

NG.137 IPX Requirements
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1 Introduction

1.1 Overview

The IP packet eXchange (IPX) is a global, private, secure, IP network which supports end-to-end quality of service and the principle of cascading interconnect payments (when applicable). In order to provide these features, the IPX can be service aware, unlike the Internet and the GPRS Roaming eXchange (GRX) network. GRX is now considered an IPX service which is offered on an IPX Network. As the mobile technology evolves toward an all IP core, the IPX network is required to support many new services and not only at the transport level.

Several new requirements including Quality of Service (QoS), service awareness, SIGTRAN, DIAMETER, and cascaded responsibilities have been added to what has now become a framework, meaning a base transport network with a set of defined services and their specific requirements.

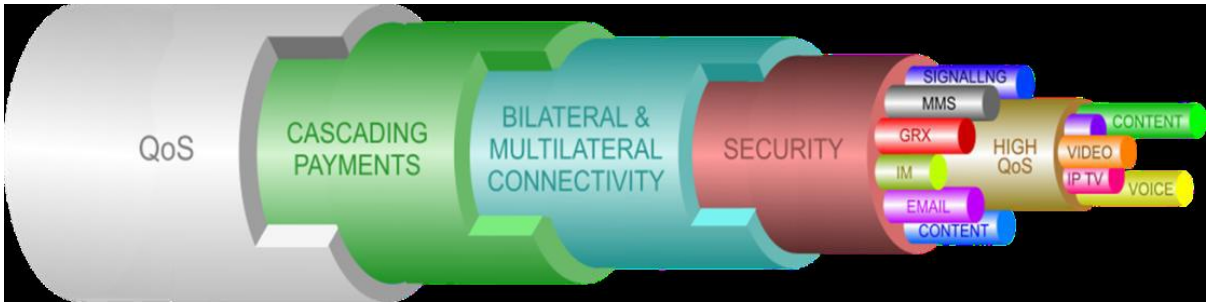

Figure 1: IPX: Schematic representation.

For definition and services that an IPX offers please refer to GSMA PRDs AA.51 and IR.34.

1.2 IPX Provider Definition

An IPX Provider is defined as an entity offering an IP network transport that provides end-to-end QoS and application/protocol proxies that provide service awareness to manage IP based application service exchanges. In addition to the IP transport network, IPX also supports cascading responsibility. The key components are:

- Secure IP network Transport
- Service awareness gateways, (also described as IPX Proxies)
- Cascading responsibility/support for billing and SLAs.

1.3 Scope

This PRD includes:

- Requirements for peering between IPX Providers
- Requirements related to cascade responsibility
- Commercial obligations of IPX Providers

This document describes the requirements and responsibilities of the IPX Provider as it relates to the Connectivity Options described below and in Annex A primarily from a data perspective. Inherent in the services provided by an IPX is signalling. GSMA PRD IR.88 provides detailed information, architecture and protocols used across the different interfaces and the role of the IPX Provider. GSMA PRD FS.09 defines the guidelines on what to protect, where to protect and how to protect the end-to-end exchange of Diameter messages within the IPX ecosystem.

1.4 Definitions & Abbreviations

Definitions & Abbreviations used in this PRD and not detailed below can be found in GSMA PRD WA.03.

1.5 References

Ref	Doc Number	Title
1	AA.51	IPX definition
2	IR. 77	Inter-Operator IP Backbone Security Requirements for Service Providers and Inter-operator IP backbone Providers
3	IR.34	Guidelines for IPX Provider networks
4	IR.67	DNS and ENUM Guidelines for Service Providers and GRX and IPX Providers
5	WA.03	Definitions & Abbreviations
6	RFC2119	“Key words for use in RFCs to Indicate Requirement Levels”, S. Bradner, March 1997. Available at http://www.ietf.org/rfc/rfc2119.txt
7	AA.80	Agreement for IP Packet eXchange (IPX) Services
8	IN.01	Interworking Service Level Agreement
9	BA.51	Roaming Service Level Agreement Guidelines
10	NG.105	ENUM Guidelines for Service Providers and IPX Providers
11	IR.88	LTE and EPC Roaming Guidelines
12	FS.09	Diameter Interconnect Security

1.6 Conventions

The key words “must”, “must not”, “required”, “shall”, “shall not”, “should”, “should not”, “recommended”, “may”, and “optional” in this document are to be interpreted as described in RFC2119 **Error! Reference source not found.**.

