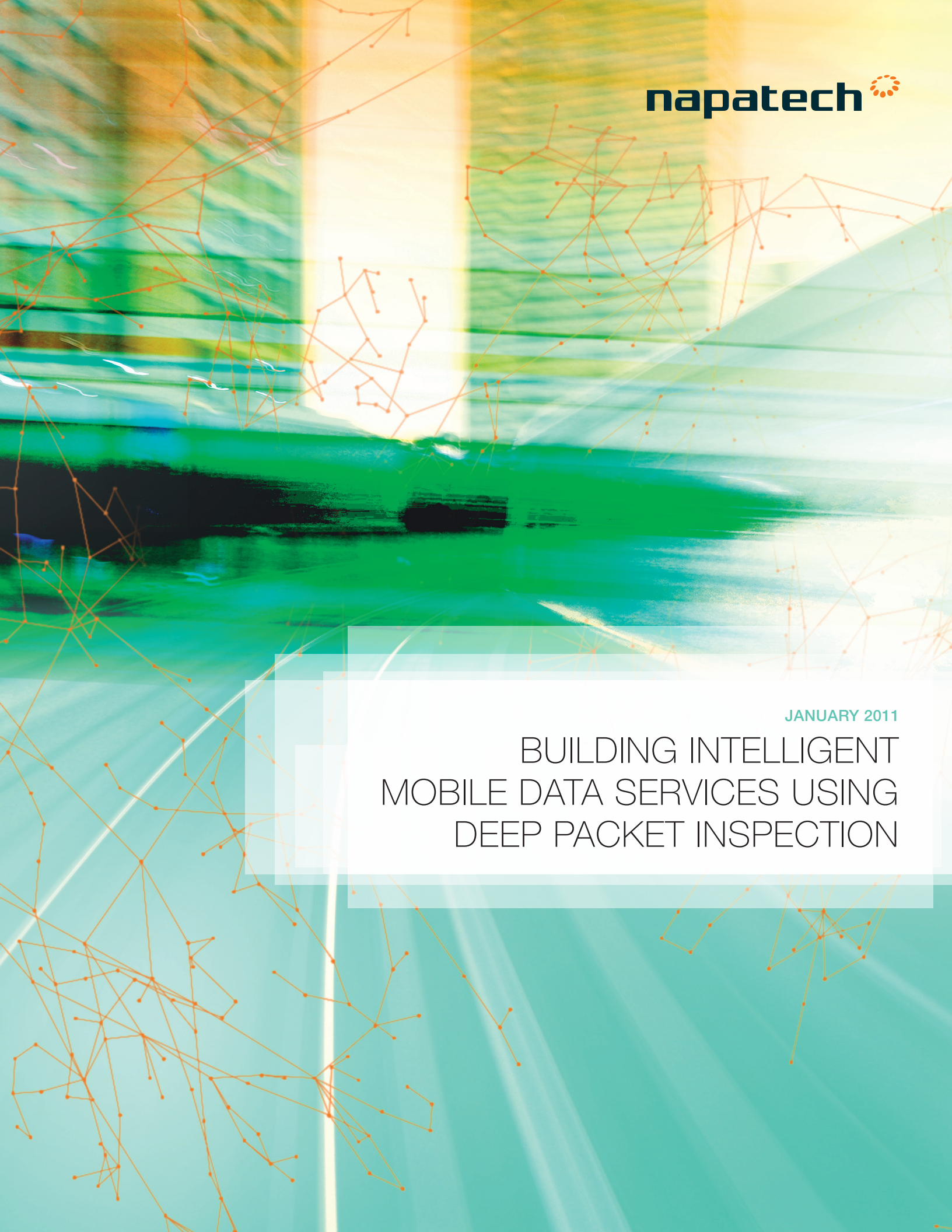

JANUARY 2011

BUILDING INTELLIGENT MOBILE DATA SERVICES USING DEEP PACKET INSPECTION

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WHAT IS DEEP PACKET INSPECTION?

Deep Packet Inspection (DPI) is a term that is now well known in mobile networks. In essence, DPI allows critical information to be extracted from packet data. This information can be used for traffic management and security purposes, but in the context of this white paper, DPI relates to the extraction of network and service management information from Ethernet and IP packets.

