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Flexi Zone Indoor Pico BTS Product Description

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Summary of changes

Changes between document issues are cumulative. Therefore, the latest document issue contains all changes made to previous issues.

This document is common for all Radio Access Technologies (RAT). You may find here information about solutions that are not available or supported in a specific SW release or RAT. Table RAT releases covered by the document lists all SW releases covered by the content of this document. For features supported in your SW release, see respective feature documentation chapter in the system library.

Table 1 Releases covered by the document

Product	Release
Long Term Evolution	RL70, FDD-LTE 15A, FDD-LTE 16
TD LTE	RL55TD, TDD-LTE 15A, TDD-LTE 16
WCDMA	WCDMA15FZ

Changes between issues 05 (2015-10-09) and 06 (2015-12-04)

Flexi Zone Indoor Pico BTS Specifications

- *Flexi Zone Indoor Pico BTS Specifications* table has been updated.

GPS / GLONASS

- Information on puck-style GPS/GLONASS antenna has been updated.

Changes between issues 04 (2015-09-09) and 05 (2015-11-23)

Flexi Zone Indoor Pico BTS Specifications

- Information about IP rating has been added.

PoE++ solution

- Information about simultaneous PoE and DC inputs support has been added.
- Information about Universal Power over Ethernet (UPOE) support has been added.

Air interface configuration

- *WCDMA Air Interface power parameters settings* table has been added.

Changes between issues 03 (2015-06-25) and 04 (2015-09-09)

Introduction to Flexi Zone Indoor Pico BTS

- Information on WCDMA supported bandwidth has been updated.

Benefits

- Information on Flexi Zone Indoor Pico BTS weight has been updated.
- Information on a power supply has been updated.

Flexi Zone Indoor Pico BTS Specifications

- *Flexi Zone Indoor Pico BTS Specifications* table has been updated.

PoE++ solution

- *Multi-port injector* figure has been updated.

Installation options

- A minimum clearance information has been added.

Supported bandwidth

- *Flexi Zone Pico Indoor BTS supported LTE bandwidth variants* table has been updated.

Diversity

- WCDMA 2-way receiver diversity support had been removed.
- WCDMA 2-way transmitter diversity support had been added.

External RF Antennas

- *Maximum Personal Exposure (MPE)* section has been updated.

GPS / GLONASS

- *GPS/GLONASS* section has been added.

Flexi Zone Indoor Pico Wi-Fi solution

- Information on integrated Wi-Fi solution has been added.

Wi-Fi coverage

- Additional information on TDD band 40 variants has been added.

1 Introduction to Flexi Zone Indoor Pico BTS

The Flexi Zone Indoor Pico BTS (FZP) is a small cell optimized for an indoor environment. The FZP provides seamless mobility and enhanced user experience in enterprise and public indoor locations by cost effectively improving the coverage and capacity of the network, delivering the best subscriber mobile broadband experience.

The main application of this BTS is to deliver an improved mobile broadband experience by offloading data traffic from macro networks. Thanks to its small size and a fanless solution, the FZP can be easily and quickly deployed in strategic locations to add coverage and capacity. The FZP features a compact single enclosure.

The Flexi Zone Pico is a fully compliant 3GPP solution and supports standard network interfaces to other network elements, such as S1 and X2 in LTE and Iub interface towards a controller in WCDMA. It allows the use of the same software as used in macro base stations and can easily integrate into Heterogeneous Networks (HetNets).

The hardware platform supports full throughput capability of 5 (only FDD), 10, 15, or 20 MHz LTE carriers with 2x2 MIMO (LTE main and diversity transmit). The BTS of the WCDMA version supports 20 MHz bandwidth with 5 MHz 2Tx2Rx carriers as well as Virtual Antenna Mapping solution. The physical transport interface is optimized for IP-based transport solutions. The FZP supports varying transmit power up to 250 mW per antenna branch. Nokia also offers a WiFi solution, which includes the Ruckus WiFi module that is integrated within the FZP.

