



**DECISION AND EXPLANATORY MEMORANDUM ISSUED BY THE
INFOCOMM DEVELOPMENT AUTHORITY OF SINGAPORE ON THE
REGULATORY FRAMEWORK FOR TELEPHONY SERVICES OVER
WIRELESS BROADBAND ACCESS NETWORKS AND INTERCONNECTION
FRAMEWORK FOR TELEPHONY SERVICES**

ISSUED ON 8 MAY 2008

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FRAMEWORK FOR TELEPHONY SERVICES OVER WIRELESS BROADBAND
ACCESS NETWORKS AND INTERCONNECTION FRAMEWORK FOR
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PART I: INTRODUCTION

1. On 5 July 2007, IDA issued a public consultation on “Proposed Regulatory Framework for Telephony Services over Wireless Broadband Access Networks and Interconnection Framework for Telephony Services” (“**Consultation**”). The Consultation closed on 3 August 2007.

PART II: OVERVIEW OF COMMENTS RECEIVED ON THE PROPOSED REGULATORY FRAMEWORK FOR TELEPHONY SERVICES OVER WIRELESS BROADBAND ACCESS NETWORKS AND INTERCONNECTION FRAMEWORK FOR TELEPHONY SERVICES

2. At the close of the Consultation, IDA received comments from five respondents:
 - i. Asia Pacific Carriers’ Coalition;
 - ii. MobileOne Limited;
 - iii. Pacific Internet Limited;
 - iv. Singapore Telecommunications Limited, Singapore Telecom Mobile Pte Ltd and Singapore Telecom Paging Pte Ltd; and
 - v. StarHub Group.
3. IDA wishes to thank all respondents for their inputs. IDA notes that the respondents in general agreed with the proposed regulatory framework for telephony services over wireless broadband access (“**WBA**”) networks and interconnection framework for telephony services, although some suggested modifications for IDA’s consideration. IDA has given careful and extensive considerations to the views received. The sections below discuss the key issues raised during the Consultation and explains IDA’s decision on the final regulatory framework for telephony services over WBA networks and interconnection framework for telephony services.

PART III: IDA’S POLICY OBJECTIVES & APPROACH

4. IDA seeks to ensure that Singapore’s interconnection framework and number allocation framework keep pace with developments in the telecommunication

sector and promote fair and effective competition in the telecommunication market. In line with this effort, in the Consultation, IDA sought views on the long-term market and technology outlook, in particular, the increasing deployment of IP-based networks and the increasing pace of Fixed Mobile Convergence (“**FMC**”). IDA also invited views on the impact of these developments on IDA’s existing interconnection framework and number allocation framework.

5. The respondents generally agreed that the current interconnection framework was still relevant and it was too premature to reconsider or revamp the interconnection framework. One respondent noted that the current progressive migration towards IP-based networks was occurring at the network “core” and transport layers, and that the access networks would still be primarily based on the traditional switched technology for the foreseeable future, while another respondent believed that the speed of development of IP-based Next Generation Networks (“**NGN**”s) and FMC would heavily depend on the development and availability of end user devices.
6. IDA agrees that the move towards IP-based networks and FMC will be a gradual process and is not proposing to revamp the interconnection regime immediately. IDA also notes that in most jurisdictions where incumbent operators have announced large scale plans to migrate their networks to IP-based NGNs (e.g., in the UK and Japan), regulators and industry bodies are also considering the implications and the appropriate interconnection model in the IP-based NGN environment. As such, IDA will continue to closely monitor the industry developments and work with the industry to review the regulatory frameworks in future.

