SECOND PUBLIC CONSULTATION ON THE REVIEW OF THE CODE OF PRACTICE FOR INFO-COMMUNICATION FACILITIES IN BUILDINGS ("COPIF")

Submission by the StarHub Group to the Info-communications Development Authority of Singapore

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Statement of Interest

StarHub Ltd is a Facilities Based Operator ("FBO") in Singapore, having been awarded a licence to provide Public Basic Telecommunication Services ("PBTS") by the Telecommunications Authority of Singapore ("TAS") (the predecessor to IDA) on 5 May 1998.

StarHub Mobile Pte Ltd is a wholly-owned subsidiary of StarHub Ltd. StarHub Mobile Pte Ltd was issued a licence to provide Public Cellular Mobile Telephone Services ("PCMTS") by the TAS on 5 May 1998. StarHub launched its commercial PBTS and PCMTS services on 1 April 2000.

StarHub Ltd acquired CyberWay Pte Ltd (now StarHub Internet Pte Ltd) for the provision of Public Internet Access Services in Singapore on 21 January 1999.

In July 2002, Singapore Cable Vision Limited (now StarHub Cable Vision Ltd) merged with StarHub Ltd, and became a wholly-owned subsidiary of StarHub Ltd. StarHub Cable Vision Ltd holds a FBO licence and offers cable TV and broadband services.

StarHub Online Pte Ltd is a wholly-owned subsidiary of StarHub Ltd. StarHub Online Pte Ltd was issued a licence to provide Public Internet Access Services in Singapore on 22 February 2005.

Nucleus Connect Pte Ltd, a wholly-owned subsidiary of StarHub Ltd, incorporated on 14 April 2009, is the appointed Operating Company of the Next Generation Nationwide Broadband Network.

This submission represents the views of the StarHub group of companies, namely, StarHub Ltd, StarHub Mobile Pte Ltd, StarHub Internet Pte Ltd, StarHub Online Pte Ltd and StarHub Cable Vision Ltd.

1. Introduction

1.1 StarHub welcomes the opportunity to comment on the Authority's second public consultation on the review of the Code of Practice for Info-communication Facilities in Buildings ("COPIF"). The COPIF plays an important role in facilitating the deployment of telecommunication networks and services to buildings, thereby providing telecommunication services to end-users.

1.2 StarHub has carefully reviewed the Authority's Proposed Revised COPIF and would highlight the following key issues which need to be addressed in the final Revised COPIF:

(i) The Mobile Telecommunication Operator ("MTOs") are now required to comply with more stringent 3G QoS obligations and will require the sufficient space and facilities to meet those obligations. Unfortunately, the Mobile Deployment Space ("MDS") is insufficient, and will leave the MTOs with serious operational issues if they attempt to provide indoor mobile coverage;

(ii) It is therefore necessary to expand the MDS requirements, and to ensure that the location and type of MDS are determined in agreement with the MTOs;

(iii) The space and facilities to be provided for MTOs should be extended to other types of developments, i.e. landed dwelling-houses and non non-residential buildings of a total usable floor area of up to and including 2,000sqm;

(iv) As part of the provision and maintenance of space and facilities, building developers/owners should be responsible for sealing all underground pipes (regardless of whether they are used or unused). Building developers/owners may engage telecommunication contractors registered under the Building Construction Authority's ("BCA") heading CR07 for sealing the underground pipes;

(v) As part of the development's space and facilities, building developers/owners should install all the necessary power supply facilities. Any telecommunication licensee who is using the power supply in the development will then be responsible for its utility charges. This approach is reasonable and equitable, and will facilitate a clear demarcation of responsibilities between the parties and prevent any unnecessary disputes;

(vi) Additional specifications (as set out below) should be incorporated into Chapter 13 of the Proposed Revised COPIF to further ensure that there is proper installation of a broadband coaxial cable system; and

(vii) To minimise the number of disputes, the Proposed Revised COPIF should acknowledge how licensees will typically deploy their fixed-line and mobile networks and services, and hence the use of space and facilities to serve external properties under those circumstances should be allowed.

1.3 StarHub's specific comments on the Proposed Revised COPIF are set out in the following section.

2. Specific Responses

2.1 Provision of Space and Facilities to Facilities-Based Operators who are Licensed to Provide Public Mobile Telecommunication Services

2.1.1. StarHub supports the Authority's decision to include the MDS requirements in the Proposed Revised COPIF, and the decision that these requirements will be applicable to both existing and new developments. However, StarHub would highlight the following concerns on the provision of MDS set out in this Proposed Revised COPIF.

(A) Type and location of MDS

2.1.2. The Authority has stated in the Proposed Revised COPIF that building developers/owners may locate the MDS at any unused space in the development (e.g. carpark and roof-top). For the avoidance of doubt, the MDS shall not be located in the main distribution frame room or the telecommunication equipment room, unless there is a clear demarcation of the space designated as MDS.

2.1.3. StarHub submits that the type and location of MDS must not be unilaterally determined by building developers/owners[1]. Rather, the type and location of MDS should be determined in agreement with the MTOs. This is because the type and location of the MDS will depend on various factors, such as the physical conditions and design of the development, and will impact how mobile coverage is provided.

2.1.4. On the location of MDS, the same considerations for location of a main distribution frame room and/or telecommunication equipment room should also apply, i.e. a building developer/owner shall not site the MDS:

(i) in an area through which any system or network of water pipes, gas pipes or electrical trunking is running;

(ii) under any area that is susceptible to dampness or moisture such as a vehicle washing bay, swimming pool, washroom or toilet;

(iii) in any area which will subject the plant deployed therein to vibration of more than 0.05 G, where G is the acceleration due to gravity (G=9.81 m/s^2); or

[1] It is important that the COPIF requirements also apply to building management as well as to agents who manage the building development (after hand over by a building developer).

(iv) in any area where it will be directly subjected to the discharge of water, steam, fumes, gases or dust.

2.1.5. In addition, it is important that the MDS:

(i) be placed at a location that would facilitate optimal signal distribution for the provision of good mobile coverage;

(ii) be placed at close proximity to power supply source and communication links/transmission links;

(iii) be properly secured to prevent unauthorized access; and

(iv) has sufficient ventilation and lighting, and free of working health hazards to workers.

2.1.6. It is important to avoid a situation in which a building developer/owner provides a MDS that would not be suitable for MTOs to provide mobile coverage to the development. For example, a building developer/owner might provide a MDS that is located directly behind a thick concrete pillar, in an area that lacks access to electrical mains. This would lead to wastage of resources for the building developers/owners and MTOs, and would adversely affect the quality of service of mobile coverage that can be achieved.

2.1.7. The Authority has also stated in the Proposed Revised COPIF that building developers/owners may provide the MDS in one or more separate spaces provided that the total space provided meets the relevant minimum MDS and each separate space is at least 6sqm with a minimum width of at least 1.5m.

2.1.8. StarHub would strongly recommend that a MDS be provided as whole instead of separate spaces for the MTOs. This is because the MTOs will require a contiguous space when a common antennae system is deployed for the provision of in-building mobile coverage. In addition, we envisage that separate spaces would take up more resources of the building developers/owners and would pose operational challenges to the deployment of in-building cabling facilities for provision of mobile coverage.

<u>(B) Size of MDS</u>

2.1.9. The Authority has revised the minimum MDS requirements (set out in Chapter 2 of the Proposed Revised COPIF) to be provided by building developers/owners. While the Authority has increased the minimum MDS requirements, the revised minimum MDS requirements are still insufficient to allow MTOs to deploy their equipment and provide mobile coverage in the development.

