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Your Ref:

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Infocomm Media Development Authority (IMDA)

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Singapore 117438

BY E-MAIL ONLY
Consultation@imda.gov.sg

Attention: Ms Aileen Chia

Director-General (Telecoms and Post)
Deputy Chief Executive (Connectivity Development & Regulation)

Dear Sirs

CONSULTATION PAPER ISSUED BY THE INFOCOMM MEDIA DEVELOPMENT AUTHORITY ON IMPLEMENTATION OF IP-BASED INTERCONNECTION IN SINGAPORE

1. We refer to IMDA's letter and Consultation Paper dated 1st March 2021 on the above matter.
2. TPG is of the view that IP-based interconnection is the way forward for the industry as it is quicker to scale, significantly more efficient, and brings support for high-definition CODECs. Tangible and clear benefits include end-to-end VoLTE calls across MNOs which improves call setup times and results in higher quality voice calls.
3. TPG is also of the view that with IP-based Interconnection, predatory pricing and posturing on physical interconnection access can be avoided.
4. TPG also believes that IP-based interconnection should be based on reciprocal terms and conditions.
5. TPG is of the view that private peering (PNI) to other FNOs provides a higher degree of security as compared to public peering.
6. TPG is aligned with IMDA's proposal to adopt Session Initiation Protocol ("SIP") based on IETF, 3GPP and GSMA IR.92 standards.
7. TPG does not foresee any impact to existing Fixed Network Portability ("FNP") arrangements due to the shift to IP-based Interconnection as TPG has successfully completed local FNP testing using SIP.
8. TPG's FNP solution is deployed with the following requirements in place:
 - a. SIP Header P-Additional-Calling-Party function as ISUP IE ACLI.
 - b. SIP 410 GONE functioning as ISUP Release Cause Value 14.
9. TPG is pleased to provide the following responses to IMDA's questions as listed in the Consultation Paper.

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Question 1:

IMDA invites views and comments on whether operators should follow a standardised set of technical requirements to implement IP-based interconnection at domestic POIs across all operators' networks that are interconnected to provision voice services.

SN	Description	TPG Comments
14	Based on the consultation responses, IMDA will determine an appropriate and relevant mode of IP-based interconnection for Singapore. IMDA would like to further propose that operators adopt the Session Initiation Protocol ("SIP") based on IETF and 3GPP specifications at the POIs (the "Proposed SIP").	TPG network supports both SIP (IETF) and SIP (IETF+3GPP) at the POIs.
15	IMDA understands that the Proposed SIP, which is defined by IETF standards, also fulfils the specifications of 3GPP. As it is based on the use of the IP Multimedia Subsystem ("IMS") defined by 3GPP, the Proposed SIP is deemed appropriate for operator's networks that use an IMS. Further, the Proposed SIP is suitable for the growing proportion of VoLTE calls over mobile networks, which are based on SIP and IMS specified by 3GPP.	TPG voice network is an IP cloud-based IMS solutions.
16	Notwithstanding IMDA's proposal for the Proposed SIP to pave the way for all domestic telephony services to be eventually provided over IP-based networks, IMDA notes that there are other SIP standards which are commonly deployed in other jurisdictions and can also be considered for Singapore. For example, based on the case studies by BEREC ("BEREC's Case Studies") on IP-based interconnection deployed in the European Union ("EU"), the fixed network operators analysed by BEREC had mostly deployed SIP (IETF and 3GPP), with some deploying SIP (IETF) or SIP-I5 (ITU-T). All the mobile network operators in BEREC's Case Studies had deployed SIP-I (ITU-T).	<ol style="list-style-type: none"> 1. TPG currently supports SIP(IETF)/SIP(IETF+3GPP)/SIP-I/ITU-T based interworking. 2. TPG is of the view that the standards focused approach of SIP(IETF+3GPP) is best for wireline and wireless networks.

Question 2:

IMDA invites views and comments on whether the Proposed SIP, based on IETF and 3GPP specifications, is appropriate and suitable to be implemented at the POIs.

