Feasibility Report for Cheltenham Town Centre CCTV System Upgrade.

Prepared by CDC Technical Services Ltd for:

CHELTENHAM
BOROUGH COUNCIL

Date - Thursday, 7 November 2013

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1. Introduction

1.1. Executive Summary.

The management of Cheltenham Borough Council's public space CCTV control room have recently inherited the monitoring of Cheltenham Town Centre's car park CCTV systems and are seeking advice as to the most effective methods of integrating these systems into the current control systems within the CCTV control room located within the Police Station at Lansdown Road.

In addition to this work, Cheltenham Borough Council (CBC) are considering the possibility of replacing their current transmission infrastructure to incorporate wireless technology, removing their current dependance on BT whilst at the same time reducing their annual expenditure.

Following a recent visit to the CBC's CCTV control room and discussions with Trevor Gladding (CBC Community Protection Manager), Carol Cross (CBC Community Protection Officer) and the current incumbent maintenance provider, Openview Security Solutions Limited (OSSL), it was agreed that independent technical advice from CDC Technical Services (CDC) was sought to investigate the best way forward.

The first stage of the technical advice from CDC was to provide a feasibility report (this document) to investigate technical solutions to accommodate the above-mentioned requirements of CBC and provide budgetary costs where possible.

Consultant's Recommendation

Several options for systems upgrade were explored during the feasibility stage and most were dismissed for operational and/or maintenance reasons.

The recommended solution is based around the implementation of a full digital systems upgrade including the installation of a new wireless network around Cheltenham town centre. This solution will provide CBC with the systems and technology necessary to take the CCTV service forward but more importantly, will remove their reliance on BT as a transmission provider and subsequently realise an annual saving after five (5) years in the region of £55K.

Additional reasoning for the implementation of a full digital systems upgrade has been given to support any planned relocation of the control room to the Tri-Service Centre at Waterwells Drive in Quedgeley.

2. Project Brief

2.1. Current Situation.

Town Centre CCTV System

The current CCTV control systems within the Police Station control room consist of a mix of analog and digital technologies as would be the expected state of affairs for a system of this age. Analog equipment provides the system control, switching and display of camera images whereas digital encoding, recording and storage is employed for the archiving and retrieval of camera images.

Synectics control and recording equipment is currently used within the control room and a summary of the configuration is given below -

- Synectics SM 80x16 Analog Switching Matrix;
- Synectics X250 Master Keyboard;
- Synectics X250 Slave Keyboard;
- Synectics Matrix Manager interface (for remote control of The Brewery and the Honeybourne Line systems);
- Rugby Clock interface;
- Several Synectics telemetry control interfaces;
- Synergy Pro combined Client/Server/Review (used as Review workstation);
- 4Tb Evidence Locker ('stubby version');
- 8-channel E800 encoders (12 no.);
- 9Tb RAID-6 PSN Storage Nodes (4 no.);

At present, all cameras images presented to the control and recording systems within the control room are in an analog format with the majority of the town centre cameras using leased BT fibre connections as a means of transmission into the control room.

- Cameras 1 to 70 are allocated as 'local' town centre cameras;
- Cameras 101 to 119 are remote access cameras from The Brewery CCTV system;
- Cameras 201 to 207 are remote access cameras from the Honeybourne Line CCTV system;

There are some wireless transmission links, installed on the mast on the roof of the Police Station, that connect more recent camera installations from the Honeybourne Line and from Welch Road Playing Field. Images from these sites are transmitted using digital transmission equipment which is then decoded back to an analog format for presentation into the control systems.

Car Park CCTV Systems

There are several car park CCTV systems that were surveyed with a view to be integrated, if possible, into the Police Station CCTV control room. The car park locations were as follows -

- Regent's Arcade;
- Grosvenor Terrace/Town Centre East;
- High Street;
- Sherborne Place;
- Portland Street;
- North Place;
- West End/Phoenix Passage;
- Chapel Walk/The Royal Well;
- Rodney Road;
- St. George's Road;
- St. James Street;
- Chelt Walk/Synagogue Lane;
- Bath Parade;
- Bath Terrace;

With the exception of Regent's Arcade and Grosvenor Terrace, each site had a very straightforward configuration of two (2), or in some cases four (4), analog dome cameras mounted on a 5m winch-over column and connected to a local digital recorder (DVR), manufactured by Eneo and located within an adjacent street cabinet. In almost all locations, a local BT broadband connection was installed within the cabinet for connection to the DVR to enable remote viewing and control from CBC's offices.

The Regent's Arcade and Grosvenor Terrace systems are much larger in size and consist of a mix of static and PTZ type cameras with all cameras generally cabled to a central security office/hut where all the recording equipment is housed and viewed. The Grosvenor Terrace system utilises the same manufacturer of DVR as the other smaller car park sites, thus enabling it to be remotely monitored from CBC's offices using the same remote access software package.

The Regent's Arcade system currently uses Dedicated Micro's recording equipment which is not compatible with the remote access software. A quote for the upgrade of this site has been submitted by the installing company, Eurolink, and is awaiting further action from CBC.

Remote viewing of the systems is done from within the CBC offices using Eneo RASplus remote viewing software installed onto a simple PC with a large LCD monitor (see pic).

At present not all car park systems are connected and/or configured for remote viewing.

Recommendations for the integration (or alternative) of these car parks is given in Section 3.

2.2. Consultant's Brief.

Integration of Car Park CCTV systems

CDC were asked to provide technical advice for the possibilities of integrating the aforementioned car park CCTV systems into the existing control room within the Police Station at Lansdown Road.

The integration is to provide a much better method of viewing and selecting the cameras within the car parks to allow a much smoother and more pro-active means of monitoring by the control room operators.

Budgets were to be provided for the different options of integration to allow CBC to choose the most appropriate way forward.

Migration to a Wireless Network

Due to the increasing cost of providing BT leased fibre for CCTV cameras within the town centre scheme, CDC were asked to investigate the possibilities for migrating the existing camera transmission network on to a new digital wireless solution.

By migrating to a digital wireless network, it is understood that there may be the need to upgrade some of the analog control systems and CDC were to advise on, and provide budgets for, all subsequent requirements.

2.3. General Condition.

Whilst it was not part of the brief to assess the condition of the systems, it would be remiss of CDC not to make some comments from the observations found during the site surveys.

In general there are clear maintenance issues that should be addressed as follows -

Town Centre CCTV Systems

- The image quality from some of the cameras was very poor due to hum interference;
- Some camera images were very poor - suggesting low video levels and/or bad connections or termination problems;
- Wiper marks on the camera glass obscuring the viewed image;
- Some wipers not working;
- Some camera images not working;
- Messy cabling in equipment racks;
- Synectics recording configuration needs to be looked at and re-configured more effectively;

Car Park CCTV Systems

- The general installation standard of most of these systems is very poor and should be rectified where appropriate;
- Location of camera column has not been thought out and, in some cases, is severely blocked by tree growth;
- Broadband connection installed but not connected;
- No extract fans are installed within the cabinets - resulting in severe heat problems with the equipment and in some instances, complete lockout/failure of the DVR and/or broadband modem;
- Inside base of the cabinet was not sealed in any way, leading to the ingress of damp.

3. Car Park Systems

3.1. Introduction.

This section will provide detailed and itemised information for the upgrade and/or integration of each of the listed car park CCTV systems.

It should be noted that in some cases, the recommendation may be to decommission the car park system altogether due to a duplication of camera coverage with existing town centre camera locations.

There are many different options for integration of these systems to the existing CCTV control room. However, in order to meet the remit provided by CBC with regards to the viewing, selection and control of the cameras, the choices considered are -

- ✴ Replace existing CCTV recording equipment with Synectics compatible digital recording equipment and integrate into a new digital wireless network (part of the partial systems upgrade);
- ✴ Replace existing CCTV recording equipment with new encoding equipment and integrate into a new digital wireless network (part of the full digital upgrade);

3.2. High Street.

The CCTV system within this car park consists of two (2) PTZ dome cameras mounted on an 5m winch-down column located centrally within the car park.

Recording equipment is located within a locked street cabinet sited adjacent to the column and a BT broadband ADSL connection is installed within the cabinet for remote connection to CBC's offices.

Recommendation

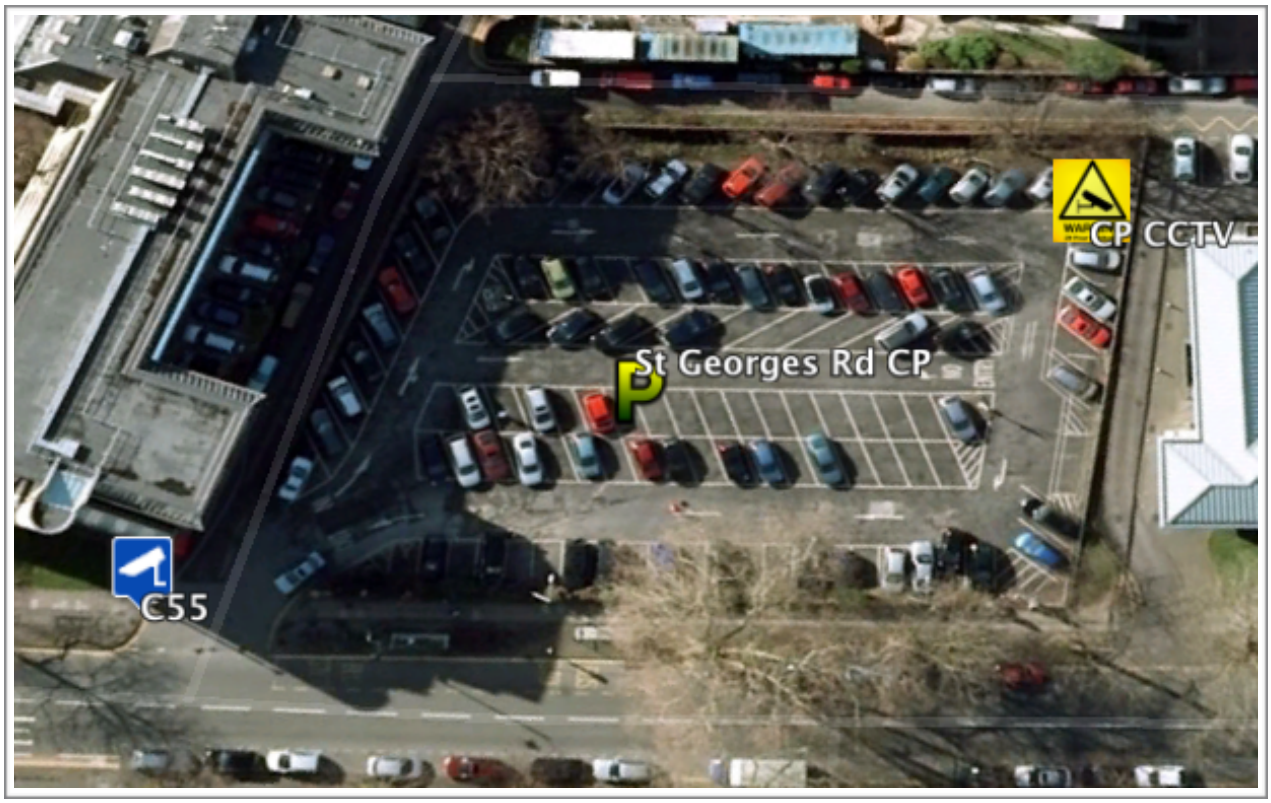
There is duplication of camera coverage within this car park from town centre camera numbers 59 and 60.

It is therefore suggested that the car park camera system is decommissioned and all equipment removed.

3.3. St. George's Road.

The CCTV system within this car park consists of two (2) PTZ dome cameras mounted on an 5m winch-down column located at the top western corner of the car park underneath some trees.

Recording equipment is located within a locked street cabinet sited adjacent to the column and a BT broadband ADSL connection is installed within the cabinet for remote connection to CBC's offices.



Recommendation

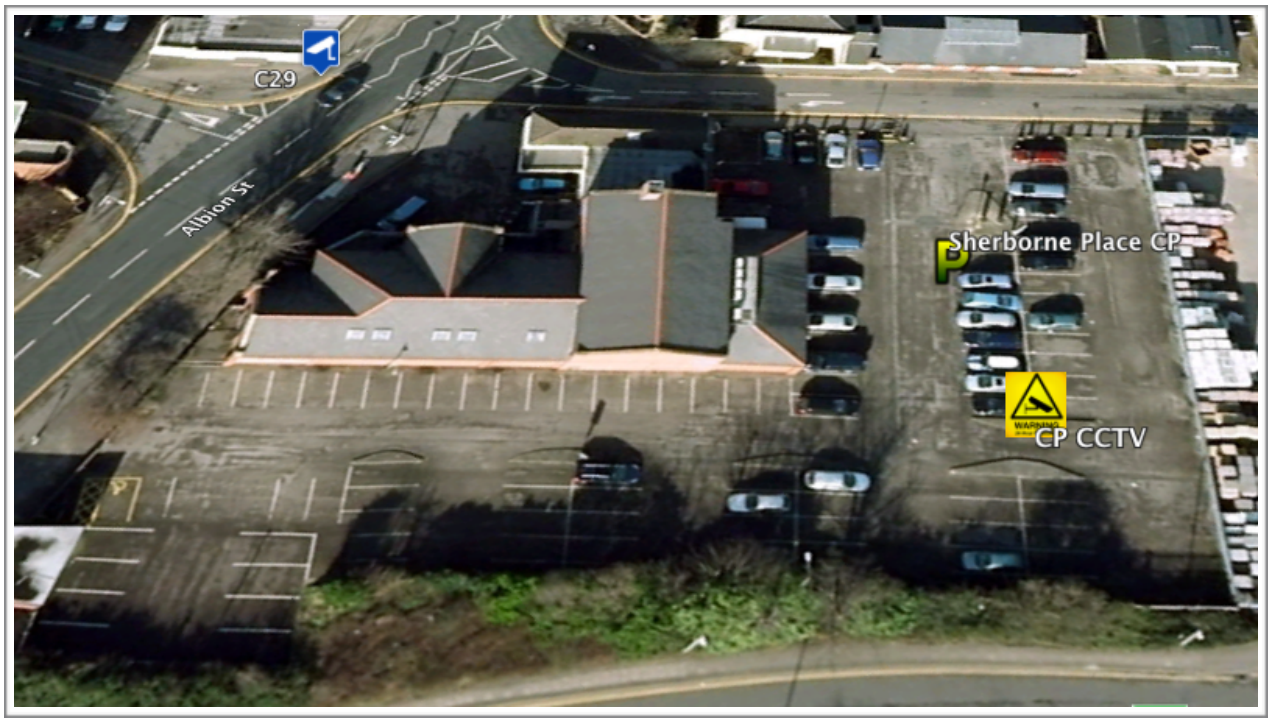
There is duplication of camera coverage within this car park from town centre camera number 55 which is located at the eastern entrance to the car park.

It is therefore suggested that the car park camera system is decommissioned and all equipment removed.

3.4. Sherborne Place.

The CCTV system within this car park consists of two (2) PTZ dome cameras mounted on an 5m winch-down column located centrally within the car park.

Recording equipment is located within a locked street cabinet sited adjacent to the column and a BT broadband ADSL connection is installed within the cabinet for remote connection to CBC's offices.



At the time of the site survey the CCTV system within this car park was not switched on and not connected to the ADSL line.

Recommendation

There are no other town centre cameras providing coverage to this car park, therefore it is recommended that these cameras are included in any integration to the town centre CCTV scheme and the location of the column provides a good line-of-sight for integration into the proposed wireless network (see Section 4).

Suggested scope of works includes the following (but not limited to) -

- Recommission both PTZ cameras to ensure correct operation;
- Remove existing DVR and replace with multi-channel H.264 encoder for direct connection to new wireless network;
- Install and commission new wireless network transmission at top of column;
- Install thermostatically controlled extract fan to cabinet;
- Cancel BT broadband ADSL connection to prevent further on-going rental costs;

3.5. West End/Phoenix Passage.

The CCTV system within this car park consists of two (2) PTZ dome cameras mounted on an 5m winch-down column located at the entrance to the car park from High Street.

Recording equipment is located within a locked street cabinet sited adjacent to the column and a BT broadband ADSL connection is installed within the cabinet for remote connection to CBC's offices.

Recommendation

There are no town centre cameras providing full coverage to this car park, therefore it is recommended that these cameras are included in any integration to the town centre CCTV scheme and the location of the column provides a good line-of-sight for integration into the proposed wireless network (see Section 4).

Suggested scope of works includes the following (but not limited to) -

- Recommission both PTZ cameras to ensure correct operation;
- Remove existing DVR and replace with multi-channel H.264 encoder for direct connection to new wireless network;
- Install and commission new wireless network transmission at top of column;
- Install thermostatically controlled extract fan to cabinet;
- Cancel BT broadband ADSL connection to prevent further on-going rental costs;

3.6. Chapel Walk/The Royal Well.

The CCTV system within this car park consists of two (2) PTZ dome cameras mounted on an 5m winch-down column located near to the front of the car park.

Recording equipment is located within a locked street cabinet sited adjacent to the column and a BT broadband ADSL connection is installed within the cabinet for remote connection to CBC's offices.

At the time of the site survey the CCTV system within this car park was not working due to suspected overheating issues.

Recommendation

There is partial coverage to this car park from town centre camera number 27, but the inclusion of the car park cameras will give some additional coverage of the road junctions at St. George's Road/ Montpellier Street/Royal Well Road. With this in mind, it is recommended that the car park cameras are included in any integration to the town centre CCTV scheme and the location of the column provides a good line-of-sight for integration into the proposed wireless network (see Section 4).

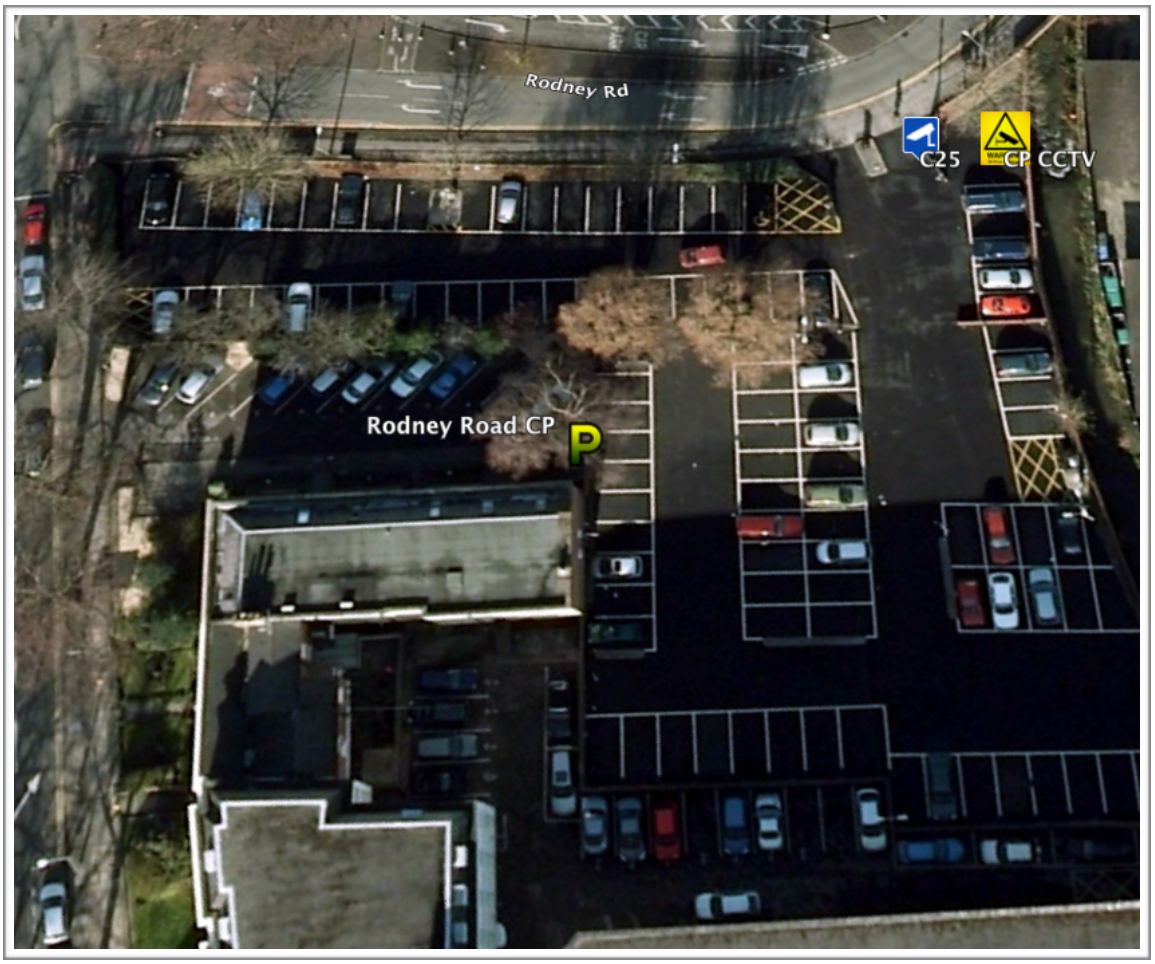
Suggested scope of works includes the following (but not limited to) -

- Recommission both PTZ cameras to ensure correct operation;
- Remove existing DVR and replace with multi-channel H.264 encoder for direct connection to new wireless network;
- Install and commission new wireless network transmission at top of column;
- Install thermostatically controlled extract fan to cabinet;
- Cancel BT broadband ADSL connection to prevent further on-going rental costs;

3.7. Rodney Road.

The CCTV system within this car park consists of two (2) PTZ dome cameras mounted on an 5m winch-down column located adjacent to the entrance of the car park underneath some trees.