Figure 1 Flexi Zone Indoor Pico BTS

2 Benefits

Flexi Zone Pico Indoor BTS (FZP) provides a vast number of benefits for the operator.

Ease of deployment

The FZP offers new site deployment possibilities thanks to its compact size and light weight (< 2.5 kg (< 5.51 lb.)), which makes it easy and fast to deploy. It can be used in existing buildings using Ethernet cabling for backhaul that significantly lower the costs in comparison to traditional systems. The FZP can be powered via a PoE++ based solution reducing complexity, cost of ownership and lead to faster deployments. In LTE, FZP supports fully automated "Plug-and-play" configuration crucial to reduce network implementation and operational costs in heterogeneous networks. The FZP can be powered by a AC power supply (optional item). The FZP incurs lower installation cost as it can be deployed by a single person while reducing running costs due to its low power consumption yet high capacity delivery.

Flexibility in installation

The FZP is specially designed to be installed onto walls, horizontal poles, vertical poles or ceilings, which makes in the perfect BTS for indoor coverage. Refer to Installation options for more details on installation scenarios.

Macro Capacity and Full Macro Parity

The FZP seamlessly integrates into existing networks by connecting to the same core and legacy Nokia O&M solution. The Software load running on FZP is the same as on Nokia Macro base stations. This solution offers a similar user experience for outdoor and indoor subscribers. Most features available for macro cells are also available for Flexi Zone Indoor Pico cells, including easy software upgrades to LTE-Advanced (LTE models) and support by the same NetAct Operations and Support System (OSS) as well as iSON.

Multiradio Access / Multi Technology

The FZP supports both LTE/WCDMA and Wi-Fi access (optional). The module is integrated within a single compact small form factor allowing for reduced number of boxes and shared devices. WCDMA FZP can be upgradable to an LTE variant via a software upgrade, using RFSTool. No new or additional hardware is required.

Low acoustic noise

Flexi Zone Pico Indoor BTS uses passive cooling.

Easy commissioning

Flexi Zone Pico indoor BTS supports wizard-based commissioning via the BTS Site Manager. The configuration can be saved to a file which can be used later as a template.

In LTE, auto-connection and auto-configuration are supported as in Flexi Multiradio BTS or Flexi Multiradio 10 BTS. In WCDMA, auto-connection is supported as in Flexi Multiradio BTS or Flexi Multiradio 10 BTS.

Software features

Flexi Zone Indoor Pico BTS reuses the Flexi Macro BTS SW enabling support for relevant features.

3 Flexi Zone Indoor Pico BTS Specifications

This topic describes Flexi Zone Indoor Pico BTS (both WCDMA and LTE) specifications, such as supported technologies, physical parameters or Wi-Fi information.

Table 2 Flexi Zone Indoor Pico BTS Specifications

Parameter	LTE and LTE + Wi-Fi variant	3G and 3G + Wi-Fi variant
3GPP RAT Support	One LTE band	One WCDMA band (software upgradable to LTE via RFSTool)
Bandwidth Supported	5, 10, 15, 20 MHz software selectable	HW support up to four consecutive 5 MHz carriers [1]
3GPP RAT and Wi-Fi Antenna Configuration	Integrated 2x2 MIMO or external antenna configuration (external antennas are not included in the base package)	
Power Output	50 mW to 250 mW per Tx branch	50 mW to 250 mW (500 mW with Virtual Antenna Mapping)
Users	Up to 400 simultaneous active subscribers	72 CE/50 HSPA users
Wi-Fi support	Via fully integrated optional Wi-Fi module	
Wi-Fi Radio/Access	5 GHz: 802.11 ac/n/a 2.4 GHz: 802.11 b/g/n	
Wi-Fi Power Output	23 dBm for 2.4 GHz 21 dBm for 5.0 GHz	
Volume / Mass	LTE (or 3G) only : Volume 2.8 L, Weight: 1.9 kg (without ceiling clip) LTE + Wi-Fi (or 3G + Wi-Fi) : Volume 2.8 L, Weight: 2.2 kg (without ceiling clip)	
Environmental Operating Temperature	0ºC to 40ºC (32ºF to 104ºF)	
Power Input	PoE++, DC input via external AC power supply adapter (optional)	
Synchronization	1588v2 / GPS (GLONASS only in LTE) / Sync-E	
Backhaul	100/1000 Base-T Copper	
Mounting	Wall / Ceiling / Pole	
Remote Local Access	Integrated Bluetooth Access[2] or LMT Port 2 on Backhaul	
1) Functionality applicable only to the future releases. 2) Supported only in LTE. Refer to Software release roadmap for feature availability.		