2 IPI Framework and the IPX Domain

The GPRS Roaming Exchange (GRX) was created as a platform for enabling mobile data roaming.

GRX networks evolved from purely the exchange of 2.5G and 3G packet switched roaming services to additionally facilitate inter-working of MMS.

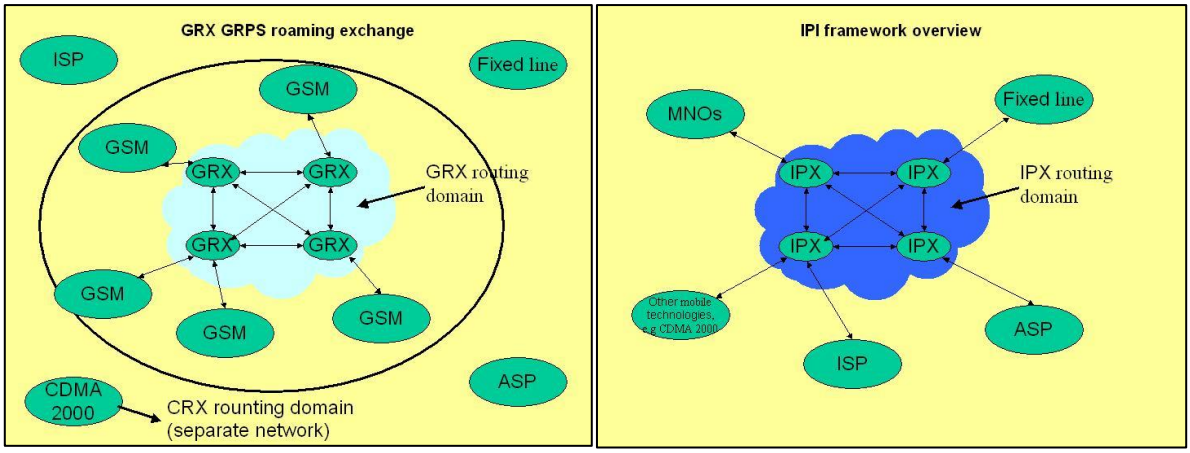

Figure 2: The Evolution of the GRX Model to the IPI Framework

The IP Inter-working (IPI) Framework extends the GRX model significantly (see above diagram). It opens this managed network approach to provide a managed IP network environment that includes traffic from both fixed and mobile networks (both GSM and non-GSM networks). It can also provide interconnection to parties such as ISPs, ASPs, Content Providers, etc. Such parties connected to the IPX are referred to as Service Providers.

To meet the demands of IP-based services, the IPI Framework introduced interworking with other Service Providers (e.g. Fixed Operators, CDMA Operators) on a broad range of IP based services while maintaining its core IPI principles.

The IPX Providers allow for interconnection at the service layer whereby individual services can be connected with specific quality and accounting as required per service, allowing Interworking between Service Providers.

The IPI delivers a secure, reliable and controlled network environment in which IPX Providers enable roaming and Interworking services between the end-users, subscribing to the services offered by relevant Service Providers (e.g. Mobile Network Operators). IPX Providers can also play a more active role, providing commercial intermediary transaction services for Mobile Network Operators and other Service Providers participating in the IPI Framework.

The template agreement for IPX Services outlining the terms and conditions between an IPX Provider and Service Provider can be found in GSMA PRD AA.80.