Recording equipment is located within a locked street cabinet sited adjacent to the column and a BT broadband ADSL connection is installed within the cabinet for remote connection to CBC's offices.



Recommendation

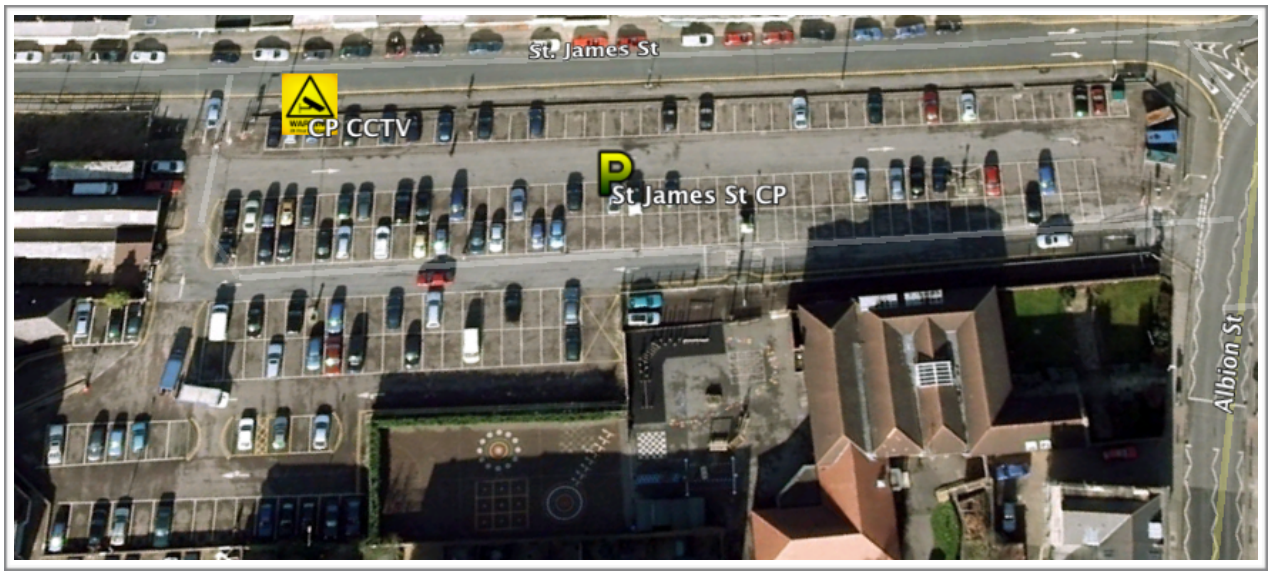
There is duplication of camera coverage within this car park from town centre camera number 25 which is located at the entrance to the car park.

It is therefore suggested that the car park camera system is decommissioned and all equipment removed. However, the location of the 5m column provides a much better line-of-sight route for any wireless network connection to the town centre camera and this has been considered as part of the proposal in Section 4.

3.8. St. James Street.

The CCTV system within this car park consists of two (2) PTZ dome cameras mounted on an 5m winch-down column located adjacent the south-west entrance of the car park from St. James Street.

Recording equipment is located within a locked street cabinet sited adjacent to the column and a BT broadband ADSL connection is installed within the cabinet for remote connection to CBC's offices.



Recommendation

There are no town centre cameras providing coverage to this car park, therefore it is recommended that these cameras are included in any integration to the town centre CCTV scheme and the location of the column provides a good line-of-sight for integration into the proposed wireless network (see Section 4).

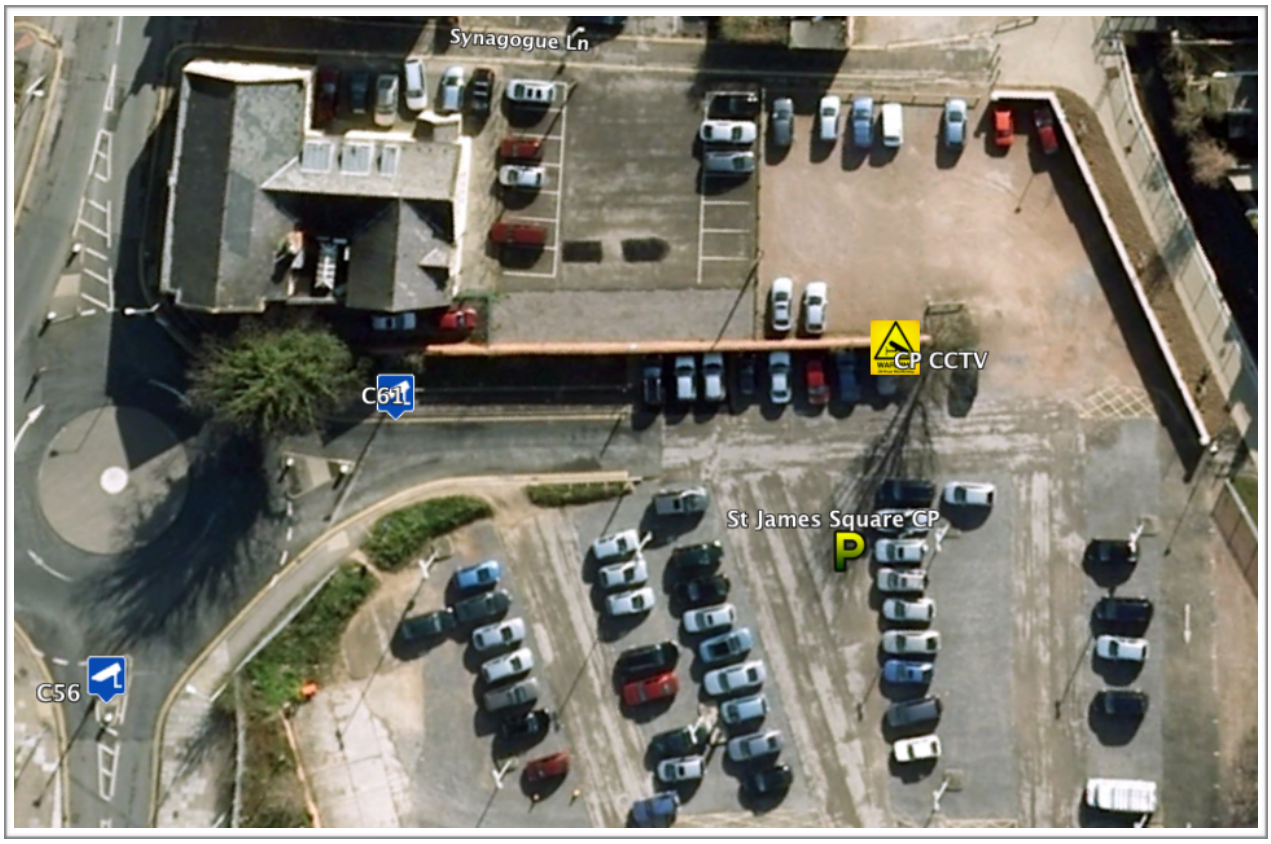
Suggested scope of works includes the following (but not limited to) -

- Recommission both PTZ cameras to ensure correct operation;
- Remove existing DVR and replace with multi-channel H.264 encoder for direct connection to new wireless network;
- Install and commission new wireless network transmission at top of column;
- Install thermostatically controlled extract fan to cabinet;
- Cancel BT broadband ADSL connection to prevent further on-going rental costs;

3.9. Chelt Walk/Synagogue Lane.

The CCTV system within this car park consists of two (2) PTZ dome cameras mounted on an 5m winch-down column located centrally within the car park giving coverage into the Synagogue Lane car park as well.

Recording equipment is located within a locked street cabinet sited adjacent to the column and a BT broadband ADSL connection is installed within the cabinet for remote connection to CBC's offices.



Recommendation

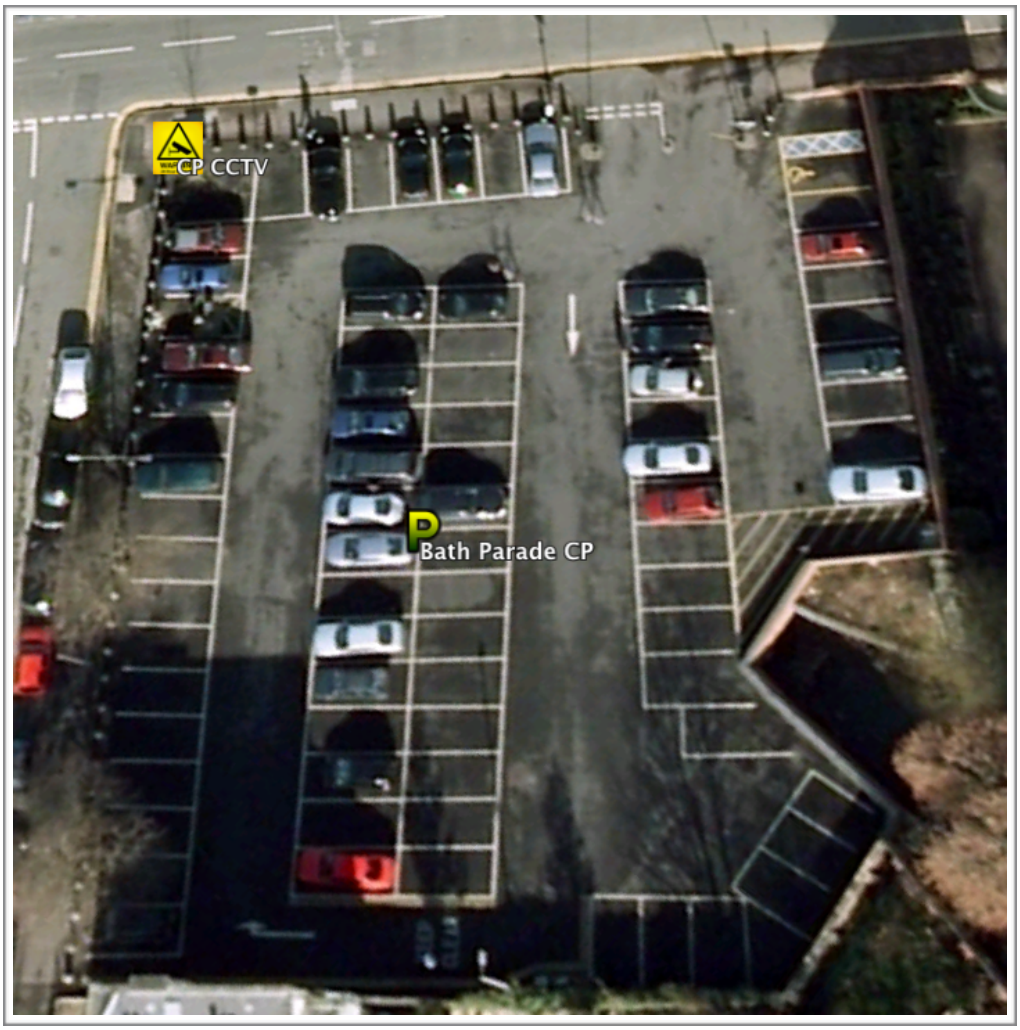
There is duplication of camera coverage within this car park from town centre camera number 61 which is located at the entrance to the car park. Camera number 56 also offers some coverage of the car park.

It is therefore suggested that the car park camera system is decommissioned and all equipment removed.

3.10. Bath Parade.

The CCTV system within this car park consists of two (2) PTZ dome cameras mounted on an 5m column located in the front corner of the car park from Bath Road underneath some trees.

Recording equipment is located within a locked street cabinet sited adjacent to the column and a BT broadband ADSL connection is installed within the cabinet for remote connection to CBC's offices.



Recommendation

There are no town centre cameras providing coverage to this car park, therefore it is recommended that these cameras are included in any integration to the town centre CCTV scheme and the location of the column provides a good line-of-sight for integration into the proposed wireless network (see Section 4). Please note however, that the location of the column is not ideal and there may be a requirement to trim back some of the trees to obtain full views of the car park.

Suggested scope of works includes the following (but not limited to) -

- Recommission both PTZ cameras to ensure correct operation;
- Remove existing DVR and replace with multi-channel H.264 encoder for direct connection to new wireless network;
- Install and commission new wireless network transmission at top of column;

- Install thermostatically controlled extract fan to cabinet;
- Cancel BT broadband ADSL connection to prevent further on-going rental costs;

3.11. Bath Terrace.

The CCTV system within this car park consists of two (2) PTZ dome cameras mounted on an 5m column located near to the entrance of the car park from Bath Road adjacent the public toilets.

Recording equipment is located within a locked street cabinet sited adjacent to the column and a BT broadband ADSL connection is installed within the cabinet for remote connection to CBC's offices.

Recommendation

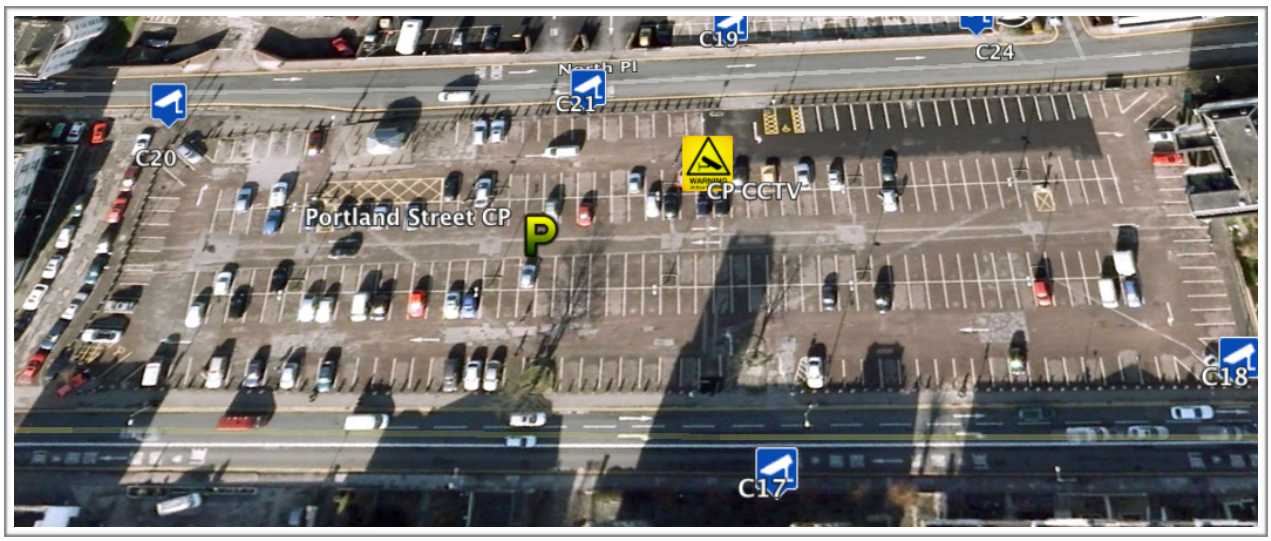
There are no town centre cameras providing coverage to this car park, therefore it is recommended that these cameras are included in any integration to the town centre CCTV scheme and the location of the column provides a good line-of-sight for integration into the proposed wireless network (see Section 4).

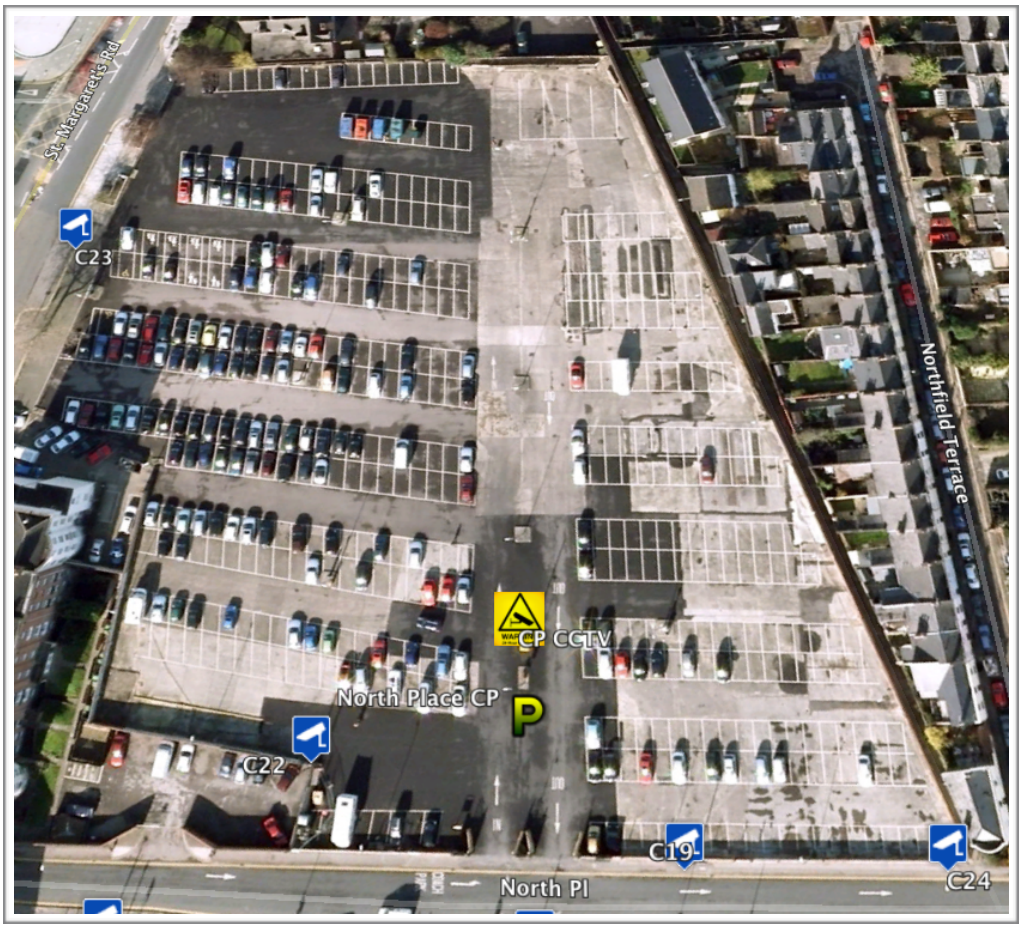
Suggested scope of works includes the following (but not limited to) -

- Recommission both PTZ cameras to ensure correct operation;
- Remove existing DVR and replace with multi-channel H.264 encoder for direct connection to new wireless network;
- Install and commission new wireless network transmission at top of column;
- Install thermostatically controlled extract fan to cabinet;
- Cancel BT broadband ADSL connection to prevent further on-going rental costs;

3.12. Portland Street and North Place.

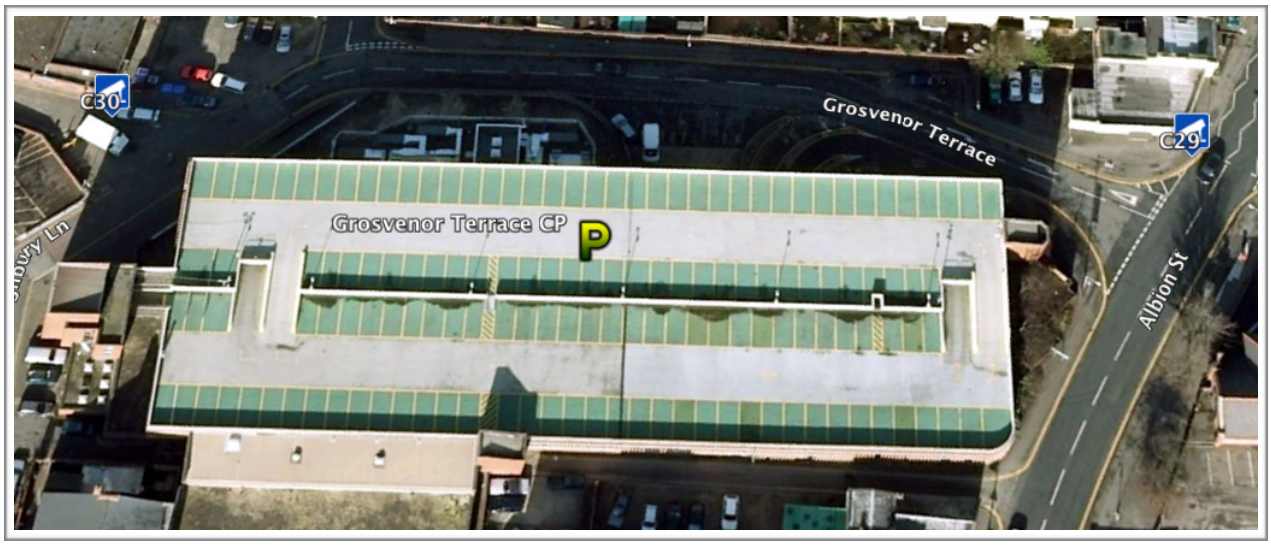
Portland Street and North Place car parks have been sold by CBC for a new development which is due to start in early 2014. As a result, all town centre CCTV cameras and car park CCTV systems affected by the works will be decommissioned and removed from both sites with a view to being used elsewhere in the town centre.