PART IV: IDA’S DECISION ON NUMBER ALLOCATION FOR TELEPHONY SERVICES OVER WBA NETWORKS

Number Allocation for Telephony Services Over WBA Networks

7. In general, the respondents agreed with IDA’s proposal that level ‘3’, ‘6’, ‘8’ and ‘9’ numbers could be allocated to operators providing telephony services over WBA networks as long as they satisfy the number allocation criteria. One respondent emphasised that it was important to ensure that the number levels continued to be associated with particular service characteristics in order to avoid confusion to end users.
8. All the respondents were of the view that mobility was a key service characteristic that should be associated with level ‘8’ and ‘9’ numbers, given that end users had come to expect it. One respondent noted that some broadband wireless technologies such as WiMax could provide mobility. It was of the view that operators using wireless technologies with fixed wireless

application should apply for level '3' or '6' numbers, rather than level '8' and '9'. However, no respondent proposed a formal definition of mobility, though one respondent elaborated that full mobility would entail uninterrupted, seamless call handover from location to location.

9. One respondent also commented that operators providing telephony services over WBA networks who were allocated level '8' and '9' numbers should be on a level playing field with mobile operators and subject to the same obligations, such as in-building coverage and registration of subscribers for pre-paid services.
10. Having reviewed the responses, IDA will adopt the proposal to allocate level '3', '6', '8' and '9' numbers to WBA operators as long as they satisfy the number allocation criteria.
11. This means that operators providing telephony services over WBA networks using level '3' numbers will not be subject to specific regulatory requirements on Quality of Service ("**QoS**") standards, access to emergency services, provision of number portability, directory enquiry services and printed directories, under the framework for the allocation of level '3' numbers today.
12. WBA operators, who already hold a valid Facilities-Based Operator ("**FBO**") licence, will be eligible for level '6' numbers for the provision of telephony services over their WBA networks if they:
 - i. Comply with the minimum duties of licensees to interconnect specified in Sections 5.2 through 5.4 of the Telecommunication Competition Code and provide any-to-any interconnection;
 - ii. Provide number portability in accordance with the same standards and requirements as may be established by IDA from time to time;
 - iii. Provide access (at no charge) to emergency services (e.g., "999", "995", and "993") in Singapore;
 - iv. Provide directory enquiry services and printed directory services; and
 - v. Comply with the QoS standards established by IDA, similar to the standards set for basic local call services.
13. WBA operators who already hold a valid FBO licence, will be eligible for level '8' and '9' numbers for the provision of telephony services over their WBA networks if they:
 - i. Comply with the minimum duties of licensees to interconnect specified in Sections 5.2 through 5.4 of the Telecommunication Competition Code and provide any-to-any interconnection;
 - ii. Provide number portability;
 - iii. Provide access (at no charge) to emergency services;
 - iv. Provides coverage for the whole of the island of Singapore (including but not limited to underground MRT stations/lines and road tunnels), the

- offshore islands and the territorial waters up to 15km from the coast line of island of Singapore;
- v. Comply with any QoS standards imposed on 3G public cellular mobile telephony operators, including in-building coverage requirements; and
 - vi. Comply with requirements for registration subscribers of pre-paid services
14. With regard to mobility, IDA had pointed out in the Consultation that this was not a requirement that was imposed by IDA on the mobile operators, but an intrinsic characteristic of a public cellular mobile telecommunication service. Nonetheless, IDA acknowledges the respondents' concern about public confusion. Hence, IDA will impose a mobility requirement for level '8' and '9' operators. Level '8' and '9' operators will be required to provide their customers with "uninterrupted, seamless call handover when moving from location to location at a speed of up to 100km/h". The ITU-R M.1034 recommendations for IMT-2000 benchmark the typical vehicular speed at 100km/h, while the speed limit on Singapore road falls within 100km/h. IDA understands that mobile WiMax should be able to provide such mobility, given that its technical specifications have included seamless call handover at speeds of up to 120km/h.