3 IPX Models

The IPI Framework plays an important role in defining the IP Packet Exchange (IPX) Domain. This managed network provides interconnection between different Service Providers - i.e. mobile and fixed operators, other service providers such as ISPs, ASPs and later possibly Content Providers and other stakeholders in a scalable and secure way, with special focus on guaranteed QoS.

Within the IPX Domain, IPX Providers manage the exchange of traffic and associated basic control information. IPX Providers must offer both technical and commercial interconnect capability via a single agreement with the Service Provider.

The IPI Framework is designed to support the delivery of services in a clearly defined, pre-agreed and guaranteed manner. These must be supported by strict and consistent associated level of security and QoS. Accounting within this managed environment will refer to both the service layer as well as the transport layer.

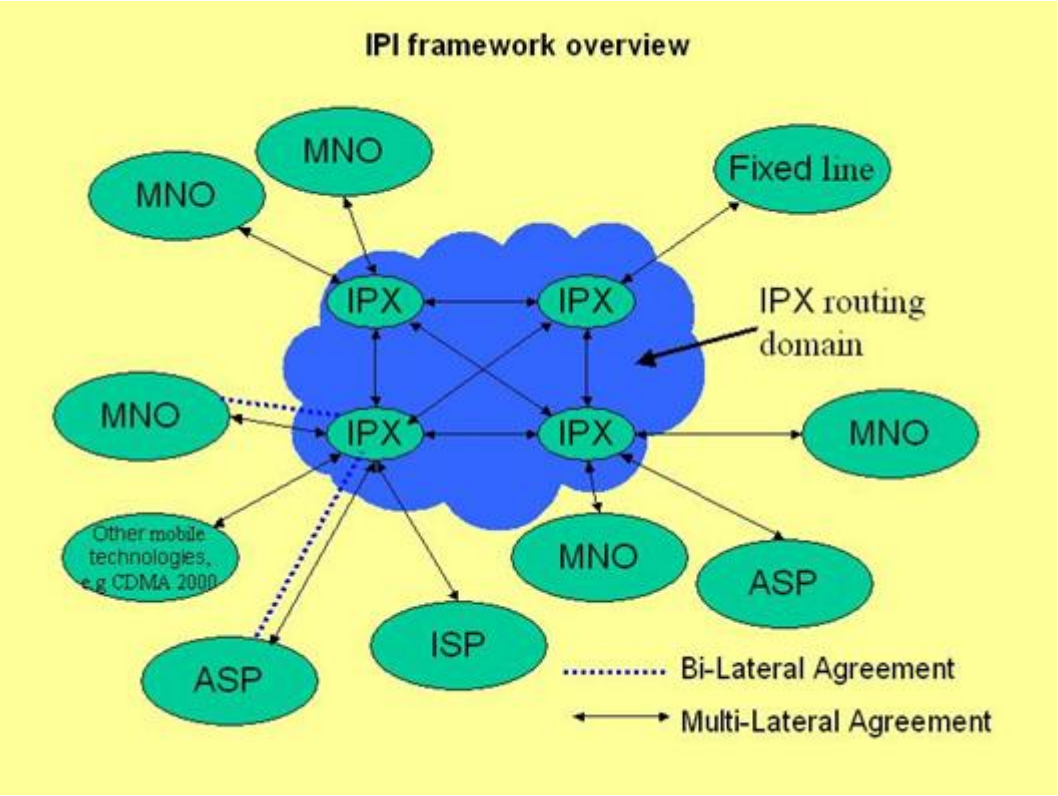

Figure 3: IPI Framework business entities

The IPI Framework is open to all relevant business entities within the IP value chain. The fig.3 above shows possible interconnection between the main business entities within the IPI Framework. While relevant for all Service Providers utilizing IPX providers, the remaining body of this PRD will focus on the relationship between the IPX Provider and MNO.

The IPX Domain supports 3 interconnection models which are outlined below. The details and requirements of the Connectivity Options can be found in Annex A of this PRD.

