Passive Network Design Guidelines

DocuSigned by: 2611DD00BE1E4EB...	Mohamed Ali Yusuf	1/31/2021 | 11:37 PM ARST
DocuSigned by: Mohamed Alkaabi 14B9B375EE7A445...	Mohamed Alkaabi	2/2/2021 | 4:44 PM ARST
DocuSigned by: SAMEERA ALI AHMED SEADEH 488649F7837A4BD...	SAMEERA ALI AHMED SEADEH	1/31/2021 | 5:04 PM ABST

Authorised by :..... Date :.....

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Part 1 Primary Network Design

1. Introduction

This design guide has been produced in order to standardise the methods and procedures of Design and Implementation of Primary network schemes.

Depending on the area requirements a scheme may be required to provide

(a) Main cable network into new areas

(b) Relief to existing cabinets

(c) Additional cabinets to split an area

(d) A new Service Node for additional capacity and/or for transmission and signaling reasons

2. Forecasting

Line Plant Forecast

A Forecast is an estimate of the level of demand to be expected and should cover a time period at least as long as that to do the planning, make a decision and execute the work. Current forecast details are given individually for year 1,2,3,4,5,10,15 and 20.

3. Information required for scheme design

(a) Latest forecast for the next 20 years

(b) Existing Main Cable Distribution

(c) Exchange area map

(d) MDF Drawing

(e) Duct Space Records

(f) Pressure Unit capacity

4. Provision Rules

When designing a Primary network scheme for an area it is important that certain rules are followed as far as it is sensible. A balance has to be achieved between:

(a) Relieving all cabinets with sufficient pairs to last until the 20th year

and

(b) Providing just enough pairs for the next few years.

Bnet should not invest in an expensive network, now, for it to lie idle for the next 10 years before it may be required. Remember we are using a forecast which has some element of risk.

However, we have to consider that with limited resources we should not have to revisit the area for some time. The time a scheme takes from conception to completion dictates that the scheme should cater for the needs of the next few years at least. Also, the growth in demand for lines is high and continues to grow. This balance should achieve a better use of existing plant, a reduction in maintenance costs and a better deployment of labour resources.

4.1 New areas

The provision rules are as follows:

(a) The planning period for duct network is 20 years

(b) The planning period for cabinet provision is 20 years

(c) The planning period for main cables is 7 years

This means that the duct network and cabinets will be provided according to the 20 year forecast but will initially be provided with sufficient pairs to meet the 7 year requirement. This concept means that provision of additional plant to meet future demand is fast as only cable work is involved.

4.2. Relief to existing areas

The rules for new areas should be applied as far as possible to existing areas. Main cable provision should be for 7 years. Pillars should be avoided wherever possible.

Primary cables can be provided to a cabinet up to a maximum capacity of 600 pairs before a new cabinet is provided.

5. General Design Steps For New Areas

(a) Determine proposed cabinet boundaries.

(b) Decide on the cabinet positions.

(c) Determine the main duct route in schematic form

(d) Design the main cable routes

(e) Finalise the duct route

5.1. Determine proposed cabinet boundaries.

Proposed cabinet boundaries should be decided upon by taking an area that according to the forecast will require 400 lines in 20 years time.

5.2. Decide on the cabinet positions.

As far as possible new cabinet positions should be at the natural junction of cables returning to the MDF. If possible, the position should also be located on a main duct route from the exchange.

Other aspects to consider are:

(a) To be a safe working position for Bnet employees

(b) To be set at the back of the footway with space all round

(c) To be in a secure location

(d) To avoid obstructing the footway

(e) To avoid obstructing road users view

(f) To avoid private land

(g) To avoid sites that enable illegal access to premises

(h) To enable maintenance of the structure

5.3. Determine the main duct route in schematic form

Choose the most suitable route from the exchange linking all the cabinets in an economical way.

5.4. Design the main cable routes

Initially design the cable routes according to the 7 year forecast. This will be the first installment. Make a rough design of the second installment in order to design the duct route for the full 20 years.

5.5. Finalise the duct route

Design the final duct route according to the 20 year forecast with sufficient duct ways and suitable chambers.

6. Designing Duct Network

Duct provision should be made to accommodate the cable installments envisaged during the 20 year planning period. Where congestion of underground services makes duct laying abnormally difficult and expensive, consideration should be made for excess provision including a margin for maintenance cables replacement purposes.

All ducts used should be to Specification BTC/1006/DUCT

6.1. Exchange Manhole

The exchange manhole needs to allow for the larger dimensioned cables to turn, usually in both directions, so currently we should construct an MRT8B for a 36 (max) way lead-in or an MRT8C for a 48 (max) way lead-in.

6.2. Cabinet Construction

For the construction details of the cabinet base refer to the civil construction drawing CC-601.

There are two types of cabinet shell in use. The standard CCC-MC which is a secure steel shell provided to give protection from fire and increased security. This shell be used in all new installations and replacements. The other type is the CCC-4a which is GRP type and exists in the network.

At each cabinet a JRC 14 should be constructed with 6 x D96 laid to the base of the cabinet shell which is mounted on a concrete base.

6.3. Duct Route

a) The duct route for Primary cables should consist of a minimum of 4-way

b) Concrete surround is required for 12-way duct and above

c) Select wider road corridors for laying multi-way track

d) The requirements of the junction cable network according to the Junction Forecast, should be considered when calculating the total number of duct ways required.

6.3. Jointing Chambers

Jointing Chambers are required to house joints as the maximum lengths of cable are usually much less than the length of cable route or larger cables need to be jointed to smaller cables for distribution. The longer the route the more difficult it becomes to rod and cable the duct.

For planning purposes, the standard maximum distance between jointing chambers is 230m.

The choice of jointing chamber depends on the number of duct ways and also the number and size of cables.

Consideration needs to be made for the space required to house, make and to maintain joints. Space is required to be able to bend cables to change direction. The use of turning manholes should be considered.

Manholes and joint boxes are coded and shall conform to the standard CC drawings.

Primary cable routes should consist of a minimum of a 4-way with JRC14 chambers. For a 9-way track manholes will be required.

Table 6.1 shows the dimensions for JRC14, JRC14A and JRC14B.

Type	**CC Drawing No.**	**Dimensions**	**Typical Duct Formation**	**Max. No of Ducts**
JRC14	CC134	Length = 2585mm Width = 1285mm Depth = 1275mm	**OO** **OO**	4
JRC14A	CC134A	Length = 2750mm Width = 1110mm Depth = 1425mm	**OO** **OO** **OO**	6
JRC14B	CC 134B	Length = 2750mm Width = 1130mm Depth = 1275mm	**OO** **OO**	4

6.4. Obtaining Planning Permission and Wayleaves

The Designer shall arrange to obtain the necessary planning permission, wayleaves and permits from all public utilities. Once the scheme is approved the wayleave form with the relevant details should be completed and issued to the Wayleave Co-ordinator.

6.5. Main Duct Plan

The duct plan/Ordnance map shall include the following information:

(a) Number and type of existing and proposed ducts

(b) Types of jointing chambers and their orientation with regard to duct entries

(c) The configuration of the duct entries

(d) Distance between salient points

(e) Cabinets and Direct Fed DP's

(f) Other details such as road number, block number etc.

(g) Winch and cable drum positions

(h) Positions where cable guiding equipment is required

(I) Duct Space Record (DSR) reference

7. Entry To Buildings

7.1. Service Node lead-in

If a new Service Node is to be provided the number of duct entries depends on the 20 year forecast but due to the difficulties and cost of adding more later it is best to overestimate the figure. Therefore, the minimum duct entry should be 24 way.

Refer to drawing CC-501 for details.

A cable chamber is always the preferred option but in smaller Service Node a cable trench is acceptable. Refer to CC-510 showing the standard layout of a cable chamber.

The main duct entry to the exchange should be in the best position to avoid unnecessary bends in the cables. The ducts should be sealed to keep out water and gas according to drawing CC-502

For all new Service Nodes it is necessary to provide an alternative lead-in for diversity.

7.2. Cable Chamber Ironwork

Refer to CC- 410 for the standard layout requirements for Ironwork in the cable chamber. This standard is to be amended to suit the measurements of the proposed chamber.

7.3. Customer buildings lead-in

The duct entry to customer buildings is dependent on the size of cable to be provided. The appropriate method illustrated in Your Guide To Service Connection (Business Sector) shall be used. The ducts should be sealed against entry of water and gas.

8. Designing the Cable Network

8.1. Service Node Termination

Primary cables are terminated in the Service Node on the Main Distribution Frame (MDF).

New Service Nodes will require standard KRONE strips to terminate the cables.

Existing MDF will require sufficient Jack Test 39/2B for every 100prs.

The existing MDF drawing should be checked to determine the next available terminating space. The next available cable code should be reserved.

8.2. Primary cables

Table 8.1 shows the current Primary cables manufactured according to specification BTC/1960/CABLE.

Polyethene Unit Twin cables (PEUT) are pressurised with dry air from the exchange/RLU.

Main cables are ordered specifically according to the requirements of the approved scheme.