PART V: IDA'S DECISION ON INTERCONNECTION SETTLEMENT REGIME

Long Term Interconnection Settlement Regime for Telephony Services

15. In the Consultation, IDA had proposed that a "Bill and Keep" ("**BAK**")¹ arrangement could be a viable long term interconnection settlement regime between the operators regardless of the technologies, networks and platforms that they deployed (i.e. Public Switched Telephone Network ("**PSTN**"), cellular or IP), the end user devices used and the number levels assigned. IDA noted that the BAK arrangement was typically used when the traffic exchanged between two networks were relatively balanced. In addition, IDA also considered that the BAK arrangement would allow each operator to manage their own costs of originating and terminating the traffic in their networks.
16. The respondents generally acknowledged that a BAK arrangement could be applied in certain situations, such as between operators with equivalent network sizes and traffic flows. However, the respondents opposed adopting a BAK arrangement for all forms of traffic scenarios. One respondent commented that interconnection settlement arrangements should take into account the different classes of services, the time and volume of traffic exchanges, the quality of service and security attribute of the services. Another respondent was of the view that the interconnection settlement arrangement should take into account the termination costs of different networks.

¹ Under a BAK arrangement, there will not be any termination charges and each operator was required to recover the costs of termination from its own customers

17. The respondents' comments affirmed IDA's view that it may be premature to prescribe the BAK arrangement now, given that IP telephony traffic is still relatively low, the development of IP-based NGN networks is still at its early stages and the appropriate interconnection models in the IP-based NGN environment remain uncertain. Therefore, IDA's position is that it will not prescribe the BAK arrangement but will monitor the industry developments and international best practices to assess the appropriate long term interconnection approach.

Medium Term Interconnection Settlement Regime

18. For the medium term, IDA had proposed that the interconnection settlement regime be based on the number level used to provide the service and independent of the underlying technologies, networks and platforms. Hence, IP telephony operators, including operators offering telephony services over WBA networks, would be viewed as fixed-line or mobile operators if they provision their services using level '6' or level '8' and/or '9' numbers respectively, and come under the respective interconnection settlement regimes accordingly.
19. Two respondents agreed with IDA's proposal. Two other respondents viewed that the interconnection settlement regime should not be based solely on the number level assignment to the services. One of them opined that the interconnection settlement regime should take into account the retail charging regime of the service, while the other respondent commented that the interconnection settlement regime should reflect the cost characteristics of an individual operator's network.
20. IDA's position is that interconnection settlement regime need not take into account the retail charging systems practised by the operators. As demonstrated by the variety of mobile services packages in our mobile market, many of which do not impose charges for incoming calls, the retail charging systems can be different from the interconnection settlement regime. Nonetheless, the operators are free to negotiate and come to a mutual agreement on their interconnection settlement. In the absence of such agreement, IDA's position is that it is fair and appropriate to prescribe an interconnection settlement regime that is based on the number level assignment to the services.

Interconnection Settlement Regime for Services using Level '3' Numbers

21. For interconnection involving IP telephony operators, including operators that offer telephony services using level '3' numbers ("**Level 3 Operators**") over WBA networks, IDA had proposed to maintain the interconnection settlement regime set out in the "Extended Interim Framework Governing Interconnection

between IP Telephony Operators and Existing Public Switched Telephone Network Operators” (herein referred to as “**Extended Interim Framework**”) issued by IDA on 29 September 2006. Under this regime, Level 3 Operators would pay the corresponding origination, transit and/or termination charges for calls originating, transiting through and/or terminating on the fixed-line networks (where applicable). Between the mobile operators and Level 3 Operators, a BAK interconnection settlement regime is adopted. IDA had also proposed that the origination or termination charges for calls originating or terminating on Level 3 Operators’ networks need not be established, as such cost of origination or termination on an efficient IP-based network was likely to be insignificant.