3.1 IPX Transport

IPX Transport is a bilateral agreement between two MNOs using the IPX transport layer with guaranteed end-to-end QoS.

As with the GRX, this connectivity option is not service aware and it can be used to transport any protocol between the two MNOs (provided compliance with security requirements is maintained).

Cascade billing is not possible under this model as service awareness is not available.

3.2 IPX Service Transit

IPX Service Transit is a bilateral agreement between two MNOs using IPX Proxy functions and the IPX transport layer with guaranteed end-to-end QoS.

This Connectivity Option provides the opportunity to include service-based interconnect charging instead of, or in addition to, the transport charging through cascaded billing.

3.3 IP Service Hub

IP Service Hub is a Connectivity Option providing multilateral interconnect with guaranteed end-to-end QoS and including service-based interconnect charging.

Hubbing/multilateral connectivity is where traffic is routed from one MNO to many destinations or interworking partners via a single agreement with the IPX Provider.

The hub functionality is provided by an IPX Proxy.

4 Obligations

All IPX providers and MNOs must follow all requirements as defined in this PRD and in GSMA PRD IR.34.

4.1 Compliance with GSMA recommendation

The IPI framework defines a set of interconnection services for roaming and interworking between Service Providers. The fundamentals of a successful, efficient and seamless interworking rely on the adoption of common standards across the entire chain between the Service Providers. IPX Providers take up a central position with the delivery of a set of connectivity services used by multiple MNOs, playing a key role and in the adoption of common standards and best practices. IPX Providers must commit to be in full compliance with GSMA recommendations and guidelines for IPX Provider networks defined in IR.34 and this PRD.

4.2 Cascade Billing

Where cascade billing is offered as a service by the IPX provider, the MNO acting as the termination network must be compensated for delivering services to the end user. For example, International voice interconnect where the terminating network needs to be paid MTR charges (Mobile Termination Rate), as per the traditional interconnect model. Any exchange of payments between two IPX providers for MTR must only be related to a cascade payment as in the above example or as a contractual penalty in case of non-compliance to a SLA (this must also be part of a cascade), or any charges as agreed upon bilaterally between the IPX providers. For the avoidance of doubt, no mark-ups are permitted for cascading payments between the IPX providers.

4.3 Cascading of responsibilities

Cascading of responsibilities means that an IPX Provider must be held responsible for the actions of the next IPX Provider (when transport/transit of traffic will need to pass through more than one IPX Provider from the originating network to the terminating network) to support end-to-end SLA and for security and anti-fraud measures. This is documented in IN.01 as it relates to end-to-end SLAs.

Conditions regarding KPIs and SLA will apply in the **inter-IPX Providers' relationship (IPX Interconnection)** as part of the bilateral agreement between each IPX Provider.

The IPXs should interconnect to one another (peering) and offer a single ubiquitous service to MNOs regardless of the geographic location of the destinations/Interworking partners and in compliance to the IPI principles.

Such inter-IPX Providers' relationship shall be implemented in accordance to the content of the bi-lateral agreements between the IPX Providers and the MNOs. The commitments agreed between the IPX Providers must enable IPX Providers to offer IPX services end-to-end and in the framework of the commitments given to the MNOs.

End-to-end responsibilities must extend from the border gateway of the originating MNO up to the border gateway of the terminating MNO (local loop connections are included in the concept in the end-to-end path). To enable and support full end-to-end services, all parties in the chain must be responsible for their requirements. These requirements are outlined in GSMA PRD IR.34.

4.4 Peering Principle

IPX is an interconnection service where the IPX Providers must interconnect or peer between each other, to complement their own reach of OnNet customers and deliver a full coverage toward the rest of the MNOs.

The individual cost for the establishment, or for any upgrade of the physical connectivity between the IPX Providers, must be borne by each individual IPX, as per the bilateral agreement between the IPX providers. This does not imply free peering, but does require commercially reasonable arrangements.