Note: Flexi Zone Indoor Pico BTS is rated at IP20.

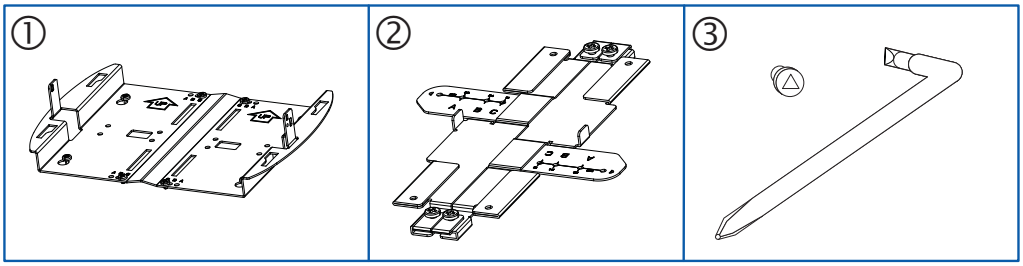
4 Construction

Flexi Zone Indoor Pico BTS consists of the following parts:

- **Core base station module**
  The core module integrates the following items into one single unit:
  - RF
  - baseband functionality
  - clock and control
  - external interfaces
  - transmission

  Some variants also contain an integrated Wi-Fi antenna that enables Flexi Zone Indoor Pico BTS to function as a wireless Access Point (AP).
- **Base station contents of delivery**
  1. Mounting Bracket
  2. Ceiling clip with screws
  3. Tamper-resistant screw and a magnetized wrench
  4. Quick start guide

  Figure 2 Contents of delivery



- **Base station ancillary options (not included in the box)**
  - power adapter with power cable
  - remote RF GPS antenna
  - external antenna (only for models without internal antenna)
  - PoE-++ power injector

4.1 Interfaces

This chapter describes interfaces of the Flexi Zone Pico module.

Flexi Zone Indoor Pico module connection panel differs between modules with and without external antenna connectors as shown in Figure 3: Flexi Zone Indoor Pico module interfaces (with external antenna connectors) and Figure 4: Flexi Zone Indoor Pico module interfaces (without external antenna connectors).

Figure 3 Flexi Zone Indoor Pico module interfaces (with external antenna connectors)