Since Ethernet and IP protocols were not designed with network and service management in mind, it is more difficult to find the same network information that is an integral part of traditional telecom protocols. DPI systems can extract the relevant information from Ethernet and the protocols encapsulated by Ethernet (e.g. IP, TCP and UDP) that can then be used to manage networks and services.

One of the ways of implementing such a DPI system is to use Deep Packet Capture (DPC) technology. Many DPI systems are based on proprietary hardware development, but by using DPC technology, it is possible to use commercial off-the-shelf PC server platforms. This provides a powerful, yet cost-effective hardware platform for system development.

DPC provides fast extraction of network and service management information at line-speed with zero data loss. This includes information on well-defined services[1]. This capability is provided by intelligent network adapters, which are designed to interact with application software hosted on the PC server's multi-core CPU architecture. This approach provides both scalability and flexibility in meeting growing bandwidth and complexity demands.

In the context of this white paper, DPI provides the foundation for policy enforcement[2] and intelligent billing solutions that can help mobile carriers to avoid the commoditization of mobile data services. By basing development on DPC technology and standard PC servers, Telecom Equipment Manufacturers (TEMs) have an opportunity to quickly address the growing concerns of carriers regarding the mobile data explosion they are facing.

Before looking at DPI and DPC in more detail, we will examine the mobile data explosion, what it means for mobile carriers and what they can do to address it. Having set the scene, we will look at the opportunity this situation presents for TEMs.

THE VALUE OF MOBILITY AND THE MOBILE DATA EXPLOSION

The ability to complete tasks while on the move has proven to be a highly valued feature for consumers. This can clearly be seen by examining the sales of computing devices.

According to iSuppli, mobile PCs, such as laptops, have replaced desktop PCs as the preferred personal computing device. However, sales of smartphones are set to outshine sales of both these devices in the near future.

The stage is thus set for mobile data success. According to Heavy Reading, there will be over 500 million mobile data subscribers by the end of 2010[3]. This should be compared with the 580 million fixed broadband subscribers forecast for the end of 2010[4]. In addition, Heavy Reading expects the number of mobile data subscribers to grow rapidly to 1.5 billion by 2014.

[1] "Well-defined services" are services that can be identified by TCP and UDP port numbers, such as email, web traffic, VoIP, IPTV etc.)

[2] Otherwise known as policy management, policy control or policy servers

[3] Heavy Reading/Tekelec White Paper: "Policy Control: Adapting for What's Next", October 2010

[4] BuddeComm report: "Global – Key Telecoms, Mobile and Broadband Statistics", 2010

FIGURE1
Shipment forecast for different computing devices
Source: iSuppli Q4 2010 Wireless Communications Special Report, Dec 2010

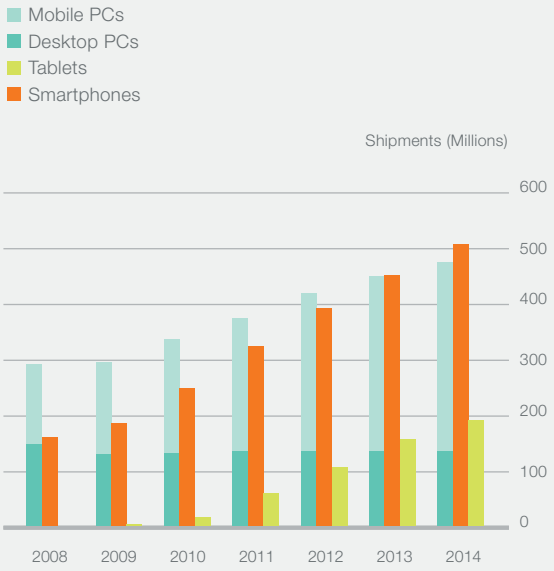
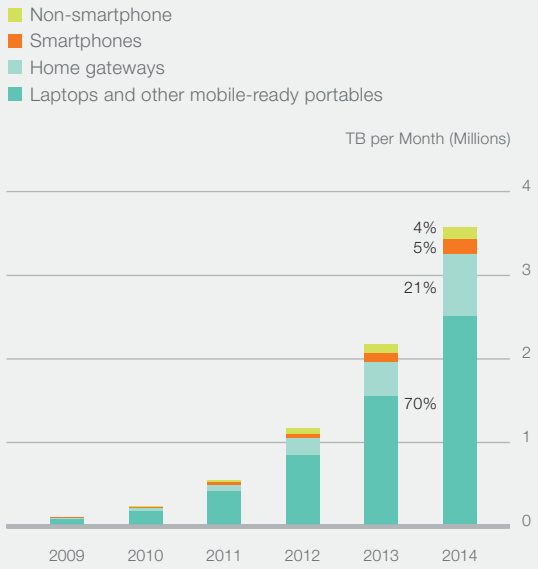