2.1.10. Based on the revised MDS requirements, each MTO would only be allocated a 6sqm MDS (with a minimum width of 1.5m). This would not provide a MTO sufficient workspace and would impede the operational and maintenance works on the equipment located in the MDS. StarHub would highlight that this is extremely important in allowing the MTOs to respond to service provisioning/restoration needs promptly.

2.1.11. The Authority should also note that the MTOs may deploy a common combiner in the MDS to provide mobile coverage for a development, which would require an additional MDS.

2.1.12. Taking into above considerations, StarHub respectfully submits that the minimum MDS requirements for each relevant development should be as follows:

Table 2.2.1 Mobile deployment space to be provided in residential development

Total number of residential units in the development	**Minimum mobile deployment space (m^2)**	**Minimum height of mobile deployment space (m)**
80 to 200	**26**	**3.5**
201 to 600	**52**	
601 to 1,500	**78**	
> 1,500	To consult IDA	

Table 2.2.2 Mobile deployment space to be provided in non-residential development

Total mobile coverage area ('000 m^2)	**Minimum mobile deployment space (m^2)**	**Minimum height of mobile deployment space (m)**
> 2 to ≤ 6	**26**	**3.5**
> 6 to ≤ 20	**52**	
> 20 to ≤ 100	**78**	
> 100 to ≤ 200	**104**	
> 200	To consult IDA	

2.1.13. In addition, StarHub would point out that a MTO may use either an outdoor antennae solution or in-building antennae system to provide mobile coverage for a development. StarHub submits that the following additional requirements in relation to the MDS should be incorporated into the Proposed Revised COPIF to enable the provision of mobile coverage:

(i) For a residential development where buildings are not more than 20 storeys high, a MTO would typically use an outdoor antennae solution. In this case, the building developer/owner should also provide an antenna support structure with an appropriate spacing between the poles located at the 4 corners of the building roof–top edge (with sufficient safety clearance) or at suitable external walls of the building; and

(ii) For residential development where buildings are more than 20 storeys high (and for non-residential buildings that have a total usable space area of more than 2,000sqm), the MTOs would typically use in-building antenna system. In this case, the building developer/owner should also provide in-building cabling (in consultation with the MTOs) at its own cost to facilitate the provision of mobile coverage in the common areas (including basement carpark if any) and individual units. This obligation is necessary to address the aesthetics requirements frequently imposed by the building developer/owners[2]. This obligation would also enable mobile users (who just moved into the development) to enjoy mobile coverage and services from an early date.

(C) Cable trays

2.1.14. In the Proposed Revised COPIF, building developers/owners are required to provide separate cable trays for coaxial and non-coaxial cable systems. In addition, the specifications for the cable trays of coaxial cable systems will be aligned with those for non-coaxial cable systems.

2.1.15. StarHub understands the cable trays for non-coaxial cable systems are provided for cables to be deployed by PTL and fixed-line FBOs. However, StarHub would highlight that the MTOs will similarly require cable trays (with a minimum width size of 300mm) for the deployment of in-building cabling from equipment located in the MDS to the mounted antennas. In addition, if the MDS is not located near a telecommunication riser, cable trays will be required from the MDS to the riser. Therefore, to enable the provision of mobile coverage in a development, it is necessary that building developers/owners also provide cable trays for the deployment of in-building cabling for provision of mobile coverage.

(D) Provision of power supply

2.1.16. In the Proposed Revised COPIF, StarHub notes that building developers/owners are required to provide electrical and earthing facilities for the main distribution

[2] For in-building antennae systems, the antenna should be exposed rather than mounted within false ceilings.. This is to avoid attenuation or blockage of mobile signals from the material used in false ceilings, as well as from the other services that run within the false ceiling.

room and telecommunication room. However, the same requirements were not included for the provision of MDS.

2.1.17. It is unclear why such requirements were omitted when a MDS is required in a development. StarHub would emphasise that, in order to enable the provision of mobile coverage, it is also essential for the MDS to have such facilities. It would be disruptive, costly, and (in many cases) entirely impractical to expect the MTOs to provide their own power supply (in some cases like underground MRT and road tunnels, which would require significant trenching works).

2.1.18. Therefore, StarHub submits that the MTOs should not be treated differently from fixed-line FBOs when space and facilities for mobile coverage for that development are required. StarHub would propose that building developers/owners provide (for the MDS) a 32A 3-phase power supply for each MTO or 100A 3-phase power supply for all existing MTOs.

<u>(E) Provision of space and facilities in development consisting of 1 or more road or MRT tunnels</u>

2.1.19. In the Proposed Revised COPIF, Chapter 9 specifies that a building developer/owner must provide a MDS of 40sqm for each MRT station or in a facility building associated with a road tunnel.

2.1.20. StarHub submits that it is also critical for the building developer/owner to provide (in addition to the 40sqm MDS) the following:

(i) An MDS that is physically capable of supporting the MTOs' equipment loading and must be connected to the MRT or road tunnels to enable the cabling to be run into the tunnels;

(ii) Power supply of 100A 3-phase at the MDS. Within the tunnels, there must also be provisions (such as space and power) to enable placement of amplifiers. The commuters would also benefit if the MTOs could use the same power source as the Land Transport Authority ("LTA"), as LTA's incoming power supply is typically designed with resiliency in the incoming mains and backed-up by generators; and

(iii) Air-conditioning of 22^{o}C to 25^{o}C, humidity of 70 to 80%, and adequate lighting for the MDS.

The above requirements are already provided for in the current practice for the provision of mobile coverage in MRT and road tunnels. To ensure that mobile coverage can be provided smoothly to these premises, StarHub submits that the current practice should continue.

(F) Provision of space and facilities for other types of developments

2.1.21. In the Proposed Revised COPIF, StarHub notes that the Authority has only required building developers/owners to provide space and facilities for the provision of mobile coverage in the following type of developments:

(i) development consisting of 1 or more multi-storey residential buildings (with 80 or more residential units);

(ii) development consisting of 1 or more non-residential buildings (all of which are not tunnels) with a total mobile coverage area of more than 2,000sqm);

(iii) development consisting of 1 or more road or MRT tunnels;

2.1.22. It is also necessary for building developers/owners of other type of developments to work with the MTOs to provide the necessary space and facilities where mobile coverage is required. These other types of developments would include:

(i) Developments consisting of 1 or more landed dwelling-houses abutting an existing road;

(ii) Developments consisting of 2 or more landed dwelling-houses abutting a new road to be constructed by the developer/owner;

(iii) Developments consisting of 2 or more strata landed dwelling-houses; and

(iv) Developments consisting of 1 or more non-residential buildings of a total usable floor area of up to and including 2,000sqm.

2.1.23. For these types of developments, it is common for MTOs to provide mobile coverage using outdoor antennae solution. StarHub proposes that the COPIF requires building developers/owners to provide the following (when required by MTOs) to enable the provision of mobile coverage to these areas:

(i) A MDS of 8sqm for housing of a MTO's equipment, with the location of the MDS following the same considerations highlighted above;

(ii) Where antennae are to be installed at the roof-top, an antennae support structure with appropriate spacing between poles at the roof-top or at suitable external walls of a building;

(iii) Where applicable or when the antennae solution in item (ii) is not feasible, a building developer/owner may provide an outdoor space of

16sqm within the development for deployment of a free standing pole with in-built antennas. A 200mm lead-in pipe shall also be provided connecting to the standing pole such that cables can be routed from the equipment located in the MDS to the standing pole;

(iv) Power supply of 32A, 3-phase at the MDS; and

(v) Other facilities (e.g. drilling of holes between uppermost floor and the rooftop) that a MTO may request.