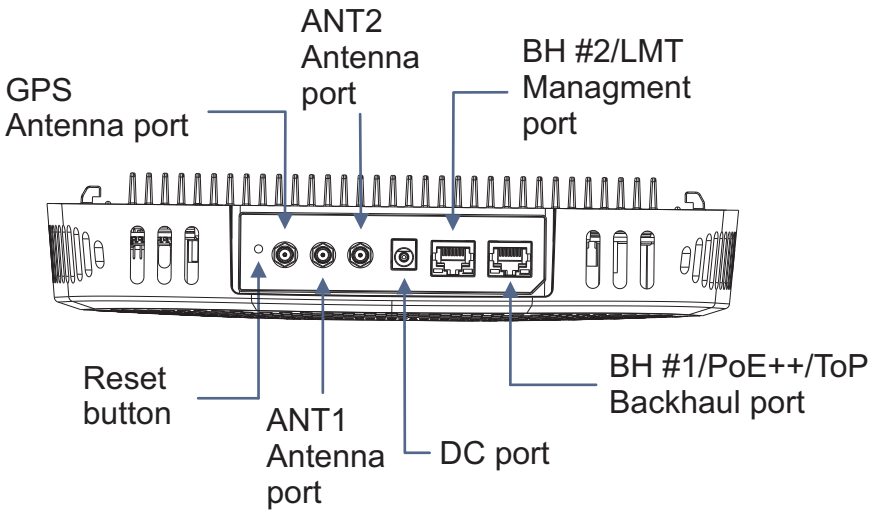
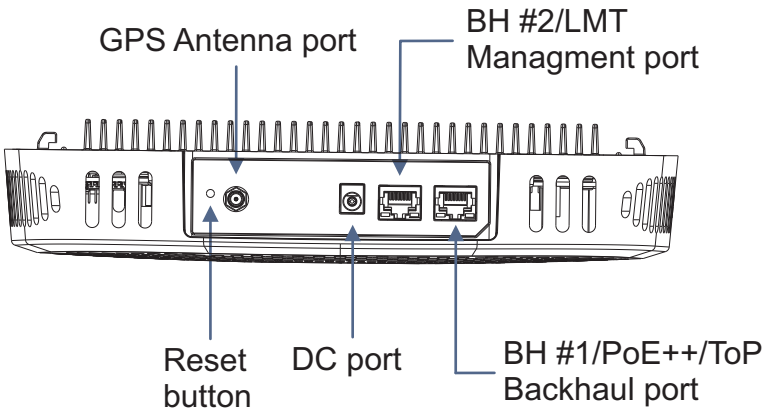


Figure 4 Flexi Zone Indoor Pico module interfaces (without external antenna connectors)



Note: See Table 3: Interfaces description for information about differences between modules.

Table 3 Interfaces description

Interface	Connector type	Description
BH #1/PoE/ToP Backhaul port	RJ45	Primary Backhaul Port PoE Input ToP (1588v2) Sync Input
BH #2/LMT Management port	RJ45	Local BTS Management Port
DC port	3.5 mm barrel connector	DC in power supply
GPS antenna port	SMA Female	GPS antenna signal receive

Table 3 Interfaces description (Cont.)

Interface	Connector type	Description
ANT1 and ANT2 antenna ports	SMA Female	External antennas (LTE/WCDMA) signal transmit and receive[1]
1) Available only with the external antenna SKU option.		

4.2 Reset button

The reset button is placed on the connection panel of the Flexi Zone Indoor Pico module. There are two functions of the reset button:

- A momentary push of the button will result in a hard reset of the device (similar to power up restart)
- Pressing and holding the button for more than 5 seconds will trigger the in factory default reset

4.3 PoE++ solution

Flexi Zone Indoor Pico modules support Power-over-Ethernet Evolution (PoE++) technology to supply the unit with power. The PoE solution allows electrical power to pass along with data on Ethernet cabling.

Note: The Pico can support simultaneous PoE and DC inputs. The PoE input has precedence over the DC input.

PoE++ offers several benefits to the user, including:

- **Cost savings** - PoE++ significantly reduces the number of electrical wiring and outlets that have to be installed inside the building
- **Easy installation** - there is no need to search for a secure place to mount the AC/DC adapter on a wall or a ceiling
- **Flexibility** - it is easy to relocate the Pico module in order to find an optimal RF and WiFi reception

The PoE++ parameters are listed in the table Table 4: PoE++ specification.

Table 4 PoE++ specification

Parameter	Value(s)
Power sourcing equipment (PSE)* output power	60 W
Power at powered device (PD)*	51 W
Voltage range at PSE*	50 - 57 VDC

Table 4 PoE++ specification (Cont.)