FIGURE 2
Mobile data traffic growth forecast 2009 to 2014
Source: Cisco VNI Mobile, 2010



This is echoed by other analysts and network companies, such as Cisco, who are predicting an annual doubling of mobile data traffic.

As can be seen, the majority of mobile data traffic will be generated by laptops and similar devices, but smartphone traffic is expected to grow rapidly with annual growth rates of 140%.

According to Cisco, the mobile data connection rates in different regions are today in the kbps range, so there is plenty of room for improvement when compared with the multi-Mbps fixed-broadband connections that consumers use at home.

TABLE 1
Average smartphone mobile speed by region
Source: Cisco VNI Mobile, 2010 – learn more at www.ciscovnipulse.com

Average Smartphone Mobile Speed by Region (in kbps)	
WAsia Pacific	280
Japan	690
Western Europe	691
North America	418
Latin America	321
Middle East and Africa	106
Central Europe	263

Those carriers that are first to provide higher connection rates will capture the largest share of the smartphone market. Smartphones are expected to account for 53% of total mobile handsets sold worldwide in 2015 and will exceed 1 billion units already in 2013, so this business is worth fighting for[5].

However, this will come at a cost. It will require investment in faster technologies, such as 4G Long Term Evolution (LTE) with promised connection rates of at least 100 Mbps. LTE is entirely IP-based and will require investment in increasing the capacity of the core IP network and mobile backhaul connections. In-Stat reported recently that total expenditures for backhaul alone will set mobile carriers back nearly $117 billion by 2014, a 41% increase over 2009 expenditures of $83 billion[6].

[5] Heavy Reading/Tekelec White Paper: "Policy Control: Adapting for What's Next", October 2010

The success and projected growth of mobile data provides a golden opportunity for mobile carriers, but also a serious threat: can the revenue generated by mobile data services cover the investment needed to increase capacity?

THE SCISSOR EFFECT

Increasing network capacity investment can only be justified if the revenue generated per customer can cover the cost. However, mobile carriers are in danger of falling into the same dilemma that has faced fixed-line carriers: namely the "revenue gap" or "scissor effect".

By maintaining a flat-rate, "all-you-can eat" model, users consume more traffic without paying more for this usage. This pricing model is very attractive for price-sensitive consumers and also has the advantage in that it is easy to administer for carriers. However, the result is commoditization, as the only competitive parameter left is price per Mbps that will inevitably be pushed lower as it is easy for competitors to copy this price model.

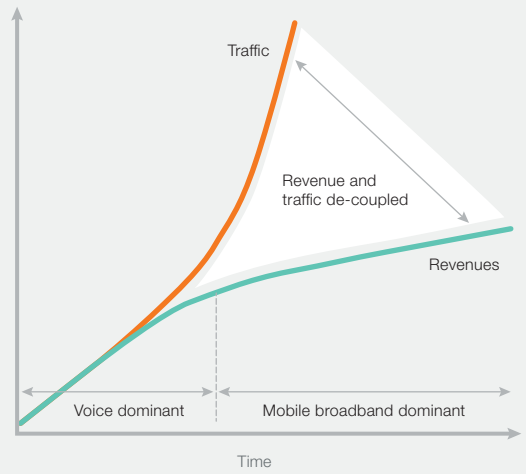


FIGURE 3
Scissor effect or revenue gap
Source: Light Reading

This effect is already being seen in the fixed broadband market. The UK regulator Ofcom reported that data volumes on UK Internet infrastructure networks rose 68% in the period Q1 2009 to Q1 2010[7]. However, fixed broadband take-up remained flat with a slight fall in fixed-line Internet access revenues. Average household spending on telecom services fell 3.7% during 2009 continuing a trend over the last 5 years, which has seen a 13% decline in household spending in real terms. This despite the fact that call volumes have gone up 10% and Internet connections have increased by 50% in the same period! In other words, more consumption, but flat or falling revenues.