2.2. Location of Main Distribution Frame Room and Telecommunication Equipment Room

2.2.1. In the Proposed Revised COPIF, it is stated where it is not possible to locate the main distribution frame ("MDF") room and telecommunication equipment room ("TER") on the first storey of a building, building developers/owners may then:

(i) Locate the MDF rooms and TERs on second or higher storeys of the buildings; or

(ii) Locate the MDF rooms and TERs on the uppermost basement level of the buildings, where such buildings have multiple basement levels.

2.2.2. However, the Authority has also stated that it will allow MDF rooms and TERs to be located on the second storey of buildings, but not any higher. StarHub would recommend that for very high-rise buildings (that has more than 40 storeys), it would be a good engineering practice to have an additional MDF room or TER to be located at the mid-floor of the building. This would facilitate distribution of cables and provide network diversity in the building. The additional MDF room or TER should also be planned with a larger riser to accommodate the cabling between the equipment in the MDF room or TER and telecommunication licensee's network.

2.2.3. StarHub also notes from the Proposed Revised COPIF that, where a MDF room or TER is located on the uppermost basement level of a building, and in the event of flooding in the MDF room or TER room leading to an outage in the provision of telecommunication services supplied to the development and/or damage caused to any licensee's installation, plant or system, the building developer/owner shall, amongst others, be required to relocate the MDF room or TER to another location in the first or second storey of the development and bear all costs in connection therewith. To avoid any potential confusion or dispute between the parties, StarHub submits that the building developer/owner should also bear any diversion cost incurred by telecommunication licensee as a result of such relocation. We submit that this point should be included in the Revised COPIF.

2.3. Provision of lead-in pipes, underground pipes and manholes

2.3.1. Chapter 10 of the Proposed Revised COPIF specifies, amongst others, the requirements for provision of lead-in pipes. However, StarHub would highlight that there are circumstances in which a new building development could be constructed within an existing building development compound, comprising existing underground pipelines. StarHub would therefore propose that the Revised COPIF should specify that for such scenarios, building developers/owners who provide the lead-in pipes should ensure that these lead-in pipes are connected to the existing underground pipeline. Building developers/owners should also assess and ensure that there is sufficient capacity in the underground pipeline in the existing compound that would be used to serve the new development within the same compound. This would avoid any unnecessary future excavation works which are often resisted by owners of the building compound.

2.3.2. StarHub would also highlight that where a building developer/owner installs lead-in pipes to over-cross the public drain (subject to the approval of PUB), the building developer/owner (including the subsequent building management or agent) must also be required to undertake any liability that may arise in the future to the telecommunication licensee or PUB for the lead-in pipes that over-cross the public drain (e.g. re-location costs arising from the diversion of the public drain). Similarly, the building developer/owner must also be required to undertake any liability that may arise in future to licensees or the relevant authorities for lead-in pipes that are provided not according to the specifications (e.g. lead-in pipes that are less than the current 1m depth requirement).

2.4 Submission of building plans to the Telecommunication Facility Co-ordination Committee

2.4.1. In the Proposed Revised COPIF, the building developer/owner is required to submit the building plans to the Telecommunication Facility Co-ordination Committee ("TFCC") during the planning stage of the development together with the information set out in the COPIF document.

2.4.2. To facilitate the TFCC's assessment of the plans, StarHub submits that (in addition to the requirements stipulated in the COPIF) the building developer/owner should also include the following in their building plans submission:

(i) Where there is any deviation from the COPIF requirements, the building developer/owner should state those deviations clearly, and provide justifications for the deviations. For those building plans that have been approved by the TFCC, where there is any deviation thereafter, the building developer/owner must state the TFCC reference number and

forward it to the TFCC members for approval. The TFCC should be allowed to reject those deviations if the building developer/owner is not able to provide valid justifications to the changes; and

(ii) The building plans submission should state the Temporary Occupation Permit ("TOP") date. In the event the building developer/owner is unable to commit on the TOP during the submission, the building developer/owner should advise the proposed TOP date first and inform the TFCC later the actual TOP date around 12 months prior to actual TOP date.

2.5. Sealing of underground pipes entering the Main Distribution Frame Rooms, Telecommunication Equipment Rooms and Telecommunication Risers

2.5.1. In the Proposed Revised COPIF, the Authority has proposed that underground pipes leading to Enclosed Facilities should be sealed. The Authority also views that it would be reasonable for the responsibility to be shared on the following bases:

(i) For new developments with Enclosed Facilities, the building developers/owners must seal all underground pipes prior to handing over the pipes to the licensees. Thereafter, the licensees shall be responsible for re-sealing the underground pipes which they have used; and

(ii) For existing developments with Enclosed Facilities, the building developers/owners must seal all underground pipes which have not been handed over to the licensees within 2 years from the effective date of the revised COPIF ("Effective Date"). Where the underground pipes have been handed over to the licensees, regardless of whether they are used or unused, the licensees shall be responsible to seal these pipes within 2 years from the Effective Date.

2.5.2. As noted in StarHub's earlier consultation response, StarHub believes that a more effective approach (to minimise flash fire incidents) would be to raise the safety awareness amongst workers on hazards in Enclosed Facilities, and reinforce the practice of work safety and the implementation of reasonably practicable control and preventive measures to reduce or eliminate risk of such hazards when working in the Enclosed Facilities.

2.5.3. Should the Authority mandate that all underground pipes for Enclosed Facilities must be sealed, given that building developers/owners are responsible for the provision and maintenance of space and facilities, StarHub would propose that building developers/owners should also be responsible for sealing the underground pipes that have been handed over to telecommunication licensees (regardless of whether they are used or unused). Building developers/owners

may engage telecommunication contractors registered under the Building Construction Authority's ("BCA") heading CR07 for sealing the underground pipes.

2.5.4. This approach is simple and will facilitate a clear demarcation of responsibility with regard to sealing and maintaining the duct seals, given that licensees could share the same underground pipes for installation of cables.

2.6. Provision of electrical distribution panels and accessories in the relevant space and facilities

2.6.1. In its consultation paper, the Authority has indicated that the provision, installation and testing of electrical distribution panels and accessories may be significant if imposed on either building developers/owners or licensees. Therefore, having carefully considered the comments, and weighing the interests of building developers/owners and telecommunication licensees, the Authority stated that a more cost-effective approach would be for the building developers/owners and licensees to first reach an agreement on the utility charges to be borne by the licensees for the installation, plant or system used to provide telecommunication services to the developments. Failing this, the utility charges to be borne by the licensees shall be based on the estimated power consumption of the licensees' installation, plant or system. However, in the case where the parties are unable to reach an agreement, the licensee may at its own cost, install the necessary electrical installation (including cables, a separate utility meter and any other accessory) to enable the utility charges to be computed on an "as incurred" basis and to be paid directly to the utility provider.

