INTERNATIONAL INTERCONNECT FORUM

FOR SERVICES OVER IP

(i3 Forum)

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Overview of network access types for a Multiservice IP interconnection (Release 1.1) May 7th, 2012

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Executive Summary

The purpose of this document is to help the reader to understand what different kinds of network access types can be envisaged for supporting future multi-service, IP-based interconnections between carriers. When moving to multiservice IP interconnections, some of these legacy "single-service" interconnections will be replaced by a single multi-service interconnect per IP(X) Provider, giving access to all the IP based services supported by that provider.

Different types of network access types exist for this purpose, all offering different levels of quality, security and availability at a different cost. When referring to GSMA-IPX, an IPX service provider has offer its services on dedicated private link or virtual private dedicated link. Networks access types with quality of service support will be better suited for IPX services with a real-time character. These links should however be available at an acceptable cost.

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1 Introduction

This document aims at briefly describing the different types of Interconnection technologies that can be used to support an IP service interconnection between two IPX Providers. As the i3 Forum is not a standardization body, this document lists the interconnection types, but does not impose any of these types. If an interconnection type is recommended or imposed by a standardisation body (ITU-T, ETSI TISPAN, IETF, 3GPP), this is mentioned in the document.

This document discusses network access types underlying an interconnection at service level. These service interconnections will be discussed more in detail in the I3forum document "Enabling inter-IPX-provider multi-service NNI (IPX-NNI)" [1].

2 Definition

The network access type is the basis for any multiservice IP service offer. Before IPX, each service was in many cases based on a different network and each service had its own physical interconnection specific for the service. Examples are a TDM interconnection supporting narrowband voice and next to that an Ethernet based interconnection supporting GRX and next to that an SDH connection to support Internet transit, etc…

When moving to multiservice IP interconnections, some of these legacy "single-service" interconnections will be replaced by a single multiservice interconnect per IPX Provider, giving access to all the IP based services supported by that IP(X) service provider.

3 Overview of IP interconnection types

3.1 Dedicated private link

Through a dedicated private link, networks are interconnected with each other. This can be a physical line at a private property, or in a carrier hotel. Depending on the bandwidth required, the policy of the datacenter and the country, the type of Layer 1 private link is Copper (distance dependent bandwidth, usually for lower bandwidth at a lower cost, not supported by all providers anymore) or Fiber (high bandwidth, higher cost).

These dedicated private links can be accompanied by back-up links. These back-up links can again be dedicated private (in a second datacenter location), virtual private, or even public Internet based.

Benefits:

- Private, security guaranteed
- Dedicated bandwidth, hence simple to set up and maintain
- Reasonable cost
- Clear responsibilities in case of outage or network problems

Disadvantages:

- Only possible if two IPX Providers are collocated in the same datacentre

3.2 Virtual private dedicated link

When a dedicated private link is not possible as IPX Providers are not present at the same location, they need to interconnect using a 3rd party network service provider. In this case, virtual private dedicated links are available offering the highest possible level of quality and security.

Different layer 2/3 options are available for setting a virtual private dedicated line, the two most common ones being:

- Leased lines (SONET/SDH9
- Ethernet Virtual Private Line (point-to-point Ethernet connection over SONET/SDH)
- Virtual leased lines (Ethernet-based point to point communication over IP/MPLS)

<u>**Benefits**</u>:

- Private, security guaranteed
- Dedicated, however virtually
- QoS, however dependent of service level of 3rd party

<u>**Disadvantages**</u>:

- Requires both IPX Providers to be connected to the same 3rd party network service provider
- Higher cost

3.3 Virtual private "over the Internet" link

If cost becomes a predominant decision factor, Internet virtual private lines or single AS connections are the most convenient solution.   Two options are available:

3.3.1 Single AS interconnections

Single AS (Autonomous System) interconnections are links using the same service provider and the same ASN (Autonomous System Number) for routing.   The use of a Single AS network ensures that packets take the shortest route which may contribute to the quality of real-time services such as voice or Video.

<u>**Benefits**</u>

- Re-use of existing Internet connections and contracts (if both parties are already connected to the same service provider)
- By avoiding the public internet :

   o there are limited security risks since traffic is on the network of the same service provider

   o High QoS levels, albeit without guarantees

<u>Disadvantages</u>

- No guaranteed QoS

- Management complexity of maintaining multiple services over the same interconnections (with associated risks on QoS)

- Requires both providers to be connected to the same 3rd party network service provider

- Reasonable cost

3.3.2 IPsec-based VPN connections

When two carriers want to interconnect using the public Internet, however with security, they could opt for an IPsec VPN.

<u>Benefits</u>:

- Allows two providers to be interconnected using different ISPs

- Low (direct recurring monthly) costs

<u>Disadvantages</u>:

- Complexity of set-up (IPsec interconnections between devices of different vendors)

- Hidden management costs

- Higher CAPEX (as specific routers are required)

- No QoS

3.4 **Public Internet**

More and more service providers interconnect over the public internet.   They do this for a number of reasons:

- Security mechanisms embedded in VoIP protocols (Digest authentication, SIP-TLS for signalling, S-RTP for real-time content), provide carrier grade security levels.