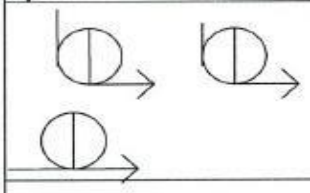
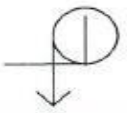
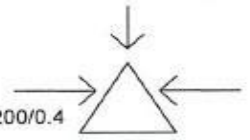
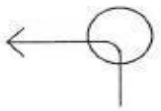
Table 8.1. E-side Cables Types

GAUGE →	0.4		0.5		0.6	
PAIRS↓	Diameter (mm)	Drum Length (m)	Diameter (mm)	Drum Length (m)	Diameter (mm)	Drum Length (m)
100	20.4	1000	24	1000	28.2	1000
200	25.9	2000	31	2000	37.6	1595
300	30.7	2000	37	1667	46	1025
400	35.1	1864	43	1181	52.6	826
500	37.6	1667	46	1025	56.4	699
600	40.6	1346	50	826	61.0	538
800	46.5	968	57	652	70.4	398
1000	51.3	826	63	538		
1200	56.1	652	69	398		
1600	65.5	497				
2000	70.0	398				

8.3. Long Length Cabling

When designing a Primary network scheme maximum use must be made of long length cabling techniques. It is necessary to ensure that there is sufficient space for locating the cable drum and winch and to lay cables out

Cabling Symbols

Symbol	Meaning of symbol
	DRUM POSITION Arrow head indicates direction of first pull Arrow tail (if any) indicates cable removed from drum and the direction in which it should be drawn
	CABLING POSITION Cable end to be drawn out of duct and re-entered in the direction shown, or fleeted through the jointing chamber by hand
	WINCH POSITION Arrows show the direction of pull on cable. Cable size is shown only if it is necessary to clarify a particular length
	CABLE GUIDING EQUIPMENT Arrow shows direction of pull This symbol is used for all types of cable guides

8.4. Maximum Cable Bending Radius

The bending radius of a cable should not exceed 6 times the outer cable diameter.

8.5. Transmission and Signalling

Refer to Document AN-1013 Secondary Network Design Guide for details on Transmission and Signalling calculations.

When designing the Primary network it may be necessary to combine the use of several gauges of cables to suit the individual scheme requirements

8.6. Joint Closures

Permanent joint closures will be used such as XAGA 1000 according to the cable diameters.

The standard XAGA 1000 kit is designed for a maximum of 4 cables branched at each ends.

If the joint is required to take additional cables, additional branch-off kits should be ordered.

Table 8.2 shows the range of XAGA 1000 closures

8.7. Location of joints

If a joint is required at the angle junction of duct routes it is preferable to site in the chamber before or after the junction, unless the chamber has been specifically designed for this purpose i.e. a turning manhole.

8.8. Direct Fed DP's

Primary cables when extended into a customer’s building are terminated on a frame using KRONE LSA-plus modules.

8.9. Cable Termination in Cabinets

Cabinets are equipped with KRONE modular strip connection equipment.

The first 3 Primary pairs are reserved as follows>

Pair 1 - air pressure alarm circuit
Pair 2 - service circuit
Pair 3 - cabinet security system

E001 ⇓ E100	D001 ⇓ D100	E301 ⇓ E400	D301 ⇓ D400	D601 ⇓ D700
E101 ⇓ E200	D101 ⇓ D200		D401 D500	D701 D800
E201 ⇓ E300	D201 ⇓ D300		D501 ⇓ D600	

KRONE accessories to be ordered for a new cabinet to allow for 400 Primary pairs and 800 Secondary pairs are as follows:

ITEM No	DESCRIPTION	TOTAL REQUIRED	UNIT
E020082	Resin Pack No 6A	2	each
E020170	Mounting Kit for CCC No4A	1	each
E020171	MCCS Mounting Column	3	each
E020172	Discon' Module 10pr L/H green	40	each
E020174	Discon' Module 10pr L/H blue	20	each
E020175	Discon' Module 10pr R/H blue	60	each
E020176	Label Holder 51A Blue	80	each
E020177	Label Holder 51A Green	40	each
E020178	Designation labels	1	each

If necessary, it is possible to terminate a maximum of 600 Primary pairs and 1200 Secondary pairs.

9. Site Survey

A site survey is required to determine

(a) The duct space available for rodding and cabling

(b) The space inside the chambers for jointing and turning cables

(c) Space above ground for the cable drum, the winch and guarding

(d) Duct alignment

(e) If anchors exist

For large schemes such as Primary schemes it may be necessary to issue a works order to make a detailed survey of a route.

Also, in doubtful situations, where a scheme requires a cable to be drawn over a works order can be issued to carry out a test rod and rope to confirm the job can be done.

9.1. Duct Space

On the Primary scheme the intended bore proposed for use should be indicated.

This is shown by a set of Manhole and Joint Box Survey Duct Space Records.

Figure 9.1 shows a copy of the form.

Standard use of duct space

a) Use lower ducts first

(b) Occupy the duct closest to the wall and work towards the centre of the manhole at each level

(c) Do not obstruct later installation of cables in adjacent ducts

(d) Where possible keep to the same bore along the route.

10. Pressurisation

10.1. Reasons for pressurisation

(a) To provide positive air pressure within a cable which prevents moisture entering the core of the cable. This prevents the loss of service when relatively small faults occur in the sheath of the cable.

(b) To provide an alarm system which operates when the air pressure within the cable falls below a pre-determined level.

(c) To provide a means of locating faults, by pressure measurements at test points along the cable and by determining which pressure monitoring device has been activated.

10.2. Continuous flow system

Air is supplied to the cable continuously by a compressor/dessicator unit as part of the Exchange equipment. The air is fed to the cables via flow meters on a distribution panel monitoring the amount of air delivered.

The system is computerised so that the air flow and pressure can be monitored remotely.

10.3. Components

Figure 10.1 shows the various components of a pressurisation system. The details are as follows:

10.3.1. Pressurisation Unit

Bnet is currently using 2 types of pressurisation unit in the Service Node.

CENTREL Pressurisation Units -

Model 5501 which has a maximum capacity of 16 junction cables with terminal gauges, or 20 local cables with flow meters.

or

DRALLIM Pressurisation Units -

Model 12255 (Compact) which takes a maximum of 20 cables
Model 12269 (Double) which takes a maximum of 40 cables

Note: any non-stock items should be ordered along with the required cables

10.3.2. Transducers

A pressure transducer is a device designed to measure air pressure by electrical means. There are two types of transducer:

(a) Addressable Transducer (AT)
(b) Non-Addressable Transducer (NAT)

An AT incorporates an electronic circuit which enables it to be identified as a specific address point and report the air pressure.

An NAT has no electronic identification circuit and therefore requires an individual pair.

Bnet is currently installing SPARTON ATs and CENTEREL NATs.

10.3.3. Air Take-off/feed

Air Take-offs and Air Feeds are provided using RAYCHEM RWPS closures which are fitted with combined feed and test points. The connector has a Schrader Valve on one side and an outlet for the air tube on the other.

Polythene tubing is provided to the Pressure Unit in the Exchange/RLU or to the Cabinet

All Dimensions are in mm

Description	Max Cable Diameter	Min Cable Diameter	Nominal Sleeve Length
RWPS 45/15-250	45	15	250
RWPS 65/20-250	65	20	250
RWPS 95/30-250	95	30	250

10.3.4. Air Blocks

All the terminal ends should be provided with air blocks. In the Exchange/RLU cable chamber/trench air blocks are fitted.

Bnet is using FUJIKURA air blocks.

10.4. System Layout

Addressable Transducers (ATs) should be located along the main cable route from the Exchange/RLU to the furthest cabinet with maximum distances of 500m between each AT. Each AT will read 250m on either side of the joint.

Interim ATs are housed outside the joint, for easy access, and are connected to the alarm pair through the connector. It is essential that sufficient transducers are provided.

The furthest cabinet should have an AT and its alarm pair should be shared by the other ATs on the route. Up to a maximum of 128 ATs can use the same pair.

Other cabinets should be fitted with NATs if the distance is more than 250m away from the nearest addressable transducer.

10.5. Pressurisation System Layout

Once the Designer has prepared a proposal of the pressurisation layout, NX may be consulted, if necessary.

11. Scheme Presentation

Common drawings for both inside and outside operations should be prepared. The scheme will consist of

(a) An Ordnance map showing the map base with the existing and proposed Bnet Plant

(b) Main Cable Drawing (MCD) showing the existing and proposed Primary cables.

(c) The Duct Space Records

(d) MDF drawing

(e) Key Plan

A common label should be used for both drawings with a key for the symbols used. A typical main duct scheme is shown in LP3041B and a typical main cable scheme is shown in LP3041C.

12. Scheme Approval

Schemes should be approved after the initial design for both duct and cable has been done.

The scheme is checked first by the SPC. It is then passed to XA1 for approval and finally authorisation from XA is required.

The stores are then ordered and the scheme can be issued.

Part 2 Secondary Network Design

1- Introduction

This Design Guide has been produced in order to standardise the methods and procedures of Design and Implementation of Secondary network schemes.

In Secondary network schemes design it is assumed that the Primary network is already provided or arranged for, the Cabinet location is known and that the Cabinet boundary is already defined as per the Primary Network Design Guide.

2- Network Provision Policy

a- Basic Distribution System

The national telephone network is designed by providing a Service Node specific for each area such that the distance to the furthest customer is not more than 4Km.

The electrical characteristics of the switch and the local lines impose limitations on the line length influencing switching and cabinet area boundaries. The planned transmission limits for the local network conform to the Bahrain Transmission Plan which specifies the line losses of 90% of the customers connected must be within 7.5 dB.

A network of underground duct enables the connection of any customer to Bnet Network using a copper pair to provide him with services from a simple telephone to telex or high speed data.

At the planning stage sufficient duct and jointing chambers are constructed for all the foreseeable cable requirements. Where the network already exists the route is surveyed to determine if additions or alterations are required.

Due consideration is given at the planning stage to the location of underground plant to ensure the safety of both the public and the operators working on the plant. Consideration is also given to the present and future provision of other utilities and future roadworks schemes.

Underground duct schemes are planned according to present Bnet planning principles and using the Civil Works Specification reference BTC/1000/CIVILS. This document controls the installation procedures, the supervision and the payment conditions.

b- Customer Connection

The ultimate customer connection to Bnet Network uses an underground lead-in. However, there are instances where this cannot be achieved instantly due to unavoidable circumstances or economics in provision. In these cases overhead connection will be adopted as a temporary solution.