2.6.2. StarHub agrees that a licensee should bear the utilities charges for its equipment located in the space and facilities. However, the licensee should not be required to bear the responsibility and cost to install the the necessary electrical installation (including cables, a separate utility meter and any other accessories) to allow the licensee to use the power supply. StarHub submits that building developers/owners (for new and existing developments) should provide the necessary electrical installation to allow licensees to use the power supply. Specifically, the works would include the installation of electrical cabling from the unmetered Busbar in the building development's power main switch room to the distribution box located in the MDF room or TER, and the mandatory testing and certification of the installation by the building developer/owner's Licensed Electrical Worker ("LEW"). In addition, from StarHub's experience, the cost of installation comes from the reinstatement works for laying the electrical wiring and the charges imposed by building developer/owner's LEW. The licensee would apply for an account with PowerGrid (where the power meter would be supplied) and pay the utilities charges directly to PowerGrid[3].

[3] StarHub's proposal is also consistent with the current practice adopted by HDB.

2.6.3. StarHub strongly believes that its proposal is reasonable and equitable as electrical installation facilities are part of a development's space and facilities. Any licensee who is using the power supply in the development will then be responsible for its utility charges. StarHub's proposal will also facilitate a clear demarcation of responsibilities between the parties and prevent any unnecessary disputes between licensees and the building developers/owners on the use of power supply.

2.7. Requirements for proper installation of a broadband coaxial cable system

2.7.1. Chapter 13 of the Proposed Revised COPIF sets out the requirements for the erection, cabling, safety, and performance requirements of broadband coaxial cable systems. Chapter 13 also provides detailed technical specifications relating to the proper installation, safety and performance of broadband coaxial cable systems for buildings that are to be interconnected to a licensee's broadband coaxial cable system.

2.7.2. In addition, where amplifiers, passive devices (such as taps, splitters and system outlets), connectors and splices are provided by the building developer/owner for the purposes of the broadband coaxial cable system, such amplifiers, passive devices, connectors and splices shall comply with the broadband coaxial cable system equipment specifications as set out in Appendix 4 of the Guidelines For Info-communications Facilities in Buildings.

2.7.3. StarHub has reviewed the performance requirements of broadband coaxial cable systems and would strongly recommend the following:

(i) To avoid any potential confusion with regard to the compliance of requirements for proper installation of broadband coaxial cable systems, the Authority should incorporate Appendix 4 of the Guidelines For Info-communications Facilities in Buildings into Chapter 13 of the Proposed Revised COPIF; and

(ii) The Authority should also reinstate the following requirements into Chapter 13 of the Proposed Revised COPIF. Such requirements were set out in the COPIF 2008 and are part of the performance requirements of broadband coaxial cable system;

13.2.4 Carrier levels at system outlets

(a) Minimum and maximum carrier levels

The minimum and maximum carrier levels will depend on many factors, including the performance of typical receivers in use, local installation practices and the ambient signal levels. Notwithstanding the above, the maximum levels shall not be exceeded and the minimum levels shall not be less than those shown in Table 13.2.4(a).

Table 13.2.4(a) Carrier signal levels at system outlets

Frequency Range and Service	Max. Level (dBμV)	Min. Level (dBμV)	Definitions
(i) 54-1002 MHz television	80	63	These levels are expressed as the r.m.s. voltage of each carrier at the peak of the modulation envelope when measured at the system outlet across an external 75Ω termination or relative to 75Ω
(ii) FM sound VHF Band (mono)	75	40	These levels are expressed as the r.m.s value of each FM carrier when measured at the system FM outlet across an external 75Ω termination or relative to 75Ω.
FM sound VHF Band (stereo)	75	50	

Note: Where successive FM channels are at an interval of 300 kHz the maximum FM level shall not exceed 66 dBμV and where the interval is 400 kHz, the level shall not exceed 74 dBμV.

(b) Carrier level differences

The differences in carrier levels shall not exceed the values given in Table 13.2.4(b).

If FM signals are present at the system outlet intended for television signals, the level of any carrier shall be at least 3 dB lower than the lowest television signal level at the outlet.

Table 13.2.4(b) Maximum level difference at each system outlet between distributed television channels

	Frequency Range	Maximum Level Differences (dB)
(i)	54 MHz to 1002 MHz	16 (FCC76.605-a-4ii)
(ii)	Adjacent Channel	3 (FCC76.605-a-4I)
(iii)	Any 60 MHz range	6

(iii) Under Section 13.3 (Network topology), StarHub proposes to adopt the following:

13.3 Network Topology

13.3.1 The network input port shall be designed for proper broadband coaxial cable system network operation with input levels and TV channel loading as follows:

- at 824MHz - Between 15 and 25 dBmV
- at 54MHz - Between 15 and 25 dBmV

13.3.2 The attenuation of upstream 5-42MHz between system outlets and the first active Amplifier (exclude drop amplifier) shall not exceed 32dBmV.

This is to ensure that the input levels of the signals is sufficiently high (i.e. with an acceptable Carrier-to-Noise Ratio) for proper distribution of the cable services to end-users.

(iv) Under Section 13.4 (Cables), StarHub proposes to replace this section with the specifications set out in Annex 1 – Broadband Coaxial Cable System Equipment Specifications.

2.8. Continuing obligation to provide access to and use of the relevant space and facilities

2.8.1. The Proposed Revised COPIF states that, where the relevant space and facilities are located at a height of more than 4m above floor level, the building developer/owner must provide the necessary means for the licensee to access such space and facilities in accordance with prevailing workplace safety and health laws and regulations, at no cost to the licensee.

2.8.2. In line with the prevailing workplace safety requirements set out by the Ministry of Manpower, StarHub proposes that this requirement applies when the relevant

space and facilities are located at a height more than 3.3m above floor level (instead of 4m above floor level).

2.8.3. The Proposed Revised COPIF also states that the building developer/owner shall not impose any charge or rent on the licensee (e.g. administrative charges, security escort charges, reinstatement costs) or impose any additional requirements on the licensee (e.g. requiring any insurance policy or additional insurance coverage to be taken) in connection with the grant of access to and use of the space and facilities, save for any charge reasonably incurred for security or safety measures which are required by any relevant authority or under any relevant laws and regulations.

2.8.4. StarHub submits that the above requirement should also apply to deposit fees which some building developers/owners require licensees to provide for access to (and use of) the space and facilities.

2.9. Use of space and facilities within development for the provision of telecommunication services to properties outside the development

2.9.1. Chapter 16 of the Proposed Revised COPIF sets out:

(i) The procedures to be observed by a licensee that intends to use the space and facilities provided within a development to serve properties outside of the development;

(ii) The procedures to be observed by a building developer/owner who is notified by a licensee of such intended use of the space and facilities; and

(iii) the principles that Authority may adopt in resolving disputes between the parties where the Authority determines that such use of the space and facilities is reasonable.

2.9.2. While the Proposed Revised COPIF envisages that a licensee can use space and facilities within development for the provision of telecommunication services to external properties and also set out the guiding principles in doing so, StarHub submits that there is still considerable uncertainty with regard to how these requirements can be implemented.

2.9.3. First, StarHub would propose that the Authority clearly specifies that the proposed notification procedures governing the licensees and building developers/owners should only apply to new building developments where a licensee seeks to use the space and facilities provided within a development to serve external properties outside of the development. For existing building developments where a licensee has used the space and facilities, there is no need for the licensee to notify the building developer/owner again.

2.9.4. Second, StarHub notes that the Authority has set down the guiding principles on the use of space and facilities to serve external properties, and has encouraged licensees and building developers/owners to refer to these principles with a view to arriving at a mutually acceptable agreement without the need for Authority's intervention. The Authority has also stated that it is prepared to resolve any dispute between the parties and determine whether a licensee is allowed to use the space and facilities to serve external properties.