Different peering principles might apply and coexist on the peering agreement depending on the scope of service and interconnection models (IPX Transport, IPX Transit and IPX hubs) covered by the peering agreement.

4.5 Transparency

The IPX Provider must transport and handle the traffic end-to-end in a transparent way as per the bilateral agreement between the IPX Providers, while supporting the requirements of the MNO. The routing used by the IPX Providers must be made transparent to the MNOs (either online or principally agreed commercially, as defined GSMA PRD IR.34). If multiple routes are used, all the routes must be specified. For example, IPX 1 connects to MNO B through either IPX 2 or IPX 3 to support the service it provides to MNO A. As part of this transparency principle, IPX 1 must publish the below two routes to MNO A:

IPX1->IPX 2-> MNO B

&

IPX1->IPX 3-> MNO B

4.6 Traceability

It is expected that traffic over the IPX is fully traceable end-to-end. Deviation from end-to-end requirements, determining any other authorised/non-authorised use, compliance with certification criteria etc. must be possible to track.

4.7 Inter-IPX Provider Interconnection obligation/Full interconnection model

The IPX provider must implement, without any hindrance or barriers (commercial, technical or otherwise), the necessary interconnection with any required IPX Provider which has a primary established traffic transmission towards the destinations/Interworking partners requested by the MNO.

Full interconnection among the IPX Providers is mandated between all the IPX Providers, in particular to avoid trombone of traffic through peering interconnection established in another region, as per the bilateral agreement between IPX Providers. This will also support the establishment of SLAs for critical services. It is recommended for IPX providers to follow an open peering principle, and in no way aim to impede or prevent regional peering connection by raising technical or commercial barriers.

Interconnection between IPX Providers must adhere to the principles and binding guidelines established by this PRD and other applicable GSMA PRDs to support the corresponding agreement between the IPX Providers and the MNO. Each IPX provider must make their standard inter-IPX peering agreement available to other IPX providers to set up peering, as outlined in GSMA PRD IR.34.

4.8 One stop shopping

The contractual framework underpinning the IPX Domain is based on technical and commercial connectivity model, whereby MNOs only need to sign one agreement with the IPX Provider in order to get connection to a range of services and a large number of MNOs – provided that such parties adhere to the IPX rules and requirements. This creates a secure, accessible and efficient model, which stimulates competition throughout the value chain.

4.9 Transport and Service Layer

The IPX provider can offer both a transport layer and/or a service layer, the latter enabling a Service Transit or a Hubbing Service.

The IPX Provider is expected to offer as a minimum the transport layer (as a necessary base for all IPX Providers' interaction) on top of which it can provide the service layer (where specific requirements will apply on an end-user service-by-service assumption).

4.10 MNOs options

An MNO can choose, for a specific selection of services, i.e. to use the IPX Domain for transport ONLY (where a bilateral arrangement has been made directly with another MNO) while the MNO continues using the IPX Domain on the Service Layer for other services.

4.11 No more than two IPX Providers

No more than two IPX Providers must be involved in the end-to-end delivery. For clarity, this rule does not apply in SS7 signalling where multiple hops where allowed historically before IPX was introduced and SS7 was part of the voice network.

4.12 Enabling indirect connectivity

Any MNO or IPX Provider acting as a gateway between the IPX Domain and the outside world (i.e. enabling other parties not directly connected to the IPX Domain, to send and receive traffic to and from the IPX Domain), must assume full responsibility with regard to all obligations as set out in this document and other relevant GSMA PRDs. This means that everything outside the “IPX domain”, interacting with the IPX-domain, must be compliant with the IPI framework as well as bilateral agreements between individual IPX Providers.

The security requirements outlined in GSMA PRD IR.77 are mandatory for IPX Providers. The IPX network shall meet the requirements as defined.

4.13 Additional Supporting Functionalities

Beyond the interconnection models described in this PRD, there are a number of value added services offered by IPX Providers to MNOs that are beyond the scope of this document (For example ENUM, Number Portability). These example value added services are described in GSMA PRD IR.67 and NG.105.