In all cases customers are advised to make provision for overhead and underground service connection to avoid any delays when the service is required.

When designing the network in new areas where the final surface levels have not been constructed, the policy is to provide an overhead network fed by aerial cables as a temporary measure and Propesed under ground plan should be drawn at GIS to be use as an indecation for plant protection and to avoid approve any development WL at area before Bnet start the civil work. The permanent underground network should then be installed when the roads are at the construction stage and drawing to be reflected on GIS.

2.1- Methods of Distribution

The following are the distribution methods used by Bnet :

2.1.1- Overhead DPs

2.1.1.1- U/G Feed:

Distribution Points fitted on poles are used to provide service by mean of Dropwires. The cable feeding the DP's is provided in duct up to the Cabinet.

2.1.1.2- O/H Feed:

This is the same as above but the feed is overhead using aerial cable. This method is used to provide service in rural areas or as a temporary where the roads are not established.

2.1.2- External DPs

Distribution Points are fixed on wall of building with U/G feed cable. Dropwires clipped on the wall are used to extend the service to the units.

2.1.3- Internal DPs

Multi-story residential and/or business blocks are provided with internal distribution Points with U/G feed. The owner should arrange for lead-in and internal distribution conduits.

2.1.4- Underground DPs

In this method group of houses, usually 6, are connected by cables laid in ducts to a common point (Joint Box) and then jointed to the distribution cables in a sleeve 31RM.

The design concept of each method will be explained in details in this guide for reference. The method of distribution to be used in a certain scheme should be based on Bnet policy with regards to method of distribution which may change for operational reasons.

3-Distribution Network Design

3.1- Secondary Pair Provision

3.1.1- Penetration Factor used by Bnet

Penetration Factor (PF) forms the basis of customer demand forecast, the accuracy of the demand forecast depends on the accuracy of the PF and its application in deriving future network design and planning requirement.

Table 3.1 - 1 shows the PF's used by Bnet in pair's provision.

3.1.2- Determination of Number of Pairs per DP

To determine the number of pairs to allocate to a DP it is necessary to consider the Penetration Factor.

First the respective Penetration Factor is applied to the premises and the result is rounded up to the next whole number of pairs.

Demand (network design) = Σ (PF x No of units)

Example 3.1 - 1 shows the number of pair's determination for a typical DP.

Table 3.1 - 1 Penetration Factors (PFs)

Code	Type of Tenancy	Unit	PF
MOH3	Ministry of Housing Town House, up to 3 bedrooms	Unit	2
MOH4	Ministry of Housing Town House, over 3 bedrooms	Unit	2
FLAT	MOH or Private Flats	Unit	2
PVT3	Private House/Villa, up to 3 bedrooms	Unit	2
PVT4	Private House/Villa, 4 bedrooms or more	Unit	2.2
HOT3	Hotel up to 3 stars	Unit	15
HOT4	Hotel 4 & 5 stars	Unit	70
HOSM	Hospital (Main)	Unit	300
HOSP	Hospital (Private)	Unit	100
CENT	Health Centre	Unit	10
CLNC	Clinic (Private)	Unit	2
CHLT	Chalet, including holiday resort	Unit	1
FLOR	Office Business Floor	M^2	0.2
INDL	Large Industry Complex	Unit	100
INDM	Medium Industry	Unit	30
INDS	Small Industry	Unit	10
PTRL	Petrol Station	Unit	2
PLCE	Police Station	Unit	8
MOVE	Movie Theatre/Cinema	Unit	4
RELG	Mosque, Church, Temple	Unit	1
SCHL	School	Unit	5
UNIV	University	Unit	100
TAXI	Taxi rank, Bus Station	Unit	1
PAYP	Payphone	Unit	1
CLUB	Club, Society	Unit	3
SUPR	Supermarket	Unit	10
MALL	Shopping Mall	Unit	100
SHOP	Shop	Unit	2
BNKM	Bank Main Office	Unit	200
BNKB	Bank Branch	Unit	10
BASE	Military camp, Air/Naval Base	Unit	100
PORT	Port, sea and air	Unit	100
SITE	Site Office	Unit	2
POST	Post Office	Unit	3

Example 3.1 - 1 Determination of Number of Pairs per DP

Example:

A Buildings with 6 Flats - PF for FLAT = 2

∴ Demand (Network Design) = ∑ (PF X Number of tenancies)

= 2 X 6

= 12 Pairs

3.2- Information Required For Secondary Network Scheme Design

(a) Existing network plans.

(b) Cabinet boundary.

(c) Maintenance difficulties.

(d) Type and number of tenancies.

(e) Future requirements.

3.3- General Design Steps

3.3.1-Preliminary Survey

A preliminary survey is conducted to verify the accuracy of the existing records and to form a basic plan for the scheme. The address and type of tenancies, street numbers and some details such as DP positions can be determined.

3.3.2- Draft Design

A draft design can be completed in a basic straight line form for the duct layout based on the results from the preliminary survey.

3.3.3- Cable Distribution Design

The cable distribution design is prepared based on the duct layout and the distribution pairs will be allocated. At first the penetration factor and the number of premises is used to calculate the total number of pairs required. This in turn will determine the cable sizes.

3.3.4- Detailed Design

The detailed design can be prepared once the proposed cable sizes and joint locations have been determined. The number of ducts required and the size of the Jointing Chambers will be finalised.

3.3.5- Final Survey

A final survey is made to confirm the planned design and to check the details for costing such as the surfaces.

3.3.6- Design Approval

The design is approved before proceeding with the estimate preparation to ensure that the scheme follows all the latest standards and all aspects of the job have been considered.

3.4- Specific Points on Distribution Methods

3.4.1- Overhead Distribution

3.4.1.1- Calculating the Maximum Number of Tenancies per DP

Maximum number of pairs per overhead DP = 20 = M
Maximum number of tenancies per Overhead DP = T

∴ T = M / PF

Example:

If PF is 2.0

∴ Max. number of tenancies per Overhead DP = 20 / 2.0

= 10 Units

3.4.1.2- Determination of DP Boundary

The following conditions should be aimed for when deciding DP boundary:

(a) The DP boundary is determined by the geographical layout
(b) The boundary should be dimensioned to have a maximum of 20 pair DP.
(c) The DP area should be designed in order to provide service to the maximum number of tenancies
(d) The DP area should be designed to avoid the need for carrier poles
(e) There should be a minimum number of dropwires in line of route
(f) Each house should be fed by a span of dropwire not exceeding 50m.

3.4.1.2- DP Position

The following points should be considered when positioning an Overhead DP:

(a) The DP should be located at the boundary of two properties.
(b) The pole should be located at least 0.5m away from the property line
(b) The load of the dropwires should be evenly distributed.
(c) The position should allow for pole testing.
(d) If near a road, it should not obscure visibility.
(e) It should not be located in front of a window.
(f) It should be away from power lines.

3.4.2 - Aerial Cabling

3.4.2.1- Cables

All cables used must complies to Specification BTC/1968/Cable which details the suspension and the special sheathing requirements for a combined, self-supporting aerial cable.

Table 3.4.2 - 1 list the standard aerial cables sizes used by Bnet .

Cable Size	Diameter (mm)	Weight (Kg/m)	Standard Drum Length (m)
10/0.5	10.5	0.14	1000
20/0.5	14.5	0.21	1000
50/0.5	18.5	0.48	1000
100/0.5	23.5	0.76	1000
50/0.63	23.5	0.60	1000
100/0.63	32.5	1.00	1000

3.4.2.2- Poles and Pole Fittings

All poles used must comply to Specification BTC/1003/POLES which outlines the requirement for wooden poles suitable for use with telephone installation.

The followings are the standard sizes of poles used by Bnet :

(a) 8m Medium.
(b) 10m Medium.
(c) 12m Medium

8m Medium poles should be used in all new installation. In cases where a taller pole is required to be installed to provide clearance or otherwise, the 10m & 12m Medium poles can be used.

All poles must be dressed with the necessary fittings based on their proposed usage.

3.4.2.3- Span lengths

Poles should normally be spaced at 50-60m intervals and the route should not cross from one side of the road to the other unless unavoidable.

Figure 3.4.2 - 5 shows a typical overhead route.

3.4.2.4- Pole Route Support

Pole routes carrying aerial cables need to be supported and strengthened to cater for the following stresses:

(a) Static stresses - weight of cable..ect.
(b) Kinetic stresses - wind force..ect.

Stays and Struts are used to provide the necessary support. The following poles in a route should be supported:

(a). Terminal Poles to cater for the in-line-of route tension using Terminal stay.
(b). Angle Poles to correct the balance at the bend using Angle stay.
(c). Poles at maximum of every 500m to provide stability in sections using Longitudinal stay.
(d). Poles in long routes in open space, at maximum of every 500m, to strengthen against wind using Transverse stay.

In cases where stay cannot be provided a strut can be used. In extreme difficult situation where neither stay nor strut can be provided, an overhead stay can be used.

For further information on determination of loads on poles, please refer to your course notes or Telecommunication Instructions.

Figure 3.4.2 - 6 shows the types of stays and struts.

3.4.2.5- Lightning protection

All permanent overhead routes of more than 4 spans of construction should be protected from lightning by providing protected block terminal for the DP’s. BT76P with arrestors (gas discharge tubes- GDT) shall be used.

3.4.3 - Internal

3.4.3.1- Internal Wiring

The location of the internal Distribution Point and the internal wiring requirements should be agreed with the Internal Planning Group at the Building design stage.

The external cable should be terminated as soon as possible once inside the building as the cable should be changed to PVC type for safety reasons.

All consultations received from Buildings owners, Consultants and Customers should be forwarded to Internal Planning Group to comment and approve the internal wiring provision before returning back.