2.9.5. While StarHub does not disagree with such approach, StarHub submits that there is a need for greater understanding and clarity upfront (for all parties) that fixed-line telecommunication licensees typically deploy their networks to buildings and connect these buildings in a "ring or mesh" configuration. Hence, deploying a ring or mesh network would require a fixed-line telecommunication licensee to use the space and facilities of a building to serve external properties. It is critical to recognise that a ring or mesh network minimises excavation works during the network rollout and ensures there is diversity and resiliency in the provision of telecommunication services to buildings connected to the ring network. The ring or mesh network also ensures a lower cost of providing telecommunication services to customers.

2.9.6. It should also be noted that there would be cases where there are few practical alternatives but to provide services to certain developments using the network and equipment from a nearby development.

2.9.7. Similarly, the MTOs may deploy outdoor antennae solution to provide mobile coverage to a development. By doing so, and given how the radio propagation works, the same antennae solution would also provide mobile coverage to areas outside the building development compound. Such mobile coverage footprints would overlap each other, allowing seamless handover from one area to another, and would also reinforce or enhance the level of mobile coverage in one area.

2.9.8. Therefore, to minimise the number of disputes, StarHub would propose the Authority to clarify further in the COPIF that the use of space and facilities to serve external properties under the above circumstances should be allowed, given that this is typically how telecommunication licensees deploy their telecommunication networks and services.

3. Conclusion

3.1 StarHub welcomes the opportunity to comment on the Authority's second public consultation on the review of the COPIF. The COPIF plays an important role in facilitating the deployment of telecommunication networks and services to buildings, thereby providing telecommunication services to end-users.

3.2 StarHub has carefully reviewed the Authority's Proposed Revised COPIF and would highlight the following key issues which need to be addressed in the final Revised COPIF:

(i) The MTOs are now required to comply with more stringent 3G QoS obligations, and will require the sufficient space and facilities to meet those obligations. Unfortunately, the MDS is insufficient, and will leave the MTOs with serious operational issues if they attempt to provide indoor mobile coverage.

(ii) It is therefore necessary to expand the MDS requirements, and to ensure that the location and type of MDS are determined in agreement with the MTOs;

(iii) The space and facilities to be provided for MTOs should be extended to other types of developments, i.e. landed dwelling-houses and non non-residential buildings of a total usable floor area of up to and including 2,000sqm;

(iv) As part of the provision and maintenance of space and facilities, building developers/owners should be responsible for sealing all underground pipes (regardless of whether they are used or unused). Building developers/owners may engage telecommunication contractors registered under the BCA heading CR07 for sealing the underground pipes;

(v) As part of the development's space and facilities, building developers/owners should install all the necessary power supply facilities. Any telecommunication licensee who is using the power supply in the development will then be responsible for its utility charges. This approach is reasonable and equitable, and will facilitate a clear demarcation of responsibilities between the parties and prevent any unnecessary disputes;

(vi) Additional specifications (as set out above) should be incorporated into Chapter 13 of the Proposed Revised COPIF to further ensure that there is proper installation of a broadband coaxial cable system; and

(vii) To minimise the number of disputes, the Proposed Revised COPIF should acknowledge how licensees will typically deploy their fixed-line and mobile networks and services, and hence the use of space and facilities to serve external properties under those circumstances should be allowed.

3.3 We would strongly urge the Authority to further engage the relevant key stakeholders to address the issues raised prior to finalising the COPIF document. This would minimise any uncertainties, implementation difficulties and disputes telecommunication licensees and building developers/owners would face.

3.4 StarHub is grateful for the opportunity to comment on this matter. In the event that submissions from other parties raise new issues or is likely to affect responses given by StarHub under this submission, we would appreciate it if we could be afforded the opportunity to comment further on the matter.

StarHub Ltd
3 August 2012

ANNEX 1: BROADBAND COAXIAL CABLE SYSTEM EQUIPMENT SPECIFICATIONS

1 DISTRIBUTION AMPLIFIER

1.1 TRUNK DISTRIBUTION AMPLIFIER

(a) The amplifier shall operate in the frequency range of 54 MHz to 1002 MHz with a minimum of 33dB forward gain on the trunk output & 43dB forward gain on the two Bridger output.

(b) The amplifier shall have a built-in return module, operating in the frequency range from 5 MHz to 42 MHz and minimum 18dB reverse gain.

(c) The amplifier shall be capable of having one trunk output and two Bridger outputs (user configurable to four outputs). With a loading of 79 analogue channels, the Bridger output shall be specified to operate at 52dBmV at 1002MHz and 35dBmV at 54MHz. The trunk output shall be specified to operate at 42dBmV at 1002MHz and 32 dBmV at 54 MHz when loaded with 79 analogue channels. With a lower channel loading of 44 analogue channels and 34 digital channels and minimum input signal of 14dBmV for all frequencies, the trunk outputs shall be able to operate at 42dBmV at 862 MHz and 31 dBmV at 54 MHz and the Bridger outputs shall be able to operate at 50dBmV at 862 MHz and 39dBmV at 54MHz.

(d) Carrier-to-composite triple beat at operating trunk output levels of 42 dBmV and 32 dBmV output at 1002 MHz and 54 MHz respectively, with 79 channels loading, shall be 84 dB or better. Carrier-to-composite triple beat at operating Bridger output levels of 52 dBmV and 35 dBmV output at 1002 MHz and 54 MHz respectively, with 79 channels loading, shall be greater than 75 dB or better.

(e) The carrier-to-composite (second order) at operating trunk output levels of 42 dBmV and 32 dBmV output at 1002 MHz and 54 MHz respectively, 79 channels loading, shall 79 dB or better. The carrier-to-composite (second order) at operating Bridger output levels of 52 dBmV and 35 dBmV output at 1002 MHz and 54 MHz respectively, with 79 channels loading, shall be 73 dB or better.

(f) The minimum performance characteristics of the high gain amplifier shall be as follows:

i. Noise figure without equaliser; less or equal to 10 dB
ii. Flatness in unity gain configuration: ± 1 dB
iii. Forward bandwidth (downstream): 54 – 1002 MHz

(g) Amplifiers housings shall be equipped with suitable means to prevent RF ingress and egress. When the cover is secured fastening, the housing shall have RF shielding effectiveness in excess of 80 dB when measured using Dipole Antennae procedure, or in excess of 70 dB when measured using the Absorbing Clamp Method. The housing shall be of watertight construction, sealed with moisture blocking gaskets.

(h) Amplifiers shall provide for the use of appropriate equalisers (input and/or interstage) and shall contain diplex filters providing sufficient isolation to avoid interaction between forward and reverse transmission.

(i) Where remote cable powering is required, the amplifier shall be able to carry up to 90 V_{ac} and a maximum continuous current passing of 12A_{ac} per port.

(j) The amplifier modules shall be able to fit into the amplifier housing in existing building without the need to replace the existing amplifier housing and to reconfigure or replace any of the existing cables, cable connectors and other cable accessories. New amplifier housing must be also compatible and similar to the existing amplifier housing so that it will be backward compatibility with the amplifier modules.

1.2 BRIDGIER DISTRIBUTION AMPLIFIER

(a) The amplifier shall operate in the frequency range of 54 MHz to 1002 MHz with a minimum of 43dB forward gain on the two Bridger output.

