

APPENDIX 2
SCHEDULE OF INTERCONNECTION RELATED SERVICES AND MANDATED
WHOLESALE SERVICES

1. INTRODUCTION

- 1.1 This Schedule describes the terms and conditions on which a Dominant Facilities-based Licensee must offer to provide certain key Interconnection Related Services and Mandated Wholesale Services to Facilities-based Licensees and Services-based Licensees that use switching or routing equipment to provide Services to the public. The Dominant Facilities-based Licensee must include these terms and conditions in its RIO.
- 1.2 In this Schedule:
- (a) “Dominant Licensee” means a Facilities-based Licensee that IDA has classified as dominant; and
 - (b) “Licensee” means a Facilities-based Licensee or a Services-based Licensee that uses switching or routing equipment to provide Services to the public.
- 1.3 A Dominant Licensee must offer to provide all categories of Interconnection Related Services and Mandated Wholesale Services to Facilities-based Licensees. The Dominant Licensee need only offer to provide specified categories of Interconnection Related Services to Services-based Licensees. The Dominant Licensee must offer the same prices, terms and conditions for such services to all Licensees.
- 1.4 The terms and conditions specified in this Schedule will remain effective until reviewed and revised by IDA.
- 1.5 As part of its review, IDA will determine whether to:
- (a) require Dominant Licensees to continue to comply with any or all of the requirements specified in this Schedule;
 - (b) require Dominant Licensees to continue to offer Interconnection Related Services and Mandated Wholesale Services, but allow the Dominant Licensees to set the prices within specified price floors and/or ceilings;
 - (c) require Dominant Licensees to continue to offer Interconnection Related Services and Mandated Wholesale Services, without specifying price floors or ceilings; or
 - (d) otherwise add to, modify or eliminate the requirements specified in this Schedule, or take any other appropriate action.
- 1.6 IDA reserves the right to review and add to, modify or eliminate the applicable requirements specified in this Schedule at any time.

2. SERVICES THAT MUST BE OFFERED UNDER THE RIO

- 2.1 The RIO must specify the prices, terms and conditions on which the Dominant Licensee will provide:
- (a) the following Interconnection Related Services:

- (i) Physical and Logical Interconnection;
- (ii) Origination, Transit and Termination;
- (iii) Essential Support Facilities;
- (iv) Unbundled Network Elements;
- (v) Unbundled Network Services; and
- (b) Mandated Wholesale Services.

3 PHYSICAL AND LOGICAL INTERCONNECTION

- 3.1 A Dominant Licensee must offer to allow Facilities-based and Services-based Licensees to physically and logically interconnect their respective networks with the Dominant Licensee's network for the purpose of exchanging telecommunication traffic.
- 3.2 The RIO must specify the prices, terms and conditions on which the Dominant Licensee will allow interconnection to occur. These must include:
 - (a) a list and description of the physical locations at which a Requesting Licensee may physically and logically interconnect with the Dominant Licensee's network and the means by which interconnection may be achieved; and
 - (b) a description of the physical and logical interfaces to the Dominant Licensee's network that are necessary to allow physical and logical interconnection and the procedures to be used if the Dominant Licensee chooses to alter those interfaces.
- 3.3 Subject to Sub-paragraph 3.4 below, a Dominant Licensee must offer to allow interconnection to occur at any technically feasible point. At a minimum, a Dominant Licensee must offer to allow interconnection to occur at the following Points of Interconnection ("POI"):
 - (a) Interconnect gateway switches ("IGS"); and
 - (b) Local switches (line side and trunk side).
- 3.4 A Dominant Licensee need only interconnect with a Services-based Licensee on a virtual (distant) basis. In a virtual (distant) interconnection arrangement, the network nodes are not located at the same site. In this arrangement, the Services-based Licensee may obtain the transmission link between the 2 nodes from either the Dominant Licensee or any other Facilities-based Licensee.
- 3.5 The transmission links used for interconnection must connect at mutually agreed points and support applicable technical standards and transmission protocols. Unless the Dominant and Requesting Licensee agree otherwise, the Dominant and Requesting Licensee will each be responsible for the provision and maintenance of the link on its "side" of the POI.
- 3.6 A Dominant Licensee must provide, and may require the Requesting Licensee to provide, reasonable capacity to meet forecast traffic flow.
- 3.7 A Dominant Licensee must provide all relevant signalling plans, including the technical specifications, interconnection test plans and the corresponding test schedules, to any Requesting Licensee.