3.4.4 - Underground

3.4.4.1 - Method Adopted by Bnet

The method of underground distribution in residential areas adopted by Bnet is based on fully ducted system. A maximum of six Houses/ Villas will be connected to a common Joint Box (Preferably JB2) using D38 ducts. The maximum length of the House/ Villa duct feed should not exceed 60 m with a maximum of two 90° bends. The maximum number of D38 ways into the end wall of a JB2 is 4.

Figure 3.4.4 - 1 shows a typical underground distribution based on the above method.

3.4.4.2 - Provision of Service for Vacant Plots

During a full cabinet scheme preparation using underground method and where the type on tenancy to be built on vacant plots is known, a duct should be provided to these vacant plots. The duct should be provided 1 m away from the nearest corner of the plot to the jointbox in Bnet corridor.

This provision will ensure that the necessary work to provide service to the Customer on the development of his plot is minimal.

Figure 3.4.4-2 shows the location of the provision.

3.4.4.3 - Special Arrangements in 10m and 12.5m Roads

As a result of the limited corridors allocated to Bnet in 10m and 12.5m roads, the following need to be considered when designing a Secondary network scheme in these types of roads:

(a) In 10m roads only single way routes can be provided and only JB2 boxes should be used. Road crossings can be provided if JB2 Joint boxes are used. Refer to Figure 3.4.4 - 3.

(b) In 12.5 m roads, a maximum of two ducts can be provided, however, a special type of JRC 12 should be used to allow for water supply pipe provision.

CC-508 and CC-509 copy of which is attached, shows the typical cross section of Bnet ducts in 10m and 12.5m roads respectively.

3.5 - Designing Duct Schemes

3.5.1 - Duct Provision

Duct provision should be made to accommodate the cable instalments envisaged during the 20 year planning period. Where congestion of underground services makes duct laying abnormally difficult and expensive, consideration should be made for excess provision including a margin for maintenance cables replacement purposes.

All ducts used should be to Specification BTC/1006/DUCT.

Table 3.5 - 1 standard Duct types used in Secondary network by Bateclo.

	Standard Depth of Cover	
Type	Footway (mm)	Carrigeway (mm)
PVC Duct Number 96	600	600
PVC Duct Number 56	600	600
PVC Duct Number 38	600	N/A

3.5.2 - Duct Routes

Duct routes should be provided:

(a) In a straight line wherever possible or between two joint boxes the maximum bend can be 90^0 with a bending radius of 10m

(b) In the footway rather than the carriageway with minimum road crossings.

(c) With the least number of jointing chambers in safe, accessible positions ie. not at the entrance or driveway to a house.

(d) Avoiding foundations and expensive pavings

(e) At a depth of cover of 600mm in both the footway and the carriageway

(f) A singleway is sufficient, when designing a new duct layout in the distribution network, unless there are 4 or more feeder cables from the Cabinet.

(g) If possible, down only one side of the road to minimise length of trench.

3.5.3 - Jointing Chambers

Jointing Chambers are required to house joints as the maximum lengths of cable are usually much less than the length of cable route or larger cables need to be jointed to smaller cables for distribution. The longer the route the more difficult it becomes to rod and cable the duct. Manholes and joint boxes are coded and shall conform to the standard CC drawings. Table 3.5 - 2 shows the standard Jointing Chambers used in Secondary network and the maximum number of ducts that can be provided.

Table 3.5.2 - 2 Joint Chambers details

Type	**CC Drawing No.**	**Dimensions**	**Typical Duct Formation**	**Max. No of Ducts**
JB23	CC 111	Length = 510mm Width = 275mm Depth = 487mm	O	1
JB24	CC 112	Length = 560mm Width = 335mm Depth = 458mm	O	1
JB2 Note-1	CC 131	Length = 800mm Width = 650mm Depth = 750mm	O	1
JRC4 Note-2	CC 132	Length = 953mm Width = 785mm Depth = 990mm	O	1
JRC12	CC133	Length = 1730mm Width = 1245mm Depth = 1050mm	OO	2
JRC12A	CC133A	Length = 1490mm Width = 1110mm Depth = 1050mm	OO	2
JRC12B	CC 133B	Length = 1580mm Width = 1055mm Depth = 1050mm	OO	2
JRC14	CC134	Length = 2585mm Width = 1285mm Depth = 1275mm	OO OO	4
JRC14A	CC134A	Length = 2750mm Width = 1110mm Depth = 1425mm	OO OO	4
JRC14B	CC 134B	Length = 2750mm Width = 1130mm Depth = 1275mm	OO OO	4

Notes:-

1. JB2 Shall be used for singleway distribution network with no branching joints.
2. JB4 Shall be used for singleway distribution network on routes where branching joints are envisaged.

3.5.4 - Road Crossings

Where duct is required to cross under a road care must be taken with the design for engineering and cost reasons.

(a) The number of road crossings should be kept to a minimum.

(b) Duct 38 should not be laid under the road.

(c) The actual crossing should be provide at the shortest point across a road

(d) The jointing chambers should be set into the minor of the two roads for a safer working environment

(e) The duct entries to the chambers should suit the cabling requirements

3.5.5 - Obtaining Wayleaves

The Planner shall arrange to obtain the necessary wayleaves and permits from all public utilities. Once the scheme is approved the wayleave form with the relevant details should be completed and issued to the wayleave co-ordinator.

General Service Notification (GSN) should be used in cases where the excavation is less than 10 metres in an asphalted or non-asphalted area, provided that the scope of work will not exceed the width of one lane of the road and that hand excavation will be used.

3.5.6- Duct Plan

The duct plan/ Ordnance map shall include the following information:

(a) Number and type of existing and proposed ducts
(b) Types of jointing chambers
(c) Distance between salient points
(d) Distribution Point location, reference number and DP type
(e) Other details such as road number, block number etc.

3.6- Cable Distribution Scheme Design

3.6.1- Cables

All cables used in the Secondary network should be of a solid polyethylene, insulted moisture barrier, jelly-filled twin cable with copper conductor and complies to Specification BTC/1421/CABLE.

Table 3.6- 1 The standard cable sizes to be used

Cable size	Diameter (mm)	Standard Drum Length (m)
5/0.5	10.5	1000
10/0.5	12.0	1000
20/0.5	14.5	1000
50/0.5	18.5	1000
100/0.5	23.5	1000
50/0.63	23.5	1000
100/0.63	32.5	1000

3.6.2- Joint Closures

Table 3.6 - 2 The types of Joint Closures used by Bnet in Secondary network.

Type	Usage
Sleeve 31RM	Radial Distribution – Openable
PEDCAP	Permanent joints in JRC4
XAGA 550	Permanent Joints in JRC12/14

3.6.3- Block Terminals/ Box Connection

Table 3.6 - 3 Types of Block Terminals and Box Connections used in the Secondary network.

Type	Max. Cable Size	Usage
BT 66B	5 pair	External/ Internal
BT 76	20 pair	External
BT 76P	20 pair	External (Overhead)
BC 251	50 pair	Internal
BC 301	100 pair	Internal

3.6.4- Cabinet Termination

The KRONE Modular Cross- Connection System (MCCS) should be installed in all new Cabinets for the termination of the Primary and Secondary cables.

3.6.5- Duct Space

Initial Secondary network duct provision should be made to accommodate the cable envisaged during the 20 years planning period. In Secondary network duct, one way would normally be sufficient, however, where it is envisaged that 4 or more feeder cables from the cabinet will be provided, the route concerned should be upgraded to two way.

When providing Secondary cables in existing congested routes, the existing duct space should be calculated to check if space is available. Provision of additional duct should only be considered after the confirmation that no duct space is available.

Figure 3.6 - 1 shows the formulas used in calculating duct space.

Example 3.6 - 2 shows a typical example of available duct space calculation.

3.6.6- Method of Cable Pair Distribution Adopted by Bnet

The method of cable pair distribution adopted by Bnet is based on the reduction of the number of joints on the feeder cable from the Cabinet. The joints on the main feeder should be of permanent type to minimise the faults occurrence.

XAGA 550 is used as a permanent closure, 3 cables can be provided on each side which enable the jointing of 6 cables in one joint. In initial provision, a maximum of 3 on one side and two on the other should be provided to allow for maintenance and future requirements.

However, due to the length of the XAGA 550 closure it is not possible to locate in JRC4. For permanent closures in JRC4 it is necessary to use a PEDCAP closure. This is capable of taking a maximum of 6 cables.

In underground method of distribution the cables from the houses are jointed in an openable sleeve type with the spur cable from the permanent joint to provide the necessary flexibility in pushing additional pairs to houses.

The cable distribution should

(a) Contain the minimum number of joints

(b) Have a maximum of 6 x 5/0.5 houseleads into a sleeve 31RM

(c) Utilise XAGA 550 or Pedcap as permanent closures to reduce faults

(d) Provide sufficient pairs according to the Penetration Factor

(e) Leave the stumped pairs at the furthest point from the cabinet on the cable leg

Figure 3.6 - 3 illustrates the method of cable pair distribution to be used by Bnet .

3.6.7- Cable Pair Distribution Plan (CPD)

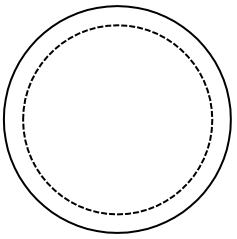
The cable pair distribution plan should show the following information:

(a) Cable size, gauge, sectional length and pairs utilised.
(b) Distribution point number and DP type.
(c) Pairs distributed.
(d) Joint closures types.
(e) Plant to be recovered, if any.