Parameter	Value(s)
Voltage range at PD*	42,5 - 57 VDC
Maximum current	1200 mA total, 300 mA/pair
Maximum cable resistance	25 Ohms per loop
CAT cable types	Cat 5e/6
Maximum cable length	100 m
Quantity of conductors used	4 pairs / 8 wires

* - PSE refers to a PoE-enabled network switch or a midspan power injector and PD means FZ Indoor Pico Module

Power injectors can either be individual or multi-port, as shown in Figure 5: One-port injector and Figure 6: Multi-port injector.

Figure 5 One-port injector

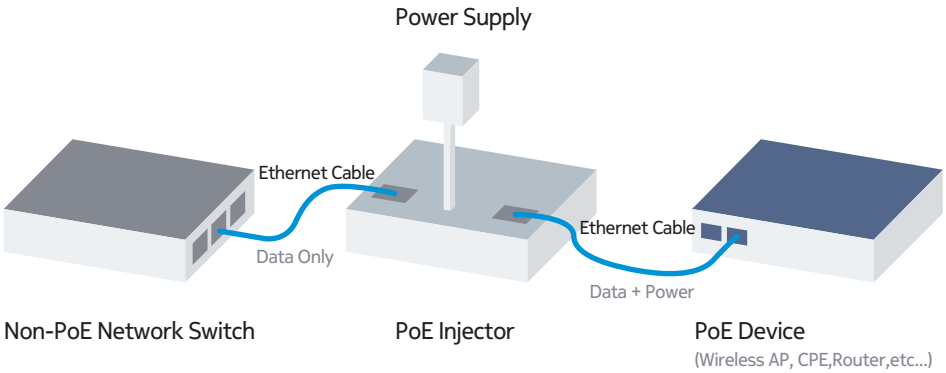
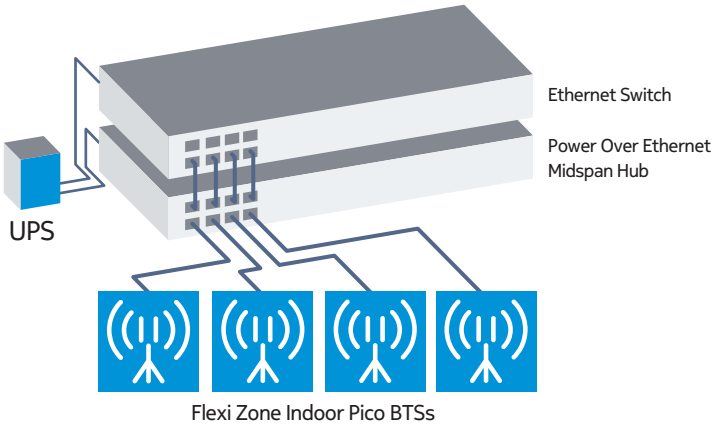


Figure 6 Multi-port injector



Nokia products **require** power injectors that support a 12.5K Ohm detection resistor and provide a power output of 60W per port in a 4PPoE implementation.

Nokia recommended midspan devices are listed in the table.

Table 5 Nokia recommended midspan devices

Manufacturer	Model	Number of ports
Micro-semi	PD-9606G/ACDC/M-NK	6
Micro-semi	PD-9612G/ACDC/M-NK	12
Micro-semi	PD-9501GR/AC-NK	1
Phihong	POE480U-4UP	4
Phihong	POE480U-8UP	8
Phihong	POE75U-1UP	1

For more information and specifications, check the manufacturers' websites.

Note: Non-standard PoE implementation called Universal Power over Ethernet (UPOE) is not supported.

4.4 Installation options

This chapter describes Flexi Zone Indoor Pico BTS possible installation scenarios, which are wall, pole and ceiling installations.

NOTICE: Flexi Zone Indoor Pico BTS equipment must be installed by trained and qualified service personnel in accordance with all local codes and requirements.

NOTICE: Flexi Zone Indoor Pico BTS equipment is intended for installation in restricted access location or equivalent.

NOTICE: The unit may become hot and should be installed away from any potential sources of moisture (away from heating or cooling ducts, doors/window). Ensure good airflow for the unit to allow proper heat dissipation.