- There is excess internet capacity

- A redundant interconnection (with 2 or more ISPs) offers (near) 100% uptime of global internet connectivity

Therefore, a public Internet interconnection has the following pro's and con's:

<u>Benefits</u>:

- Allows two carriers to be interconnected using different ISPs

- Low costs (set-up as well as recurring)

- Simplicity of interconnection

Disadvantages:

- No QoS (which can negatively impact the quality of services with a real-time character especially during internet peak hours)

- No security (if no encryption is set up)

3.5 Multi-service exchange (MSE)

An alternative to directly interconnecting between carriers is to interconnect indirectly through Service Exchanges (ex. Voice Exchanges). In theory, the benefit of interconnecting with such Exchanges is that by simply connecting to a limited number of them would allow you to interconnect to a large number of service providers without having to directly (physically or virtually) connect with each of them.

The success of MSE's until date is limited.   Between 2005 and 2008, many companies started offering Voice Peering Exchange services (VPE).   Because of the high number of voice peering service providers,   service providers wanting to interconnect with each other were often interconnected to different VPE and, as a result, had to interconnect directly anyways.   As a result of decreased interest in VPE services, a considerable number of services and service providers disappeared from the market.
The fact that today a limited number of players remain, increases again the likelihood of being able to interconnect with a large number of service providers using one single MSE.   An element that speaks against future development of MSE's is the fact that some standardisation bodies/industry associations, such as the GSMA requires private interconnections between IPX Providers or a limited number of hubs in between originating and terminating service provider networks.

Hereby an overview of pro's and con's of working with a MSE:

Benefits

- Only one singe interconnection gives access to the services of a private community of service providers

- Low costs for set up (especially when a large number of service providers are part of the community)

Disadvantages

- As many service providers host at the same locations, interconnecting directly may still be the most cost-effective way to interconnect.

- Business model not in-line with GSMA IPX requirements. In other words, this approach cannot be used by GSMA compliant IPX service providers, for services that require a limited number of hops.

- Chance of not being able to interconnect with the service provider of choice (as both are interconnected to a different MSE)

4 Relation between IP interconnection and IPX services

In theory, all kinds of IP communication services (voice, video, presence, network authentication information) can be delivered over all the interconnection types described in section 3 of this document. The dedicated private links will provide the highest quality and security guarantees at the highest costs, the private or public links over the internet (if implemented redundantly) will provide good quality at a reasonable cost.

The term IPX has been introduced by the GSMA and is in the context of mobile wholesale services referred to as GSMA-IPX. As QoS is a cornerstone of the GSMA-IPX specifications, a GSMA-IPX compliant service cannot be built on internet-based connectivity, see below.

Today, the term IPX is used as a generic word, going beyond the mobile industry. It is most often, but not always, referred to as a high quality IP-based service interconnection between service providers. Sometimes, VoIP service providers use the term for any VoIP interconnection regardless of the quality aspects of the service. The flavors of "IPX"-named services and their differences with regards business model, QoS, SLA, interoperability, routing, security and business model have been set out in document [2] .

4.1 GSMA-IPX

For QoS and security reasons, a full GSMA-IPX network as per the GSMA specifications must only use a private IP network. Which means an IP network logically isolated from other networks using the Internet or accessible from the Internet. It must be an IP network that is only connected to other networks that are part of the GSMA-IPX system only. The GSMA specification recently authorized the interconnection of a GSMA-IPX voice equipment to the TDM network where required to terminate traffic, e.g. voice call.

From a pure theoretical technical point of view, IP-sec-based interconnections currently allowed for access only) could support GSMA IPX as they are secure. However in practice, an IP-sec based interconnection can never respect the QoS requirements imposed to a GSMA-IPX service.

We can conclude that the above described internet-based interconnections types, regardless of the security services that are implemented on top the internet, are not compatible with GSMA-IPX specifications. Hence only the following two interconnection types qualify for GSMA-IPX:
- Dedicated private line (as described in section 3.1)
- Virtual private dedicate line (as described in section 3.2)

4.2 I3 forum IP interconnection and VoIPX

Although the I3 forum is not a standardisation body, it developed recommendations for migrating TMD interconnections to VoIP hereby specifying requirements with regards to QoS and security.

Today, the internet can be congested during peak hours. By consequence, using dedicated links that guarantee QoS will be more suitable to support real-time traffic. IPX cannot only assure capacity and end-to-end QoS, but also security.

Detailed recommendations can be found in documents [3] and [4].

4.3 **Other IPX-labelled services**

Several TDM voice service providers allow their customers to interconnect in IP with no specific requirements with regards to interconnection technology used.   Some name these services "IPX". In other words, all of most interconnection types are possible and are negotiated between parties. Several VoIP service providers offer voice origination and termination services over internet-based interconnections.   Some of these providers label their service "IPX". [2]

5 Conclusions

IPX services are different from internet-based services. The key differciator for IXP end-to-end quality of service, security and cascading. While real-time internet-based services (such as voice or video), may suffer quality issues because of congestion of internet traffic, IPX- services offer a consistent quality of service.
When referring to GSMA-IPX, an IPX service provider has offer its services on dedicated private link or virtual private dedicated link. The I3forum recommends using dedicated, quality of service enabled links for future IP-based multi-service interconnections between carriers to the condition that these dedicated links are available at an acceptable cost.

6 References

[1] I3forum "Enabling inter-IPX-provider multi-service NNI (IPX-NNI)", not yet published.

[2] I3forum "Understanding the different flavours of IPeXchanges", May 2011.

[3] i3forum "Technical Specification for Voice over IPX service ,Release 3", May 2012.

[4] I3forum "Technical Interconnection Model for International Voice Services", Release 5, May 2012.