Figure 3.6 - 1 Duct Space Calculation

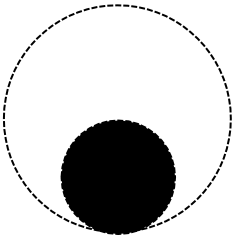
Empty Duct

eg: Duct No 96



One Existing Cable

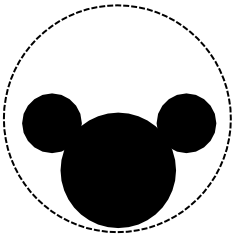
Space Available =
Cable Space (of Duct) - Dia. of Existing Cable



Two or more Existing Cables-1

Is the Sum of the diameters of the smaller Cables less than 1/2 that of the largest Cable?

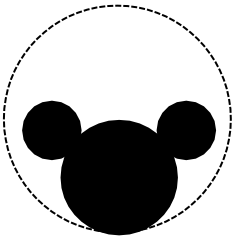
If so then Space Available =
Cable Space - Dia. of largest Cable.



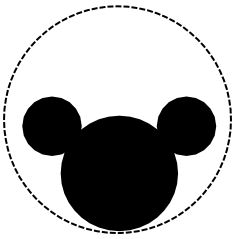
Two or more Existing Cables-2

Is the Sum of the diameters of the smaller Cables more than, or equal to, 1/2 that of the largest Cable?

If so then Space Available =
Cable Space - (Sum of all Cables Dia. x 0.7).



Example 3.6 - 2 Duct Space Calculation Example



Example:

The cables that exist in the duct 54D above are as follows:

1- 100/0.5 = 22.5 mm Diameter.
2- 50/0.5 = 16.2 mm Diameter.
3- 50/0.5 = 16.2 mm Diameter.

The sum of the diameters of the smaller cables = 32.4 mm, which is more than the diameter of the largest cable.

∴ Available cabling space = cable Space - (Sum of all cables X 0.7)

= 83 - (54.9 X 0.7)

= 83 - 38.43

= 44.57

∴ *There is sufficient space to provide additional 100 pair cable.*

3.7- Relief to Existing Distribution

In areas where additional network is required - new areas - relief should be provided using an overlay method. This helps to maintain the network by leaving it untouched.

However, if additional pairs are required at an Overhead DP and the existing cable is fully utilised, A larger cable should be provided to replace the existing rather than providing two cables to the DP.

When providing additional lines to a premise the surrounding area should be also considered for relief.

If a customer in an overhead area requires additional lines and the new house-lead is to be provided underground, allowance should be made for the adjacent houses if the trench is crossing the front of their property.

However, difficulties can occur where the land is privately owned as the landowner may not be pleased with the idea of having any alteration.

In these cases it is necessary to try all means to persuade the owner that it is their interest that the work be carried out and of the benefits to him.

3.8 - Network Provision in Private Property

As a policy, Bnet will prepare the design and will supply the necessary Civil material free of charge to the owner provided he will arrange for the necessary excavation and duct installation under Bnet supervision. On completion of the duct work by the owner, Bnet will arrange for the cable installation.

In residential development the network design will be the same as the Underground method of distribution explained earlier.

When designing the distribution for complexes such as Factories or Schools, it is necessary to provide the main DP in the main office where the PABX will be provided and not necessarily the Guardroom. The other buildings within the Complex are linked back to the main DP using Sub DP’s. This will provide the necessary flexibility in providing direct lines from the Service Node or external extension from the PABX.

4- Cable Entry to Premises

4.1- Business /Commercial Premises

The appropriate method illustrated in Your Guide to Service Connection (Business Sector) should be used as the standard method of cable entry to Business and Commercial premises.

In cases where more than 200 pairs are required, a direct feed from the Service Node should be used. Please refer to Primary Network Design Guide for details.

The entry can be provided in a separate telephone room or in the entrance of the buildings where sufficient head clearance and separation from other services is available.

In cases where the building is completed and provision is made for the cable entry, the alternative method in Figure 4 - 1 can be used using Pedestal for protection. This method of cable protection is especially design to avoid spoiling buildings view.

4.2- Houses/Villas

The standard method of cable entry illustrated in Your Guide to Service Connection shall be for Houses/ villas.

The entry can be provided in the garage, porch or the boundary wall, the extending of the service to inside the houses is by internal wire provided in a conduit.

In cases where the House/ Villa is completed and no provision is made for the standard cable entry, one of the alternative method shown in Figure 4 - 2, should be used in all new installation. This method of cable protection is especially design to avoid spoiling Houses/ Villas view.

5- Transmission and Signalling Limits

As per the Primary Network Design Guide, the cabinet boundary and the transmission & the signalling limits of the Primary pairs should have been determined considering that all distribution points will be within the standard limits using 0.5 conductors in the Secondary network unless otherwise stated.

Bnet standard limits for transmission and signalling from the Service Node to the furthest distribution point are as follows:

(a) Transmission Limit is 7.5 dB.
(b) Loop Resistance is 1000Ω.

The above limits should not be exceeded by more than 10%.

In cases where it is suspected that the limits will be exceeded when designing a Secondary network scheme, Table 5-1 should be used to calculate the loss and the loop resistance as per Example 5-1. Should it found that the limits are exceeded using 0.5 conductors, the conductor can be changed to 0.6.

In difficult situation and where even 0.6 cable will not solve the problem, the following options can be considered as a solution after discussing with the area SPC:

(a) Line Conditioning Units.
(b) Cable Loading.

Table 5 - 1 Transmission and Signalling

Conductor Diameter (mm)	**Loss dB / Km. At 1600 Hz (Unloaded)**		**D.C. Loop Resistance Ohms/Km**	
↓	U/G	O/H	U/G	O/H
0.32	2.94	3.09	455	497
0.4	2.37	2.48	285	305
0.5	1.84	1.94	180	192
0.6	1.47	1.54	117	125

TRANSMISSION LIMIT (FROM SERVICE NODE TO THE FURTHEST DP)

- TRANSMISSION LOSS OR ATTENUATION = 7.5 dB
- LOOP RESISTANCE = 1000 Ω

Example 5 - 1 Transmission and Signalling Example

Example:

To check if DP 51 is within set the limits;

		dB's	Ω
From Service Node to Cabinet:		-----	-----
2.5 Km of 0.4		5.93	713
From Cabinet to DP:			
0.85 Km of 0.5		1.56	153
Total:	7.49	866	
Limits:	7.50	1000	

∴ *The 0.5 gauge conductor will satisfy the proposals.*

6- Protection of Telephone Plant From Power Cables

A contact between a Telephone cable and an Electric cable can endanger life and property. The two networks approach and cross at many places. It is essential therefore to adopt protective measures which will give and a adequate degree of safety not only during installation, but also for future maintenance and upgrade. Standard Separation should be strictly adhered to ensure the required safety is assured.

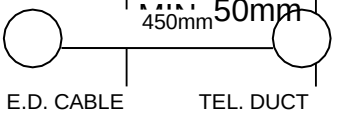
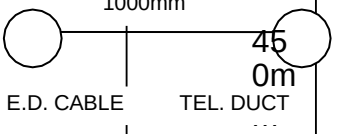
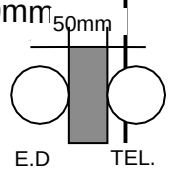
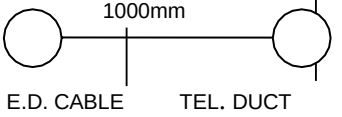
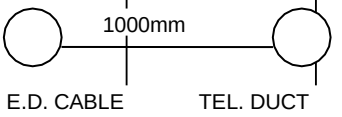
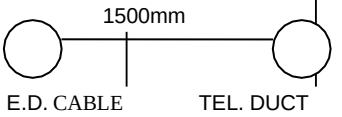
6.1- Separation From Overhead Power Routes

Figure 6 - 1 shows the standard separation from overhead power routes.

6.2- Separation From Underground Power Routes

Figure 6 - 2 shows the standard Bnet separation from underground power cables.

Figure 6 - 2 Separation From Underground Power Routes

VOLTAGE	STANDARD NORMAL CLEARANCE	RELAXATION		VERTICAL CLEARANCE
		MINIMUM	DIFFICULT	NORMAL
LESS THAN 650 V				300mm
MORE THAN 650V - 11KV				300mm 
33 KV				300mm
66 KV				300mm
220 KV				300mm

7- Schemes Presentation

Common drawings for both Inside and Out side operations should be prepared. The scheme will generally consist of two drawings, an Ordnance map showing the map base with the existing and proposed Bnet plant and a Cable Pair Distribution (CPD) drawing showing the existing and proposed cable pairs distribution. The link between both drawings is achieved by alphabetic reference.

A common label should be used for both drawings with a key of the symbol used, the following are the information's that need to be supplied:

(a) Service Node Code.
(b) Cabinet Number.
(c) Scheme Title.
(d) The Planner name, code and Telephone number.
(e) The Ordnance Map number.
(f) The scale of the drawing.

An example of a typical scheme is shown overleaf.

8- Schemes Approval

All schemes should be checked and approved before proceeding with the estimate preparation. The scheme is to be checked to ensure the quality of the planned work and that the set standards are adhered to.

The Officers schemes are to be checked and approved by the Senior Officers and the Senior Officers schemes are to be checked and approved by the SPC.

The schemes are to be submitted for approval before proceeding with the estimate preparation and the data entry in Works Order Control System to avoid re-entry in case changes have to be made.