NOTICE: The unit should be located away from any RF radiation sources, out of direct sun exposure, and away from a potential salt spray.

NOTICE: Avoid installing the device near windows to avoid external interference.

NOTICE: When installing the mounting bracket onto a vertical pole or a wall ensure the arrows point upwards.

NOTICE: Provide 50 mm (2.0 in.) clearance from all sides of the unit to ensure proper air flow and heat dissipation. Install the unit away from any potential sources of moisture (away from heating or cooling ducts, doors/window).

Note: *OPTIONAL:* Secure the module to the bracket with the tamper-resistant screw and wrench (provided). The screw should be hand-tightened.

Note: Install the cable SMA connectors using the 0.34-057Nm torque.

For wall, pole and ceiling installation instructions refer to the *Flexi Zone Indoor Pico BTS Quick Start Guide*.

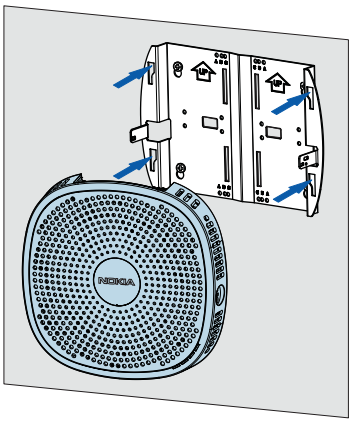
The FZ Pico Indoor module can be installed in three possible ways.

Flexi Zone Indoor Pico wall installation

Note: Use the mounting bracket to install the Flexi Zone Indoor Pico BTS onto a wall.

Note: Since the wall material, thickness and used screws are unknown, Nokia does not specify a type of the torque which has to be used. These details are the responsibility of the installer.

Figure 7 Mounting Flexi Zone Indoor Pico onto a wall



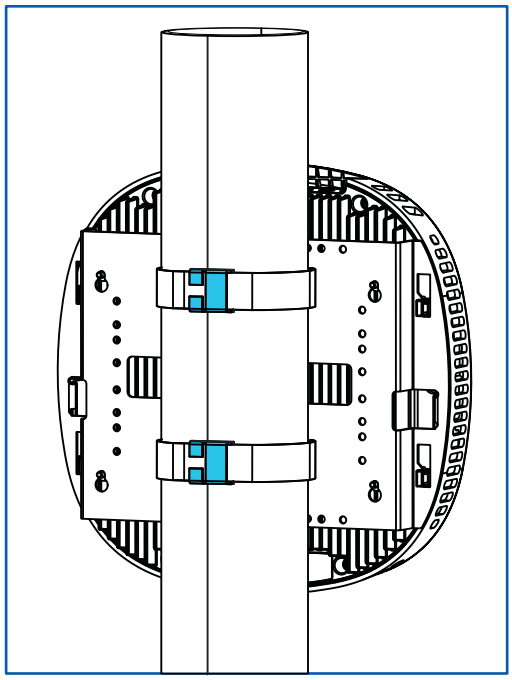
Flexi Zone Indoor Pico pole installation

Note: Flexi Zone Indoor Pico can be mounted onto a vertical or horizontal indoor pole.

Note: Use the mounting bracket delivered in the box and band straps to install the Flexi Zone Indoor Pico BTS onto a pole.

Note: The band straps are not included within the package and need to be ordered separately.

Figure 8 Mounting Flexi Zone Indoor Pico onto a pole



Flexi Zone Indoor Pico ceiling installation

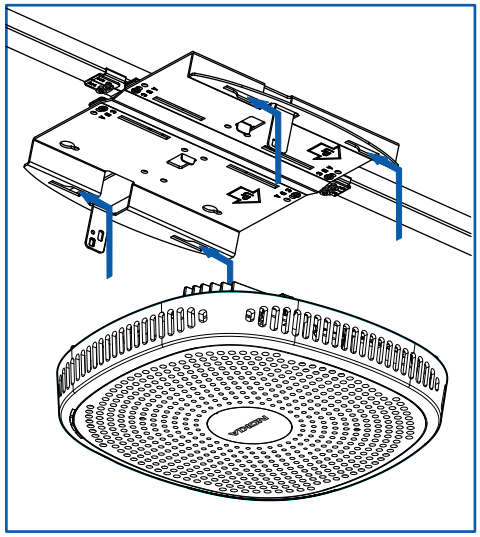
NOTICE: Ensure that the ceiling grid location is well supported.