4 ORIENTATION/TRANSIT/TERMINATION

- 4.1 Origination, transit and termination (“O/T/T”) services involve the switching, routing and/or transmission of telecommunication traffic between Licensees. O/T/T services allow traffic originating from one Licensee’s network to terminate on or transit through another Licensee’s network. A Dominant Licensee must offer to provide O/T/T services to Facilities-based and Services-based Licensees.
- 4.2 The RIO must specify the prices, terms and conditions on which the Dominant Licensee will provide O/T/T services. In particular, the RIO must contain:
- (a) a list and description of all the O/T/T services to be provided; and
 - (b) the prices, terms and conditions on which the Dominant Licensee and the Requesting Licensee will be compensated for such services.
- 4.3 The Dominant Licensee need only offer to provide transit services between Licensees interconnected to the Dominant Licensee’s IGS. The Dominant Licensee need not offer to route transit traffic between the IGS and a local switch. In the case of transit traffic, the Dominant Licensee may require the Licensee originating the call to pay the Dominant Licensee for the cost of transit, irrespective of the type of traffic and payment between the End Users and the Licensees that are using the transit service.
- 4.4 At a minimum, the Dominant Licensee must provide the following O/T/T services:
- (a) Line side (local exchange) origination;
 - (b) Line side (local exchange) termination;
 - (c) Trunk side (local exchange) origination;
 - (d) Trunk side (local exchange) termination;
 - (e) IGS origination;
 - (f) IGS termination; and
 - (g) IGS transit.

5 ESSENTIAL SUPPORT FACILITIES

- 5.1 Essential Support Facilities (“ESF”) are passive support structures, for which no practical or viable alternatives exist, that enable the deployment of telecommunication infrastructure. A Dominant Licensee must offer to provide ESF to Facilities-based Licensees.
- 5.2 The RIO must specify the prices, terms and conditions on which the Dominant Licensee will provide ESF. In particular, the RIO must contain:
- (a) the prices, terms and conditions on which a Facilities-based Licensee can physically co-locate and access its equipment within the Dominant Licensee’s network, including:
 - (i) the locations at which physical co-location is available;
 - (ii) any reasonable restrictions or procedures that the Dominant Licensee intends to impose due to space, safety or security concerns; and

(iii) the situations in which virtual (distant) co-location will be required.

(b) the prices, terms and conditions on which the Dominant Licensee will provide Facilities-based Licensees with access to and the use of lead-in ducts and lead-in manholes.

(b)(c) the prices, terms and conditions on which the Dominant Licensee will provide Facilities-based Licensees with access to and the use of ducts and associated manholes in its submarine cable common duct network.

5.3 Co-Location

5.3.1 A Dominant Licensee must offer to allow Facilities-based Licensees to co-locate equipment at any technically feasible location within its network. In particular, the Dominant Licensee must allow co-location at the following facilities (when controlled by the Dominant Licensee):

- (a) Exchange buildings housing tandem, local, interconnection and international switches and facilities;
- (b) Telecommunication equipment rooms located in commercial buildings;
- (c) Telecommunication equipment rooms located in residential buildings;
- (d) Submarine cable landing stations; and
- (e) Roof spaces.

5.3.2 A Dominant Licensee must offer to provide equipment space, power, security and site maintenance at each co-location site.

5.3.3 A Dominant Licensee may decline to provide co-location space in any currently unused network location if it can demonstrate that, as a result of its reasonably projected growth, the Dominant Licensee will use that space to locate equipment used to provide its own Service.