TEMs have been under pressure to reduce prices, and thereby cost, to help carriers in meeting this challenge and achieving a lower cost per bit, but there are limits to how much this type of cost reduction can achieve.

AVOIDING THE SCISSOR EFFECT

How can mobile carriers avoid the scissor effect? There is no question that investment in extra capacity is needed, both strategically and operationally. Higher line-rates also help reduce cost per bit. The challenge is to avoid commoditization of mobile data services.

Avoiding commoditization can be achieved in the following ways:

- Use limits or caps on bandwidth or consumption so that the price per Mbps can be controlled
- Establish a walled garden for content-based services running on top of all-you-can-eat connections
- Provide more user-centric, intelligent services with built-in customer service features at a premium price

Using download caps with penalties for exceeding bandwidth agreements is an effective approach, as it does curb usage and provides a means of controlling bandwidth. However, download caps are a paradox. They essentially penalize behavior that would normally be encouraged, namely product consumption. More importantly, download caps are not effective in the long term, as competition can easily lure customers away with higher caps or lower prices per cap. The inevitable end game is the disappearance of caps and a return to all-you-can-eat models.

Building loyalty by offering valued services of high quality is the alternative approach. One approach taken by many carriers is the establishment of exclusive content only available

[6] In-Stat research: "Wireless Backhaul: The Network Behind LTE, WiMAX, and 3G", October 2010
[7] Ofcom annual "Communications Market Report", August 2010
[8] Morgan Stanley: "Mobile Internet Report", December 2009

via the carrier's portal. Music download services are a good example. Unfortunately, research is showing that customers do not remain within this "walled garden" for too long. In the UK, mobile carrier portals' share of Internet users fell from 57% of Internet accesses in 2008 to 22% in 2009. At the same time, Google rose from 44% to 82%[8].

This highlights another issue for carriers, namely dealing with "Over-The-Top" (OTT) content offered on Internet websites. The availability of this content on the Internet makes it extremely difficult for carriers to capture a share of the revenue generated by this content, which is the basis of the net neutrality discussion in the United States. Building a business model on the basis of content and walled gardens is thus questionable, as customers will find a way around any imposed restrictions.

Alternative pricing models do exist that have the potential of avoiding the scissor effect, while also potentially addressing the OTT issue.

Heavy Reading provided a comprehensive overview of existing and alternative services and pricing models in a recent white paper[9]. These alternatives ranged from traditional consumption cap approaches to differentiated service plans based on the type of service, device, time of day, location or state of congestion in the network. This included the ability to prioritize OTT services. The most interesting alternative was a service allowing the customer to control their own service via a dashboard or portal.

Common for all these services is the need for up-to-date information on network and service usage. The availability of real-time information not only helps build more intelligent services that better suit customer usage needs, but also allows better responsiveness as users' needs change.

INTELLIGENT MOBILE SERVICES

As stated previously, one of the advantages of all-you-can-eat models is that they are simple to administer. No special intelligence is needed in either the network or the service management. All that is required is that a bill is paid each month by the subscriber and that the agreed bandwidth is provided. This service offering meets the needs of price-sensitive, but low loyalty customers. The disadvantage is that the prices that such a service can command will inevitably be pressed lower by competition. Cost, value and price are thus interlinked, as one would expect.