SN	Description	TPG Comments
17	Depending on the eventual agreed migration plans by industry, IMDA notes that each operator could have differing readiness levels for implementing the Proposed SIP at all the POIs established with the other domestic operators. In such a scenario, IMDA believes that a transition period may be inevitable, whereby operators may have to support	<ol style="list-style-type: none"> 1. TPG is of the view that IP-based interconnection for voice services should be made available at the earliest to facilitate the migration of interconnection from TDM to IP.

	and cater for both SS7 and the Proposed SIP signalling at the POIs (“Transition Period”).	2. There would not be any strong technical or commercial rationale for transition periods exceeding 2 years.
18	Considering the possibility of a Transition Period, and that interconnection with Singtel (being the Dominant Licensee regulated under its RIO for TDM-based interconnection) is currently offered based on SS7, IMDA is of the view that it may be necessary to firm up the specific details of the interconnection arrangement under an IP-based interconnection environment before commencing the migration. IMDA considers that providing clarity to the industry on the specific details of any IP-based interconnection arrangement with Singtel will facilitate the migration planning and preparation of industry players who are currently directly interconnected with Singtel via Singtel’s RIO. This will also serve as a reference for other IP-based interconnection arrangements between Non-Dominant Licensees which are commercially negotiated. With both sets (TDM-based and IP-based) of interconnection arrangements ready/in place, IMDA believes the Transition Period will be smoother and more manageable for the industry.	TPG welcomes IMDA’s facilitation and regulation of the Dominant Licensee(s) during the transition period.
19	In this regard, following the conclusion of this consultation, IMDA intends to require Singtel to propose the offerings of the RIO services related to IP-based interconnection for IMDA to consult the industry on. Once the RIO offerings to support IP-based interconnection are finalised and approved by IMDA, IMDA will engage the industry further on implementation and migration plans.	<ol style="list-style-type: none"> 1. TPG believes that RIO offerings which support IP-based interconnection should foster and promote competition and ensure a level playing field for all operators. 2. Hence TPG will like to propose that IMDA together with all relevant operators define the technical standards jointly for IP-based interconnection via a new agreement as compared to using an “updated RIO” agreement.
20	Primarily, IMDA will require Singtel to propose an RIO offering that will eventually replace the current RIO Schedule 1 – Physical and Virtual (Distant) Interconnection. The proposed offer should contain a similar level of technical details, requirements and specifications (including transmission, signalling, routing, interconnect testing, etc.) to enable operators to establish IP-based interconnection with Singtel’s network. At this juncture, IMDA believes that IP-based interconnection should also be on reciprocal terms and conditions, as per the current interconnection regimes, and that all parties should bear their own cost of establishing interconnection.	TPG agrees that the new IP-based interconnection should be based on reciprocal terms & conditions.

21	In order to ensure the public's uninterrupted access to emergency call services, IMDA will also require Singtel to propose a similar service to be offered under IP-based interconnection, if the implementation of IP-based interconnection affects Singtel's provision of emergency call services under Schedule 4A of the RIO.	TPG agrees on the proposed dedicated SIP trunking for Emergency call service to ensure the public's uninterrupted access to emergency call services.
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Question 3:

IMDA invites views and comments on the proposed approach to finalise the offerings of the RIO services related to IP-based interconnection, before commencing the migration to IP-based interconnection.

SN	Description	TPG Comments
22	In the Public Consultation, some of the respondents submitted that a shift to IP-based interconnection might have an impact on the existing Fixed Number Portability ("FNP") arrangements, and that therefore would be a need to study the implications.	<ol style="list-style-type: none"> 1. TPG has since completed the IOT for FNP with the solution verified for N1 and N2 mappings as well as SIP Header and ISUP IE mappings: <ol style="list-style-type: none"> a. <i>ISUP IE ACLI</i> corresponding header to SIP is <i>P-Additional Calling Party</i> b. <i>ISUP Release Cause Value 14</i> corresponding header map to SIP is <i>410 GONE</i> 2. The impact is minimal, if any. Attached is TPG's FNP Solution for IMDA's reference.
23	IMDA understands that the FNP service is currently implemented using an Intelligent Network ("IN") solution based on the Query-on-Release ("QoR") method. In order to support the QoR method, the network is required to implement a signalling option to indicate to the originating network that the dialled number has been ported out. Each network has its own database as the solution requires the originating network operator to query its database for the routing number to route the call to the port-in operator. Given that the current signalling option used to support the QoR method is based on SS7, IMDA believes that the migration to IP-based interconnection will require changes to the technical solutions currently implemented for the FNP service.	<ol style="list-style-type: none"> 1. TPG FNP is based on ACQ 2. TPG has since completed FNP IOT and the relevant conversions from ISUP to SIP can be supported. 3. For SIP-to-SIP interconnect, SIP Header <i>P-Additional-Calling-Party</i> and <i>410 GONE</i> are forwarded to SIP interconnect Partner that carries the same functionality of the ISUP <i>IE Additional Calling Party</i> and <i>Release Cause Value 14</i>.