5.3.4 In cases where the Dominant Licensee cannot offer physical co-location due to space limitations or any other legitimate reasons, the Dominant Licensee must take reasonable measures to find an alternative solution. An alternative solution may include options such as virtual co-location, conditioning additional equipment space, optimising the use of existing space or finding adjacent space. The Dominant Licensee is not required to offer to construct additional buildings to accommodate co-location requests.

5.3.5 A Dominant Licensee must not restrict the type of equipment co-located so long as it is telecommunication equipment of a type customarily located in a telecommunication operator's exchange building or other network locations. However, this space cannot be used for the co-location of a specific End User's equipment (e.g., a PABX) or general purpose computing equipment that is not required for operation or management of the co-located equipment (e.g., a billing system). The equipment footprint space made available by the Dominant Licensee to each Facilities-based Licensee at each exchange building or submarine cable landing station must be no less than 1 square metre and no more than 10 square metres, provided that where a Facilities-based Licensee reasonably requests for footprint space exceeding 10 square metres, the Dominant Licensee must grant the

request unless the Dominant Licensee can demonstrate that the use of more than 10 square metres of footprint space will preclude other Facilities-based Licensees from placing permitted equipment in a given exchange building or submarine cable landing station.

5.3.6 A Dominant Licensee must take all reasonable measures to reduce the costs to be assumed by the Facilities-based Licensees. In particular, the Dominant Licensee may not require the use of co-location cages or equivalent structures or impose any unnecessary or excessive minimum space requirements. The Dominant Licensee must incur the cost of preparing co-location space, which it can recover through non-discriminatory, pro-rata prices to be paid by the Facilities-based Licensees.

5.3.7 A Dominant Licensee must offer Facilities-based Licensees access to their co-located equipment on a 7-days-a-week, 24-hours-a-day basis. The Dominant Licensee can require reasonable security precautions. These can include escorted access, provided the escort is available 7 days a week, 24 hours a day. The Dominant Licensee must make escort available on the following basis:

- (a) for service-affecting emergencies, within 1 hour of notification;
- (b) for non-service affecting emergencies, within 4 hours of notification; and
- (c) in all other cases, within 24 hours of notification.

5.4 Lead-in ducts and lead-in manholes

5.4.1 Lead-in ducts and lead-in manholes are ESF that house the telecommunication transmission cables (e.g. copper, coaxial and fibre cables) that connect to buildings.

5.4.2 A Dominant Licensee must offer to lease the lead-in ducts and lead-in manholes to Facilities-based Licensees for the purpose of placing their own telecommunication transmission cables. The Dominant Licensee must maintain the lead-in ducts and lead-in manholes, and also be responsible for any right of way fees payable, where applicable.

5.5 Submarine cable common duct networks

5.5.1 Submarine cable common duct networks are ESF that are designed to be used by multiple submarine cable operators to house the submarine cables which they deploy from the beach manhole at landing sites to inland submarine cable termination points.

5.5.2 A Dominant Licensee must offer to lease the ducts and associated manholes in its submarine cable common duct network to Facilities-based Licensees for the purpose of deploying their own submarine cables.

6 UNBUNDLED NETWORK ELEMENTS

6.1 Unbundled network elements (“UNE”) are physical telecommunication plant and equipment and the associated service functionality that Facilities-based Licensees need to have access to in order to provide a competing Service. IDA will find that telecommunication plant or equipment are UNE if they:

- (a) are technically or operationally required to provide a competing Service; and

- (b) cannot be replicated, or obtained from a source other than the Dominant Licensee, at commercially reasonable rates.

A Dominant Licensee must offer to provide UNE to Facilities-based Licensees.

- 6.2 The RIO must contain the prices, terms and conditions on which the Dominant Licensee will offer to provide UNE, including:

- (a) a list and description of the UNE to be provided;
- (b) any modification that the Dominant Licensee is prepared to make; and
- (c) the extent to which the Dominant Licensee is prepared to combine individual elements.