Annex B Connectivity Options

The specific commercial requirements and charging and payment terms will be in accordance to the respective Agreement between the Service Provider and the IPX Provider. A template for this Agreement can be found in GSMA PRD AA.80.

B.1 Connectivity Option: "IPX Transport"

B.1.1 Definition of connectivity option "IPX Transport" (transport only, i.e. without service awareness):

The 'IPX Transport' connectivity option enables a bilateral connection between the Service Provider and one other Participating Service Provider utilising the IPX Transport Layer, but without service awareness. This includes providing guaranteed QoS only if the participating Service Provider is connected (a) directly to the IPX Provider or (b) to any other third Party IPX Provider who has separately agreed on guaranteeing QoS with the IPX Provider.

"IPX Transport" technically is specified in IR.34.

B.2 Commercial Requirements

The scope of the IPX Transport connectivity option is considered applicable only between the IPX Provider and the Service Provider and is to implement the IPX connection between the Service Provider and a Participating Service Provider. Any other circumstance with regard to the bilateral connection is outside the scope of their direct Agreement and shall be subject to a separate agreement between the Service Provider and the Participating Service Provider.

The IPX Provider agrees to convey traffic exchanged between the Service Provider and the respective other Participating Service Provider, either directly or via a Third Party IPX Provider for delivery to the Service Provider or the Participating Service Provider's respective networks.

B.3 IPX Transport Charging and Payment

IPX Transport Charging and Payment shall be settled in accordance to AA.80 Financial Annex.

In the event that Third Party IPX Providers are involved, the remuneration to such Third Party IPX Providers for the traffic handling shall be paid by the IPX Provider, who may then charge the Service Provider with these costs in addition to its own service charges, based on bilateral agreement.

B.4 Technical Requirements

IPX Transport technical requirements shall be defined in accordance with IREG PRD IR.34, IR.77 and IR.67 and NG.105.

B.5 Operational and Maintenance Requirements and IPX Transport SLA

Operational and Maintenance requirements and IPX Transport are stated in BA.51 and IN.01.

Annex C CONNECTIVITY OPTION “IPX SERVICE TRANSIT”

C.1 Definition of Connectivity Option “IPX Service Transit”

The IPX Provider’s service transit is a bilateral connection based on Service Awareness.

The ‘IPX Service Transit’ Connectivity Option enables a bilateral connection between the Service Provider and one other Participating Service Provider utilising the IPX Transport layer and the IPX Service layer provided by the IPX Provider with guaranteed QoS end-to-end and service awareness.

Several bilateral agreements (i.e. SPA-IPXP, SPB–IPXP, SPA–SPB in the simple case of two Service Provider being connected by one IPX Provider)” enable inter alia cascading of service aware payments; the two Service Provider negotiating and agreeing the termination fee, the IPXP taking the role of a clearing house.

IPX Service Transit and IPX Service Hub are technically the same (utilizing the same infrastructure: IPX service and transport layer), but contractually very different. IPX Service Transit is managed through many inter-related, bilateral agreements whereas the IPX Service Hub is managed through a single hub agreement between SP and IPX Providers and many bilateral agreements among IPX Providers.

C.2 Commercial requirements

C.2.1 IPX Service Transit

The scope of the IPX Service Transit connectivity option is applicable only between the IPX Provider and two Service Providers.

C.2.2 Responsibility of the IPX Provider

IPX Provider agrees to convey the traffic exchanged between the Service Provider and the Participating Service Provider (with whom the Service Provider also deploys the IPX Provider’s IPX Service Transit), either directly or via a Third Party IPX for delivery to the Service Provider or the Participating Service Provider’s respective networks .

C.2.3 Responsibility of the Service Provider

The Service Provider agrees to convey the traffic received from the IPX Provider to the Service Provider’s network, whereas (for the avoidance of doubt) such traffic may be:

Data received by the IPX Provider directly from the respective Participating Service Provider (with whom the Service Provider also deploys the IPX Provider’s IPX Service Transit); or

Data received by the IPX Provider from the Participating Service Provider (with whom the Service Provider deploys the IPX Provider’s IPX Service Transit) via a Third Party IPX Provider.