24	<p>In this regard, IMDA would like to propose the following options for FNP operators' consideration:</p> <p>(a) The FNP operators can review whether there is a similar "Release" message with a specific cause value under SIP signalling, or a similar signalling function under SIP signalling, which all FNP operators can agree to use as an indication to the originating network that the dialled number has been ported out; or</p> <p>(b) To adopt an All-Call-Query ("ACQ") method, given that all FNP operators have their own database.</p> <p>IMDA seeks FNP operators' comments on the feasibility of the proposed options to change the technical implementation of the FNP service, following the migration to IP-based interconnection. IMDA also welcomes FNP operators' suggestions on other feasible solutions.</p>	<p>1. TPG FNP Solution is mainly based on the following "Release" message:</p> <ol style="list-style-type: none"> a. For ISUP-to-SIP interconnect – ISUP Release messages with Cause Value 14 are mapped to <i>SIP Release Message 410 GONE</i> b. For SIP-to-ISUP interconnect – <i>SIP Release Messages 410 GONE</i> are mapped to ISUP Release message with Cause Value 14 c. For SIP-to-SIP interconnect – <i>SIP Release Messages 410 GONE</i> are used
25	<p>As for Mobile Number Portability ("MNP"), IMDA understands that the technical implementation of the current MNP service is not related to SS7 signalling. Thus, IMDA believes that the implementation of IP-based interconnection will not have an impact on MNP service.</p>	<p>TPG agrees that there is no impact on MNP service.</p>

Question 4:

IMDA invites views and comments on the feasibility of IMDA's proposals to revise the technical implementation of FNP service in an IP-based interconnection environment.

SN	Description	TPG Comments
26	<p>In the Public Consultation, one of the respondents submitted that SS7 was an established technology which was reliable and secure, with high Quality of Service ("QoS"). The respondent opined that in comparison, there could be security and QoS issues if operators were to migrate to IP-based interconnection. A lower QoS standard would be a concern for operators, especially those with regulatory obligations to meet IMDA's QoS requirements.</p>	<ol style="list-style-type: none"> 1. TPG has existing active SIP Interconnects which have been proven to be reliable and safe. 2. TPG seeks IMDA's further elaboration of its concerns and QoS requirements.

<p>27</p>	<p>On network security, IMDA has taken reference from BEREC’s Case Studies and notes that almost all of the EU operators analysed by BEREC had interconnected their networks using direct physical interconnection links (mostly 1 Gigabit Ethernet), and not the public Internet. BEREC noted that such arrangements would already provide substantial protection against threats from the Internet. Further, BEREC found that almost all of the EU operators studied had implemented the recommended security measures for IP-based networks, such as the use of a Session Border Controller (“SBC”), external Border Gateway Protocol (“eBGP”) authentication, topology hiding, and firewall, etc. to protect their networks.</p>	<ol style="list-style-type: none"> 1. TPG proposes to not limit the various interconnection topologies. 2. TPG is of the view that private peering (PNI) to other FNOs will provide a high level of security. 3. When SIP Interconnect is implemented over public internet, security can be enhanced using <ol style="list-style-type: none"> a. Firewall, b. VPN tunnelling, c. SBC topology hiding, and/or d. IPsec Tunnelling
<p>28</p>	<p>IMDA emphasises the importance of operators securing their IP-based networks to address cyber security risks and vulnerabilities. IMDA believes that a baseline set of network security requirements that are aligned with industry best practices should be adopted. These baseline requirements will be in addition to other security measures and protection that operators should undertake to protect their own IP-based networks, and/or avoid technical harm to the telecommunication network and/or system of another operator. Such baseline requirements can include the following:</p> <ol style="list-style-type: none"> a) Monitor and analyse signalling messages to detect malicious traffic; b) Adopt signalling firewalling to filter malicious traffic; c) Harden interconnect infrastructure such as Signalling Transfer Points (“STP”) and Diameter Signalling Controllers (“DSC”); and d) Perform external network security assessments and penetration tests periodically, if domestic exchange points are used. 	<ol style="list-style-type: none"> 1. TPG IMS supports network security layering through: <ol style="list-style-type: none"> a. Zone segregation, network isolation and packet filtering security policies to protect all IMS network resources and services. b. IMS access security features include user authentication and signalling protection. 2. TPG is in the view that private peering (PNI) to other FNOs will provide a high degree of security as compared with public peering via IP-Transit providers.
<p>29</p>	<p>On how a network should be connected to another network under an IP-based interconnection environment, IMDA will continue to leave it to the industry to discuss the appropriate and mutually agreed arrangements in good faith, be it via direct physical transmission links (ethernet or otherwise) or via domestic exchange points, if operators choose not to take up the RIO for interconnection purposes. IMDA notes that BEREC’s observation of the EU operators’ deployments reflects the trend that the number of POIs is usually reduced with the migration to Next Generation Network (“NGN”) and all-IP networks. Thus, with fewer POIs and the corresponding decrease in the overall number</p>	<ol style="list-style-type: none"> 1. TPG agrees that such interconnections will need to be mutually agreed and interconnection principles should be reciprocal. 2. With SIP interconnect replacing ISUP interconnect, it will definitely result in significant cost savings, reduced complexity and better reliability and quality. 3. Design complexity will be greatly reduced since interconnect over SIP involves agreement in terms of defined IP addresses and port numbers while TDM interconnect