(b) The amplifier shall have a built-in return module, operating in the frequency range from 5 MHz to 42 MHz and minimum 18dB reverse gain.

(c) The amplifier shall be capable of having two Bridger outputs - user configurable to four outputs). With a loading of 79 analogue channels, the Bridger output shall be specified to operate at 52dBmV at 1002MHz and 35dBmV at 54MHz. With a lower channel loading of 44 analogue channels and 34 digital channels and minimum input signal of 14dBmV for all frequencies, the Bridger outputs shall be able to operate at 50dBmV at 824 MHz and 39 dBmV at 54 MHz.

(d) Carrier-to-composite triple beat at operating output levels of 52 dBmV and 35 dBmV output at 1002 MHz and 54 MHz respectively, 79 channels loading, shall be 75 dB or better.

(e) The carrier-to-composite (second order) at operating output levels of 52 dBmV and 35 dBmV at 1002 MHz and 54 MHz respectively, 79 channels loading, shall be 73 dB or better.

(f) The minimum performance characteristics of the high gain amplifier shall be as follows:

i. Noise figure without equaliser; less or equal to 9 dB
ii. Flatness in unity gain configuration: $\pm$ 1 dB
iii. Forward bandwidth (downstream): 54 – 1002 MHz

(g) Amplifiers housings shall be equipped with suitable means to prevent RF ingress and egress. When the cover is secured fastening, the housing shall have RF shielding effectiveness in excess of 80 dB when measured using Dipole Antennae procedure, or in excess of 70 dB when measured using the Absorbing Clamp Method. The housing shall be of watertight construction, sealed with moisture blocking gaskets.

(h) Amplifiers shall provide for the use of appropriate equalisers (input and/or inter-stage) and shall contain diplex filters providing sufficient isolation to avoid interaction between forward and reverse transmission.

(i) Where remote cable powering is required, the amplifier shall be able to carry up to 90 V_{ac} and a maximum continuous current passing of 12A_{ac} per port.

(j) The amplifier modules shall be able to fit into the amplifier housing in existing buildings without the need to replace the existing amplifier housing and to reconfigure or replace any of the existing cables, cable connectors and cable accessories. New amplifier housing must be also compatible and similar to the existing amplifier housing so that it will be backward compatibility with the amplifier modules

2 SPLITTERS & TEE UNITS

(a) Markings shall be clearly and indelibly marked with :
- Manufacturer's name, trade mark, or identification;
- Manufacturer's model or type reference.

(b) The nominal impedance of the splitter (including line splitters & drop splitters), directional couplers, power inserters and multi-taps combination shall be 75Ω.

(c) The frequency response of all passive devices, including multi-taps, splitters (including line splitters & drop splitters), directional couplers and power inserters shall be minimally (5 to 1000) MHz.

(d) All the splitters, directional couplers, power inserters and multi-tap combinations shall provide the minimum requirements as specified here under:

In Line Splitters / Directional Couplers / Power Inserters

Frequency (MHz)	5-10	11-50	51-300	301-400	401-600	601-900	901-1000
Isolation (dB)	20	23	23	23	20	19	19
Return Loss (in/Out) (dB)	15	15	15	17	18	16	16

Multi-Taps

Frequency (MHz)	5-10	11-20	21-400	401-500	501-600	601-900	901-1000
Isolation (dB)*	18	23	23	23	20	18	18
Return Loss (dB)+	15	18	20	18	17	16	15

* Isolation between any two output ports.
\+ Return loss at any port with all unused ports properly terminated.

Drop Splitters

Frequency (MHz)	5-15	16-40	41-450	451-550	551-750	751-870	871-1000
Isolation (dB)	20	25	24	24	23	20	17
Return Loss (in/Out) (dB)	15	18	20	18	17	16	15

(e) All the in-line splitters, directional couplers, power inserters, multi-tap combinations & drop splitters shall have a minimum of 100 dB & 120 dB respectively of RFI shielding (screening) in order to minimise signal leakage (egress) from the installation.

(f) Where remote cable powering is required, the outdoor types of inline splitters, directional couplers and power inserters shall be able to carry up to 60 V_{ac} and a current capacity of 15A.

(g) In-line Splitters, Directional Couplers, Power Inserters and multi-taps combinations shall be proof against humid conditions, ie. Relative humidity between 91% to 95%, with the temperature of the air at 40°C ±2°C, which may occur in normal applications. Under such conditions, the splitters, multi-taps, directional couplers and power inserters shall show no damage.

(h) The in-line splitters, directional couplers, power inserters and multi-taps combinations shall be able to fit into the existing passive housing without the need to replace any passive housing and to reconfigure any of the existing cables and cable connectors.

3 COAXIAL SECTION OF THE DROP CABLE

3.1 Coaxial Cable Types

This section covers two types of service drop coaxial cable:

- Aerial
- Underground

3.2 Center Conductor

3.2.1 Material

Coaxial cables must have a single, copper coated, steel center conductor with a nominal diameter as specified. The copper coating must be metallurgically bonded, have uniform thickness and continuously cover the steel core.

	RG6	RG11
Nominal Diameter (mm)	1.02	1.63

3.2.2 Mechanical

The center conductor must have a minimum breaking strain as specified

	RG6	RG11
Min. Breaking Strain (N)	641	1615

3.2.3 Electrical

The center conductor must have a maximum DC resistance at 20°C as specified

	RG6	RG11
Max. DC Resistance *(Q.* per km)	119	47

3.3 Dielectric

3.3.1 Material

The dielectric must be constructed using a closed cell, gas expanded polyethylene.

3.3.2 Mechanical

The dielectric must be mechanically bonded to the center conductor in such manner as to facilitate 100% removal with minimum effort.

The dielectric must have a nominal diameter as specified

	RG6	RG11
Nom. Diameter (mm)	4.57	7.11

3.4 First Shield

3.4.1 Material

The first shield must consist of a Laminated Aluminum Tape (LAT). The LAT must be constructed using two aluminum foils laminated to a strength member with a bonding resin on one side to facilitate bonding to the dielectric. The thickness of the LAT must be as specified

LAT Thickness	
Min. (microns)	47.24
Max. (microns)	81.28

3.4.2 Mechanical

The LAT must:

- Overlap the dielectric circumference by 18% minimum to 35% maximum;
- Be applied longitudinally to the dielectric, free of creases or twists over the entire length;
- Be bonded to the dielectric.

3.5 Core (Dielectric & LAT)

3.5.1 Core Diameter

The diameter over the LAT in the finished product must be as specified

	RG6	RG11
Core Diameter (mm)	4.75 +0.13	7.29 +0.15

3.5.2 Core Ovality

The core ovality must be determined by subtracting the measured minimum from the measured maximum diameter over the LAT in the finished product. The maximum core ovality must be as specified

	RG6	RG11
Core Ovality (mm)	0.33	0.38

3.6 Second Shield

3.6.1 Material

The second shield must be constructed using 0.160mm (34AWG) aluminum braid wire.

3.6.2 Mechanical

The aluminum braid wire must have a minimum:

- Tensile strength for individual strands of 296MPa (43,000psi);
- Elongation for individual strands of 3%;
- Braid coverage over the first shield of 60%.

3.7 Third Shield

3.7.1 Material

The third shield must consist of a LAT. The LAT must be constructed using two aluminum foils laminated to a strength member. The thickness of the LAT must be as specified

LAT Thickness	
Min. (microns)	38.0
Max. (microns)	55.0

3.7.2 Mechanical

The LAT must:

- Overlap the dielectric circumference by 18% minimum to 35% maximum;
- Be applied longitudinally over the second shield, free of creases or twists over the entire length.