3.13. Grosvenor Terrace/Town Centre East.

This multi-storey car park (MSCP) has a CCTV system consisting a total of thirty-two (32) static and PTZ cameras located around the car park providing coverage on all levels, stairwells and at all entrances.



During the site survey it was not possible to view the CCTV equipment but it is understood that there are two (2) 16-channel DVR's installed within the basement security office where ALL cameras are cabled to. The system was installed by and is currently maintained by Eurolink and remote access from CBC's offices is fully operational.

There are currently also five (5) existing static cameras installed within the car park that can be viewed from the Police Station control room and these are duplicated by some of the car park CCTV cameras.

Recommendation

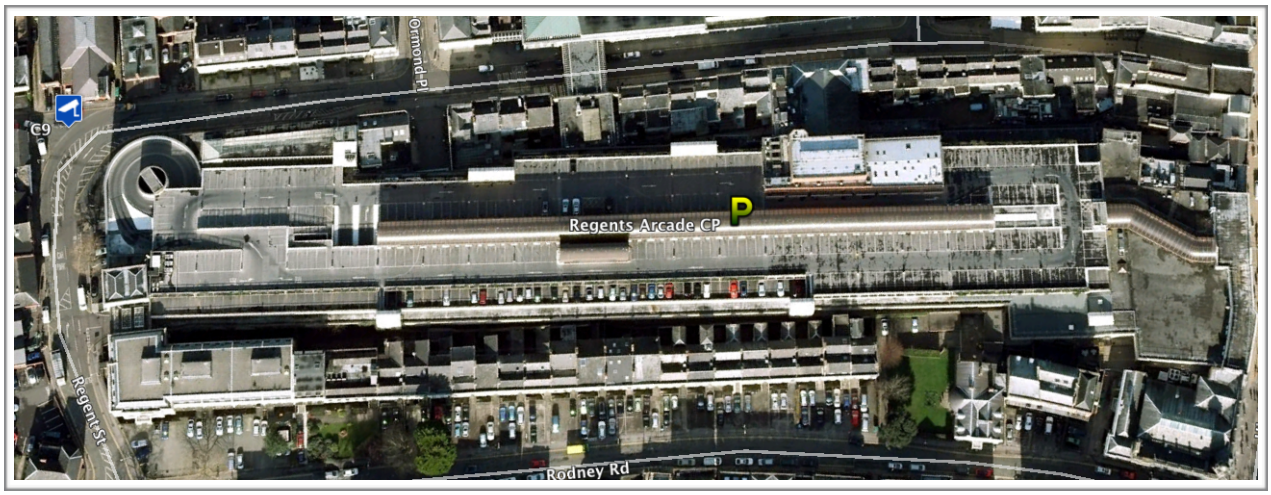
There are no town centre cameras providing FULL coverage to this MSCP, therefore it is recommended that this system is included in any integration to the town centre CCTV scheme and the height of the top floor of the MSCP provides a good line-of-sight for integration into the proposed wireless network (see Section 4).

Suggested scope of works includes the following (but not limited to) -

- Remove existing DVR's (due to incompatibility with Synectics) and replace with new compatible digital recording devices for direct connection to new wireless network;
- Install and commission new wireless network transmission hub on top of MSCP;
- Remove any duplicated camera coverage;
- Cancel BT leased fibre where appropriate;
- Cancel BT broadband ADSL connection to prevent further on-going rental costs;

3.14. Regent's Arcade.

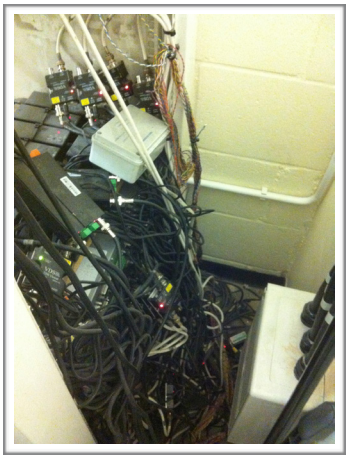
This MSCP has a CCTV system that consists of a total of forty-four (44) static cameras located around the car park providing coverage on all levels, stairwells and entrances.



The cameras are divided over three (3) Dedicated Micros BX-2 digital recorders which are located in two (2) different locations within the car park - one is located in the security hut on the upper level whilst the other two are located inside a staff room on the opposite side of the car park.

The condition of the system installation is very poor and it is clear that maintenance of the system

CBC have been provided a quote from Eurolink to upgrade the cameras and digital recording systems in line with other sites and based around the same method of monitoring - i.e. via a BT broadband connection to CBC's offices.



Recommendation

A full assessment of the condition of this system was not part of CDC's initial remit but from the brief site survey, it is clear that this system is in need of attention. The digital recording system needs to be upgraded to suit any planned expansion of the town centre CCTV scheme but more importantly, the cameras and quality of camera coverage needs to be addressed.

The location of the MSCP is key to any planned wireless network proposal since the height of the top floor of the MSCP provides a good line-of-sight for several town centre locations (see Section 4). This should be taken into account for any future upgrade works.

Suggested scope of works includes the following (but not limited to) -

- Remove existing DVR's (due to incompatibility with Synectics) and replace with new compatible digital recording devices for direct connection to new wireless network;
- Assess quality of existing camera coverage and determine upgrade options;
- Install and commission new wireless network transmission hub on top of MSCP;
- Remove any duplicated camera coverage;
- Cancel BT broadband ADSL connection to prevent further on-going rental costs;

3.15. Alternative Suggestions for Connection to Control Room

All recommendations given above are based around the assumption that a wireless network will be provided to the locations suggested.

It should be noted that other methods of connectivity for the car park CCTV systems exist and some of these are described below -

Use of Broadband

The existing car park CCTV systems already use BT ADSL broadband lines for remote connectivity from CBC's offices.

The main issue with any type of broadband connection is the available bandwidth to transmit video images. The amount of bandwidth cannot be guaranteed and so the image quality and PTZ camera latency can vary significantly.

For these reasons, pro-active monitoring cannot be achieved to the standards expected by the CBC CCTV control room operators.

Use of 3G/mobile broadband

A mobile 3G broadband connection can be used as an alternative to an ADSL connection. However, the same issues experienced with ADSL are apparent with 3G because a good mobile connection can vary with location and the amount of bandwidth available is directly proportional to the number of active connections on the specific mobile cell tower at the time of connection.

For these reasons, pro-active monitoring cannot be achieved to the standards expected by the CBC CCTV control room operators.

BT Leased Fibre

Without doubt, a BT Leased fibre connection will provide the best quality connection type and this type of connection is already being used by CBC for their town centre CCTV cameras.

The biggest issue with this type of connection is the cost. BT only provide these connections based on a fully comprehensive maintenance type contract (usually 5 years or more) and this is reflected in their annual rental cost.

4. Wireless Network

4.1. Introduction

As part of the initial remit, CDC were asked to investigate the possibility of migration the existing BT fibre transmission network onto a new digital wireless network.

The information within this section outlines the requirements for the full implementation of a new digital wireless network to incorporate all of the existing cameras locations within the town centre as well as the car park CCTV systems detailed in the previous section.

The new digital wireless network would allow the connectivity of additional systems, such as the car park CCTV systems, in a much simpler and cost effective way and would also provide CBC the infrastructure to plan for the future in terms of expanding their CCTV systems and CCTV monitoring service.

The CCTV industry has, for some years, been slowly moving into the digital age with digital encoding and recording systems, IP[1] networks and first-generation IP cameras. High definition (HD) and megapixel cameras, are nowadays much better quality than their analog counterparts and this drive for increased image quality, and overall flexibility, has subsequently driven the requirement for high quality digital networks with increased bandwidth capabilities.

4.2. Site Survey

In general, any wireless network in a town centre environment needs to deployed at high level in order to avoid interference from buildings and other obstructions such as trees.

The relatively flat topography of Cheltenham presents a design challenge to any wireless network specialist due to the lack of high-rise buildings and the abundance of trees (during the summer months) within the town centre.

However, from the surveys undertaken, CDC believe that a wireless network could be employed to a high number of the existing camera locations and to the car park locations described in the previous section.

Based on the locations in question, CDC were able to determine the following possible 'points of presence' or 'PoP' that could be used to deploy the wireless network connectivity around the town centre -

- The roof top of CBC Offices on The Promenade;
- The roof top of The Brewery;
- The roof top of Regent's Arcade shopping centre;
- The roof top of Grosvenor Terrace multi-storey car park;
- The roof top of Eagle Tower;
- The roof top of Lansdown Road Police Station;

[1] IP - Internet Protocol

Eagle Tower

Eagle Tower is the only high-rise building within the town centre of Cheltenham and would be an ideal location (and in some instances, the only location) for a wireless network PoP.

CDC made contact to Eagle Tower through their website enquiry page and were initially told that the use of the Eagle Tower roof top would not be allowed (due to the current high population of wireless network antennas). However, once CDC had explained that the wireless network was for use by CBC for their town centre CCTV system, the owner/landlord of Eagle Tower was much more engaging and has given an agreement in principle for the use of the roof top.

The Brewery

This location was also 'unknown' as a possible PoP due to permission for it's use and whilst the roof top of the Brewery is not particularly high, its position in the town centre relative to some of the town centre cameras is key to the network design.

A site visit by CDC, Trevor Gladding (CBC) and Carol Cross (CBC) to meet with Terri Brewster (The Brewery Security Manager) determined exactly what was likely to be required and an agreement in principle was given by Ms. Brewster based on the added benefit that The Brewery would be able to cancel their own BT leased fibre connection to the Lansdown Road Police Station control room.

Unreachable Locations

Throughout the site survey work, it was clear that some existing camera locations would not be able to be included in any wireless network scheme due to their location.

- Camera 10 (Montpellier Walk) - The location of this camera is heavily surrounded by trees with no clear line of sight to another camera location or to any of the PoP previously detailed;
- Camera 55 (St. George's Road) - as above;
- Camera 62 (St. Mary's Church/Church Street) - The location of this camera is heavily surrounded by buildings with no clear line of sight to another camera location or to any of the PoP previously detailed;

Use of Street Lighting Columns

For the purposes of this feasibility report, it has been assumed that the use of street lighting columns as possible 'hop' locations is acceptable. Some camera locations (as listed below) are difficult to link from any of the PoP locations described above OR from any other camera location.

- C9 (Regent Street) - possible link to Regent's Arcade via street lighting column on junction of Regent Street/Ormond Place;
- C58 (Imperial Circus) - possible link to C4 via street lighting column on Promenade;
- C11 (Montpellier Street) - possible link to Eagle Tower via lighting column on junction of Lansdown Road/Parabola Road;
- C2 (High Street) - possible link to C36 via street lighting column on junction of Bath Street/Cambray Place;

North Place/Portland Street

The car parks at North Place and Portland Street are to be redeveloped in 2014 and subsequently all town centre camera locations and car park CCTV systems will be decommissioned and removed.

This report has taken into account this redevelopment in terms of wireless network planning and associated budgeting and once further information is known about the redevelopment, implementation into the wireless network can be investigated and options given to CBC.

4.3. Camera Locations

A summary of the site survey for each camera location is given in the table below.

Location	Notes
C1 (High Street)	Good views of C36;
C2 (High Street)	Good views of C3; Possible link to C36 via Bath Street;
C3 (High Street)	Good views of C2, C4 and C12;
C4 (High Street)	Good views of C5, C3 and C20; Possible link to C58 via Promenade or Clarence St.
C5 (High Street)	Good views of C6 and C4; Future redevelopment of this area may relocate this camera.
C6 (High Street)	Good views of C5 and C13;
C7 (Promenade)	Only view to roof of CBC offices. Heavy tree cover around this camera.
C8 (Promenade)	Good views of CBC roof and C17;
C9 (Regent Street)	View to Regent's Arcade roof top via lamp post on Regent St - LIMITED;
C10 (Montpellier Walk)	UNREACHABLE
C11 (Montpellier Street)	View to Eagle Tower via lamp post on Lansdown Road - LIMITED;
C12 (Winchcombe Street)	Good view of C3;
C13 (High Street)	Good views of C6 and C14;
C14 (High Street)	Good view of C13;
C15 (o/s St. Gregory the Great Church	Partial views of C6. Reliability of wireless link to this location needs to be confirmed.
C16 (Royal Well Road)	Good view of CBC roof only;
C17 (Portland Street)	<u>North Place/Portland Street Car Parks.</u> All cameras in this location have good views of each other. However, these car parks are to be redeveloped in early 2014 and as a result, CCTV coverage in this area will be subject to change. PoP link to The Brewery roof top from C24.
C18 (Portland Street)	
C19 (North Place)	
C20 (North Place)	
C21 (North Place)	
C22 (North Place)	
C23 (St. Margaret's Road)	
C24 (North Place)	
C25 (Rodney Road)	Limited views from this camera. View of Regent's Arcade can be achieved from car park CCTV system column - works required to link both CCTV columns.
C26	-
C27 (Royal Well Road)	Good view of CBC roof only;
C28	-
C29 (Albion Street)	Good view of C33 only;

Continued...

Location	Notes
C30 (Grosvenor Terrace MSCP)	All cameras located inside MSCP and are duplicated with car park CCTV cameras. Suggest cameras are removed and coverage provided by car park CCTV system.
C31 (Grosvenor Terrace MSCP)	
C32 (Grosvenor Terrace MSCP)	
C33 (Grosvenor Terrace)	Good views of C29 and Grosvenor Terrace PoP;
C34 (Grosvenor Terrace MSCP)	As C30 - C32;
C35 (Promenade)	Good view of C8 only;
C36 (Bath Road)	Good views of C1 and Eagle Tower PoP;
C37	Cheltenham Racecourse. An assumption has been made that all cameras in this location are hardwired to a single location which can be linked back to Eagle Tower via the use of a single wireless link.
C38	
C39	
C40	
C41	
C42	
C43	
C44	
C45	
C46	
C47	
C48	
C49	NOT USED
C50 (Honeybourne Line)	View of The Brewery PoP only;
C51	NOT USED
C52	
C53	
C54	
C55 (St George's Road)	UNREACHABLE
C56 (Jessop Avenue)	Good view of C57 and C61 and Eagle Tower PoP;
C57 (St George's Place)	Good view of C56 only;
C58 (Imperial Circus)	Limited views from this camera. Possible link via Clarence Street or Promenade to C4;
C59 (Swindon Road)	Good view of C60 only;
C60 (High Street Car Park)	Good view of C59 and The Brewery PoP;
C61 (St James' Square)	Good view of C56 only;
C62 (Church Street)	UNREACHABLE

Continued...

Location	Notes
C63	Link from Regent's Arcade
C64	Link from Beechwood Arcade
C65	Welch Road Playing Fields These cameras are already linked to control room via existing wireless link to Police Station roof.
C66	
C67	
C68	
C69	Springbank Community Centre This camera is already linked to control room via existing wireless link to Police Station roof.
C101 - C119	The Brewery These cameras are linked to control room via BT fibre which will be replaced by new wireless link;
C201 - C207	Honeybourne Line These cameras are linked to control room via existing wireless link to Police Station roof.

4.4. Car Park Locations

A summary of the site survey for each car park location is given in the table below. However, only car parks that will be integrated into the control room have been detailed.

Location	Notes
Regent's Arcade CP	The roof top of this car park will be used as a PoP. The chosen CCTV system solution for this car park will be linked to the control room via this link.
Grosvenor Terrace CP	The roof top of this car park will be used as a PoP. The chosen CCTV system solution for this car park will be linked to the control room via this link.
Sherborne Place CP	This car park has a good line-of-sight from Grosvenor Terrace or from Eagle Tower.
West End CP	This car park can be linked into the new wireless network via C14 on the High Street.
Chapel Walk CP	This car park can be linked into the new wireless network via C27 on Royal Well Road.
St. James Street CP	This car park has a good line-of-sight from Eagle Tower.
Bath Parade CP	This car park can be linked into the new wireless network via C36 on Bath Road.
Bath Terrace CP	This car park has a good line-of-sight from Eagle Tower.

4.5. Wireless Points of Presence (PoP) Locations

A summary of the site survey for each point of presence location is given in the table below.

Location	Notes
Regent's Arcade CP	Located in the centre of the town with good views of CBC offices, Grosvenor Terrace CP and Eagle Tower. Views to The Brewery tbc.
Grosvenor Terrace CP	The lift motor room of this car park offers the optimum height for a PoP location. Views of Regent's Arcade, Eagle Tower and Lansdown Road Police Station mast.
CBC Offices roof top	The lift motor of CBC offices provides the additional height required to give coverage to both sides of the building. Views of Regent's Arcade, Eagle Tower and maybe Grosvenor Terrace CP (tbc)
The Brewery roof top	Limited views available at time of survey - plant area for agreed PoP location is surrounded by high panelling. Views to Regent's Arcade tbc.
Eagle Tower roof top	Excellent views of the town centre. This location is key to the success of the wireless scheme.
Lansdown Road Police Station	The mast on top of the Police Station is the connection into the control room and can be seen from Eagle Tower and Grosvenor Terrace CP.

4.6. Network Switching Equipment

All networks require an element of network switching equipment to manage and route data traffic as required and given the indicative design of the network described above, there will be a need for a significant amount of switches and/or routers to be employed.

4.7. Summary

Details within this section highlight that there is a definite upgrade path for CBC to replace their current BT fibre transmission to a new digital wireless network.

During the preparation of this feasibility report, CDC employed the services of Horsebridge Networks, a wireless network specialist based in Cheltenham. Horsebridge prepared an indicative design for the wireless network to ensure its feasibility. Part of this design is included in the Appendix of this report for reference.

5. Control Room & System Upgrades

5.1. Introduction

As previously outlined in Section 2 of this report, the Synectics control systems currently employed within the Police Station control room are a hybrid mix of analog and digital systems.

In order to accommodate the remit of integrating the existing car park systems, some upgrades to the Synectics control equipment will be necessary and the extent of these upgrades is directly related to the chosen upgrade pathway as follows -

- Full Digital Upgrade - installation of new wireless network links for ALL CCTV cameras (town centre and car park systems), removal of Synectics analog equipment, upgrade of Synectics digital equipment and installation of new digital display wall and digital control client workstations;
- Partial Digital Upgrade - installation of new wireless network links for car park CCTV systems ONLY, Synectics analog and digital encoding/recording systems upgrade;

5.2. Full Digital Upgrade

The initial remit given to CDC was to provide possibilities for integration of the existing car park CCTV systems AND to investigate the migration of the town centre CCTV cameras on to a new wireless network.

Section 4 of this report outlines that the implementation of a wireless network within the town centre is feasible and this wireless network includes links for the existing car parks as detailed in section 3 of this report.

To make full and proper use of this new digital wireless network, it is therefore necessary to implement some upgrades to the Synectics control equipment within the Police Station control room and create a fully digital Synectics virtual matrix.

Synectics Synergy Server

At present, the existing Synergy server is combined with the Review Client located within the control room and is only used for managing the digital recording and playback facilities of the system.

In larger systems where the server is managing and controlling client workstations, displaying video to spot monitors and display walls, recording images to storage nodes and providing playback facilities to the operators, it is normal to have a dedicated and separate server which is located within the equipment room.

Synergy Workstations

Two (2) existing analog operator positions exist within the control room and these shall need to be wholly replaced with two (2) new digital workstations complete with new Synectics navigator joystick controllers (see pic).

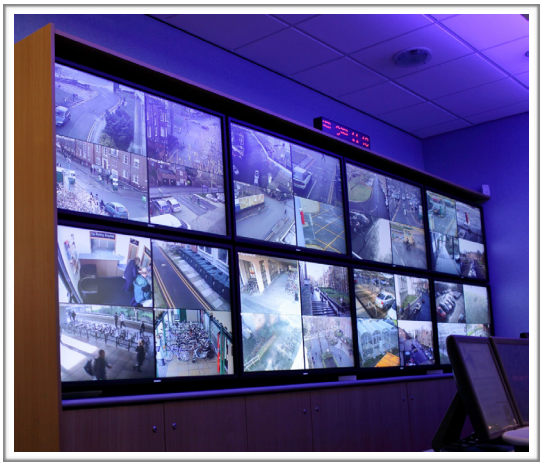
Display Wall Upgrade

One of the largest and most noticeable upgrades for the control room shall be the display wall. The existing spot and wall monitors can only display analog images so will need to be replaced with new large-screen LCD (or equivalent) digital display monitors (see pics).

The additional flexibility for this type of display wall will allow operators to change the layout of the wall as required to suit any situation.

At present, not all images are displayed on the wall due to the lack of monitor space. Any new display wall shall be sized to allow for all existing camera images to be displayed.

There are two (2) other additional benefits gained from this type of wall. The amount of space required for a display wall of this type is much less, so some floor space within the control room will be realised. The other significant benefit from LCD monitors is the much reduced power consumption compared to standard CRT[2] monitors and subsequently the amount of heat produced by these monitors will be much less.



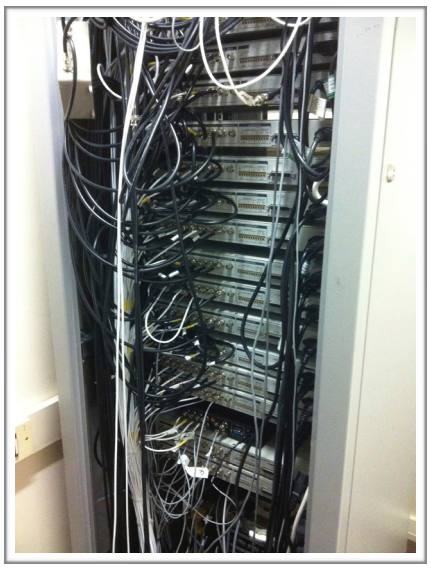
[2] CRT - Cathode Ray Tube

Synectics Analog Equipment

The full digital upgrade option will involve the removal of the majority of the existing Synectics analog control equipment, including the matrix, keyboards and some other interface equipment. Additionally, the quad splitters will become redundant because they cannot be used on the new digital display wall.