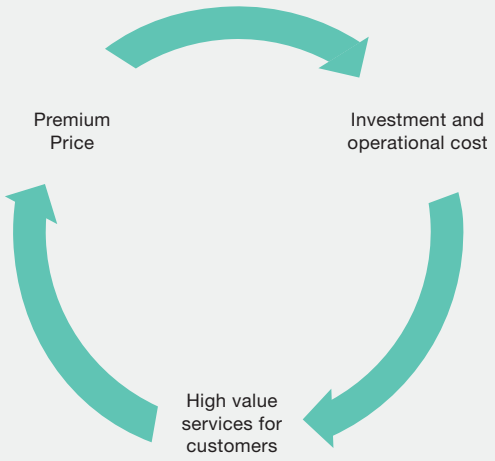


FIGURE 4
Positive cycle of premium mobile service investment

High loyalty, quality conscious customers can be addressed with a different set of service offerings that focus on ease of use and customer service. These customers are willing to pay more for a no-fuss, quality service experience, but it stands to reason that if you want to increase the quality and value provided, the cost and investment will also increase. On the other hand, the premium price will generate revenue that can drive investments.

Implementing intelligent mobile services requires investment in a network, service and policy management infrastructure that is based on detailed service consumption information:

- Which services are being used?
- Who are using them?
- How much are they using them?
- Are they receiving the quality and performance that was agreed?

The key difference with mobile services based on IP, such as in LTE, is that this picture is dynamic. Since multiple consumers and services share IP network bandwidth on a packet-by-packet basis, maintaining an overview of what is going on in the network requires constant monitoring and extraction of management information. The advantage of doing this is that changes in behavior, service mix or consumption can be detected immediately providing an opportunity for the

[9] Heavy Reading/Tekelec White Paper: "Policy Control: Adapting for What's Next", October 2010

carrier to react constructively and proactively to improve the user's experience. For example, take the case of a download of an HD film to your mobile device. Imagine that your credit runs out in the middle of the download. At this point, the carrier can react in three ways:

- If real-time data is not being collected, the credit over-run will first be detected later and potentially charged at a punitive rate
- If the credit over-run is detected immediately, the carrier can choose to stop the download
- Alternatively, the carrier can detect the over-run and offer the possibility of upgrading or extending the credit for the length of the download

Which of these options would lead to a more satisfied and loyal customer?

INTELLIGENT MOBILE NETWORKS

The foundation for intelligent mobile services is management information. Specifically, the network must have the capability of extracting management information and providing this to management systems that will allow the carrier to react in real-time to changes in the network.

In the case of mobile networks and LTE in particular, Policy Charging and Enforcement Functions (PCEF) have been defined that are responsible for extracting and forwarding service usage and other management information to the Policy Charging and Rule Function (PCRF)[10]. The PCEF function can be implemented in a number of network nodes and requires DPI technology to extract the information required.

Policy servers can be used to implement the PCRF function, which also requires DPI capabilities. Dedicated DPI systems are also being used to implement the PCEF function. The advantage of dedicated, independent systems, such as DPI systems, is that they can be deployed at critical points in the network to provide the information required by network, service and policy management solutions.

Many DPI systems today are based on proprietary system hardware development. But, network adapters[11] are now available that allow DPI systems to be built using standard PC servers. Intelligent network adapters providing DPC capabilities can be used to extract network and service management information in real time. These adapters have the advantage of being able to operate at full line-rate with zero packet loss for all packet sizes. This means that no critical management information is lost.

Intelligent network adapters are designed to be installed in standard PC servers. Modern PC servers provide a powerful, multi-core CPU architecture with enough processing power and memory for even the most demanding applications. There are also PC servers available that can meet strenuous telecom requirements, such as NEBS[12]. The combination of intelligent network adapters with DPC capability and PC servers provides a powerful, but cost-effective hardware platform for development of policy servers or DPI systems.

For more information on the DPC approach see the Napatech white paper "Scaling Policy Enforcement and Deep Packet Inspection".

SCALING PERFORMANCE TO MEET THE BANDWIDTH EXPLOSION

One of the advantages of the DPC approach is its ability to scale. Intelligent network adapters such as Napatech accelerators for network management and security applications can operate at line-rate, even at speeds up to 40 Gbps. Network and service management information is extracted in real time for well-defined services and provided to application software running on the PC server for further processing and presentation.