- 6.3 A Dominant Licensee may not place any restriction on a Facilities-based Licensee as to the End Users or Licensees to which any Service provided using the UNE may be offered. For example, a Facilities-based Licensee can lease copper local loop for the provision of Digital Subscriber Line (“DSL”) services, for resale to other Facilities-based or Services-based Licensees.

- 6.4 At a minimum, a Dominant Licensee must offer to provide the following UNE:

- (a) Local loops;
- (b) Sub-loops;
- (c) Line sharing; and
- (d) Distribution frame access.

- 6.5 A Dominant Licensee must also offer to provide Facilities-based Licensees with access to UNE at the following points of access (“POA”) in its exchange MDF, building MDF and outdoor cabinets (if controlled by the Dominant Licensee):

- (a) Distribution frames;
- (b) Fibre distribution frames; and
- (c) Digital cross connect frames.

6.6 Local loops — including loop feeder, loop distribution, distribution point, and inside wiring (where applicable)

- 6.6.1 A Dominant Licensee must provision the loops in a timely and non-discriminatory manner, and must take all feasible actions to provision loops that are suitable for digital signal transmission. The Dominant Licensee will retain responsibility for the maintenance and administration of the loops.

- 6.6.2 A Dominant Licensee must provide loops that are of the same quality and are capable of supporting the same transmission characteristics as those it supplies to its own End Users. The Dominant Licensee must also provide maintenance and repair services on the unbundled loops that are equivalent to the services it would provide to itself on loops serving its own End Users.

- 6.6.3 To maintain the integrity of the loop and associated equipment, a Dominant Licensee may retain responsibility for performing the necessary cross-connections and circuit-grooming activities required at the distribution frames to connect the Facilities-based Licensee’s equipment to each loop provided. However, the

Dominant Licensee must not use this authority in a manner that restricts supply. If the Dominant Licensee performs these functions, it must recover the cost through the loop prices.

- 6.6.4 Where the Facilities-based Licensee plans to use the loop to provide a DSL type service, the loop performance should be typical of those used by the Dominant Licensee for its own DSL services. This requires the Dominant Licensee to “condition” a loop pair. Typically, this will require the Dominant Licensee to remove any impediments to DSL service (such as bridge taps and loading coils) and to choose a pair that is unlikely to suffer from interference caused by other DSL services. In so far as the Dominant Licensee uses loops for its own DSL services, the Dominant Licensee must supply loops to other Facilities-based Licensees for DSL that perform at a level equivalent to the loops the Dominant Licensee uses for its own DSL services.

6.7 Sub-loops — loop feeder or loop distribution, distribution point and inside wiring (where applicable)

A Dominant Licensee must also offer to provide sub-loops and the associated distribution points to Facilities-based Licensees on the same terms and conditions as loops.

6.8 Line sharing (loop spectrum) — loop feeder, and/or loop distribution, distribution point and inside wiring (where applicable)

- 6.8.1 A Dominant Licensee must offer to provide Facilities-based Licensees with line sharing (loop spectrum). The Dominant Licensee must provide a DSL-capable loop (in the same manner as described in Sub-paragraph 6.6.4 above). The Dominant Licensee must offer to allow each Facilities-based Licensee to attach its own transmission equipment.

- 6.8.2 A Dominant Licensee must provide timely information to Facilities-based Licensees to assist their deployment of DSL services. The information will be the same as that provided to its own operations in order to assess the capability of providing DSL on a loop.

- 6.8.3 Facilities-based Licensees must adhere to a spectrum management and deployment plan, which the Dominant Licensee must include in its RIO. The plan must be no more restrictive than necessary to minimise cross-talk and to ensure the integrity of the voice network.

6.9 Distribution frame access — exchange MDF, building MDF and outdoor cabinets

- 6.9.1 A Dominant Licensee must offer to provide Facilities-based Licensees with access to its distribution frames in order to allow the Facilities-based Licensees to place the terminal blocks and cabling required to cross-connect loops to the Facilities-based Licensee’s equipment.