3.8 Fourth Shield (Only Applicable to Quadshield Cable)

3.8.1 Material

The fourth shield must be constructed using 0.160mm (34AWG) aluminum braid wire.

3.8.2 Mechanical

The aluminum braid wire must have a minimum:

- Tensile strength for individual strands of 296MPa (43,000psi);
- Elongation for individual strands of 3%;
- Braid coverage over the third shield of 40%.

3.9 Outer Sheath

3.9.1 Material

The outer sheath material of the cable must meet the requirements as specified. Polyethylene used in underground applications must contain 2.0% to 3.0% carbon black having a maximum particle size of 23 milli-microns to insure UV stability. PE jackets shall contain an anti-oxidant to insure long-term thermal stability

Material	Areal	Underground
	Polyvinylchloride (PVC)	Polyethylene (PE)
UV Stability	UL 1581-80% Retention after 720 hours	UL 1581 -80% Retention aft 720 hours

3.9.2 Mechanical

The nominal thickness and diameter over the outer sheath of the coax section of the cable must be as specified

	RG6	RG11	RG11 underground
Nom. Diameter (mm)	12.07	15.49	19.94
Nom. Thickness (mm)	0.80	0.89	0.89

3.10 Corrosion Protection

All coaxial cables intended for underground use must contain a corrosion inhibitor (flooding compound) such as Migraheal®. The inhibitor must not flow from the cable at any connector interface. The relevant standards and test methods that the inhibitor complies with must be specified by the supplier.

3.11 RF and Electrical Performance

3.11.1 Impedance

The nominal impedance of all coaxial cables shall be 75 +/- 3 ohms as determined in accordance with clause 13 of IEC 60096-1 (23), must = Zo + Zo/25 where Zo = 75Q.

3.11.2 Velocity of Propagation

The nominal velocity of propagation of electromagnetic waves in coaxial cables, determined in accordance with clause 13 of IEC 60096-1 (23), must be >82% of the speed of light in vacuum.

3.11.3 Capacitance

The nominal capacitance of all coaxial cables must not exceed 53pF/m.

3.11.4 Structural Return Loss

The minimum structural return loss of all coaxial cables must be >20dB from 5 to 1000MHz.

3.11.5 Shielding Effectiveness

The shielding effectiveness measured in accordance with IEC 60096-1 must be >70dB in the range 30 to 1000MHz for cables having a 60% braid coverage and > lOOdB for cables constructed with quad shields (i.e. tape/braid/tape/braid).

3.11.6 DC Loop Resistance

The maximum DC loop resistance at 20°C must be as specified

	RG6	RG11
Max. DC Loop Res. (£2 per km)	139	58

3.11.7 Electrical Withstand

Electrical withstand tests must be performed using the minimum limits specified

The cable dielectric test must be performed between centre conductor and the first shield. The outer sheath test must be performed between the last shield and the outside of sheath

	Dielectric	Outer Sheath
	Aerial/ Underground	Aerial/ Underground
kV a.c.	2.5	2.5

For voltage tests to the cable sheath a layer of conductive material must be wrapped around the cable sheath to facilitate a connection.

3.11.8 RF Attenuation

The maximum RF attenuation at 20°C, determined in accordance with clause 13 of IEC 60096-1 (23), must not exceed that specified[1]

Frequency (MHz) *	RG6(dB/100m)	RG11 (dB/100m)
	Maximum	Maximum
5	1.90	1.25
55	5.25	3.15
211	10.00	6.23
250	10.82	6.72
300	11.64	7.38
350	12.63	7.94
400	13.61	8.53
450	14.43	9.02
500	15.29	9.51
550	16.08	9.97
600	16.73	10.43
750	18.54	11.97
865	20.01	13.05
1000	21.49	14.27

[1] Maximum RF attenuation figures and the predicted % variation with temperature for all coaxial cables are as specified by the supplier and are typically better than those specified above.

4 COAXIAL SECTION OF THE TRUNK CABLE

4.1 Coaxial Cable Types

This section covers two types of coaxial cable:

- Aerial
- Underground
- If required, both aerial and underground cables can be installed in conduit.

4.2 Center Conductor

4.2.1 Material

Coaxial cables must have a single, solid copper or copper coated aluminum center conductor with a diameter as specified. If the later is used, the copper coating must be metallurgically bonded and have uniform thickness and continuously cover the aluminum core.

	.412 type	.540 type	.715 type
Nominal Diameter (mm)	2.26	3.15	4.22

4.2.2 Mechanical

The center conductor must have a minimum breaking strain as specified. The elongation for all conductors shall be a minimum of 1%.

	.412 type	.540 type	.715 type
Min. Breaking Strain (N)	551	1073	1152

4.2.3 Electrical

The center conductor must have a maximum DC resistance at 20°C as specified.

	.412 type	.540 type	.715 type
Max. DC Resistance (Ω, per km)	6.79	3.34	1.90

4.3 Dielectric

4.3.1 Material

The dielectric must be constructed using a closed cell, gas expanded polyethylene.

4.3.2 Mechanical

The dielectric must be mechanically bonded to the center conductor in such manner as to effectively block air and moisture migration, but facilitate 100% removal with minimum effort as typical with ACT®. The dielectric must also be bonded to the outer shield to enhance mechanical performance of the cable.

	.412 type	.540 type	.715 type
Nominal Diameter (mm)	9.19	13.03	17.42

4.4 Outer Shield

4.4.1 Material

The outer shield must consist of solid aluminum, either seamless or RF welded construction. The thickness of the shield must be as specified.

Aluminum thickness	.412 type	.540 type	.715 type
(mm)	0.64	0.343	0.37

4.4.2 Electrical

The outer conductor must have a maximum DC resistance at 20°C as specified

4.5 Outer Sheath

4.5.1 Material

Max. DC Resistance	*.412 type*	.540 type	.715 type
(Q per km)	*1.64*	1.94	1.37

The outer sheath material of the cable must contain a minimum of 2.0% to 3.0% carbon black having a maximum particle size of 23 milli-microns. The extruded jacket must meet the requirements as specified. The polyethylene sheath shall have a density ranging between 0.955 and 0.930 grams/cc.

Material	Medium Density Polyethylene
UV Stability	UL 1581 - 80% retention 720 hours of Xenon Arc

4.5.2 Mechanical

The nominal thickness and diameter over the outer sheath of the coax section of the cable must be as specified.

	.412 type	**.540 type**	**.715 type**
Nom. Diameter (mm)	12.07	15.49	19.94
Nom. Thickness (mm)	0.80	0.89	0.89

4.6 Corrosion Protection

All coaxial cables intended for underground use must contain a corrosion inhibitor (flooding compound) such as Migraheal®. The inhibitor must not flow from the cable at any connector interface. The relevant standards and test methods that the inhibitor complies with must be specified by the supplier.

4.7 RF and Electrical Performance

4.7.1 Impedance

The nominal impedance of all coaxial cables shall be 75 +/- 2 as determined in accordance with clause 13 of I EC 60096-1 (23), must = Zo ± Zo/25 where Zo = 75Q.

4.7.2 Velocity of Propagation

The nominal velocity of propagation of electromagnetic waves in coaxial cables, determined in accordance with clause 13 of IEC 60096-1 (23), must be >87% of the speed of light in vacuum.