Note: Use the mounting bracket and the ceiling clip delivered in the box to mount the Flexi Zone Indoor Pico BTS onto a ceiling.

Note: Attach the mounting bracket to the ceiling clip using the supplied M4 (nylok) screws and an approximate torque of 06-07Nm.

Note: Since the ceiling grid material and thickness are unknown, Nokia does not specify a type of the torque which has to be used. These details are the responsibility of the installer.

Figure 9 Mounting Flexi Zone Indoor Pico onto a ceiling



5 Air Interface

5.1 Air interface configuration

The BTS transceiver supports single band 2 Tx and 2 Rx antenna connections with each transmit port supporting a maximum transmission power of 250 mW per antenna branch and operates within a maximum bandwidth window of 20MHz.

A cell created in the OMS Element Manager has default power parameter values for a macro BTS (20W). For Flexi Zone Pico WCDMA these parameters must be adjusted. The parameters for single cell (SC) and dual cell (DC) configurations are listed in the following table:

Table 6 WCDMA Air Interface power parameters settings

Parameter	Object	Default macro value (20W)	Pico SC value	Pico DC value	Remarks
PtxCellMax	WCEL	43	24	21	For Pico SC the maximum power is 2*250 mW/24dBm per cell. For Pico DC the maximum power is 2*125 mW/21dBm per cell. Note that VAM should always be enabled.
PtxMaxHSDPA	WCEL	43	24	21	Typically same as Cell max power.
PtxPrimaryCPICH	WCEL	33	14	11	10% from the maximum as general rule.
PtxDLabsMax	WCEL	37	18	15	37 dBm for 128kbps, 35 dBm for 384kbps
PtxHighHSDPAPwr	WCEL	41	22	19	2 dB below cell max output power.
PtxTarget	WCEL	40	23	20	-
PtxOffset	WCEL	1	0.8	0.8	-
PtxTargetPSMax	WCEL	40	23	20	-
PtxTargetPSMin	WCEL	36	18	15	-
PtxTargetTotMax	WCEL	Disabled	Disabled	Disabled	-
PtxTargetTotMin	WCEL	Disabled	Disabled	Disabled	-

5.2 Supported bandwidth

Flexi Zone Pico Indoor BTS supported LTE bandwidth variants

The LTE supported bandwidth variants are shown in Table 7: Flexi Zone Pico Indoor BTS supported LTE bandwidth variants.

Table 7 Flexi Zone Pico Indoor BTS supported LTE bandwidth variants

Duplex Mode	Operating Band	Uplink (UL) operating band BTS receive UE transmit	Downlink (DL) operating band BTS transmit UE receive	Unit's name	Integrated Wi-Fi	Antenna
		F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}			
FDD	1	1920 MHz - 1980 MHz	2110 MHz - 2170 MHz	FWGI	Yes	Embedded
				FWGJ	No	Embedded
				FWGK	No	External
	2	1850 MHz - 1910 MHz	1930 MHz - 1990 MHz	FWFB	Yes	Embedded
				FWFC	No	Embedded
				FWFD	No	External
				FWFH	Yes	Embedded
	3	1710 MHz - 1785 MHz	1805 MHz - 1880 MHz	FWEC	Yes	Embedded
				FWED	No	Embedded
				FWEE	No	External
	4	1710 MHz - 1755 MHz	2110 MHz - 2155 MHz	FWIC	Yes	Embedded
				FWID	No	Embedded
				FWIE	No	External
				FWIG	Yes	Embedded
	7	2500 MHz - 2570 MHz	2620 MHz - 2690 MHz	FWHG	No	Embedded
				FWHI	No	External
				FWHH	Yes	Embedded
TDD	40	2300 MHz - 2400 MHz		FWNA	Yes	Embedded
				FWNB	No	Embedded
				FWNC	No	External

Flexi Zone Pico Indoor BTS supported WCDMA bandwidth variants

The WCDMA supported bandwidth variants are shown in Table 8: Flexi Zone Pico Indoor BTS supported WCDMA bandwidth variants.