The removal of all this analog equipment will provide a significant amount of space within the equipment rack and will consequently allow for the removal of redundant cabling and tidying of any remaining existing cabling (see pics).

The rack space gained will be more than sufficient to accommodate any new digital equipment and provide CBC some much needed expansion space for the future.



System Downtime

It should be noted that due to the increased amount of work required to undertake a full digital upgrade as described above, the amount of downtime for the control room will be increased.

5.3. Partial Digital/Analog Upgrade

For comparison purposes, it is important to note that a partial systems upgrade is possible to achieve the integration of the car park CCTV systems only. However, this is not a recommended route for upgrade due to the lack of scope for future expansion of the control room and the fact that there is insufficient space within the existing equipment room to accommodate the equipment required.

Wireless Network

A partial installation of the wireless network (detailed in section 4) could be achieved to link the car park CCTV systems identified in section 3 into the control room.

Connectivity to the control room will be in exactly the same way as described but on a much smaller scale. However, the wireless network link for West End Car Park could not be achieved unless the full network transmission path along the High Street were implemented. Instead, the link to this car park would be via an upgraded BT circuit at Camera 14 on the High Street and budget costs for this have been shown.

Synectics Analog Equipment

To provide the functionality required by the control room to select and control individual cameras, it will be necessary to install new Synectics matrices at the larger car parks, Regent's Arcade and Grosvenor Terrace. This will allow control of images in the same way as is currently achieved with The Brewery cameras.

Similarly, the cameras from the smaller car parks will be connected into the existing control room matrix which will need to be expanded to accommodate the additional inputs. Expansion space for new inputs is very limited on the existing matrix and as such a new expanded matrix will be required.

Encoding/Decoding[3]

In the same way as for the full digital system upgrade, all cameras from the smaller car parks will need to be encoded for connectivity and transmission over the new digital network. However, in order to connect these cameras into the existing/expanded analog matrix, the images will need to be decoded as well.

Synectics Digital Equipment

Any new camera images connected to the analog equipment in the control room will need to be recorded and as such the Synectics digital recording equipment will need to be expanded to suit.

New digital recording equipment will be required in the two (2) larger car parks at Regent's Arcade and Grosvenor Terrace as well. These systems need NOT be manufactured by Synectics but will need to have the facility for remote access for recorded image retrieval over the wireless network.

System Downtime

The expected downtime for this type of systems upgrade is minimal as there is no significant disruption to the systems.

Expansion Space

It should be noted that this type of upgrade requires a significant amount of space within the control room equipment room and this space does not currently exist. It is likely that modifications to the existing equipment room will be required.

[3] Encoding and Decoding is the means by which an analog CCTV image is converted (or encoded) to a digital format (usually H.264) for transmission over a digital network and then re-converted (or decoded) from H.264 to an analog format for connection into analog control equipment such as a CCTV switching matrix.

6. Budgets

The following section outlines some of the current revenue spend by CBC for the existing systems and gives budgets for proposals detailed in the previous sections of this report.

6.1. Current Situation

BT Leased Fibre Connections

Information provided by CBC shows the following costs from BT for their leased fibre connections -

- April 2012 to March 2013 - Total Cost £34,883.10 + VAT
- April 2013 to March 2014 - Total Cost £39,728.04 + VAT

This shows an increase in costs of approximately 13%.

The following table shows the estimated projected spend for CBC over the next five (5) years using a more conservative percentage increase in costs of 6% per year as well as 13% per year for comparison.

Year	Cost £ (6% increase)	Cost £ (13% increase)
2013-2014	£39,728.04	£39,728.04
2014-2015	£42,111.72	£44,892.69
2015-2016	£44,638.43	£50,728.73
2016-2017	£47,316.73	£57,323.47
2017-2018	£50,155.74	£64,775.52
TOTAL	**£223,950.65**	**£257,448.45**

BT Broadband Connections

As described in section 2 of this report, as part of each of the existing car park CCTV systems a BT Broadband connection is currently installed.

The current QUARTERLY rental cost for BT Telephone and Broadband connections is shown in the table below. These figures have been supplied by CBC and are deemed correct at the time of writing this report.

Multiplying the total figure over twelve (12) months gives a total of £2,339.90 x 4 = £9,359.60 per annum.

Over five (5) years, this figure is expected to be a minimum of 5 x £9,359.60 = **£46,798.00 + VAT**

Description	Type of Service	£ Cost (Net) PER QUARTER
CCTV Bath Parade Car Park	Telephony	£54.15
CCTV Bath Parade Car Park	Broadband	£121.00
CCTV Bath Terrace Car Park	Telephony	£54.15
CCTV Bath Terrace car park	Broadband	£113.80
CCTV Chapel Walk Car Park	Telephony	£54.15
CCTV Chapel Walk Car Park	Telephony	£54.15

CCTV Chapel Walk Car Park	Telephony	£54.15
CCTV Chapel Walk Car Park	Broadband	£121.00
CCTV Chapel Walk Car Park	Broadband	£123.40
CCTV Chapel Walk Car Park	Broadband	£103.90
CCTV Coro Sq car park	Telephony	£54.15
CCTV Coro Sq car park	Broadband	£121.00
CCTV High Street Car Park	Telephony	£54.15
CCTV High Street Car Park	Broadband	£121.00
CCTV Phoenix Passage car park	Telephony	£54.15
CCTV Phoenix Passage car park	Broadband	£103.90
CCTV Portland St Car Park	Telephony	£54.15
CCTV Portland St Car Park	Broadband	£103.90
CCTV Regents Arcade	Broadband	£110.30
CCTV Rodney Road Car Park	Telephony	£54.15
CCTV Rodney Road Car Park	Broadband	£101.50
CCTV Sherbourne Place car park	Telephony	£54.15
CCTV Sherbourne Place car park	Broadband	£112.20
CCTV St Georges Rd car park	Telephony	£54.15
CCTV St Georges Rd car park	Telephony	£54.15
CCTV St Georges Rd car park	Broadband	£103.90
CCTV St James car park	Telephony	£54.15
CCTV St James car park	Broadband	£121.00
	TOTAL COST PER QUARTER	£2,339.90

In addition to these BT Broadband costs, CBC have identified a number of other broadband and ISDN lines that are currently paid for on a MONTHLY basis as part of the car park CCTV systems as follows -

Description	Type of Service	£ Cost (Net) PER MONTH
Cable Modem 4096K Grosvenor Terrace	Broadband	£140.00
Cable Modem 4096K Grosvenor Terrace	Broadband	£140.00
Regents Arcade Kiosk 2Mbs	Broadband	£100.00
Regents Arcade Car Park ISDN lines	Broadband	£81.00
	TOTAL COST PER MONTH	£461.00

Multiplying the total figure over twelve (12) months gives a total of £461.00 x 12 = £5,532.00 per annum.

Over five (5) years, this figure is expected to be a minimum of 5 x £5,532.00 = **£27,660.00 + VAT**

The total figure for the amount spent by CBC over five (5) years for ALL the existing broadband, telephony and ISDN connections for the car park CCTV systems is £46,798.00 + £27,660.00 = **£74,458.00 + VAT**

Existing Car Park CCTV Maintenance

Consideration also needs to be taken into account for the savings obtained from the decommissioning of some of the car park CCTV systems as detailed in section 2.

Out of the fourteen (14) car parks surveyed, it was recommended that six (6) of the systems are decommissioned and removed due to duplication of coverage from existing town centre cameras.

Information provided by CBC shows that only High Street Car Park has an existing annual maintenance contract of £240.00 + VAT that could be cancelled and the money saved.

6.2. Full Digital Upgrade

Budget costs for the full digital upgrade as detailed in the previous section are given below.

Description	Budget Cost £
Control Room	
Synx Server Hardware	£3,000
Synergy Client Workstations (incl Navigator controller) (2x)	£9,000
Integration work for The Brewery system	£2,000
Display Wall	
Synx Display Wall controllers(2x)	£10,000
55" LCD Monitors (4x)	£8,000
Modifications to existing monitor wall furniture	£7,500
Wireless Network	
Transmission equipment	£130,000
Bracketry	£5,000
Network switching equipment	£5,000
Encoding equipment	£17,500
Integrator Costs	
Synx manufacturer commissioning	£2,000
Installation & commissioning	£50,000
TOTAL	**£249,000**

6.3. Part Digital/Analog Upgrade (for Car Park Systems only)

Budget costs for the part digital part analog upgrade works to integrate the existing car park CCTV systems only is given below.

Description	Budget Cost £
Control Room	
Existing matrix upgrade	£5,000
Additional telemetry interfaces	£2,000
Digital recording upgrade	£10,000
Digital encoding upgrade	£8,500
Regent's Arcade CP	
New Synx Matrix for 48 inputs	£9,000
New Digital Recording system (compatible with Synx)	£6,000
Grosvenor Terrace CP	
New Synx Matrix for 32 inputs	£8,500
New Digital Recording system (compatible with Synx)	£4,000
Smaller CP's	
Encoding & Decoding equipment	£8,000
Wireless Network	
Transmission Equipment	£35,000
Network switching equipment	£2,500
BT Upgrade costs for Cam 14	£1,500
Integrator costs	
Installation & Commissioning	£25,000
TOTAL	£125,000

6.4. Capital Funds

At the time of writing this report, CBC have not identified any funds that are available to contribute to any upgrade project.

6.5. Exceptional Costs

Contingencies

It should be noted that in general terms, contingency costs and costs associated with general compliance with contract preliminaries are estimated at around 10% of overall capital works contract cost.

No contingency costs have been included in any budgetary figures.

VAT

All budgetary figures are exclusive of VAT which should be added at the prevailing rate.

Other fees of note

There are several other fees that should be taken into account for a project of this size and complexity as follows –

- System specification compilation;
- Tender documents and tender process (including evaluation);
- Planning fees or change of use fees for proposed sites;
- Provisional Sums (not specifically mentioned previously);
- OFCOM transmission licenses – 1st year usually included in capital installation costs;
- New CCTV signage to comply with Data Protection Act 1998;
- Contract/Project Management fees for any new project;

6.6. Summary of Costs

In summary, the following cost information should be considered.

Current Situation

- CBC are expected to be paying BT Redcare between £223,950.65 and £257,448.45 over the next five (5) years for the provision of leased fibre for their current CCTV locations;
- CBC are likely to be paying BT and Virgin Media a minimum of £74,458 for Business Broadband and telephony connections to the existing car park CCTV systems;
- In total and with NO UPGRADES of CCTV equipment, the estimated minimum spend for CBC over the next five (5) years will be a combined cost in the region of £298,408.65 and £331,906.45;

Partial Upgrade for Car Parks

- The projected budget for the upgrade works necessary to incorporate the identified car park cameras into the existing CCTV control room is £125,000;
- This upgrade cost removes the need for any BT Broadband connections but DOES NOT remove the reliance on BT Redcare for the leased fibre connections to existing CCTV locations;
- This upgrade cost provides some upgrades to analog and digital control equipment;

Full Upgrade to Digital

- The projected budget for a complete digital upgrade which incorporates the identified car park systems and a practical migration to a digital wireless network is £249,000;
- This upgrade cost includes a significant overhaul of the existing control and recording systems and removes the reliance on BT to provide links to existing CCTV locations;
- A full digital upgrade will provide an easy pathway for relocation of the existing control room to another location[4].

[4] Costs associated with any relocation have not been included in the budget costs provided in this report.

7. Conclusions

Costs for BT Redcare leased fibre circuits are increasing year-on-year throughout the UK and local authorities and the like, are investigating ways of implementing new technology to try and mitigate these costs.

This report highlights that the current spend by CBC on BT Redcare leased fibre and BT Business Broadband has a significant impact on the council's CCTV budget and, in general, prevents any investment in system upgrades and expansion. This situation is only likely to get worse as the existing analog systems get older and consequently need more attention in terms of maintenance and as technology moves on, increasing the likelihood of future incompatibilities and of components becoming obsolete.

7.1. Invest To Save

Whilst an option is given for a partial upgrade of the existing CCTV systems, it should be noted that this option will only provide CBC an estimated saving of circa £15K per annum for the removal of the BT and Virgin Media broadband connections and does not provide CBC with any expected cost savings from the BT leased fibre connections. More importantly, the partial upgrade does not provide the council with a way forward in terms of an easy and cost effective means of relocation of the control room or any future expansion of the CCTV service and compatibility with new digital IP/HD/ Megapixel technology.

However, the option to implement a full digital upgrade of the control systems and transmission network may, at first glance, seem expensive but from the budget costs provided in this report, it can be shown that this commitment would provide a significant saving of circa £55K per annum to CBC within five (5) years.

7.2. Control Room Relocation

It is understood that there is a desire to relocate the existing CCTV control room to the Tri-Service Centre at Waterwells Drive in Quedgeley ('Waterwells') due to the likelihood of closure of the Lansdown Road Police Station in the near future.

One of the major disadvantages of any CCTV system employing analog transmission, such as BT leased fibre circuits, is the high cost of relocating BT fibres and transmission equipment from one location to another. In addition to this, BT calculate their annual rental cost based on the distance of the fibre from camera location to control room, so it can be very quickly realised that any relocation of the control room will, without doubt, increase the annual rental cost for each circuit.

With this in mind, the full digital upgrade of the CCTV system and digital wireless network installation makes even more sense.

In general, the re-routing of a wireless network is as simple as pointing the antenna (or antennas) in another direction and the proposed design of the wireless scheme, as detailed in this report, would allow this re-direction to probably take place from the roof top of the Eagle Tower which could be undertaken very easily and, more importantly, very quickly.

Due to the distances involved between Cheltenham and Quedgeley, the relocation to Waterwells would require an upgraded wireless link provision between the Eagle Tower and the Tri-Service Centre and, subject to the necessary permissions, would likely be routed via Gloucester due to the topography of the area. It should be noted that the costs of such a wireless link (or links) have not been included in the budgets given in this report but an indicative budget would be in the region of £25-30K

With regards to the relocation of the proposed digital control and recording system upgrades outlined in this report, these could very 'simply' be decommissioned from the existing control room location, re-installed and recommissioned in the new location following the installation of the above-mentioned wireless link[5].

End of Report.

[5] Costs associated with any relocation of the control room systems have not be included in this report.

Horsebridge
www.horsebridge.net

Horsebridge Network Systems Ltd

Response to Cheltenham CCTV Network

Submission Date 10/09/2013

"Supporting the Requirements of Today and Tomorrow

with the Technology of the Future"

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Tel: 0844 81 50 510 e-mail: info@horsebridge.net web:www.horsebridge.net Registered in England 04167419

1 Welcome

On behalf of Horsebridge I would like to thank CDC for this opportunity to work with you to deliver a CCTV Network to Cheltenham.

CDC can be assured that we have a proven track record of delivering this type of service to a huge range of organisations of various sizes across the UK, pan-European and globally and within different markets working directly with our clients or through established partnerships with recognised global experts.
Network services design and delivery constitute some of our core competencies; I am pleased that we continue to experience healthy growth in this area.

Gavin Warrington

Solutions Specialist – Horsebridge Networks

2 Executive Summary

The purpose of this document is to outline the services that HORSEBRIDGE is proposing it will provide to CDC.
CDC requires an innovative approach to providing CCTV backhaul to Cheltenham. The use of Radwin PTP / PTMP technology has several advantages for this requirement

This will deliver and improve;

- Business efficiency through faster data transfer between sites / offices
- Reduction of installation time to add new sites to the network.
- Improved service levels for its customers and stakeholders.
- Future proof technology allowing the Inclusion of additional services at later dates.

Horsebridge will deliver this network using technology that is recognised as industry leading, scalable and capable of maintaining performance in the harshest of environments. Typical customers include the MOD and Police services across the UK as well as the majority of tier one mobile telecommunications companies operating within the UK, EMEA and globally.

The deployment will be managed and supported by Horsebridge. Horsebridge will partner with CDC to deliver this solution to Cheltenham.

In terms of the physical planning of the sites for the backhaul and distribution Horsebridge use both desktop feasibility and live drive test methodologies to assess the exact system design for a deployment.
Pre Deployment Planning performed by -qualified individuals includes:

- Complete on-site survey of all areas to be covered, using same solution that will be deployed.
- Site analysis Infrastructure, radio, backhaul, capacity and management
- On-site RF spectrum analysis to identify potential interference issues.
- Post survey analysis and report including coverage maps and RSSI values.

Post install survey to confirm installed equipment meets proposal requirements

Requirements

- CCTV Backhaul
- Provide full control of this network

Horsebridge have kept this requirement in mind when selecting the equipment suitable for this solution. Horsebridge are a vendor agnostic solutions provider who have designed a solution which will work in these environments, provide the client with maximum control over the network whilst minimising the bandwidth use of the control overhead thus giving maximum bandwidth for the daily traffic.
This solution has the capability to expand to include additional services should the need arise however we would strongly recommend that the bandwidth requirement be established before these were added to the solution.

Horsebridge Overview

Horsebridge is a private company established in 2000 that was created to bring innovative thinking to telecoms problems. With an initial focus and immediate success in the network synchronisation sector it has evolved and grown and provided innovative solutions to the marketplace in such diverse areas as Defence (Mobile Broadband Solutions in Afghanistan) to Formula 1 events for the McLaren Racing Team on behalf of Vodafone

In the last couple of years it has expanded globally with offices in Africa, Middle East and Asia Pacific and established a 24X7 Network Operation and Technical Support Centre with in excess of 70 customers including Vodafone, Cable & Wireless, Virgin Media, MBNL and the Ministry of Defence.

Horsebridge has achieved its success through listening to clients problems and designing innovative solutions to meet those requirements.

We believe there are a number of unique reasons why CDC should select Horsebridge for this programme. These are summarised as follows:

- **Trusted Supplier**

Major blue chip clients use Horsebridge regularly to resolve specialist or difficult 'technical' problems fast. These have been utilised regularly for high profile customers, temporary solutions and special events.

- **Technical Services Management**

Resulting from this and the lessons learnt we believe that the 'best' solution for CDC regarding the Managed Services approach to the provision of CCTV to Cheltenham utilising a technically innovative lead partner known and trusted by CDC so that the Cheltenham Deployments can be delivered without problems

- **Blend of Technical and Project Experts**

Our solution is designed to give CDC with this 'ideal' blend of Technical Project Management and Solutions with experienced teams of Logistics and Deployment experts all of whom are well versed with and understand the issues and problems involved in these projects.

- **Compliant Solution**

We are submitting a technically compliant solution supported by a strong commercial offering that we believe will deliver a compelling solution economically and technically sound.

3. RADWIN SOLUTION

RADWIN 2000 Portfolio Highlights (PTP)

- Up to 200 Mbps net aggregate throughput
- Native TDM (up to 16 E1s/T1s) + Ethernet
- Long range - up to 120 Km/75 miles
- Telco-grade, incorporating advanced MIMO & OF DM technologies
- Multi-band radio supports multiple bands on same platform
- Extremely robust - systems operate in NLOS, high interference and harsh weather
- Extremely simple to install and maintain
- TDM service protection through Hot Monitored Standby
- Ethernet service protection through 1+1 and Ring topology

Radwin 2000 c-Series
Ultra-capacity radios for iP & TDM Backhaul RADWIN 2000 C is the ultimate backhaul solution for IP & TDM networks. Reaching 200 Mbps aggregate throughput and providing IP and TDM over the same link make this product ideal for today's and tomorrow's networks, preparing operators for the seamless migration from legacy TDM to all-IP networks.
RADWIN 2000 C-Series products deliver IP with end-to-end QoS. The solutions operate in symmetric and in adaptive asymmetric mode where channel capacity is dynamically allocated between uplink and downlink based on traffic loads and air-interface conditions. Extremely simple to install and maintain, the RADWIN 2000 C-Series solutions operate flawlessly in the most challenging environments, including non-line-of-sight scenarios, interference-ridden environments and extreme temperatures.
For operators who want to break the capacity barrier and meet the skyrocketing demand for broadband, the RADWIN 2000 C-Series is the right choice.

RADWIN SOLUTION – (PTMP)

The RADWIN 5000 HPMP Point-to-MultiPoint delivers up to 250Mbps per sector and is the ideal choice for last mile enterprise connectivity and high-end applications that demand guaranteed bandwidth per subscriber, this will provide high capacity backhaul from the delivery points to the backhaul points across Cheltenham where applicable which will provide sufficient bandwidth whilst reducing CAPEX

RADWIN 5000 HPMP APPLICATIONS

CARRIERS & ISPS

RADWIN 5000 HPMP is an excellent revenue generator for Carriers and ISPs that are looking to deploy last mile enterprise connectivity and deliver high-capacity broadband access to end users. Carriers can leverage upon RADWIN 5000 HPMP high capacity capabilities to backhaul wireless and landline access systems such as Wi-Fi hot spots, cellular base stations and DSLAMs.