22. Two respondents agreed with IDA’s proposal that the interconnection settlement regime set out in the Extended Interim Framework should be maintained and that the cost of origination or termination on an IP network was likely to be insignificant, as Level 3 Operators did not have access networks of their own, but simply ride on the existing access network infrastructure of the FBOs. However, one other respondent commented that the origination or termination costs of Level 3 Operators might not necessarily be insignificant, and if such Level 3 Operators had to recover costs from their own customers, it would undermine the Level 3 Operators’ competitiveness. Another respondent also proposed that, given the relatively low IP telephony traffic now and the traffic imbalance between the Level 3 Operators and fixed-line and mobile operators, an interconnection settlement regime of bilateral charging and net settlement would ensure a fair compensation to both interconnecting parties and not prejudice either party’s position. In the longer term, when the traffic volume is relatively balanced, a BAK arrangement might be applied.
23. Taking into consideration the respondents’ comments and given that the development of IP-based networks is still at a nascent stage, IDA considers that it is premature to prescribe any particular interconnection settlement regime for IP-based networks at this early stage. IDA also notes that the interconnection models in IP-based NGN environment remain uncertain. In this regard, IDA’s decision is to maintain the interconnection settlement regime set out in the Extended Interim Framework as the current approach.

Interconnection Settlement Regime for Services Using Other Numbers Levels

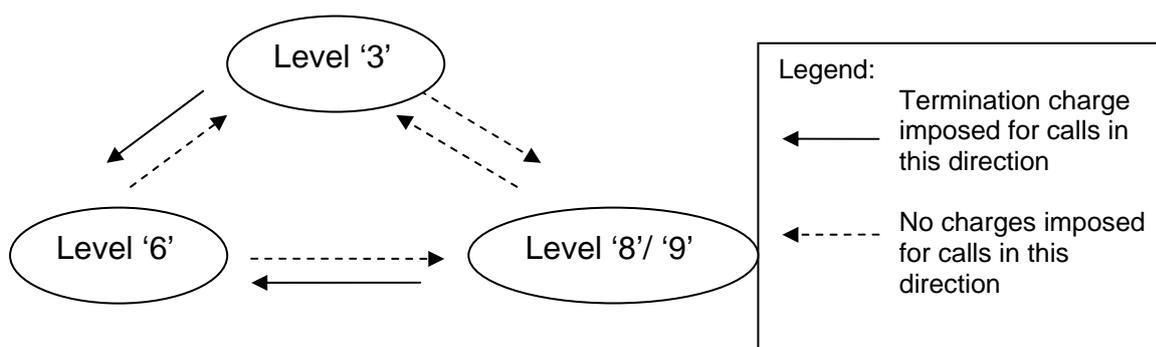
24. For a dominant operator using level ‘6’ numbers, IDA’s position is that the existing inter-operator interconnection settlement regime is still applicable at this time. If the dominant operator originates or terminates a call, it will be entitled to recover the origination and termination rates determined under its Reference Interconnection Offer (“**RIO**”). However, as the PSTNs migrate towards the more efficient IP-based NGNs, IDA is of the view that the cost of origination and termination is likely to reduce. For a non-dominant operator

using level '6' numbers, the non-dominant operator can come to a mutual agreement with the Level 3 Operators on the compensation arrangements, failing which the prevailing compensation arrangements of the non-dominant operator will apply.

25. For operators using level '8' and '9' numbers, IDA's position is that the existing 'Mobile Party Pays' regime will remain, given that this arrangement has served Singapore well and there are no compelling reasons to change at this point.
26. In summary, IDA's decision on interconnection settlement regime based on number level assignment for the services is as follows:-

| | Level '6' | Levels '3', '8' & '9' |
|-----------------------------------|---|---|
| Interconnection settlement regime | <p>'Calling Party Pays' (with network origination/transit/termination rates payable)*</p> <p>*includes any local, international and ISDN calls requiring PSTN for completing transmission</p> | No origination, transit or termination charges payable to operators providing telephony services based on these number levels |

27. The following diagram illustrates the interconnection settlement between operators deploying service using the various number levels.