C.3 IPX Service Transit Charging and Payments

C.3.1 General

IPX Service Transit Charging and Payment information shall be stated within the AA.80 Financial Annex.

C.3.1.1 Charging Components

The charging components applicable to the IPX Provider's IPX Service Transit with regard to any specific Service are defined in the AA.80 Financial Annex.

The charging components for IPX Service Transit consist of

- the IPX Service Transit Charge, i.e. the remuneration of the IPX Provider for the IPX Service Transit and
- the Termination Charges (a) quoted by the Service Provider and (b) agreed directly between Service Provider and the Participating Service Provider.

The Service Providers shall pay the same IPX Service Transit Charge, whether a Third Party IPX Provider is involved or not.

The Termination Charges for each applicable Service shall be

- agreed directly between the Service Provider and the Participating Service Provider in a separate agreement and brought to the attention of the IPX Provider.

In the event that Third Party IPX Providers are involved, the remuneration to such Third Party IPX Providers for the traffic handling shall be dealt with by the IPX Provider who considers this activity in its pricing.

C.3.2 Settlement for IPX Service Transit:

The Service Provider, the IPX Provider(s), and the Participating Service Provider jointly have to agree the method of settlement. Two options are possible for IPX Service Transit.

C.3.2.1 Direct Settlement of termination rates

The Service Provider and the Participating Service Provider(s) (with whom the Service Provider deploys the IPX Provider's IPX Service Transit) shall perform the settlement of the applicable Termination Charges for the corresponding Service.

The IPX Provider may invoice the Service Provider for the IPX Service Transit Charges and the Service Provider shall pay the IPX Provider, as bilaterally agreed.

The IPX Service Transit Charges applicable for a respective Service are defined in the AA.80 Financial Annex.

C.3.2.2 Cascaded Settlement of termination rates

The IPX Provider may invoice the Service Provider for the IPX Service Transit Charges and the Service Provider shall pay the IPX Provider, as bilaterally agreed.

Service Providers shall pay the same IPX Service Hub Transit charge, whether or not a Third Party IPX Provider is used.

The IPX Service Transit Charges applicable for a respective Service are defined in the AA.80 Financial Annex.

The Service Provider shall specify its Termination rate to the IPX Provider by Service in the AA.80 Financial Annex.

The IPX Provider shall ensure transparency on the Participating Service Providers' Termination rates. Transparency in this context means a clear split, at an invoice level, between the Elected Participating Service Providers' Termination rates and other Service charging components.

C.4 Technical Requirements

IPX Service Transit technical requirements shall be defined in accordance with IREG PRD IR.34, IR.67, NG.105 and IR.77 and the AA.80 Technical Annex.

C.5 Operational and Maintenance Requirements and IPX Service Transit SLA

Both Parties will adhere to the GSMA IREG PRD IR.34, IR.67, NG.105, IN.01 and IR.77.

Annex D CONNECTIVITY OPTION “IPX SERVICE HUB”

D.1 Definition of Connectivity Option: IPX Service Hub

The IPX Provider’s hub functionality ("IPX Hub”) is a multilateral connection based on Service Awareness.

Traffic is exchanged between the Service Provider and multiple Participating Service Providers through the IPX Hub, which facilitates the service through a single agreement and connection between the Service Provider and the IPX Provider. The single agreement and connection enables inter alia cascading of quality of service responsibilities and of payments.

D.2 Commercial Requirements

D.2.1 IPX Service Hub

The IPX Provider operates the IPX Hub enabling traffic exchange and Service Interworking between Participating Service Providers. Upon the terms and subject to the conditions set out in their Agreement, the Parties wish to establish terms and conditions for the IPX Service Hub.