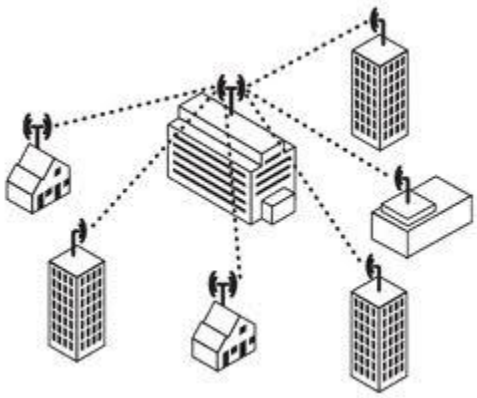
GOVERNMENT & ENTERPRISE NETWORKS

RADWIN 5000 HPMP offers exclusive wireless broadband infrastructure for Government and Enterprise networks to dramatically reduce their total cost of ownership when implementing the following applications:

- Connectivity of high resolution video surveillance
- Wide range Inter-office connectivity
- Mission critical broadband applications

RADWIN 5000 HPMP Highlights

- Up to 250Mbps per Base Station sector
- Unique mechanism guaranteeing SLA per subscriber
- Variety of Subscriber Units – 100,50,25, 20, 10Mbps
- Small Form Factor MIMO Subscriber Unit
- OFDM MiMO 2x2 / Diversity enables nLOS deployment
- Low latency
- Long range – 40 km / 25 miles
- Supporting Multiband 4.9 to 6GHz in the same unit
- Coexists with RADWIN's Point-to-Point solutions



Radio Planning Report

Project Name	Cheltenham Wireless CCTV Network
Author	Gavin Warrington
Last Modified	10/09/2013

Proposed Network Layout

General Information

Description

Wireless CCTV Net

Customer

CDC

Disclaimer

Links Designed Using Client Information / Subject to Full RF Survey

Sites Summary

Site Name	Latitude	Longitude	Altitude
NewSite	51.898318	-2.076657	15
Courthouse	51.898978	-2.083315	15
Walkway	51.899268	-2.075855	10
C17	51.897364	-2.078986	6
LC1	51.894604	-2.083467	6
Lamp Post 1	51.899636	-2.076964	8
The Brewery	51.903451	-2.076445	20
West End CP	51.904625	-2.082322	5
C36	51.897754	-2.072408	6
C50	51.902258	-2.086603	5
Hop Point	51.899021	-2.071006	23
Chapel Walk CP	51.898754	-2.079271	5
St James Square CP	51.900085	-2.081521	5
Regents Arcade CP	51.899278	-2.074907	22
Grosvenor Terrace CP	51.899753	-2.070296	21
Sherbourne Place CP	51.900296	-2.069622	5
Portland Street CP	51.903452	-2.072275	5
North Place CP	51.903697	-2.072982	5
Rodney Road CP	51.897239	-2.075492	5
ST Georges Rd CP	51.898797	-2.082287	5
St James St CP	51.89843	-2.069658	5
Bath Parade CP	51.896895	-2.072986	5
Bath Terrace CP	51.889949	-2.079548	5
C60	51.903176	-2.077564	5
C59	51.90425	-2.076992	5
C24	51.904121	-2.072434	5
C55	51.898907	-2.081543	5

C49	51.900364	-2.081167	5
C56	51.900614	-2.081391	6
C57	51.900291	-2.079682	5
C16	51.899856	-2.077938	6
C12	51.900996	-2.072177	5
C25	51.897572	-2.075574	5
C9	51.898293	-2.077077	5
C8	51.897969	-2.078381	5
Untitled Placemark	51.881677	-2.050801	0
C27	51.899057	-2.078774	6
C10	51.895595	-2.081591	5
C18	51.904071	-2.07144	5
C23	51.9034	-2.074482	5
C22	51.90344	-2.073134	5
C21	51.903603	-2.072601	5
C19	51.903818	-2.072641	5
C20	51.903124	-2.072948	5
C15	51.901821	-2.08012	5
C6	51.90312	-2.079043	6
C5	51.902589	-2.077173	6
C14	51.904535	-2.082638	5
C4	51.901098	-2.074845	6
C58	51.900649	-2.076191	5
C3	51.900115	-2.073282	6
C13	51.903644	-2.080688	5
C7	51.899537	-2.076621	5
CBC Offices	51.899185	-2.077958	20
C1	51.898179	-2.071582	5
C30	51.899089	-2.071342	5
C2	51.899153	-2.072522	7

Police Station Control Room	51.893748	-2.097079	42
C29	51.900046	-2.070321	5
C11	51.89498	-2.083351	5
C17	51.903554	-2.071623	5
High Street CP	51.903561	-2.077338	5
Eagle Tower Bld	51.894251	-2.076389	50

P2P Links Summary

Side A Name	Side B Name	Distance	Capacity	RW Family
C36	C1	0.074 Km	85.8 Mbps Agg ,(42.9 Mbps Peak)	RW2000
Hop Point	Grosvenor Terrace CP	0.095 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
Hop Point	C30	0.029 Km	20.4 Mbps Agg ,(10.2 Mbps Peak)	RW2000
Grosvenor Terrace CP	Sherbourne Place CP	0.077 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
Police Station Control Room	Hop Point	1.882 Km	168.4 Mbps Agg ,(84.2 Mbps Peak)	RW2000
St James Square CP	C56	0.06 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
C57	C56	0.123 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
C30	C29	0.127 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
Eagle Tower Bld	CBC Offices	0.56 Km	213.8 Mbps Agg ,(106.9 Mbps Peak)	RW2000
C15	C6	0.162 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
Eagle Tower Bld	Hop Point	0.647 Km	169.8 Mbps Agg ,(84.9 Mbps Peak)	RW2000
C7	Lamp Post 1	0.026 Km	20.4 Mbps Agg ,(10.2 Mbps Peak)	RW2000
C25	Regents Arcade CP	0.196 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
C3	C12	0.124 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000

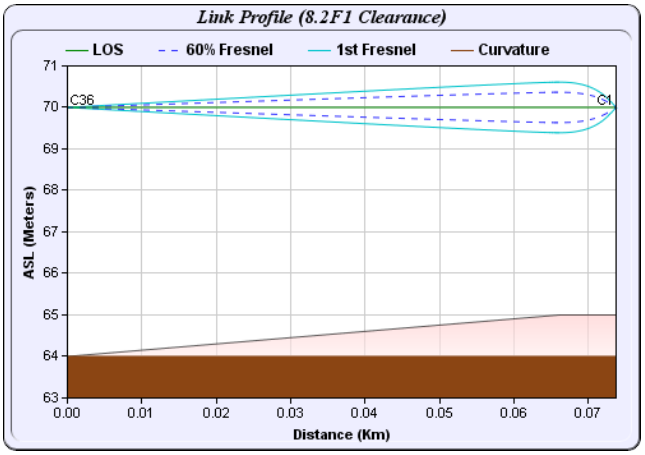
Walkway	Regents Arcade CP	0.067 Km	20.4 Mbps Agg ,(10.2 Mbps Peak)	RW2000
Bath Terrace CP	Eagle Tower Bld	0.527 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
Hop Point	The Brewery	0.618 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
C23	C22	0.093 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
Bath Parade CP	C36	0.103 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
Police Station Control Room	Eagle Tower Bld	1.42 Km	191.6 Mbps Agg ,(95.8 Mbps Peak)	RW2000
CBC Offices	Lamp Post 1	0.085 Km	20.4 Mbps Agg ,(10.2 Mbps Peak)	RW2000
LC1	C11	0.043 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
C4	C20	0.26 Km	128.5 Mbps Agg ,(64.2 Mbps Peak)	RW2000
C60	High Street CP	0.046 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
Hop Point	Regents Arcade CP	0.269 Km	20.4 Mbps Agg ,(10.2 Mbps Peak)	RW2000
High Street CP	C59	0.08 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
C14	West End CP	0.024 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
C13	C14	0.166 Km	20.4 Mbps Agg ,(10.2 Mbps Peak)	RW2000
C6	C13	0.127 Km	20.4 Mbps Agg ,(10.2 Mbps Peak)	RW2000
C9	Walkway	0.137 Km	20.4 Mbps Agg	RW2000

			,(10.2 Mbps Peak)	
C5	C6	0.141 Km	43.2 Mbps Agg ,(21.6 Mbps Peak)	RW2000
Eagle Tower Bld	C56	0.788 Km	212.1 Mbps Agg ,(106.1 Mbps Peak)	RW2000
C4	C5	0.23 Km	43.2 Mbps Agg ,(21.6 Mbps Peak)	RW2000
CBC Offices	C56	0.284 Km	82.6 Mbps Agg ,(41.3 Mbps Peak)	RW2000
C3	C4	0.153 Km	43.2 Mbps Agg ,(21.6 Mbps Peak)	RW2000
Chapel Walk CP	C27	0.048 Km	9 Mbps Agg ,(4.5 Mbps Peak)	RW2000
C2	C3	0.119 Km	63.9 Mbps Agg ,(31.9 Mbps Peak)	RW2000
C1	C2	0.126 Km	85.8 Mbps Agg ,(42.9 Mbps Peak)	RW2000

P2P Links

LINK: C36_C1

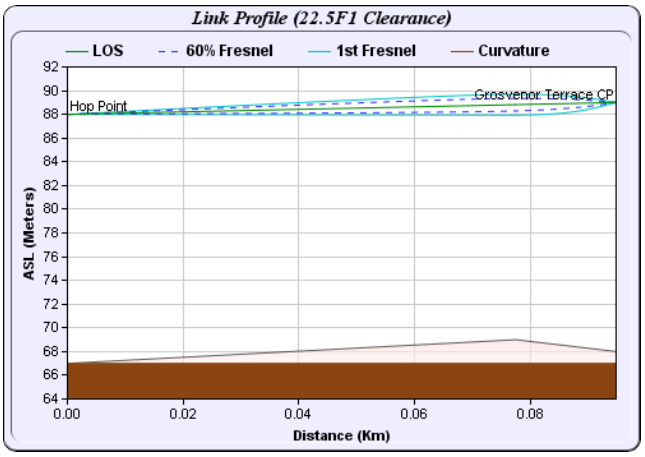
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	40 Mhz	0.074 Km	Dual	85.8 Mbps Agg ,(42.9 Mbps Peak)	108 Mbps	100%	None	E



Properties	*C36*	*C1*
Height above Sea	70 m	70 m
Antenna Height	6 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/C/F54/ETSI/INT	RW2000/ODU/C/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-34.5 dBm	-34.5 dBm
Fade Margin	43.5 dB	43.5 dB
Azimuth	50.2°	230.2°
Elevation	-0.7°	0.7°
HSS	INU	HSC

LINK: HOP POINT_GROSVENOR TERRACE CP

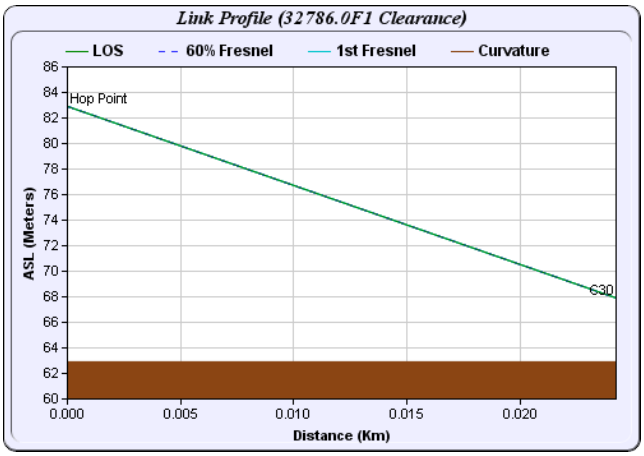
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.095 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*Hop Point*	*Grosvenor Terrace CP*
Height above Sea	88 m	89 m
Antenna Height	21 m	21 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-39.6 dBm	-39.6 dBm
Fade Margin	49.4 dB	49.4 dB
Azimuth	30.9°	210.9°
Elevation	0.5°	-0.5°
HSS	HSM	INU

LINK: HOP POINT_C30

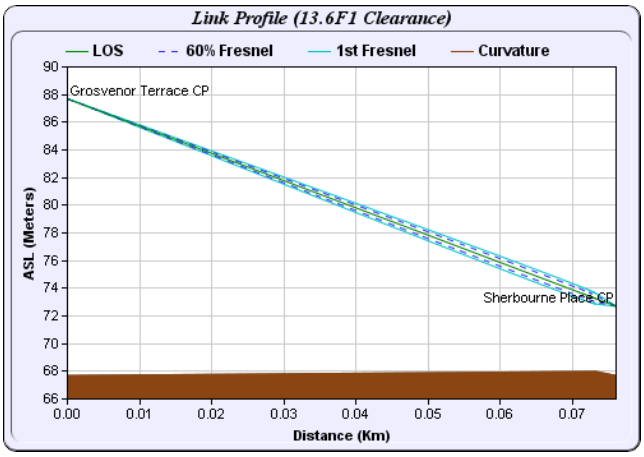
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	20 Mhz	0.029 Km	Dual	20.4 Mbps Agg ,(10.2 Mbps Peak)	26 Mbps	100%	None	E



Properties	*Hop Point*	*C30*
Height above Sea	87 m	72 m
Antenna Height	20 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-26.3 dBm	-26.3 dBm
Fade Margin	59.7 dB	59.7 dB
Azimuth	288.2°	108.2°
Elevation	4°	-4°
HSS	HSC	INU

LINK: GROSVENOR TERRACE CP_SHERBOURNE PLACE CP

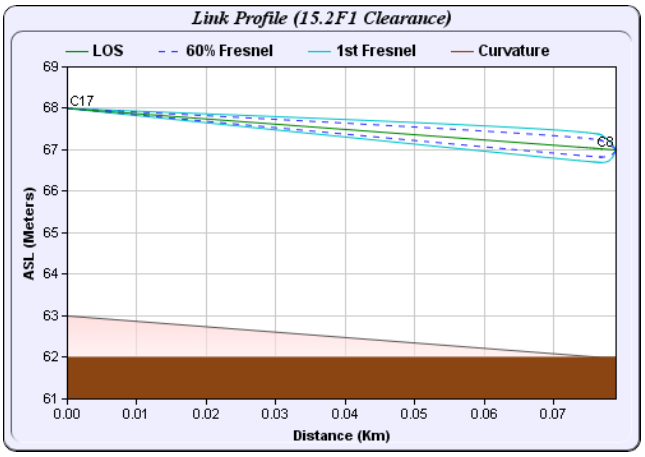
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.077 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*Grosvenor Terrace CP*	*Sherbourne Place CP*
Height above Sea	88 m	73 m
Antenna Height	20 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-37.8 dBm	-37.8 dBm
Fade Margin	51.2 dB	51.2 dB
Azimuth	37.4°	217.4°
Elevation	0.8°	-0.8°
HSS	INU	INU

LINK: C17_C8

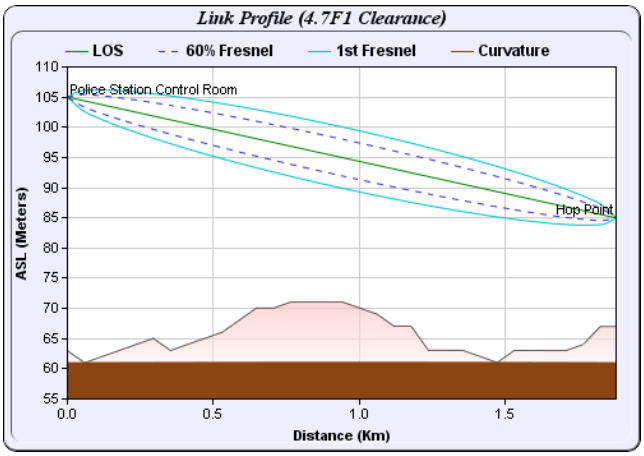
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.079 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*C17*	*C8*
Height above Sea	68 m	67 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-38 dBm	-38 dBm
Fade Margin	51 dB	51 dB
Azimuth	31.7°	211.7°
Elevation	14.3°	-14.3°
HSS	INU	INU

LINK: POLICE STATION CONTROL ROOM_HOP POINT

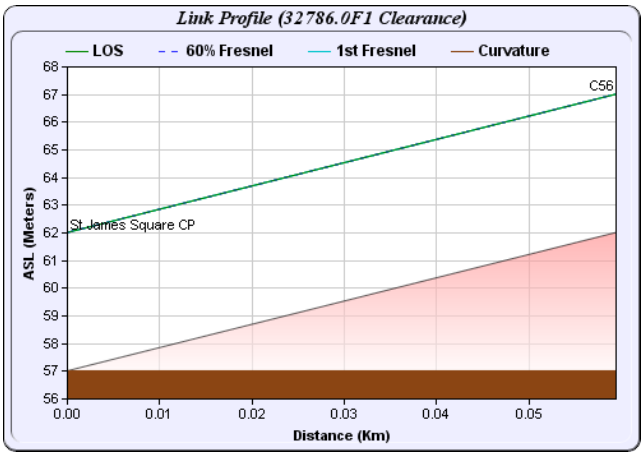
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	40 Mhz	1.882 Km	Dual	168.4 Mbps Agg ,(84.2 Mbps Peak)	216 Mbps	99.9999%	None	E



Properties	*Police Station Control Room*	*Hop Point*
Height above Sea	105 m	85 m
Antenna Height	42 m	18 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/C/F54/ETSI/INT	RW2000/ODU/C/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-62.6 dBm	-62.6 dBm
Fade Margin	6.4 dB	6.4 dB
Azimuth	71.8°	251.8°
Elevation	-1.2°	1.2°
HSS	INU	HSC

LINK: ST JAMES SQUARE CP_C56

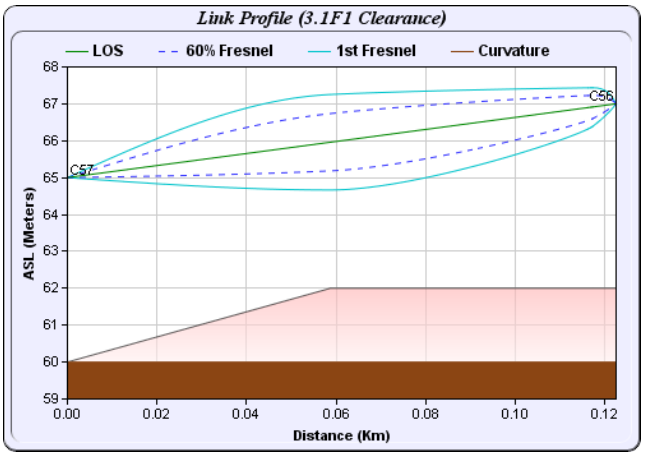
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.06 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*St James Square CP*	*C56*
Height above Sea	62 m	67 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-35.6 dBm	-35.6 dBm
Fade Margin	53.4 dB	53.4 dB
Azimuth	8.6°	188.6°
Elevation	0.1°	-0.1°
HSS	INU	HSM

LINK: C57_C56

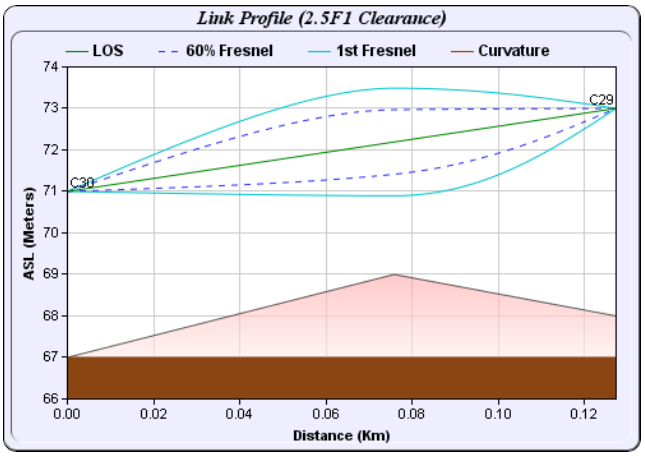
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.123 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*C57*	*C56*
Height above Sea	65 m	67 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-41.9 dBm	-41.9 dBm
Fade Margin	47.1 dB	47.1 dB
Azimuth	287°	107°
Elevation	0°	0°
HSS	INU	HSC

LINK: C30_C29

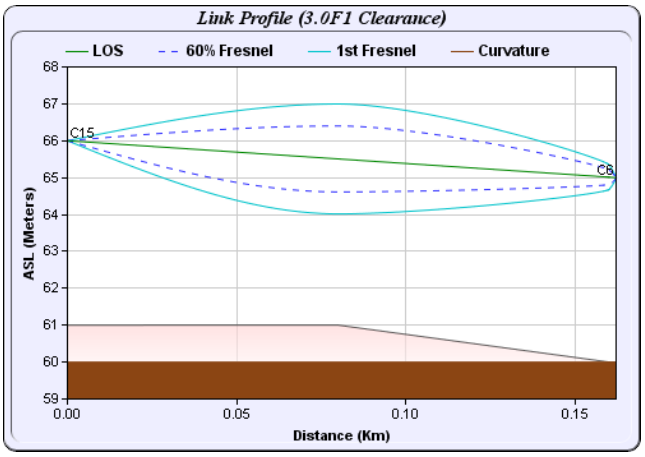
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.127 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*C30*	*C29*
Height above Sea	71 m	73 m
Antenna Height	4 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-42.2 dBm	-42.2 dBm
Fade Margin	46.8 dB	46.8 dB
Azimuth	33.4°	213.4°
Elevation	0.5°	-0.5°
HSS	INU	INU