Cost of Opening of Number Levels

28. In the Consultation, IDA had proposed that each operator should bear its own cost of opening up new numbers to cater to telephony traffic to and from all IP telephony operators, including the WBA operators that provide telephony services. The only exception was in the case of opening of access codes, such as 00X, 15XX and 1800 numbers, where the cost of such openings should be borne by the access code service providers.

29. One respondent agreed with IDA's proposal that each operator should bear its own cost of opening up of new number levels. However, respondents who were fixed-line and mobile network operators commented that the arrangement in IDA's proposal should only apply to FBOs and not be extended to Services-Based Operators ("**SBO**"s). This is because SBOs did not invest as heavily in networks and there was a clear disparity in the costs of opening up new number levels for FBOs and SBOs. Another respondent also believed that the 'cost-causality' principle should apply where SBOs were concerned. In the case of new access codes, the respondents generally agreed that the cost of opening up of new access codes should be borne by the access code providers as the calls to access codes were uni-directional. Therefore, the benefit of opening up of access codes would accrue primarily to the access service code providers.
30. IDA sees the opening up of number levels in the operators' networks as part of the interconnection to enable the exchange of traffic between the operators' networks and the associated benefits could be attributed to the subscribers of the operators. However, IDA recognises that there is a significant disparity in the costs associated with opening up of new number levels. In this regard, IDA notes that by requiring each operator to bear its own cost for the opening up of new number levels may not be the fairest arrangement. Therefore, IDA's decision is that operators may recover the cost of opening up new number levels in their networks, via the imposition of **cost-based charges** upon the operator that requested the opening up of new number levels. For the case of opening up of access codes, such as 00X, 15XX and 1800 numbers, the cost shall similarly be borne by the access code operators. IDA will not hesitate to take enforcement action against any operator who attempt to levy unreasonable non cost-based number level opening charges to create barriers to entry or undermine competition.

Wholesale Arrangements with Hub Operator

31. In the Consultation, IDA had proposed that hub operators in the wholesale agreements with Level 3 Operators should be considered as transit operators. IDA also sought views as to whether Level 3 Operators in such agreements would still need to enter into separate interconnection agreements with the indirectly interconnected operators ("**the other interconnecting licensees**").
32. The respondents generally agreed that the hub operators were in effect transit operators. One respondent commented that the hub operator should be responsible for dealing directly with the other interconnecting licensees and that it was not necessary for Level 3 Operators to enter into separate interconnection agreements with the other interconnecting licensees. Two respondents were concerned that if the other interconnecting licensees did not have any contractual relationship with such Level 3 Operators via

separate interconnection agreements, there might be issues (e.g., during customer dispute resolution, call investigations and payments).

33. IDA understands that it is the industry norm for hub operators, as wholesale service providers, to be responsible for interconnection contractual obligations and liabilities (e.g., indemnities, network faults and changes) associated with calls between such Level 3 Operators and other interconnecting licensees. IDA also notes that such wholesale arrangements can enable new Level 3 Operators, especially during the initial stage where traffic volume is low, to establish interconnection with all the other interconnecting licensees efficiently and expeditiously and thus avoid significant administrative and transaction costs associated with negotiating with separate interconnection agreements.
34. Therefore, IDA's decision is that Level 3 Operators in wholesale agreements with a hub operator need not enter into separate agreements with the other interconnecting licensees. However, the hub operator, as a wholesale provider to these Level 3 Operators, will need to front the implementation of interconnection and be responsible for interconnection contractual obligations through its interconnection agreement with other interconnecting licensees.

Responsibility for Costs of Interconnection Links

35. IDA notes that in addition to the interconnection charges payable for each call, there are costs associated with establishing and maintaining the interconnection links between the IP telephony and WBA operators that provide telephony services, and the fixed-line and mobile operators. The decision on the responsibility of these costs between operators is set out in Part VI of this decision and explanatory memorandum.