- 6.9.2 A Dominant Licensee must offer to provide Facilities-based Licensees with pins on the Dominant Licensee’s distribution frames for the purposes of connecting their cables. The Dominant Licensee must develop a reasonable process for allocating

pins to Facilities-based Licensees and for updating plant records. Where physical space is available, the Dominant Licensee must offer to construct additional distribution frame capacity to meet requests for access. The Dominant Licensee must detail the process for allocating pins in its RIO.

7 UNBUNDLED NETWORK SERVICES

7.1 Unbundled network services (“UNS”) are telecommunication network services that Facilities-based and Services-based Licensees need to have cost-based access to in order to provide a competing Service. IDA will find that telecommunication network services are UNS if the services:

- (a) are technically or operationally required to provide a competing Service; and
- (b) cannot be self-provisioned, or obtained from a source other than the Dominant Licensee, at commercially reasonable rates.

Dominant Licensees must offer to provide all UNS to Facilities-based Licensees, but only need offer to provide specified UNS to Services-based Licensees.

7.2 The RIO must contain the prices, terms and conditions on which the Dominant Licensee will offer to provide UNS, including:

- (a) a list and description of the UNS to be provided;
- (b) any modification that the Dominant Licensee is prepared to make; and
- (c) the extent to which the Dominant Licensee is prepared to combine individual elements.

7.3 A Dominant Licensee must, at minimum, offer to provide the following UNS to Services-based Licensees:

- (a) Emergency services (as stipulated in Sub-paragraph 7.5 below).

7.4 A Dominant Licensee must offer to provide the following UNS to Facilities-based Licensees:

- (a) Emergency services (as stipulated in Sub-paragraph 7.5 below);
- (b) Connection services at submarine cable landing stations (as stipulated in Sub-paragraph 7.6 below); and
- (c) Tail local leased circuits (as stipulated in Sub-paragraph 7.7 below).

7.5 Emergency Services

A Dominant Licensee must offer to provide Facilities-based and Services-based Licensees with access to emergency services call centres and the ability to add local telephone location data to the emergency services database.

7.6 Connection services at submarine cable landing stations

7.6.1 A Dominant Licensee must offer to provide services at its submarine cable landing stations to Facilities-based Licensees in order for them to connect and access capacity on any submarine cable system that lands at those stations.

7.6.2 A Dominant Licensee must offer to provide Facilities-based Licensees with access to connection services at the following POA (when controlled by the

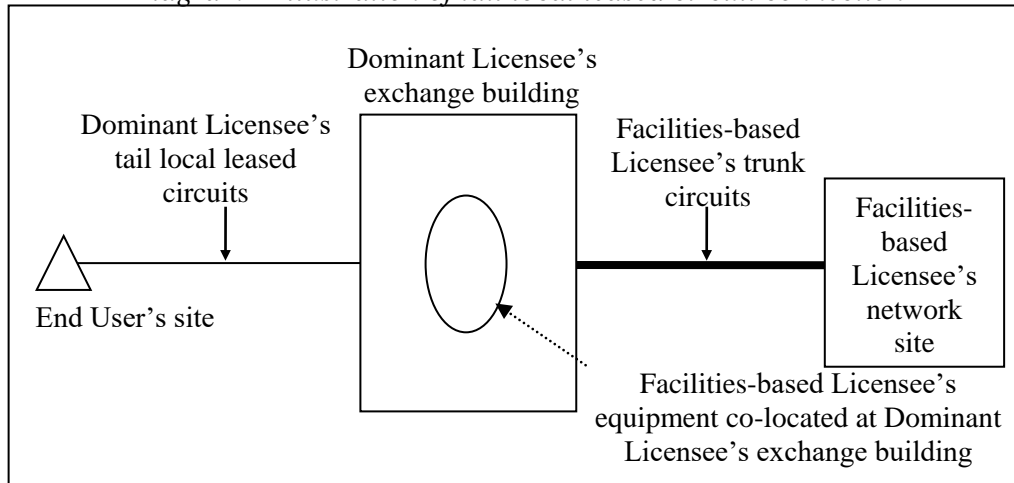
Dominant Licensee):

- (a) Digital or fibre distribution frames; and
- (b) Digital cross-connect frames.