Certain services cannot be determined without complex inspection of the Ethernet frame and encapsulated payloads. This is the case for Internet OTT services and services that trying to avoid detection. Such service discovery tasks can be performed by application software taking advantage of the PC server's multi-core CPU architecture.

One of the advantages of performing service discovery on multi-core CPUs is scalability. New CPU chipsets are released each year providing approximately 60% performance improvement and typically more cores per CPU. PC server

[10] This is a central function in LTE mobile networks that controls subscriber access to services.
[11] A network adapter or Network Interface Card (NIC), is a data input/output expansion board that can be installed in a standard PC server
[12] Network Equipment Building Services (NEBS) – US telecom equipment design guidelines for central office equipment

manufacturers are quick to take advantage of these developments leading to an annual performance scaling opportunity.

Network intelligence software exists that can help implement service discovery. This type of software is designed to run on multi-core CPUs and can detect literally hundreds of services that are normally difficult to detect. This provides a significant head-start for any policy server or DPI system implementation.

For more on network intelligence software, see the Network Intelligence Alliance (www.nialliance.org).

GRASPING THE MOBILE DATA OPPORTUNITY WITH DEEP PACKET CAPTURE

TEMs can use the DPC approach to build scalable and flexible policy servers and DPI systems and thereby grasp the tremendous opportunity developing in mobile data. In particular TEMs focused on network, service and policy management have an opportunity to provide high value solutions to mobile carriers that will allow them to implement intelligent mobile data services and thus avoid commoditization of these services.

Infonetics has forecast the market for independent DPI systems to be $1.5 billion in 2014. The associated market for policy servers, which use DPI technology, is estimated by Infonetics to be $471 million in 2010 growing to $1.6 billion in 2014. This strong growth reflects mobile carriers' interest in building more intelligent networks capable of supporting mobile data services.

DPC technology can be used by TEMs to build policy servers and DPI systems quickly and cost effectively based on standard off-the-shelf hardware. This will help TEMs to react quickly to the needs of mobile carriers for more intelligent services that can help avert the dreaded scissor effect.

COMPANY PROFILE

Napatech is the world leader in accelerating network management and security applications. As data volume and complexity grow, the performance of these applications needs to stay ahead of the speed of networks in order to do their jobs. We make this possible, for even the most demanding financial, telecom, corporate and government networks.

Now and in the future, we enable our customers' applications to run faster than the networks they need to manage and protect.

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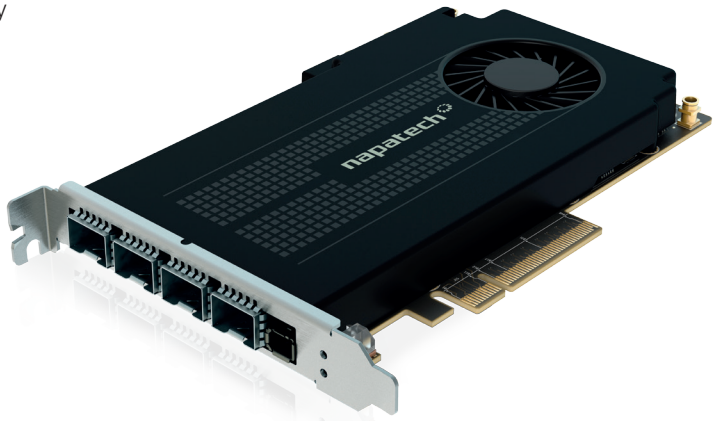

EUROPE, MIDDLE EAST AND AFRICA
Napatech A/S
Copenhagen, Denmark

Tel. +45 4596 1500
ntemeasales@napatech.com
www.napatech.com

NORTH AMERICA
Napatech Inc.
Boston, Massachusetts
Mountain View, California
Washington D.C.

Tel. +1 888 318 8288
ntamericassales@napatech.com
www.napatech.com

SOUTH AMERICA
Napatech
São Paulo, Brazil

Tel. +55 11 2127 0782
ntsouthamericasales@napatech.com
www.napatech.com

APAC
Napatech Japan K.K.
Tokyo, Japan
Tel. +81 3 5326 3374

Napatech Korea
Seoul, South Korea
Tel. +82 2 6001 3545

ntapacsales@napatech.com
www.napatech.com