Final Interconnection Framework Governing Interconnection between IP Telephony Operators and Existing Public Switched Telephone Network Operators

36. IDA had stated in the Consultation that IDA would establish a final interconnection framework for IP telephony services after soliciting feedback from the public consultation exercise. The decisions taken by IDA in Part V of this decision and explanatory memorandum shall form the final interconnection framework ("**Framework**"). The Framework is attached as Annex A.
37. The Extended Interim Framework shall cease to be of effect from the date of this decision and explanatory memorandum. Level 3 Operators who have interconnected with the fixed and mobile operators under the Extended Interim Framework or the interim interconnection framework set out in IDA's 26 May 2006 direction shall conclude their interconnection agreements by a date to be notified by IDA.

38. Going forward, Level 3 Operators shall commercially negotiate their own interconnection agreements. If operators fail to reach a mutually acceptable interconnection agreement, they may approach IDA for conciliation or dispute resolution, in accordance with the relevant provisions set out in the Telecom Competition Code. IDA will rely on the Framework when resolving such interconnection-related disputes.

PART VI IDA'S DECISION ON DIRECT AND INDIRECT INTERCONNECTION FRAMEWORK

Direct vs Indirect Interconnection

39. IDA's rationale for imposing a POI Interconnection Arrangement is to retain the flexibility for operators to commercially agree whether to enter into direct or indirect interconnection arrangements, while providing a default arrangement that balances both interconnecting operators' negotiation positions. In this respect, IDA believes that the POI Interconnection Arrangement will not only send the appropriate signals to operators in their interconnection negotiations, but will also allow operators to retain their current network configurations without having to incur significant implementation costs and resources.
40. In general, IDA notes that many of the respondents to the consultation have expressed broad agreement with IDA's proposed POI Interconnection Arrangement. These included expressions of opinion to the effect that the proposed POI Interconnection Arrangement was fair and would provide the correct incentives for the establishment of efficient interconnection arrangements amongst operators, and that implementation complexities were unlikely. Nonetheless, there were some concerns raised on the POI Interconnection Arrangement which IDA believes should be addressed for the avoidance of doubt.
41. First, a respondent submitted that unlike the existing interconnection arrangements which took into consideration the interests of both the requesting operator and the operator receiving the interconnection request, the POI Interconnection Arrangement may unsettle the balance and thus adversely impact end users ultimately. To this, IDA will clarify that the POI Interconnection arrangement is intended to restore, rather than unsettle, the balance in negotiating positions between two interconnecting operators. Specifically, by prescribing that the party who refuses a direct interconnect request will have to bear the costs of transit, that party will be prevented from imposing unnecessary transit cost burden on the requesting party; which in the first place is avoidable if both parties agrees to enter into a direct interconnection arrangement.

42. Conversely, IDA views that the current situation is unfairly tilted in favour of the party receiving the interconnection request, i.e., that party can possibly reject a request for an direct interconnection arrangement even though the call traffic volume to be conveyed between the two networks indicates clearly it will be more efficient for both parties to enter into such an arrangement.
43. Second, the same respondent expressed concern that operators would have to terminate all existing interconnection arrangements in order to re-negotiate new arrangements. As a result, significant resources and time are to be incurred, as well as service disruptions. In relation to this concern, IDA will clarify that the POI Interconnection Arrangement does not necessarily require the abolition of current interconnection agreements, if both parties agree to continue with their existing agreements. Rather the POI Interconnection Arrangement provides for equitable default arrangements should negotiations fail. Thus, any two operators contented with their existing interconnection arrangements will not be required to make any changes.
44. IDA believes that other than administrative changes in the interconnection agreements to reflect that the responsibility for transit charges will now be borne by the party that refuses a direct interconnection request, the extent of resources and time to be expended by operators to reflect the POI Interconnection Arrangement will not be very significant. Even in the event where certain operators decide to terminate existing interconnection arrangements and pursue direct arrangements, IDA believes these operators will have done their necessary sums to determine that direct interconnection arrangements will be more efficient and beneficial in the longer run, rather than to simply enter into such arrangements for the sake of doing so.
45. For the avoidance of doubt, IDA also deems that it will be reasonable and more efficient for each party to bear its own costs for the effect of any operational or administrative changes arising from the POI Interconnection Arrangement, or from a migration to a direct interconnection arrangement. Otherwise, the party which refuses direct interconnection arrangement in the first place, can potentially deter the other party from migrating into a POI Interconnection Arrangement or a direct interconnection arrangement, by alleging high implementation costs that has to be borne by the latter party. By prescribing that each party shall bear its own costs, both parties will be appropriately incentivised to ensure any implementation costs will be kept to a minimum.
46. Third, the same respondent also expressed concern that there might be difficulties in designating POIs at another operator's switch, and there was no certainty that such an arrangement would be commercially feasible.
47. In relation to this concern, IDA notes that the designation of POIs at another operator's switch is no different from the existing indirect interconnection