4.7.3 Capacitance

The nominal capacitance of all coaxial cables must not exceed 53pF/m.

4.7.4 Structural Return Loss

The minimum structural return loss of all coaxial cables must be >30dB from 5 to 1000MHz.

4.7.5 Shielding Effectiveness

The shielding effectiveness measured in accordance with IEC 60096-1 must be >120dB in the range 30 to 1000MHz.

4.7.6 DC Loop Resistance

The maximum DC loop resistance at 20°C must be as specified.

	.412 type	**.540 type**	**.715 type**
Max. DC Loop Res. (Q per km)	8.43	5.28	3.27

4.7.7 Electrical Withstand

Electrical withstand tests must be performed using the minimum limits specified.
The cable dielectric test must be performed between centre conductor and the outer shield. The outer sheath test must be performed between the outer shield and the outside of sheath.

	Dielectric	**Outer Sheath**
	Aerial/ Underground	**Aerial/ Underground**
kV a.c.	**2500**	**2500**

For voltage tests to the cable sheath a layer of conductive material must be wrapped around the cable sheath to facilitate a connection.

4.7.8 RF Attenuation

The nominal and maximum RF attenuation at 20°C, determined in accordance with clause 13 of IEC 60096-1 (23), must not exceed that specified[1]

'

Frequency (MHz)	.412 type (dB/100m)		.540 type (dB/l00m)		.715 type (dB/l00m)	
	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum
5	0.62	0.65	0.43	0.46	0.30	0.36
55	2.16	2.26	1.48	1.54	1.15	1.18
211	4.40	4.62	2.99	3.12	2.33	2.43
250	4.82	5.05	3.25	3.38	2.53	2.66
300	5.31	5.57	3.54	3.71	2.73	2.92
350	5.84	6.13	3.84	4.03	2.99	3.18
400	6.17	6.46	4.13	4.33	3.22	3.44
450	6.59	6.92	4.44	4.59	3.41	3.67
500	6.99	7.34	4.63	4.89	3.61	3.90
550	7.35	7.71	4.95	5.12	3.87	4.10
600	7.71	8.10	5.23	5.38	4.01	4.30
750	8.69	9.12	5.92	6.07	4.47	4.89
865	9.41	9.87	6.23	6.56	4.86	5.31
1000	10.20	10.73	6.91	7.12	5.23	5.74

Maximum RF attenuation figures and the predicted % variation with temperature for all coaxial cables are as specified by the supplier and are typically better than those specified above

5 THE SUBSCRIBER'S OUTLET (ISOLATOR /BOX)

(a) All TV/FM isolator shall pass PSB Type and Batch Tests. The details of the PSB Type and Batch Test Scheme can be obtained from the PSB.

(b) The TV/FM front plate of the isolators shall be made of white polycarbonate, urea or other material and match the colour of the electrical/telecoms outlets and having the same brand/finishes. The polycarbonate, urea or other approval material shall be UV stabilised and shall be not discolour within the Defects Liability Period even if the outlet is exposed to sunlight.

(c) Both the isolator box and the front plate shall not emit toxic fumes or support combustion when burnt. The flame shall extinguish as soon as the flame is withdrawn.

(d) The printed board shall be fibreglass type. It shall be 'masked', 'tin-resisted'.

(e) The isolator shall be clearly and indelibly marked with :
- Manufacturer's name, trade mark, or identification
- Manufacturer's model or type reference

(f) The isolator shall be clearly and indelibly engraved on as TV and FM on the front to indicate the television and FM radio ports. It is preferred that the markings be made below the ports.

(g) Separate ports shall be provided for TV and FM receptions. The spacing between the ports shall preferably be 25.4mm. The two ports are preferably to be positioned horizontally.

(h) The isolator shall be capable of accepting coaxial cables having "F" type connector.

(i) The isolator shall be designed to operate in both the VHF and UHF bands.

(j) The isolator of both the TV and FM ports shall have 75 Ω (nominal) impedance. It shall have a frequency range of 5 to 860 MHz. Its electrical performance shall comply with the requirements as stated in Table1.

Table 1

Type	Description	Insert Loss		Mutual Attenuation	Return Loss at Input & Output
		TV	FM	Between TV & FM Sockets of Same Isolator	
Isolator	1 TV & 1 FM Socket	VHF < 1.5 dB UHF < 2 dB	≥ 10 dB	> 10 dB	VHF ≥ 17 dB UHF ≥ 12 dB

(k) The electrical performance shall also comply with the requirements as stated in Table 1 above over the temperature range of 20°C to 40°C.

(l) For safety isolation, isolating transformer or blocking capacitors, shall be provided at the centre conductor.

(m) The isolator shall be proof against humid conditions, ie. relative humidity between 91% to 95%, with the temperature of the air at 40°C ±2°C, which may occur in normal applications. Under such conditions, the isolator shall show no damage.

(n) The insulation resistance between the isolator plate and each conductor of the socket isolator shall be more than 5 MΩ at 500V DC for the duration of 1 minute in accordance with SS 255:1981.

(o) Every isolator unit shall be capable of withstanding a voltage of 2 kV of approximately sine wave form a frequency of approximately 50 Hz applied for one minute. The cut-off current shall not be more than 5mA.
No flashover or breakdown shall occur during the test.

(p) The isolator shall include the required safety isolator, and shall be constructed and installed so as to maintain shielding (screening) integrity and moisture sealing of the connector ports. The isolator shall utilise female F type connectors for TV and FM ports. The isolators shall have a minimum of 60 dB RF shielding (screening), the shielding effectiveness test should cover the range of 55MHz, 200MHz, 400MHz, 600MHz and 750MHz, when measured in accordance with BS EN 50083-2:1995 Part 2 "Electromagnetic Compatibility for Equipment".

(q) The quality and workmanship of the isolator shall be acceptable to the approving representative.

6 RF CABLE CONNECTORS

6.1 Trunk Connector

(a) The construction shall be :

- Heavy duty, alloy aluminium construction, superior alloy for corrosion resistance or other approved type;

- Ultra Violet Resistant O-rings;

- Contacts : Brass with Brite Nickel Plate impervious to ageing and extreme environmental conditions or other approved type;

- Withstands minimum 40 PSIG pressurisation;

(b) The Return Loss should be better than -30 dB up to 824 MHz.

(c) At extreme temperatures (-40°C to +60°C) high RF integrity maintained, with RFI shielding shall be better than 80 dB.

(d) Connector Holding Power maintained over the full temperature range, without damage to cable.

(e) Positive weather seal with controlled O-Ring compression.

(f) Each connector individually stamped to identify connector size and type.

6.2 Drop Connector

(a) The construction shall be :

- High quality brass or other equivalent;

- Cadmium plated with iridescent chromate coating for maximum corrosion resistance or other equivalent;

- Ultra Violet Resistant plastic and O-rings providing a reliable environmentally sealed product;

- Contacts : Impervious to ageing and extreme environmental conditions.

(b) The Return Loss shall be better than -20 dB up to 824 MHz.

(c) The RFI shielding shall be better than 80 dB (60% bonded foil).

(d) Connector to cable retention 40 pounds minimum.

(e) F-nuts/connectors shall be of the “long-sleeve” type, snap-and-seal or 360° full compression connectors shall be used. The Contractor shall use the specially designed tool to clamp the F-nuts/connectors.

(f) Each connector individually stamped to identify connector size and type.