LINK: C15_C6

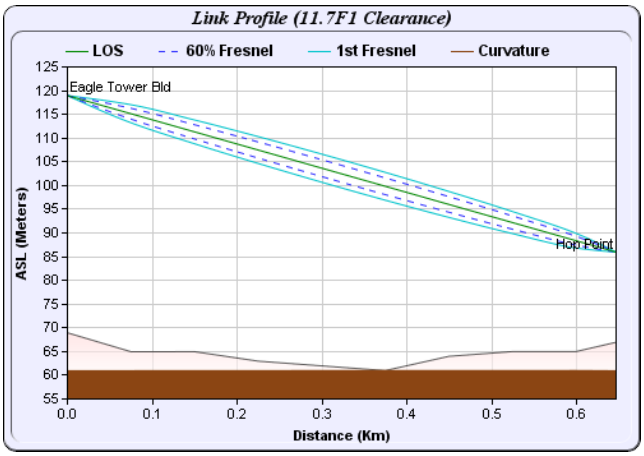
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.162 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*C15*	*C6*
Height above Sea	66 m	65 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-44.3 dBm	-44.3 dBm
Fade Margin	44.7 dB	44.7 dB
Azimuth	27.1°	207.1°
Elevation	0.1°	-0.1°
HSS	INU	HSC

LINK: EAGLE TOWER BLD_HOP POINT

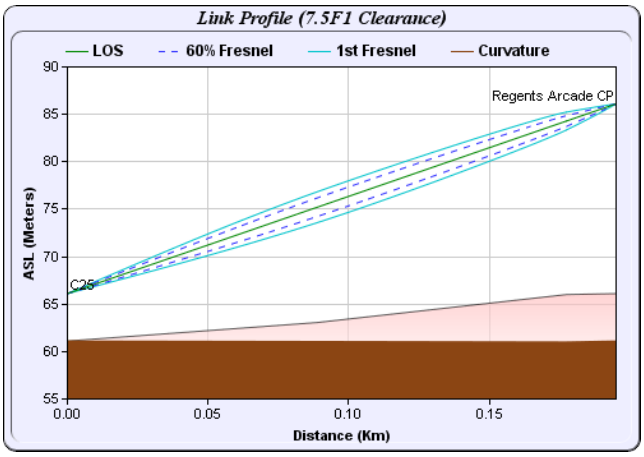
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	40 Mhz	0.647 Km	Dual	169.8 Mbps Agg ,(84.9 Mbps Peak)	216 Mbps	100%	None	E



Properties	*Eagle Tower Bld*	*Hop Point*
Height above Sea	119 m	86 m
Antenna Height	50 m	19 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/C/F54/ETSI/INT	RW2000/ODU/C/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-53.3 dBm	-53.3 dBm
Fade Margin	15.7 dB	15.7 dB
Azimuth	34.9°	214.9°
Elevation	-4.1°	4.1°
HSS	HSC	INU

LINK: C25_REGENTS ARCADE CP

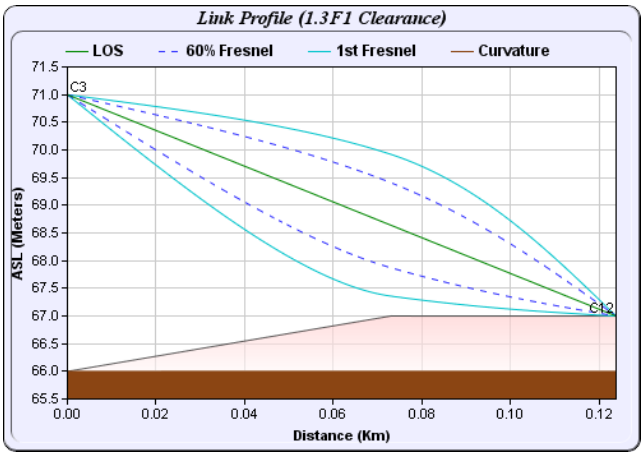
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.196 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*C25*	*Regents Arcade CP*
Height above Sea	66 m	86 m
Antenna Height	5 m	20 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-45.9 dBm	-45.9 dBm
Fade Margin	43.1 dB	43.1 dB
Azimuth	13.6°	193.6°
Elevation	4.5°	-4.5°
HSS	INU	INU

LINK: C3_C12

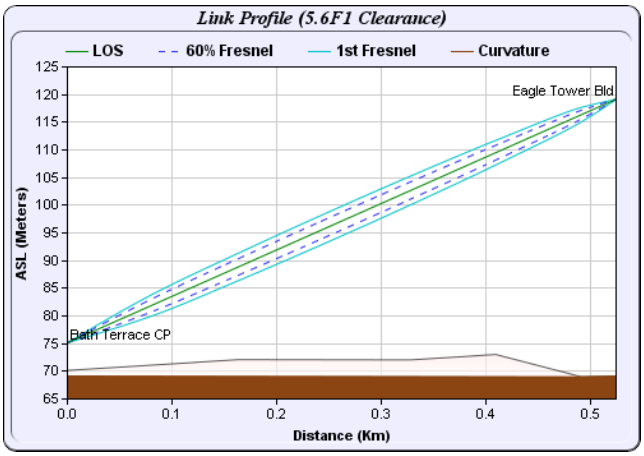
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.124 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*C3*	*C12*
Height above Sea	71 m	67 m
Antenna Height	5 m	0 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-42 dBm	-42 dBm
Fade Margin	47 dB	47 dB
Azimuth	37.7°	217.7°
Elevation	-2.2°	2.2°
HSS	HSC	INU

LINK: BATH TERRACE CP_EAGLE TOWER BLD

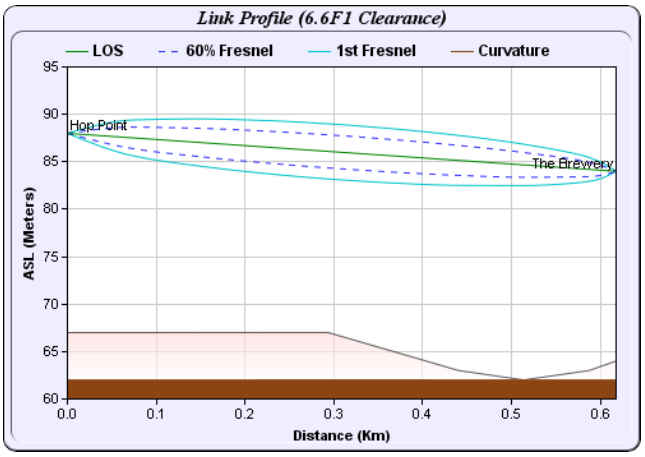
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.527 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*Bath Terrace CP*	*Eagle Tower Bld*
Height above Sea	75 m	119 m
Antenna Height	5 m	50 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-54.5 dBm	-54.5 dBm
Fade Margin	34.5 dB	34.5 dB
Azimuth	24.4°	204.4°
Elevation	5°	-5°
HSS	INU	HSM

LINK: HOP POINT_THE BREWERY

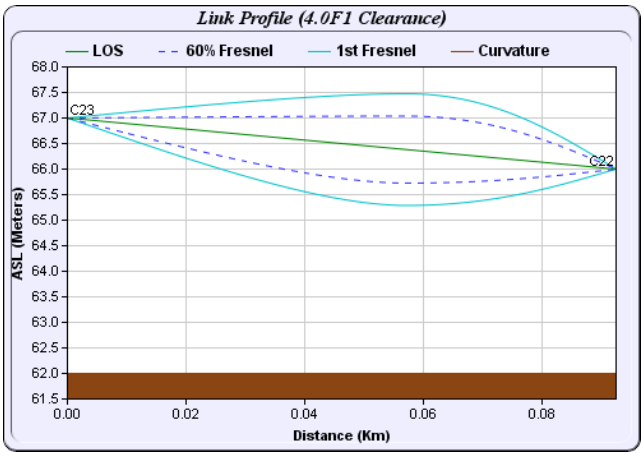
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.618 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*Hop Point*	*The Brewery*
Height above Sea	88 m	84 m
Antenna Height	21 m	20 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-55.9 dBm	-55.9 dBm
Fade Margin	33.1 dB	33.1 dB
Azimuth	322.9°	142.9°
Elevation	1.5°	-1.5°
HSS	HSC	INU

LINK: C23_C22

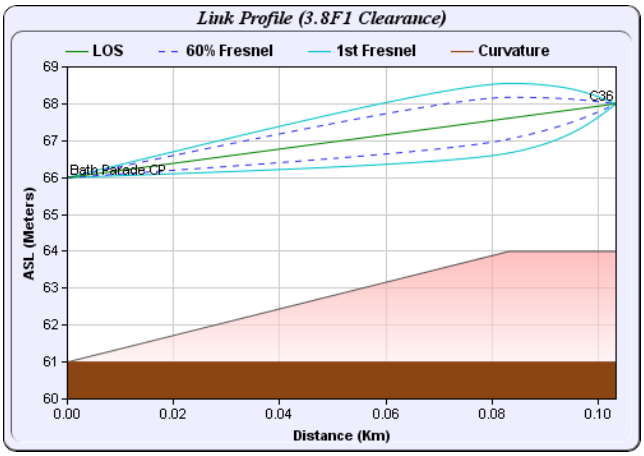
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.093 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*C23*	*C22*
Height above Sea	67 m	66 m
Antenna Height	5 m	4 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-39.5 dBm	-39.5 dBm
Fade Margin	49.5 dB	49.5 dB
Azimuth	87.2°	267.2°
Elevation	-0.6°	0.6°
HSS	INU	INU

LINK: BATH PARADE CP_C36

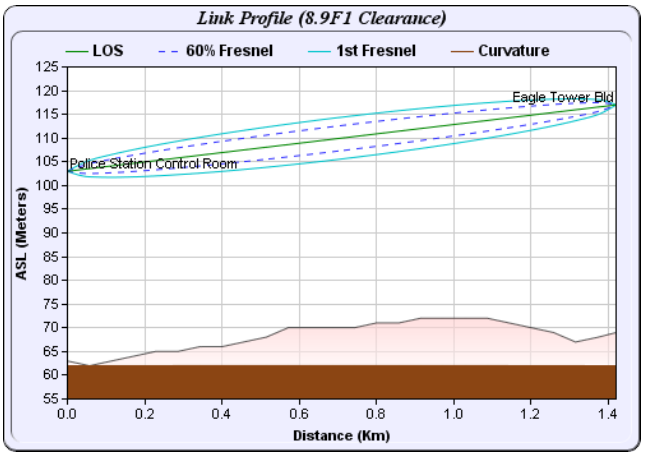
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.103 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*Bath Parade CP*	*C36*
Height above Sea	66 m	68 m
Antenna Height	5 m	4 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-40.3 dBm	-40.3 dBm
Fade Margin	48.7 dB	48.7 dB
Azimuth	22.5°	202.5°
Elevation	-0.4°	0.4°
HSS	INU	HSC

LINK: POLICE STATION CONTROL ROOM_EAGLE TOWER BLD

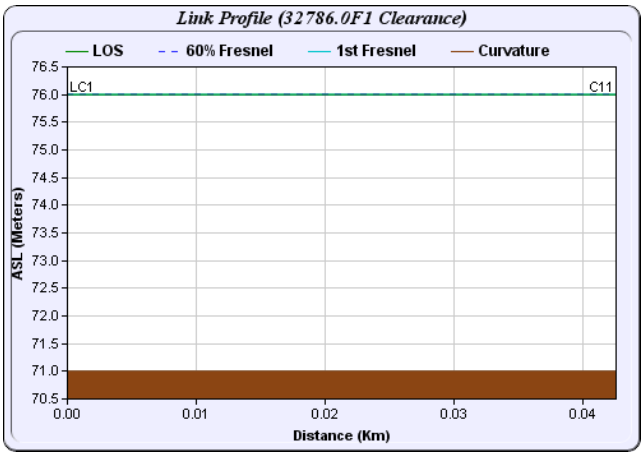
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	40 Mhz	1.42 Km	Dual	191.6 Mbps Agg ,(95.8 Mbps Peak)	243 Mbps	100%	None	E



Properties	*Police Station Control Room*	*Eagle Tower Bld*
Height above Sea	103 m	117 m
Antenna Height	40 m	48 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/C/F54/ETSI/INT	RW2000/ODU/C/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-60.1 dBm	-60.1 dBm
Fade Margin	6.9 dB	6.9 dB
Azimuth	87.7°	267.7°
Elevation	0.4°	-0.4°
HSS	INU	HSC

LINK: LC1_C11

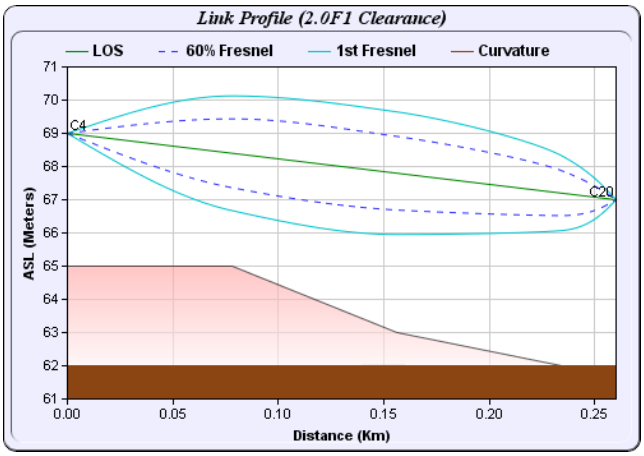
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.043 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*LC1*	*C11*
Height above Sea	76 m	76 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/C/F54/ETSI/INT	RW2000/ODU/C/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-32.8 dBm	-32.8 dBm
Fade Margin	56.2 dB	56.2 dB
Azimuth	10.8°	190.8°
Elevation	0°	0°
HSS	INU	INU

LINK: C4_C20

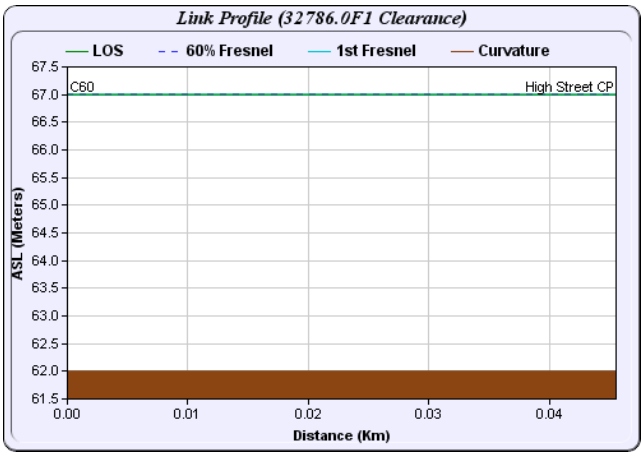
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	40 Mhz	0.26 Km	Dual	128.5 Mbps Agg ,(64.2 Mbps Peak)	162 Mbps	100%	None	E



Properties	*C4*	*C20*
Height above Sea	69 m	67 m
Antenna Height	4 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/C/F54/ETSI/INT	RW2000/ODU/C/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-45.4 dBm	-45.4 dBm
Fade Margin	28.6 dB	28.6 dB
Azimuth	30°	210°
Elevation	0.3°	-0.3°
HSS	INU	HSM

LINK: C60_HIGH STREET CP

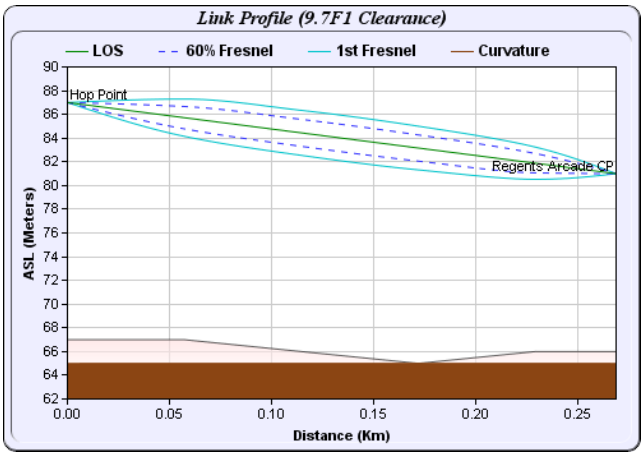
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.046 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*C60*	*High Street CP*
Height above Sea	67 m	67 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/C/F54/ETSI/INT	RW2000/ODU/C/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-33.3 dBm	-33.3 dBm
Fade Margin	55.7 dB	55.7 dB
Azimuth	19.9°	199.9°
Elevation	0.1°	-0.1°
HSS	INU	HSM

LINK: HOP POINT_REGENTS ARCADE CP

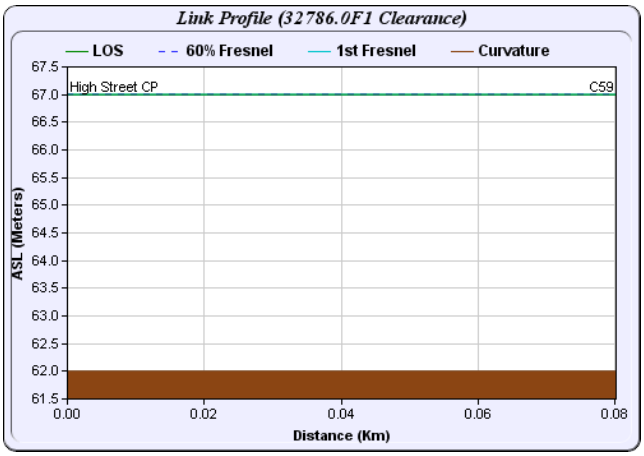
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	20 Mhz	0.269 Km	Dual	20.4 Mbps Agg ,(10.2 Mbps Peak)	26 Mbps	100%	None	E



Properties	*Hop Point*	*Regents Arcade CP*
Height above Sea	87 m	81 m
Antenna Height	20 m	15 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-45.7 dBm	-45.7 dBm
Fade Margin	40.3 dB	40.3 dB
Azimuth	276.1°	96.1°
Elevation	2.5°	-2.5°
HSS	HSC	INU

LINK: HIGH STREET CP_C59

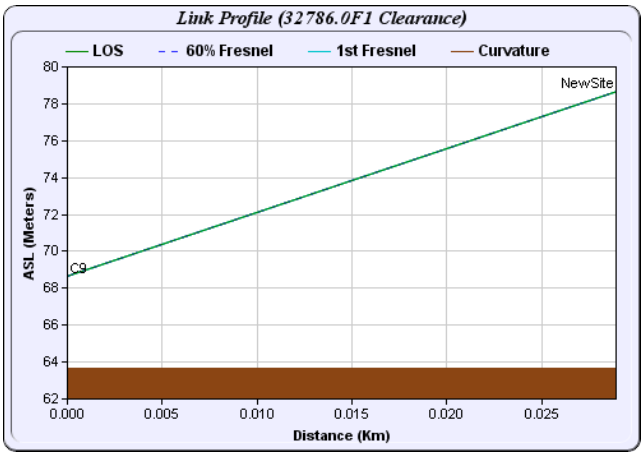
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.08 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*High Street CP*	*C59*
Height above Sea	67 m	67 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/C/F54/ETSI/INT	RW2000/ODU/C/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-38.1 dBm	-38.1 dBm
Fade Margin	50.9 dB	50.9 dB
Azimuth	17.2°	197.2°
Elevation	0.1°	-0.1°
HSS	HSC	INU

LINK: C9_NEWSITE

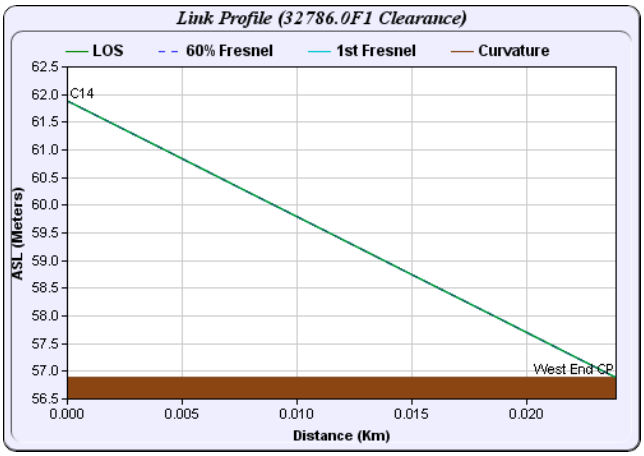
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.031 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*C9*	*NewSite*
Height above Sea	68 m	78 m
Antenna Height	5 m	15 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-29.9 dBm	-29.9 dBm
Fade Margin	59.1 dB	59.1 dB
Azimuth	84.5°	264.5°
Elevation	-20.5°	20.5°
HSS	INU	INU

LINK: C14_WEST END CP

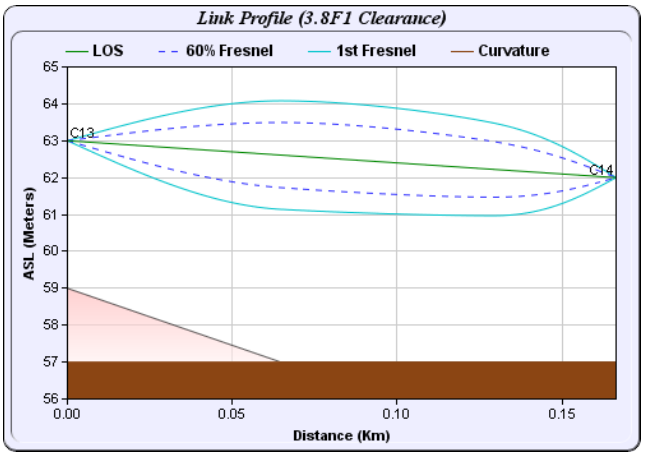
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.024 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*C14*	*West End CP*
Height above Sea	62 m	57 m
Antenna Height	5 m	0 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-27.7 dBm	-27.7 dBm
Fade Margin	61.3 dB	61.3 dB
Azimuth	65.2°	245.2°
Elevation	-11.8°	11.8°
HSS	HSM	INU