7.7 Tail local leased circuits

- 7.7.1 A Dominant Licensee must offer to allow a Facilities-based Licensee to obtain tail local leased circuits between an End User's site to the exchange building controlled by the Dominant Licensee nearest to and serving the End User's site (please see illustration in Diagram below), in accordance with Sub-paragraphs 7.7.2 to 7.7.6. The Dominant Licensee must not prevent a Facilities-based Licensee from reselling the tail local leased circuits to other Licensees for the purpose of enabling the other Licensees to connect to End Users' sites.

Diagram – Illustration of tail local leased circuit connection



- 7.7.2 Tail local leased circuits shall be offered with effect from the following dates:
- (a) in relation to tail local leased circuits terminating at an End User's site located within the CBD proxy-region, with effect from 15th April 2006; and
 - (b) in relation to all other tail local leased circuits, with effect from 15th October 2006.
- 7.7.3 In Sub-paragraph 7.7.2 above, "CBD proxy-region" means the area within the Central Business District containing the locations where the Dominant Licensee, as of 20th July 2004, offers retail local leased circuits pursuant to its retail tariff for local leased circuits in the Central Business District area, as approved by IDA. The Dominant Licensee must provide clear and sufficient information, including boundaries of the CBD proxy-region, to enable Facilities-based Licensees to ascertain the CBD proxy-region.
- 7.7.4 Tail local leased circuits shall be offered at the following bandwidths:
- (a) 64 Kbps;
 - (b) 128 Kbps;

- (c) 192 Kbps;
- (d) 256 Kbps;
- (e) 384 Kbps;
- (f) 512 Kbps;
- (g) 768 Kbps;
- (h) 1024 Kbps;
- (i) 1536 Kbps;
- (j) 1984 Kbps;
- (k) 2 Mbps;
- (l) 45 Mbps; and
- (m) 155 Mbps.

7.7.5 In offering to allow a Facilities-based Licensee to obtain tail local leased circuits, the Dominant Licensee must also offer to provide co-location space at the exchange building in accordance with Sub-paragraph 5.3.1 above for the purpose of enabling the Facilities-based Licensee to access the tail local leased circuits served by that exchange building. Should the Dominant Licensee be unable to offer co-location space at the exchange building due to actual space constraints or technical or operational considerations, the Dominant Licensee must allow virtual (distance) co-location in accordance with Sub-paragraph 5.3.4 above.

7.7.6 Tail local leased circuits shall be –

- (a) offered to Facilities-based Licensees in a timely and non-discriminatory manner, and
- (b) of the same quality and capable of supporting the same transmission characteristics as tail local leased circuits that the Dominant Licensee supplies to its End Users.

The Dominant Licensee will retain responsibility for the maintenance and administration of the tail local leased circuits. The Dominant Licensee must provide to Facilities-based Licensees maintenance and repair services on the tail local leased circuits that are equivalent to the services that it provides to its End Users. To maintain the integrity of the tail local leased circuits and associated equipment, a Dominant Licensee may retain responsibility for performing the necessary cross-connections required to connect the Facilities-based Licensee's equipment to each tail local leased circuit provided.

8 MANDATED WHOLESALE SERVICES

8.1 Mandated Wholesale Services are services that IDA finds are:

- (a) necessary inputs for the provision of competitive Services in Singapore; and
- (b) sufficiently costly or difficult to provide in that requiring other Licensees to do so would create a significant barrier to the provision of competitive Services in Singapore by an efficient Licensee.

A Dominant Licensee must offer to provide Mandated Wholesale Services to Facilities-based Licensees.

8.2 The RIO must specify the prices, terms and conditions on which the Dominant Licensee will offer to provide Mandated Wholesale Services (where specified by IDA).

8.3 A Dominant Licensee must offer to provide the following Mandated Wholesale Services:

(a) **[Intentionally left blank]**