Part 3 GPON Network Design

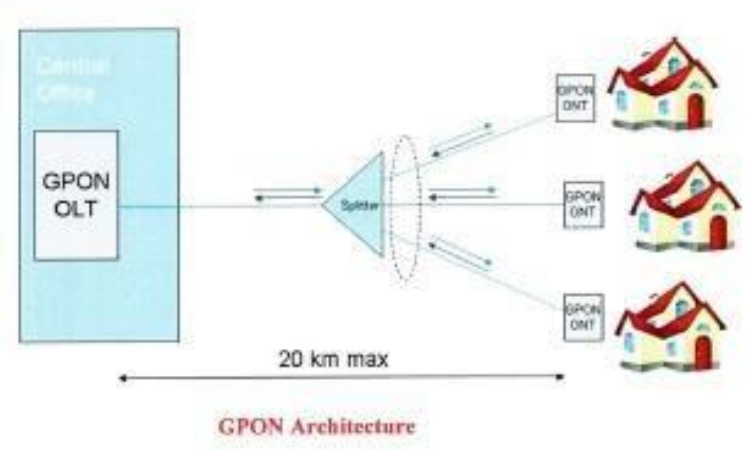
1- GPON Overview

a) GPON (Gigabit Passive Optical Networks)

b) GPON is a point-to-multi point access mechanism. Its main characteristic is the use of passive splitters in the fiber distribution network, enabling one single feeding fiber from the provider's central office to serve multiple homes and small businesses.

c) A GPON network consists of OLT (Optical Line Terminals), ONT (Optical Network Terminals), and a splitter. The splitter will divide the signal when needed. The OLT takes in all of the optical signals in the form of beams of

light from ONTs and will convert it to an electrical signal.



GPON Architecture

d) GPON has the benefits of saving costs for moves and ads or other changes, low price per port on passive components, easy installation and low installation costs and supports triple play (Voice, data and TV).

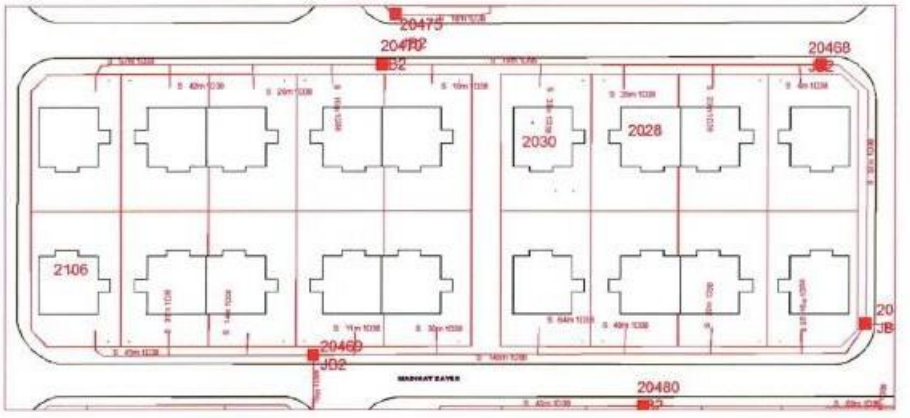
2- GCOMM -The GIS of Bnet

a) GCOMM provides details of the components that create, maintain, and utilize the Fiber Optic network.

b) GCOMM describes to place two types of features Infrastructure Features and Network features

c) GCOMM enables to provide a mirror image of the on-field data in the Inventory system, which will help to identify the capacity of the network and enable us to extend the network to serve the customers with optimal solution of cost and infrastructure. The duct drawing of the block is exported from GCOMM and printed for physical survey for Planning and Design.

d) GCOMM enables to provide fiber connection with respect to as built, thereby making the inventory more efficient to identify the usage of the fiber at different locations and making best use of the feeder cable.



Sample Drawing exported from GComm

3- Preliminary Onsite Survey

a) Preliminary survey/Physical survey of premises on site is the key part of network planning and design, in which the surveyor visits each premises and verify the house number and details (Flats number and count of flats/units) as per drawing.

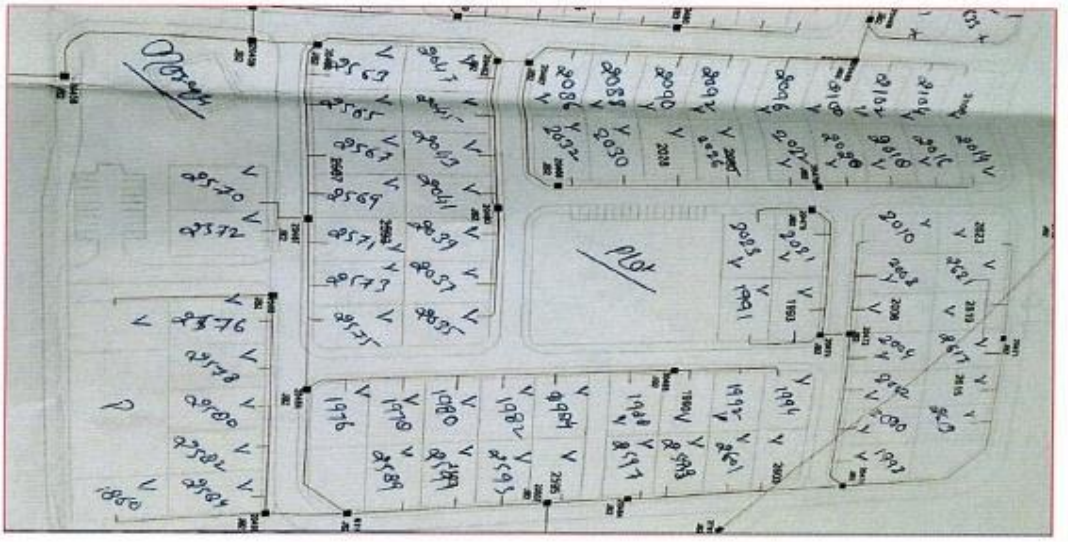
b) The data differences such address mismatch, duct route, JB location, number of flats in a building etc... Between GComms drawing/data and onsite verification are highlighted and marked.

c) Preliminary survey will enable us to keep the spare for future expansion of the network by providing optimal solution with effective utilization of the feeder fiber.

d) Planning and Design are carried out based on the Preliminary survey

and corrections are updated in GComms .

e) Below is the example for address missing in GComms but actually exists on site and address placed in wrong location in GComms.



Sample Preliminary Site Survey Details

4- Civil Works Planning & Design

Prior to proceeding with GPON Network Planning & Design for any Scheme, Duct Infrastructure in the area needs to be reviewed and any Civil Works needs to be designed as per primary and secondary .The existing Duct should be used as much as possible and only essential Civil. Works are planned if no alternatives are available.

5- GPON Network Planning & Design

a) Preliminary Survey details are incorporated in the drawing. Based upon which the planner will Plan and Design the network.

b) Service Node for the Specified blocks is decided based on Bnet Master Plan.

c) Planner checks if there is an existing feeder available (or) a new feeder is required for the block.

d) In case of existing feeder, we need to ensure that there are sufficient 25% spares left for the existing block and to the going to be designed block for sharing the same feeder.

e) Numbers of Feeder Joints are decided based on the density, area and

coverage of the network in the Block.

f) Based on the Preliminary Survey report, planner will design the network by assigning splitters based on the capacity and density of the area.

g) Minimal Capex and Optimal Solution are the key factors of the design of the network.

h) Each PON is divided into 25 Units, allowing for a 20% spare at each splitter. Each PON area is marked with a PON boundary, PON Numbering and Distribution side (DS) numbering.

i) Design comprises of three parts.

i. Feeder Drawing: It shows the feeder route from the Service Node till the last Feeder Joint.
ii. Secondary Drawing: Comprises of cable route and PON allocation from first Feeder Side joint till 1:4.
iii. Distribution drawing: Comprises of the route and Splitter allocation from PON to Distribution side splitter.

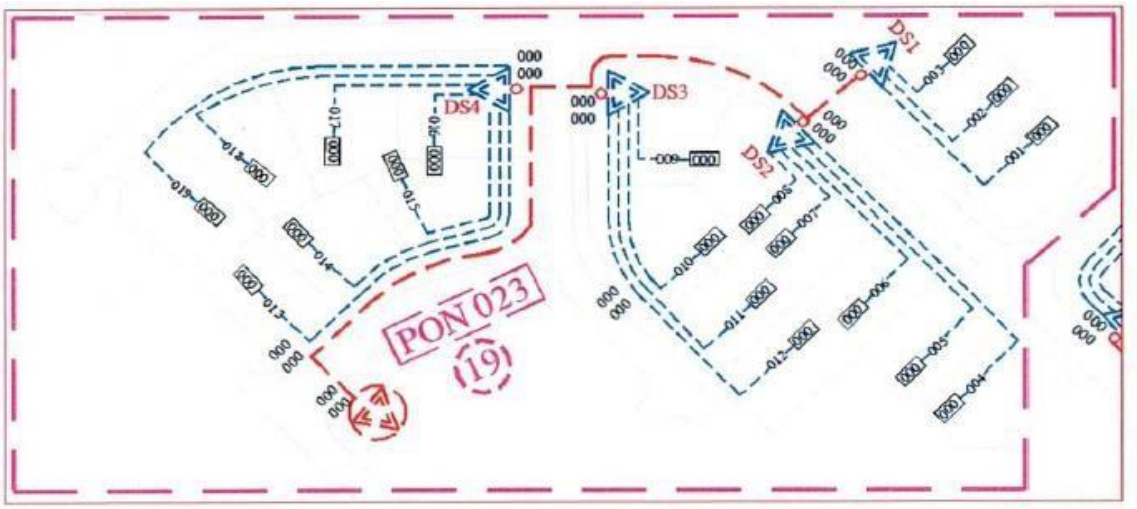
Step-by-Step Design Procedure:

a) Verify the GComm block boundary with Municipality block boundary and Bahrain locator and draw adjacent line to cover complete block.