LINK: C13_C14

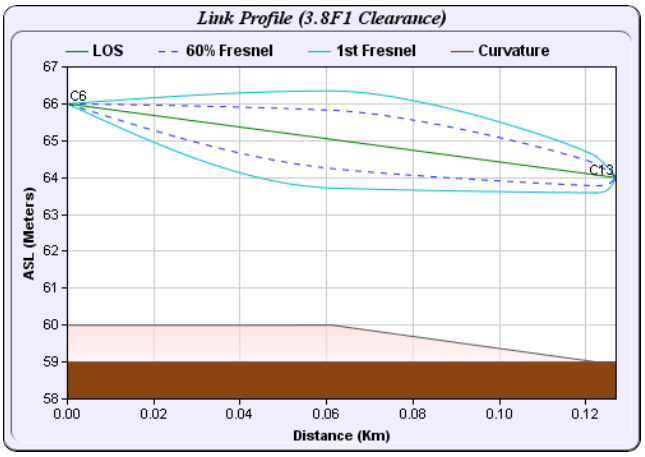
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	20 Mhz	0.166 Km	Dual	20.4 Mbps Agg ,(10.2 Mbps Peak)	26 Mbps	100%	None	E



Properties	*C13*	*C14*
Height above Sea	63 m	62 m
Antenna Height	4 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-41.5 dBm	-41.5 dBm
Fade Margin	44.5 dB	44.5 dB
Azimuth	306.5°	126.5°
Elevation	0.4°	-0.4°
HSS	INU	HSC

LINK: C6_C13

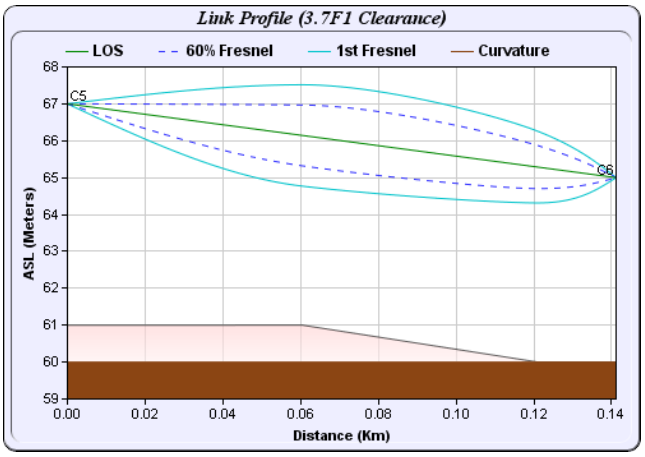
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	20 Mhz	0.127 Km	Dual	20.4 Mbps Agg ,(10.2 Mbps Peak)	26 Mbps	100%	None	E



Properties	*C6*	*C13*
Height above Sea	66 m	64 m
Antenna Height	6 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-39.2 dBm	-39.2 dBm
Fade Margin	46.8 dB	46.8 dB
Azimuth	297.3°	117.3°
Elevation	-0.5°	0.5°
HSS	INU	HSC

LINK: C5_C6

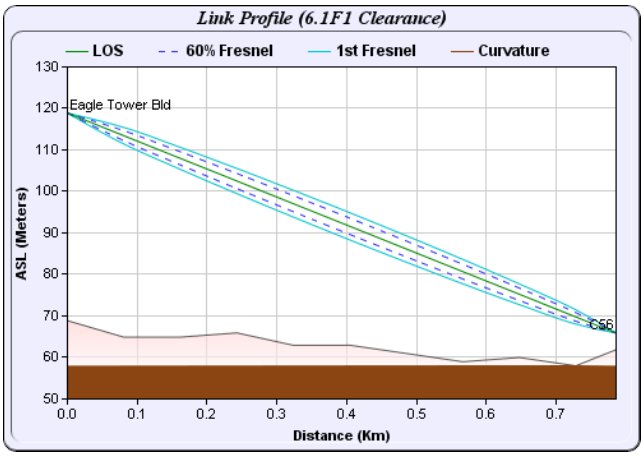
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	40 Mhz	0.141 Km	Dual	43.2 Mbps Agg ,(21.6 Mbps Peak)	54 Mbps	100%	None	E



Properties	*C5*	*C6*
Height above Sea	67 m	65 m
Antenna Height	6 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-40.1 dBm	-40.1 dBm
Fade Margin	42.9 dB	42.9 dB
Azimuth	294.7°	114.7°
Elevation	-0.4°	0.4°
HSS	INU	HSC

LINK: EAGLE TOWER BLD_C56

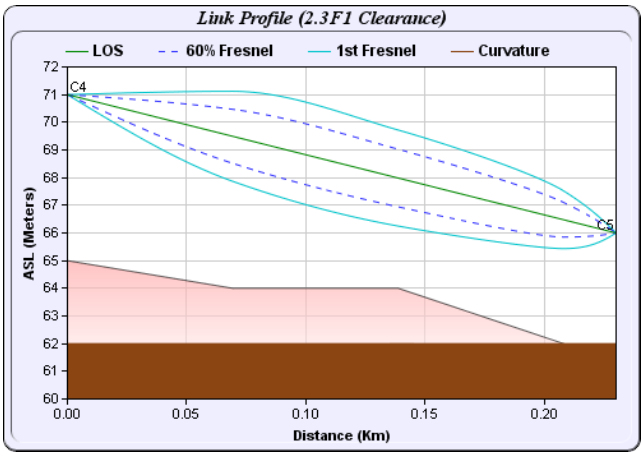
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	40 Mhz	0.788 Km	Dual	212.1 Mbps Agg ,(106.1 Mbps Peak)	270 Mbps	100%	None	E



Properties	*Eagle Tower Bld*	*C56*
Height above Sea	119 m	66 m
Antenna Height	50 m	4 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/C/F54/ETSI/INT	RW2000/ODU/C/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-55 dBm	-55 dBm
Fade Margin	9 dB	9 dB
Azimuth	334.1°	154.1°
Elevation	-3.3°	3.3°
HSS	HSC	INU

LINK: C4_C5

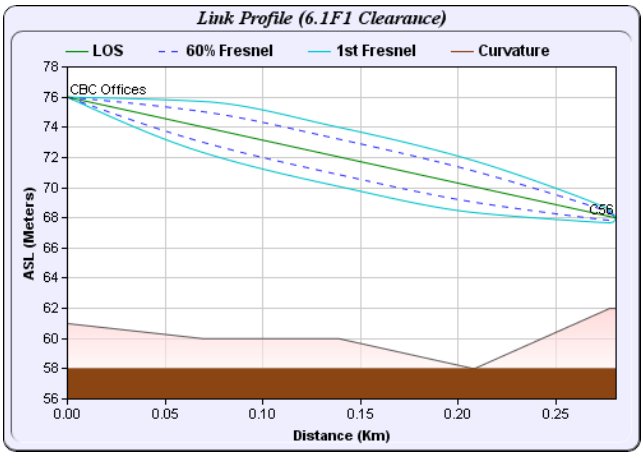
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	40 Mhz	0.23 Km	Dual	43.2 Mbps Agg ,(21.6 Mbps Peak)	54 Mbps	100%	None	E



Properties	*C4*	*C5*
Height above Sea	71 m	66 m
Antenna Height	6 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-44.3 dBm	-44.3 dBm
Fade Margin	38.7 dB	38.7 dB
Azimuth	316.1°	136.1°
Elevation	-0.2°	0.2°
HSS	INU	HSC

LINK: CBC OFFICES_C56

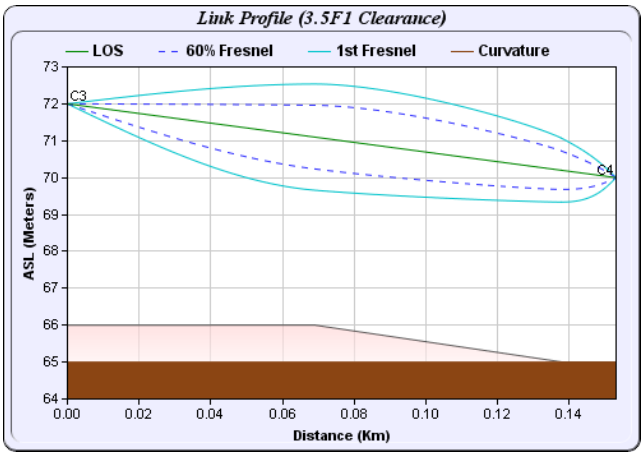
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	20 Mhz	0.281 Km	Dual	82.6 Mbps Agg ,(41.3 Mbps Peak)	104 Mbps	100%	None	E



Properties	*CBC Offices*	*C56*
Height above Sea	76 m	68 m
Antenna Height	15 m	6 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/C/F54/ETSI/INT	RW2000/ODU/C/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-46.1 dBm	-46.1 dBm
Fade Margin	25.9 dB	25.9 dB
Azimuth	316.1°	136.1°
Elevation	2.8°	-2.8°
HSS	HSC	INU

LINK: C3_C4

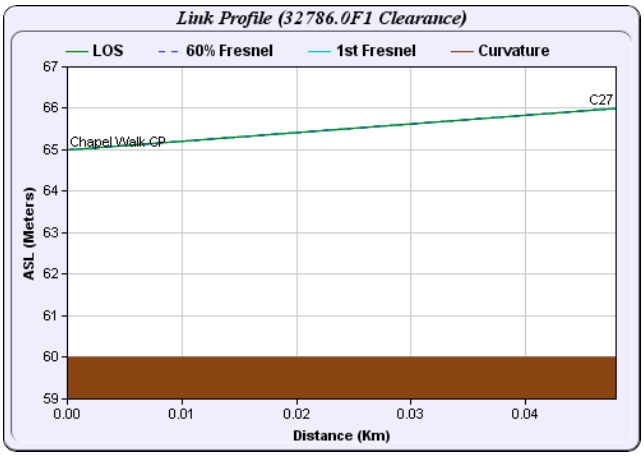
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	40 Mhz	0.153 Km	Dual	43.2 Mbps Agg ,(21.6 Mbps Peak)	54 Mbps	100%	None	E



Properties	*C3*	*C4*
Height above Sea	72 m	70 m
Antenna Height	6 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-40.8 dBm	-40.8 dBm
Fade Margin	42.2 dB	42.2 dB
Azimuth	315.5°	135.5°
Elevation	-0.3°	0.3°
HSS	INU	HSC

LINK: CHAPEL WALK CP_C27

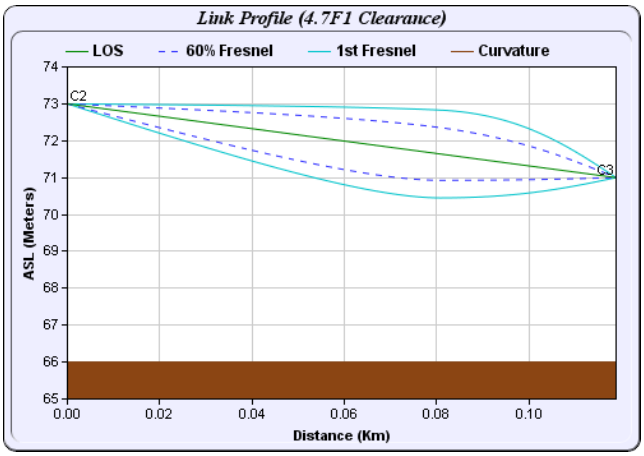
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	10 Mhz	0.048 Km	Dual	9 Mbps Agg ,(4.5 Mbps Peak)	13 Mbps	100%	None	E



Properties	*Chapel Walk CP*	*C27*
Height above Sea	65 m	66 m
Antenna Height	5 m	6 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/B/F54/ETSI/INT	RW2000/ODU/B/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	1 dBm	1 dBm
EIRP	27 dBm	27 dBm
RSSI	-33.7 dBm	-33.7 dBm
Fade Margin	55.3 dB	55.3 dB
Azimuth	45.3°	225.3°
Elevation	1.3°	-1.3°
HSS	INU	INU

LINK: C2_C3

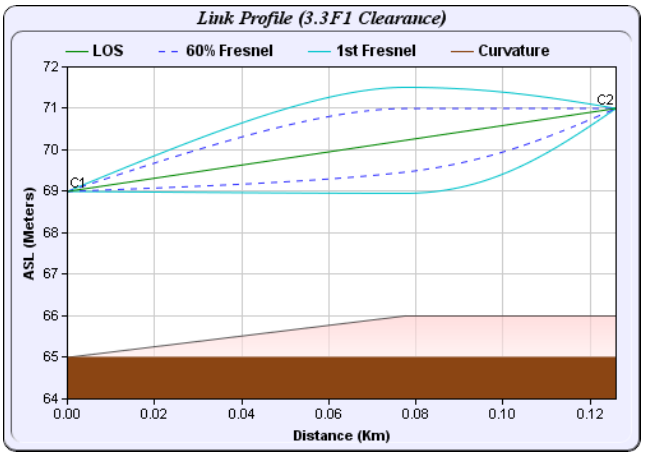
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	40 Mhz	0.119 Km	Dual	63.9 Mbps Agg ,(31.9 Mbps Peak)	81 Mbps	100%	None	E



Properties	*C2*	*C3*
Height above Sea	73 m	71 m
Antenna Height	7 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/C/F54/ETSI/INT	RW2000/ODU/C/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-38.6 dBm	-38.6 dBm
Fade Margin	41.4 dB	41.4 dB
Azimuth	334°	154°
Elevation	-0.9°	0.9°
HSS	INU	HSC

LINK: C1_C2

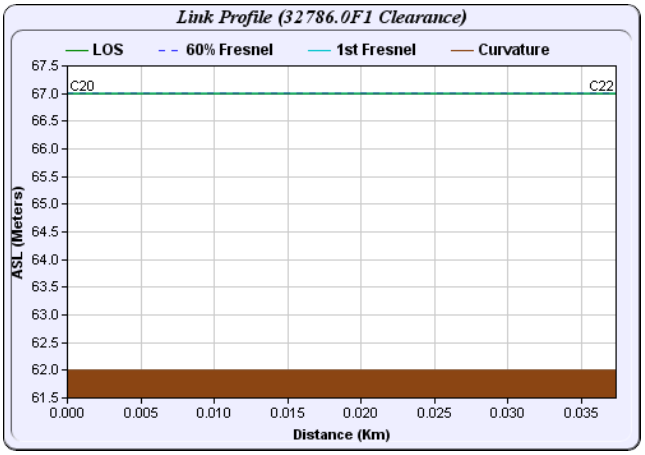
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW2000	40 Mhz	0.126 Km	Dual	85.8 Mbps Agg ,(42.9 Mbps Peak)	108 Mbps	100%	None	E



Properties	*C1*	*C2*
Height above Sea	69 m	71 m
Antenna Height	4 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW2000/ODU/C/F54/ETSI/INT	RW2000/ODU/C/F54/ETSI/INT
Antenna	MT0070760	MT0070760
TX Power	4 dBm	4 dBm
EIRP	30 dBm	30 dBm
RSSI	-39.1 dBm	-39.1 dBm
Fade Margin	38.9 dB	38.9 dB
Azimuth	329.2°	149.2°
Elevation	0.5°	-0.5°
HSS	INU	HSC

LINK: C20_C22

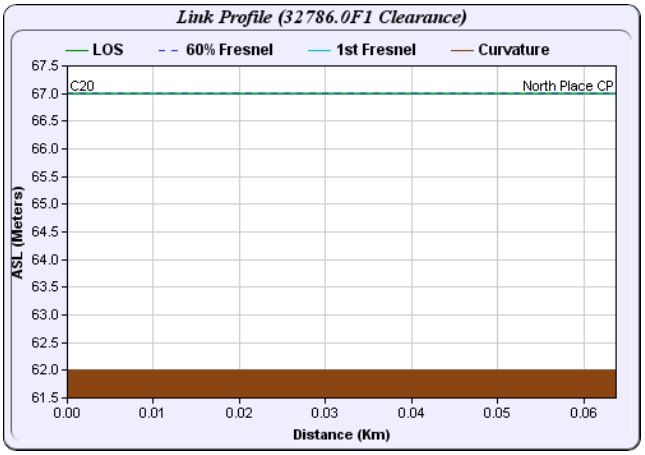
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW5000	40 Mhz	0.037 Km	Dual	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	270 Mbps	100%	None	E



Properties	*C20*	*C22*
Height above Sea	67 m	67 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5001	Embedded Antenna
TX Power	14 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-39.5 dBm	-37.5 dBm
Fade Margin	27.5 dB	26.5 dB
Azimuth	0°	160°
Elevation	0.1°	-0.2°
HSS	HSC	INU

LINK: C20_NORTH PLACE CP

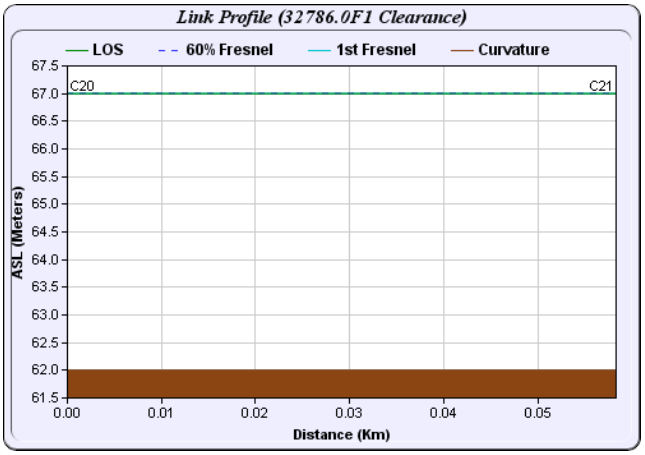
Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW5000	40 Mhz	0.064 Km	Dual	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	270 Mbps	100%	None	E



Properties	*C20*	*North Place CP*
Height above Sea	67 m	67 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5001	Embedded Antenna
TX Power	14 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-42.8 dBm	-40.8 dBm
Fade Margin	24.2 dB	23.2 dB
Azimuth	0°	177.9°
Elevation	0.1°	-0.1°
HSS	HSC	INU

LINK: C20_C21

Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
RW5000	40 Mhz	0.058 Km	Dual	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	270 Mbps	100%	None	E



Properties	*C20*	*C21*
Height above Sea	67 m	67 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5001	Embedded Antenna
TX Power	14 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-43.4 dBm	-41.4 dBm
Fade Margin	23.6 dB	22.6 dB
Azimuth	0°	204.1°
Elevation	0.1°	-0.1°
HSS	HSC	INU

HBSs Summary

HBS: HBS1

Properties

Product	RW5000/HBS/5200/F54/ETSI/EXT
Site Name	Eagle Tower Bld
Frequency (GHz)	None
CBW (MHz)	40
Azimuth (Deg°)	0
Elevation (Deg°)	-3.7
Antenna Beam Width (Deg.)	120
Ratio	50% / 50%
Allocated TS / Total TS	12 / 64
Aggregated Capacity (Mbps)	30.9
BH Link	

HBS1 ‘s HSUs Summary:

HSU Name	TS	HSU Series	Capacity	Distance
C22	1	510	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.037 Km
North Place CP	1	510	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.064 Km
C21	1	510	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.058 Km
C24	1	510	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.116 Km
Portland Street CP	1	510	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.059 Km
C18	1	510	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.148 Km
C17	1	510	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.103 Km
C19	1	510	2 Mbps/2 Mbps DL/UL	0.08 Km

			Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	

HBS: HBS2

Properties

Product	RW5000/HBS/5200/F54/ETSI/EXT
Site Name	CBC Offices
Frequency (GHz)	None
CBW (MHz)	40
Azimuth (Deg°)	0
Elevation (Deg°)	3.8
Antenna Beam Width (Deg.)	90
Ratio	50% / 50%
Allocated TS / Total TS	4 / 64
Aggregated Capacity (Mbps)	14.7
BH Link	

HBS2 ‘s HSUs Summary:

HSU Name	TS	HSU Series	Capacity	Distance
Regents Arcade CP	2	510	3.2 Mbps/3.2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.21 Km
C27	1	510	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.059 Km
C16	1	510	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.075 Km

HBS: HBS1

Properties

Product	RW5000/HBS/5200/F54/ETSI/EXT
Site Name	Eagle Tower Bld
Frequency (GHz)	None
CBW (MHz)	40
Azimuth (Deg°)	0
Elevation (Deg°)	-3.7
Antenna Beam Width (Deg.)	120
Ratio	50% / 50%
Allocated TS / Total TS	12 / 64
Aggregated Capacity (Mbps)	30.9
BH Link	