D.2.2 Responsibility of the IPX Provider

The IPX Provider shall supply the IPX Hub to the Service Provider whereby the IPX Hub conveys traffic received from the Service Provider to the Elected Participating Service Providers’ Systems run by each Elected Participating Service Provider either directly or via another IPX Hub for delivery to a Participating Service Provider; vice versa the IPX Provider shall also convey traffic from the Elected Participating Service Providers to the Service Provider for termination to the Service Provider.

The IPX Provider shall procure and provide to the Service Provider, the necessary Termination Services from, and in respect of each Elected Participating Service Provider from which the Service Provider has elected to receive traffic by means of the IPX Hub in order to enable Service interworking.

The IPX Provider provides to the Service Provider the IPX Hub, the Service Level Agreement and Test Plan and Operational Procedures.

D.2.3 Responsibility of the Service Provider

The Service Provider agrees to provide its Termination Service for traffic sent via the IPX Provider to the Service Provider according to their Agreement which may include:

Data received by the IPX Provider directly from a respective Participating Service Provider (with whom the Service Provider deploys the IPX Provider’s IPX Service Hub) i.e. Elected Participating Service Provider; and

Data received by the IPX Provider from a Participating Service Provider (with whom the Service Provider deploys the IPX Provider’s IPX Service Hub) i.e. Elected Participating Service Provider, via a Third Party IPX Provider.

The Service Provider shall use the IPX Hub in accordance with their Agreement.

D.2.4 Cascading of Payments

The Service Provider shall specify its Termination rate to the IPX Provider by Service within the AA.80 Financial Annex.

The IPX Provider shall ensure transparency on the Participating Service Providers' Termination rates. Transparency in this context means a clear split, at an invoice level, between the Elected Participating Service Providers' Termination rates and other Service charging components.

Service Providers shall pay the same IPX Service Hub Transit charge, whether or not a Third Party IPX Provider is used.

D.2.5 Charges, Payment and Settlement

IPX Service Hub Charging and Payment shall be settled in accordance to any applicable clauses referring to this concept in their Agreement.

IPX Service Transit Charging and Payment shall be made in accordance to the AA.80 Financial Annex .

Charging components: The Charging Components applicable to the IPX Providers for the IPX Service Hub with regards to any specific Service are defined in AA.80 Financial Annex .

The Charging component applied by the Service Provider to the IPX Provider for the Termination Service is detailed in the AA.80 Financial Annex.

In the event that Third Party IPX Providers are involved, the remuneration to such Third Party IPX Providers for the traffic handling, shall be paid by the IPX Provider who may charge the Service Provider this cost in addition to the service charges in the invoice.

D.2.6 Opt-in or opt-out

Whether opt-in or opt-out applies may need to be subject to trial on a Service-by-Service basis, i.e. in reference to which particular Service is being implemented through the IPX Hub, and therefore it will be stated and defined in the AA.80 Technical Annex .

D.2.7 Technical requirements

Technical requirements shall be defined in accordance with IREG PRD IR.34, IR.67, NG.105 and IR.77.

D.2.8 Operational and Maintenance Requirements and IPX Service Hub SLA

Both Parties will adhere to the GSMA IREG PRD IR.34, IR.67, NG.105, IN.01 and IR.77.

Annex E Document Management

E.1 Document History

Version	Date	Brief Description of Change	Approval Authority	Editor / Company
1.0	31 October 2019	New PRD WA.14	WAS eVote	Kathleen Leach (Sprint)
1.1	12 February 2020	Add signalling service language and references	WAS eVote	Kathleen Leach (Sprint)
NG.137 1.0		PRD tranfered to NG. New Refrence is NG.135	NG	Javier Sendin (GSMA)
NG.137 1.1	17 April 2023	Add CR 1002 and 1003	NG	Kathleen Leach (T-Mobile US)

E.2 Other Information

Type	Description
Document Owner	NG/NRG
Editor / Company	Kathleen Leach / T-Mobile US

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