	of transmission links deployed by operators to interconnect the IP-based networks (as compared to the current overall number of E1 transmission links deployed), IP-based interconnections may result in cost savings and reduced complexity for operators in the steady state.	involves Signalling Point Code, Signalling Link Code and Circuit Identification Code amongst others.
30	Further, IMDA would like to highlight that at any point in time (whether during the Transition Period or otherwise), IMDA will require each operator to prevent or minimise any adverse impact on the voice services it is providing to end-users (including any emergency call services).	TPG will comply.

Question 5:

IMDA invites views and comments on IMDA's preliminary views on network security and QoS under an IP-based interconnection environment.

SN	Description	TPG Comments
31	<p>Broadly, the following is IMDA's preliminary proposals on the migration approach:</p> <p>(a) If industry can agree on and co-ordinate a common cut-over time to deploy the Proposed SIP at the POIs, then a co-ordinated single migration approach may be more efficient overall; or</p> <p>(b) If there is differing readiness of the operators to deploy the Proposed SIP at the POIs, then a phased approach with a Transition Period may have to be adopted for industry to migrate in phases.</p> <p>Further, to avoid/minimise migration issues, IMDA considers that it may be prudent for industry to conduct a co-ordinated industry-wide trial migration on testing platforms first before actual migration, while IMDA will remain involved in facilitating the exercise.</p>	<ol style="list-style-type: none"> 1. TPG would propose to proceed with migration as described in option B. 2. TPG supports the coordination of an industry-wide trial migration on testing platforms with IMDA facilitation.
32	<p>IMDA is of the view that the assessment of whether a co-ordinated single approach or a phased approach is more appropriate can only be carried out at a later stage when there is more clarity on the various aspects of the implementation of IP-based interconnection, specifically the technical details. As such, IMDA will consult and engage the industry on migration plans after completing (a) this consultation and (b) the proposed RIO consultation to finalise the RIO offerings for IP-based interconnection.</p>	<ol style="list-style-type: none"> 1. TPG appreciates IMDA's consultative approach. 2. TPG will like to propose that IMDA together with all of the operators define the technical standards for IP-based interconnection via a new agreement as compared to using an "updated RIO" agreement.
33	<p>The broad outline of IMDA's proposed steps to implement IP-based interconnection in Singapore is appended as Annex 1.</p>	TPG will comply.

Question 6:

IMDA invites views and comments on IMDA's preliminary views on the broad migration approach.

SN	Description	TPG Comments
34	While this consultation broadly outlines IMDA's proposals and preliminary views on implementing IP-based interconnection in Singapore, IMDA recognises that a migration of this scale will involve many considerations for each operator to plan, implement and operationalise the change to IP-based interconnection. Sufficient time needs to be catered for each individual operator's preparation and procurement of necessary hardware and/or systems, and careful planning and co-ordination amongst all operators is critical to a successful migration. In this regard, IMDA will work closely with the industry to address the issues for the proposed implementation of IP-based interconnection.	TPG agrees.
35	Following the close of this consultation, IMDA will give careful consideration to all views and comments received, in implementing IMDA's decision on the matter. In this regard, IMDA may issue a direction and/or make the relevant changes to the specific regulatory instruments as may be necessary, to effect the same.	TPG notes.

Sincerely,

Richard Tan Chung Yaw, CEO
 TPG Telecom Pte. Ltd.
 Attachments