arrangements, where calls conveyed between the originating and terminating operators are handed over at the transit operators' switches. Therefore, if indeed indirect interconnection arrangements are not commercially viable as compared against direct interconnection arrangements, clearly the two interconnecting parties ought to have entered into the latter arrangement instead.

Responsibility for Cost of Interconnection Links

48. As part of the POI Interconnection Arrangement, IDA's rationale is to allow operators to commercially negotiate the sharing of the cost of interconnection, with a default arrangement that requires each operator to bear the cost of the interconnection link on their side of the POI. IDA believes this will encourage the equitable distribution of interconnection cost between operators. While one respondent to the consultation commented that it would be fair for operators to be responsible for interconnection links on their side of the POI, two other respondents raised certain concerns which IDA will address as follows.
49. First, one respondent submitted that while it agreed that PSTN should share the cost of interconnection links, the existing arrangement for mobile operators to bear the cost of interconnection links to fixed-line operators should however be maintained. The respondent claimed that the cost of interconnection links to mobile operators had not been incorporated in the retail pricing for fixed-line telephony service. Therefore, should the existing arrangements be changed, there might be a significant impact on the manner in which retail fixed-line telephony services would be charged to end users.
50. With regard to the concern raised, IDA views that there is no tenable basis that simply because retail fixed-line telephony service had not included the cost of interconnection links to mobile networks, the cost of interconnection links should thus be borne by mobile operators. The responsibility for the cost of interconnection links is a distinct matter from the tariffs of retail fixed-line telephony services. Otherwise, it will lead to an undesirable and unreasonable situation where an operator's responsibility of cost will be dictated by the retail tariffs of another operator, which the former clearly has no control over with.
51. Second, another respondent submitted that the sharing of link cost was only appropriate for PSTN to PSTN interconnection. For other forms of interconnection, new operators should be responsible for establishing the links, since these operators were causing cost to be incurred through their entering the market. It was added that this would be fully consistent with IDA's stated policies on interconnection.

52. IDA will clarify that its policies have always maintained that all licensees have a duty to interconnect with each other, to ensure there will be seamless any-to-any communications throughout Singapore. Therefore, contrary to the claim, all operators, irrespective whether they are existing or new, have the responsibility to establish interconnection (and hence responsibility for the cost of the interconnection) links to each other since such interconnection benefits both operators and ultimately their end users. The exception to this, being the case in which the call traffic carried on the interconnection links is uni-directional, e.g., calls to 15XX access codes.

PART VII GOING FORWARD

53. The infocomm industry is undergoing rapid developments, particularly driven by several trends such as the FMC and the emergence of IP technologies and IP-based NGNs. Such trends have raised questions on the impact to the current regulatory and business models. While IDA has consulted and issued this decision on the number allocation and interconnection regulatory frameworks, IDA will continue to closely monitor the industry developments and work with the industry to review the regulatory frameworks in future when necessary.