GCom Block Boundary

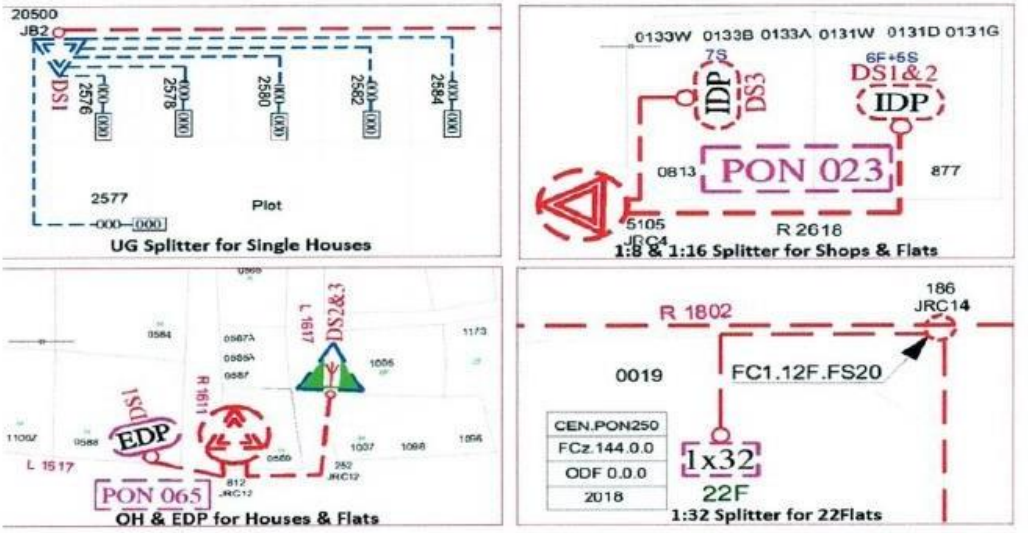
Bahrain Locator Block Boundary

b) Draw PON boundary to cover total serving units by a PON splitter.



PON Boundary

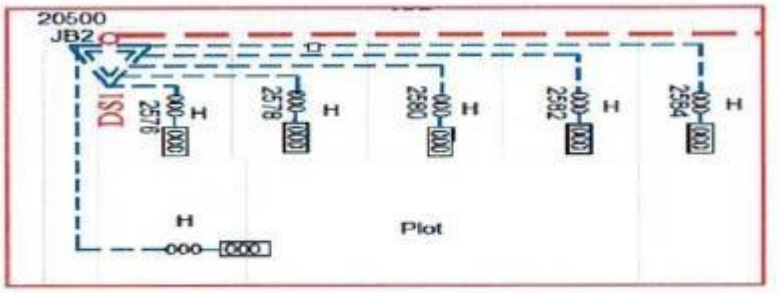
c) Assign splitter to each of the building as per unit capacity and place underground splitter for single house .



Splitter Capacity as per Unit

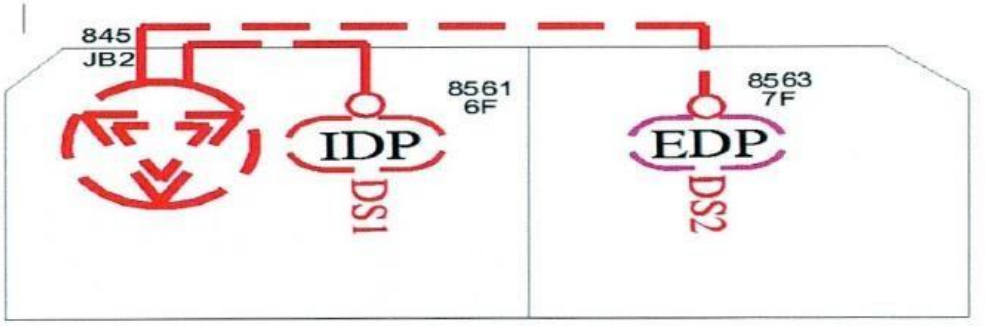
d) Splitters are many types differentiate as per size of the building as below :

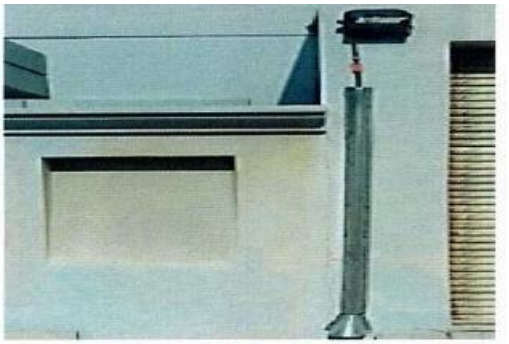
1- 1:8 undergound splitter for six houses of single ONT each



1:8 Splitter, Under Ground Distribution Point

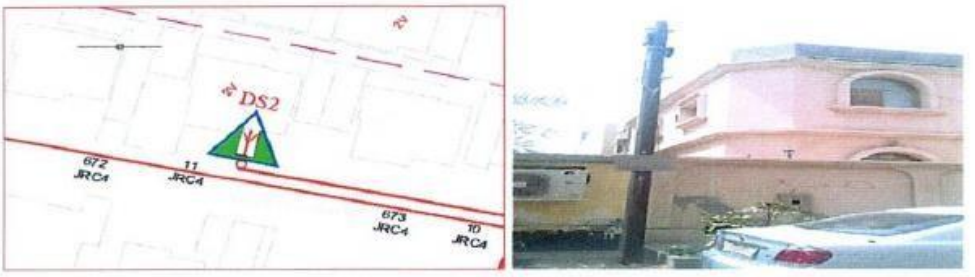
2- 1:8 IDP and EDP to serve building of 5-8 flats





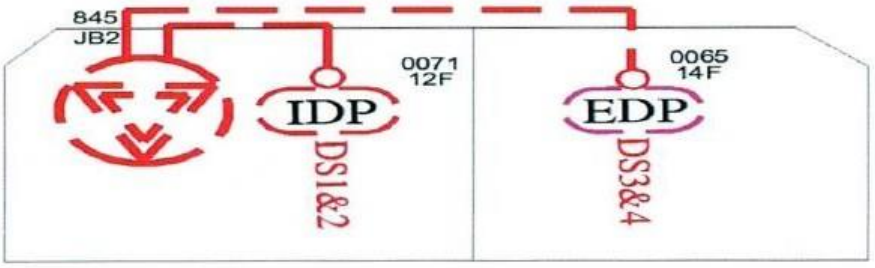
1:8 Splitter, 8F Internal Distribution Point and External DP

3- In case if there is no undergournd duct available then we will go to OH splitters 1:8 to serve up to 8 house of single ONT each



1:8 Splitter, 8F Over Head Distribution Point

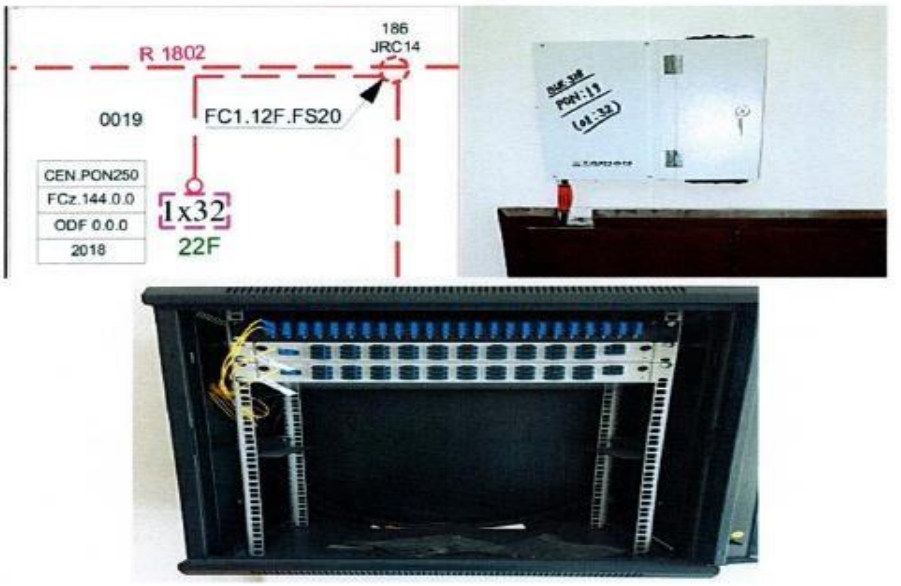
4- 1:16 IDP and EDP to seve building of 9-12 flats



1:16 Splitter, 16F Internal Distribution Point and External Distribution Point

5- 1:16 OH splitter to serve up to 16 houses of single ONT in case the building do no have IDP or EDP

6- 1:32 splitter to building have flats 17 to 25 and RM for high rise building and commercial complex



1:32 Splitter, 32F Wall Mount Box and Rack mount

7- 1:64 splitter to building having flats 1 to 52

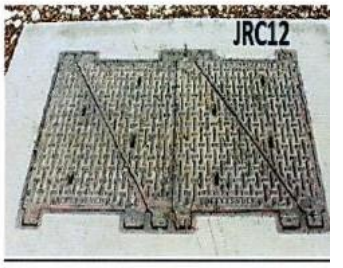
1:32*2 Splitter, 64F Wall Mount Box.

a. Based on the density of the area spare fiber are allotted at each feeder joints for future expansion.

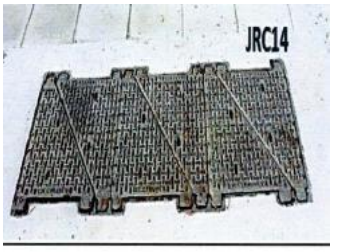
b. The desing need to be optimal in terms of number of joints which shouldbe minimal.
c. Jointing location are determined as
    i. JRC14/12 feeder joints
    ii. JRC12/JRC4-PON (1:4 splitter)
    iii. JRC4-UG splitter (1:18 splitter)
d. Once the desing is ready it submiited for Bnet for design approval

JB2 Joint Box

JRC4 Joint Box



JRC12 Joint Box



JRC14 Joint Box

6- Budget Loss

The maximum theoretical distance between the OLT and the ONT is 20 Km, though the actual reach depends on the power budget. The Power Budget takes into account the loss of the fiber, splitters and optical connectors, the power output of the laser and the sensitivity of the optical detector. The dB limit for the OLT is 28dB

The designer shall verify that the furthest ONT in the schemes losses does not exceed the dB limit of the OLT which is 28dB. A safety margin of 2 dB to cover any unexpected losses.