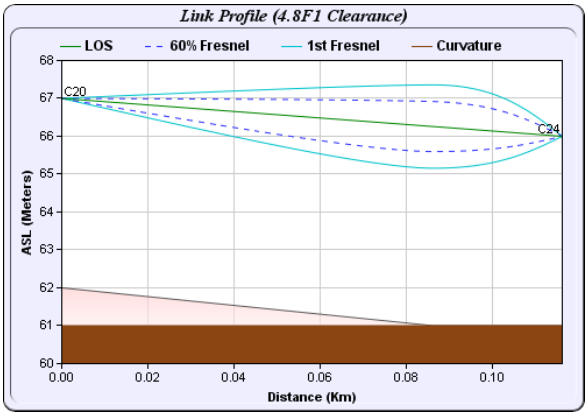
HBS1 ‘s HSUs Summary:

HSU Name	TS	HSU Series	Capacity	Distance
C17	2	510	3.7 Mbps/3.7 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.392 Km
LC1	4	510	2.4 Mbps/2.4 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.489 Km
St James St CP	2	510	3.2 Mbps/3.2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.657 Km
C36	2	510	3.7 Mbps/3.7 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.478 Km
C49	2	510	2.4 Mbps/2.4 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	0.757 Km

P2MP Links

HBS LINK: C20_C24

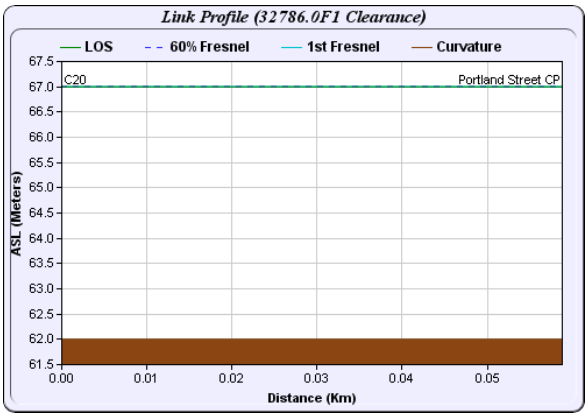
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS3	RW5000	40 Mhz	0.116 Km	Dual	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	270 Mbps	100%	None	E



Properties	*C20*	*C24*
Height above Sea	67 m	66 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5001	Embedded Antenna
TX Power	14 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-49.4 dBm	-47.4 dBm
Fade Margin	17.6 dB	16.6 dB
Azimuth	0°	197.6°
Elevation	0.1°	-0.1°
HSS	HSC	INU

HBS LINK: C20_PORTLAND STREET CP

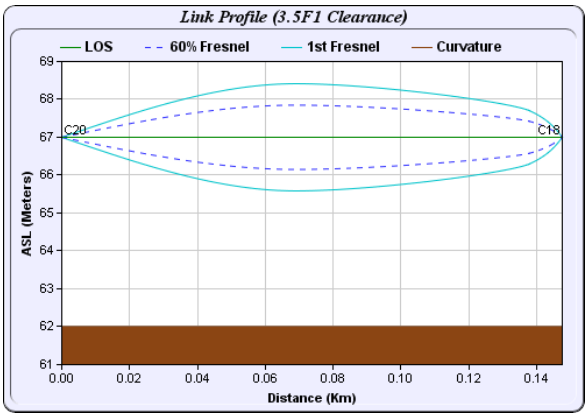
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS3	RW5000	40 Mhz	0.059 Km	Dual	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	270 Mbps	100%	None	E



Properties	*C20*	*Portland Street CP*
Height above Sea	67 m	67 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5001	Embedded Antenna
TX Power	14 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-46.7 dBm	-44.7 dBm
Fade Margin	20.3 dB	19.3 dB
Azimuth	0°	231.7°
Elevation	0.1°	-0.1°
HSS	HSC	INU

HBS LINK: C20_C18

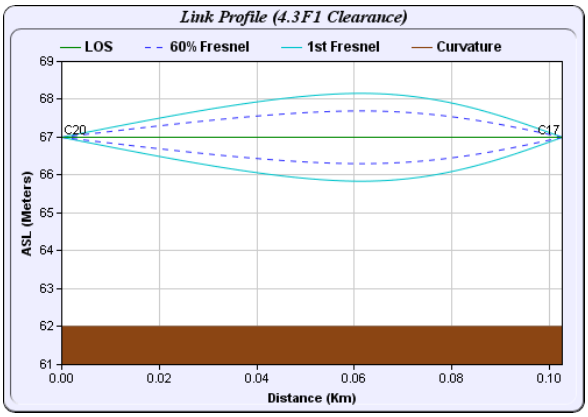
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS3	RW5000	40 Mhz	0.148 Km	Dual	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	270 Mbps	100%	None	E



Properties	*C20*	*C18*
Height above Sea	67 m	67 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5001	Embedded Antenna
TX Power	14 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-53.2 dBm	-51.2 dBm
Fade Margin	13.8 dB	12.8 dB
Azimuth	0°	224.5°
Elevation	0.1°	-0.1°
HSS	HSC	INU

HBS LINK: C20_C17

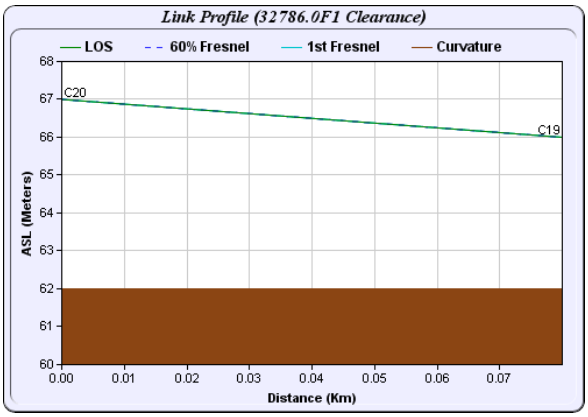
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS3	RW5000	40 Mhz	0.103 Km	Dual	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	270 Mbps	100%	None	E



Properties	*C20*	*C17*
Height above Sea	67 m	67 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5001	Embedded Antenna
TX Power	14 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-52.7 dBm	-50.7 dBm
Fade Margin	14.3 dB	13.3 dB
Azimuth	0°	242.3°
Elevation	0.1°	-0.1°
HSS	HSC	INU

HBS LINK: C20_C19

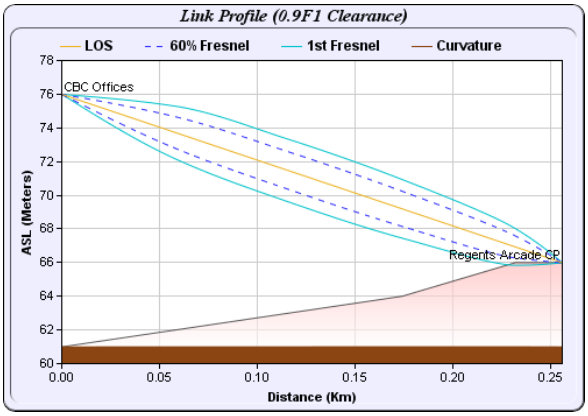
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS3	RW5000	40 Mhz	0.08 Km	Dual	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	270 Mbps	100%	None	E



Properties	*C20*	*C19*
Height above Sea	67 m	66 m
Antenna Height	5 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5001	Embedded Antenna
TX Power	14 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-45.9 dBm	-43.9 dBm
Fade Margin	21.1 dB	20.1 dB
Azimuth	0°	195.3°
Elevation	0.1°	-0.1°
HSS	HSC	INU

HBS LINK: CBC OFFICES_REGENTS ARCADE CP

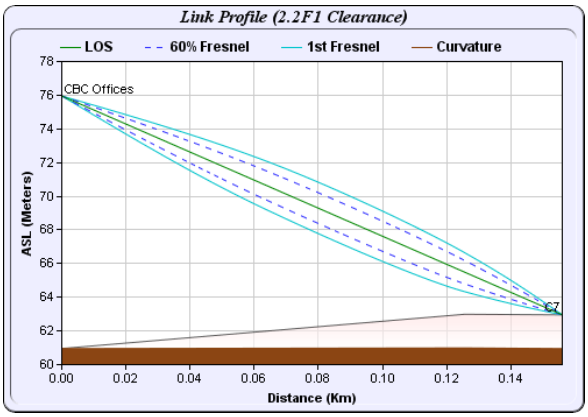
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS2	RW5000	40 Mhz	0.256 Km	Dual	3.2 Mbps/3.2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	216 Mbps	100%	None	E



Properties	*CBC Offices*	*Regents Arcade CP*
Height above Sea	76 m	66 m
Antenna Height	15 m	0 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5001	Embedded Antenna
TX Power	14 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-63.9 dBm	-61.9 dBm
Fade Margin	8.1 dB	7.1 dB
Azimuth	0°	257.9°
Elevation	1.7°	-1.7°
HSS	HSM	INU

HBS LINK: CBC OFFICES_C7

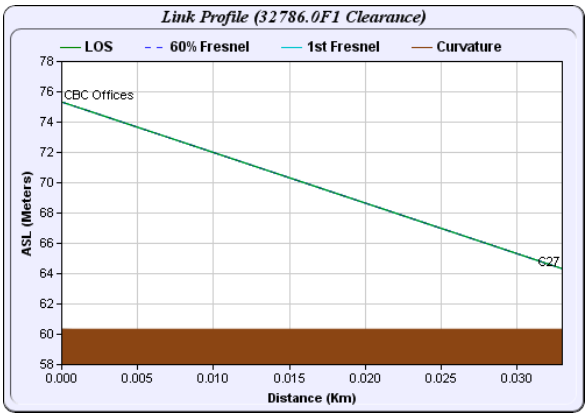
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS2	RW5000	40 Mhz	0.157 Km	Dual	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	270 Mbps	100%	None	E



Properties	*CBC Offices*	*C7*
Height above Sea	76 m	63 m
Antenna Height	15 m	0 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5001	Embedded Antenna
TX Power	14 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-55.8 dBm	-53.8 dBm
Fade Margin	11.2 dB	10.2 dB
Azimuth	0°	238.1°
Elevation	1.7°	-2.7°
HSS	HSM	INU

HBS LINK: CBC OFFICES_C27

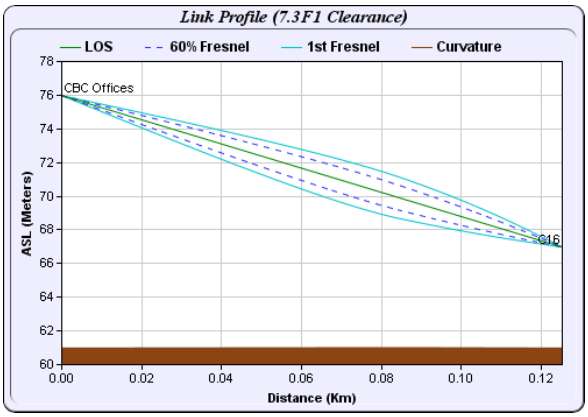
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS2	RW5000	40 Mhz	0.035 Km	Dual	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	270 Mbps	100%	None	E



Properties	*CBC Offices*	*C27*
Height above Sea	76 m	65 m
Antenna Height	15 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5001	Embedded Antenna
TX Power	14 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-39 dBm	-37 dBm
Fade Margin	28 dB	27 dB
Azimuth	0°	152.5°
Elevation	1.7°	-20.5°
HSS	HSM	INU

HBS LINK: CBC OFFICES_C16

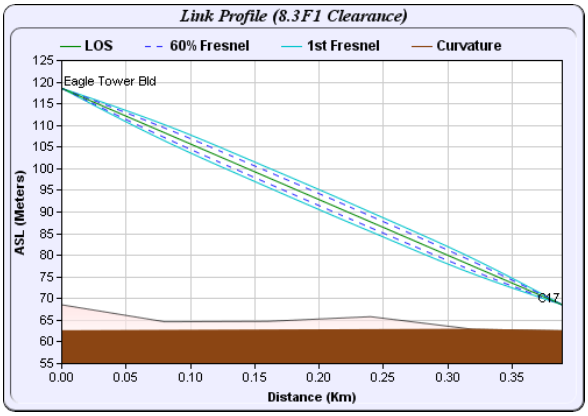
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS2	RW5000	40 Mhz	0.126 Km	Dual	2 Mbps/2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	270 Mbps	100%	None	E



Properties	*CBC Offices*	*C16*
Height above Sea	76 m	67 m
Antenna Height	15 m	6 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5001	Embedded Antenna
TX Power	14 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-50.1 dBm	-48.1 dBm
Fade Margin	16.9 dB	15.9 dB
Azimuth	0°	199.6°
Elevation	1.7°	-6.1°
HSS	HSM	INU

HBS LINK: EAGLE TOWER BLD_C17

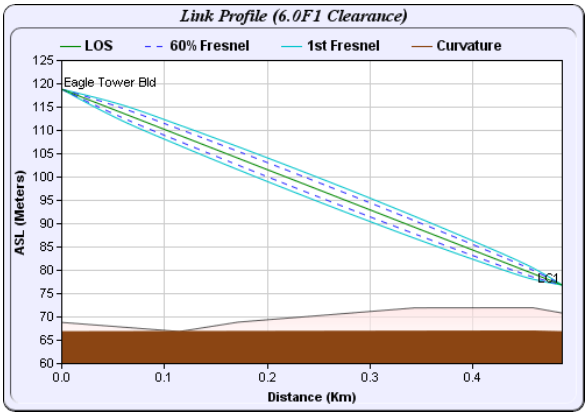
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS1	RW5000	40 Mhz	0.392 Km	Dual	3.7 Mbps/3.7 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	243 Mbps	100%	None	E



Properties	*Eagle Tower Bld*	*C17*
Height above Sea	119 m	69 m
Antenna Height	50 m	6 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5004	Embedded Antenna
TX Power	17 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-61.4 dBm	-56.4 dBm
Fade Margin	8.6 dB	10.6 dB
Azimuth	0°	152.8°
Elevation	-3.7°	9.3°
HSS	HSC	INU

HBS LINK: EAGLE TOWER BLD_LC1

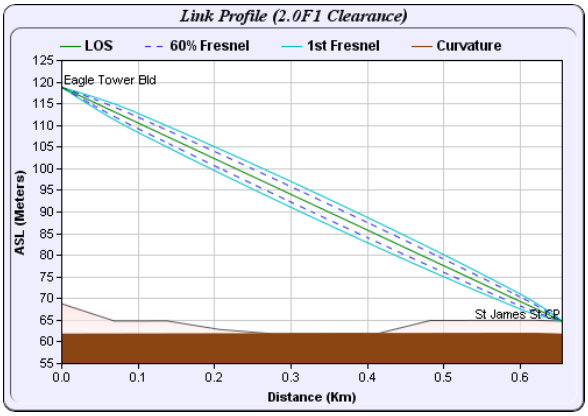
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS1	RW5000	40 Mhz	0.489 Km	Dual	2.4 Mbps/2.4 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	81 Mbps	100%	None	E



Properties	*Eagle Tower Bld*	*LC1*
Height above Sea	119 m	77 m
Antenna Height	50 m	6 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5004	Embedded Antenna
TX Power	17 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-75.8 dBm	-70.8 dBm
Fade Margin	7.2 dB	9.2 dB
Azimuth	0°	94.6°
Elevation	-3.7°	5.2°
HSS	HSC	INU

HBS LINK: EAGLE TOWER BLD_ST JAMES ST CP

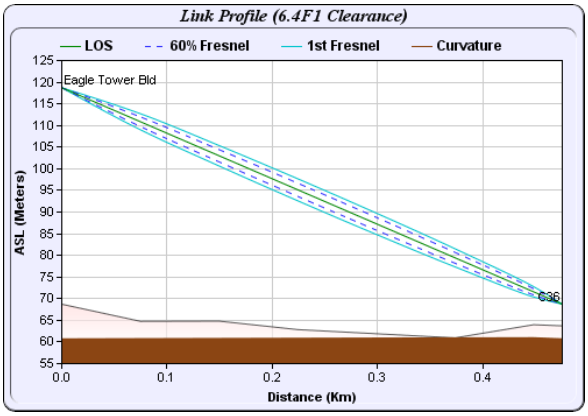
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS1	RW5000	40 Mhz	0.657 Km	Dual	3.2 Mbps/3.2 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	216 Mbps	100%	None	E



Properties	*Eagle Tower Bld*	*St James St CP*
Height above Sea	119 m	65 m
Antenna Height	50 m	0 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5004	Embedded Antenna
TX Power	17 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-65.9 dBm	-60.9 dBm
Fade Margin	6.1 dB	8.1 dB
Azimuth	0°	224.8°
Elevation	-3.7°	4.3°
HSS	HSC	INU

HBS LINK: EAGLE TOWER BLD_C36

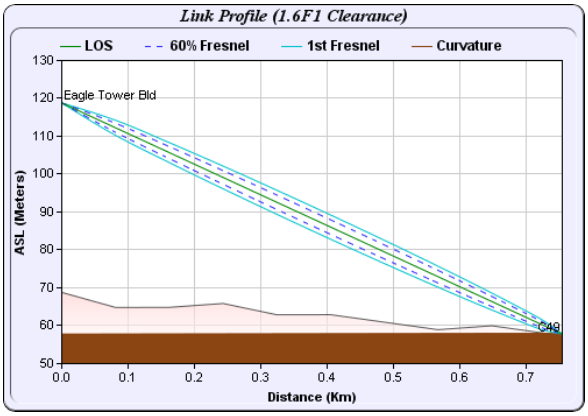
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS1	RW5000	40 Mhz	0.478 Km	Dual	3.7 Mbps/3.7 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	243 Mbps	100%	None	E



Properties	*Eagle Tower Bld*	*C36*
Height above Sea	119 m	69 m
Antenna Height	50 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5004	Embedded Antenna
TX Power	17 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-63.1 dBm	-58.1 dBm
Fade Margin	6.9 dB	8.9 dB
Azimuth	0°	215°
Elevation	-3.7°	5.3°
HSS	HSC	INU

HBS LINK: EAGLE TOWER BLD_C49

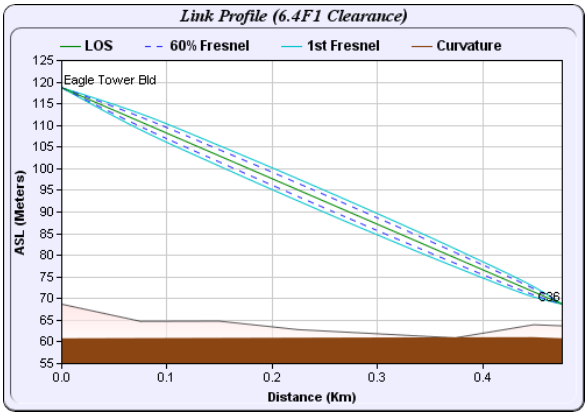
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS1	RW5000	40 Mhz	0.757 Km	Dual	2.4 Mbps/2.4 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	162 Mbps	100%	None	E



Properties	*Eagle Tower Bld*	*C49*
Height above Sea	119 m	58 m
Antenna Height	50 m	0 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5004	Embedded Antenna
TX Power	17 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-67.1 dBm	-62.1 dBm
Fade Margin	9.9 dB	11.9 dB
Azimuth	0°	154.3°
Elevation	-3.7°	3.7°
HSS	HSC	INU

HBS LINK: EAGLE TOWER BLD_C36

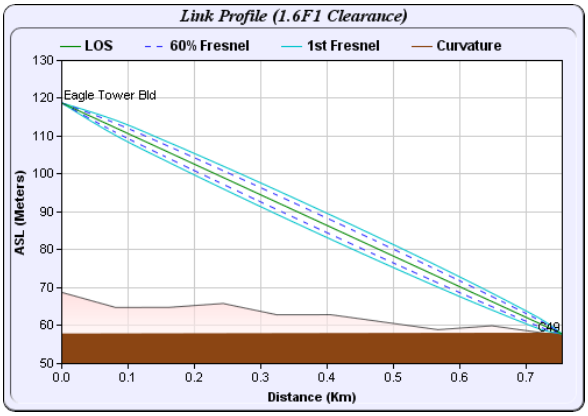
HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS3	RW5000	40 Mhz	0.478 Km	Dual	3.7 Mbps/3.7 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	243 Mbps	100%	None	E



Properties	*Eagle Tower Bld*	*C36*
Height above Sea	119 m	69 m
Antenna Height	50 m	5 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5004	Embedded Antenna
TX Power	17 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-63.1 dBm	-58.1 dBm
Fade Margin	6.9 dB	8.9 dB
Azimuth	0°	215°
Elevation	-3.7°	5.3°
HSS	HSC	INU

HBS LINK: EAGLE TOWER BLD_C49

HBS Name	Family	CBW	Distance	Polar	Services	Rate	Availability	Frequency	RFP
HBS2	RW5000	40 Mhz	0.757 Km	Dual	2.4 Mbps/2.4 Mbps DL/UL Assured ,(10 Mbps/10 Mbps DL/UL DBA Peak)	162 Mbps	100%	None	E



Properties	*Eagle Tower Bld*	*C49*
Height above Sea	119 m	58 m
Antenna Height	50 m	0 m
Regulation	5.4 GHz ETSI	5.4 GHz ETSI
Product ID	RW5000/HBS/5200/F54/ETSI/EXT	RW5000/HSU/5510/F54/ETSI/EMB
Antenna	RW-9061-5004	Embedded Antenna
TX Power	17 dBm	12 dBm
EIRP	30 dBm	30 dBm
RSSI	-67.1 dBm	-62.1 dBm
Fade Margin	9.9 dB	11.9 dB
Azimuth	0°	154.3°
Elevation	-3.7°	3.7°
HSS	HSC	INU