No	Item	Unit of Measure	Loss (dB)
1	Cable loss	KM	0.4
2	Splice	Each	0.6
3	1:4 Splitter	Each	7.2
4	1:8 Splitter	Each	10.5
5	Interconnection	Each	0.8
6	Safety Margin	Each	2

7- Cables Laying

Once the Design is approved, OSP teams are deployed to carry out the implementation process, which includes Installation of Cables as below:

a) Feeder Cable installation

i. Installation of feeder cable from Service Node until the Feeder Joints.
ii. It also involves entry of feeder fiber at Service Node.
ili. 144F is the feeder Cable.

b) Secondary Cable Installation

i. Installation of cable from Feeder side joints to the respective PON's.

ii. 48F is used between Feeder side Joints and used to extend feeder spares to other block for optimal usage of feeder cables.

iii. 12F cable is used between PON to PON.

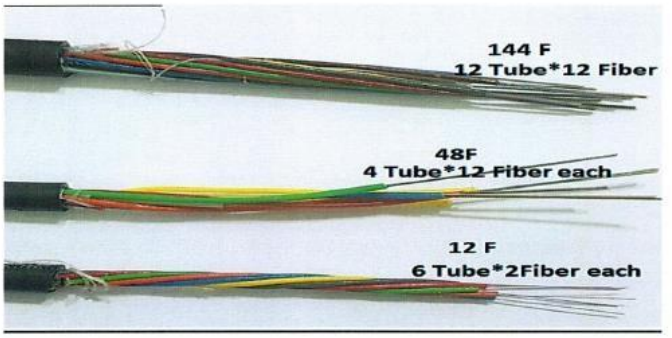
iv. Maximum number of PONs assigned in 12F is 9 and remaining three are kept as spare for future expansion of network.

c) Distribution Cable Installation

i. Installation of cable from PON to its respective distribution side splitter.

ii. 12F cable is used between PON and DS.

iii. Civil and Maintenance cases are also identified during the course of OFC installation and it is marked & updated in the drawing. The same is submitted to Bnet for the Maintenance clearance and civil completion.



8- Splicing Plan

a) Splice Plan comprises of details about Joint location and fiber allocation to each PON.

b) Splice Plan provides the flow of fiber from Service node to last splitter, fiber assigned to each PON with its color code of tube and fiber.

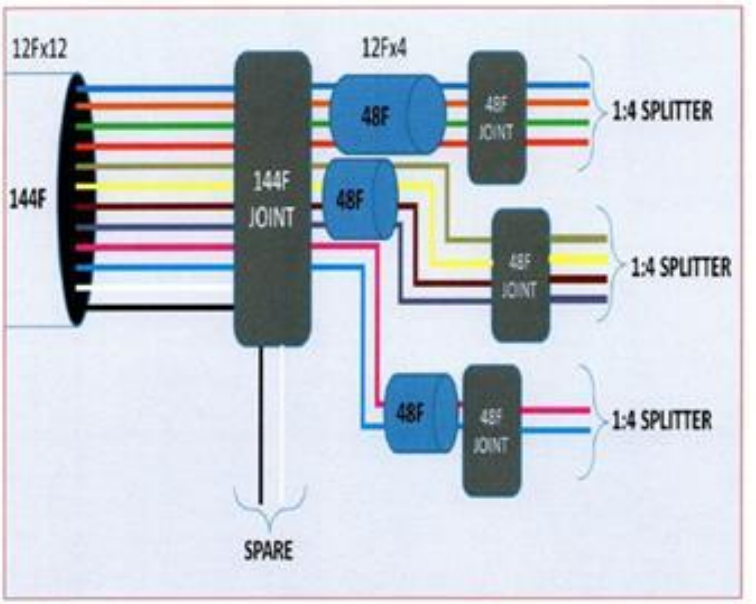
c) Splice plan also shows the details of spare fiber.

Fiber No.	Standard
1	Blue
2	Orange
3	Green
4	Red
5	Slate
6	Yellow
7	Brown
8	Violet
9	Pink
10	Aqua
11	White
12	Black

Splice plan consists of three parts:

a) Feeder Splice Plan

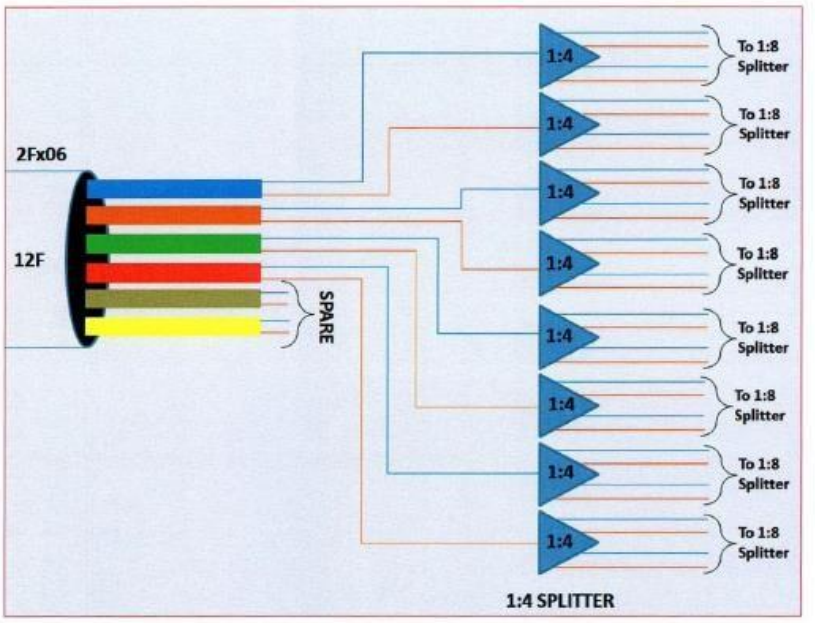
i. Feeder Splice Plan shows the distribution of 144 fibers from service node to FS joints.



Example of Feeder Splice Plan

b) Secondary Splice Plan

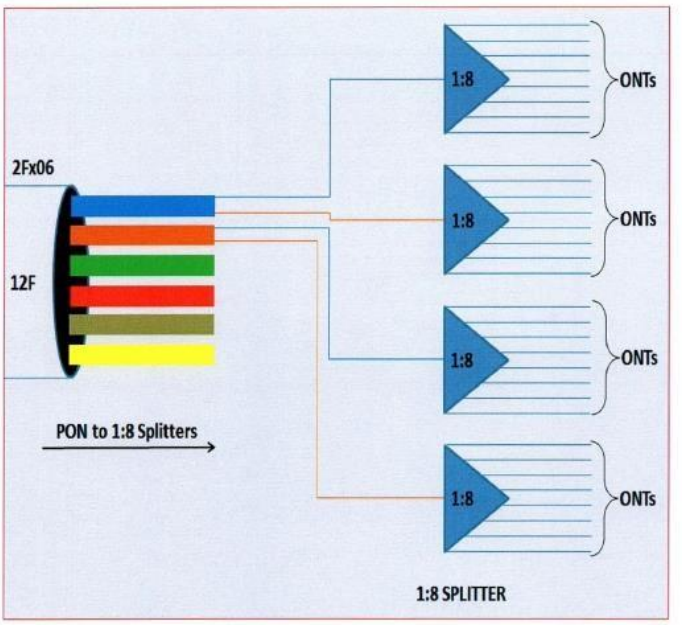
i. Secondary Splice Plan shows the distribution of fibers from FS Joints to PONs and PON to Internal 1:32, 1:64 and Rack Mount Splitters assign to buildings.



Example of Primary Splice Plan

c) Distribution Splice Plan

i. Distribution Splice Plan shows the fiber distribution from PON to distribution side splitter.



Example of Secondary Splice Plan

9- Cables Splicing & Termination

Based on the Splice plan and the Design, teams are deployed to carry out
a) Feeder, Secondary and Distribution Splicing.
b) Building Termination and Jointing.
c) ODF termination at Service Node.
d) OLT Patching.

10- Scheme Presentation

Common drawings for both inside and outside operations should be prepared. The scheme will consist of

a) An Ordnance map showing the map base with the existing and proposed Bnet Plant

b) Cable Distribution Drawing showing the existing and proposed cables.

A common label should be used for both drawings with a key for the symbols used

11. Scheme Approval

Schemes should be approved after the initial design for both duct and cable has been done.

The scheme is checked and approved by the SPC. It is then passed to Manager Planning & Design for approval and finally authorization from SM Access Network is

required.

The stores are then ordered, and the scheme can be issued.

12- As built and GIS update

As-built/GIS Update is comprised of the following

a) Door to Door Survey details of each address.

b) Cable installation and Termination completion details.

c) Cable route, Termination, splice locations are marked with their specified legends.

d) The details about the termination and cabling which are not completed with its reason.

e) Updating of Maintenance and civil affected areas.

f) Once the as built drawing is prepared, the same is submitted to update GComms.

13- RFS and Handover

a) As-built drawings are updated in GComms by and by, based on the completion of the respective block, which includes cabling, splicing, termination and association of the address to the respective Splitters.

b) Blocks will be declared as RFS once the Cabling, Splicing, Termination, Patching and Updating in inventory are complete.

c) Declaring the blocks for Sales.

d) Bnet will carry out inspection of each Joint, as the Handover process and provide the final acceptance.

AMENDMENTS AND ISSUE HISTORY

Issue No.	Date	Reason for Issue
1	1st June 2020	Mohamed Ali Yusuf (Passive Network Deisgn Guidline)
2		