Table 8 Flexi Zone Pico Indoor BTS supported WCDMA bandwidth variants

Operating Band	Uplink (UL) operating band BTS receive UE transmit	Downlink (DL) operating band BTS transmit UE receive	Variant	Integrated Wi-Fi	Antenna
	F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}			
1	1920 MHz - 1980 MHz	2110 MHz - 2170 MHz	FWGL	Yes	Embedded
			FWGM	No	Embedded
			FWGN	No	External
2	1850 MHz - 1910 MHz	1930 MHz - 1990 MHz	FWFE	Yes	Embedded
			FWFF	No	Embedded
			FWFG	No	External
			FWFI	Yes	Embedded

5.3 Diversity

In LTE 2-way receiver diversity is supported. Single receiver configuration is supported by both receivers in case of failure of one of the receivers. Single transmit configuration is supported in case of failure of one of the transmitters or antennas, allowing a transmit mode configuration of Tx Diversity (SIMO).

2-way transmitter diversity with enabled VAM is supported in WCDMA.

5.4 RF Output Power

Transmit power maximum:

- 250 mW + 250mW
- 24 dBm per branch

Transmit power can be configured in different steps from the maximum down to the transmit power defined for a LTE or WCDMA Local Area class:

- 250mW + 250mW
- 24 dBm (supported commissioning values: from 17 dBm to 24 dBm, step of 1 dB)

5.5 External RF Antennas

Pico indoor variants primarily utilize internal antennas. External antennas are also supported but require additional hardware, as the Pico Indoor radio is not supplied with external antennas or antenna mounting.

Guidelines for selecting external antennas

Table 9 Flexi Zone Pico Indoor external antenna requirements / recommendations

Parameter	Requirement / Recommendations
Type	Application specific (primarily ceiling mount is envisioned but any type can be used)
Frequency range	Operating band uplink and downlink frequencies have to be covered for the Pico model used
Polarization	Linear, cross-polarized, or vertical and horizontal
Gain	Application specific (refer to MPE/SAR section)
Beamwidth	Application specific
Return loss	>= 10 dB recommended for best performance
Input power rating	>= 2 W peak, 0.25 W average
Isolation	> 15 dB for Ant 1 and Ant 2 (main to diversity)

Maximum Personal Exposure (MPE)

This equipment complies with EU radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.

Note: Please reference the actual Pico MPE/SAR reports for further details.

Cabling

Connection to the Pico SMA-F requires a SMA-M. Adapter cables are required.

NOTICE: For best performance direct the antenna main beam away from the Pico.

Nokia does not recommend directly attaching rubber-duck stick OMNI antennas directly to the Pico antenna outputs. This is due to the low isolation between the antennas for main and diversity that would result in degrading MIMO performance.

To insure optimal performance, high quality low loss cable should be used while keeping the cable length to a minimum. Excessive cable lengths and low quality cable cause significant performance degradation. Care should be taken to prevent the external cables from causing excessive strain on the SMA connectors of the Pico.

Lightning and surge protection

Flexi Zone Pico does not require surge protection.

Recommended antennas

Nokia does not currently supply external antennas, but some examples for recommended antennas are:

- Galtronics Pear$_{TM}$ M4969i
- Pulse DASLTE500NFMIMO

Both are broadband antennas which requires only one antenna for MIMO.

6 Synchronization

Overview of Flexi Zone Indoor Pico synchronisation mechanisms.

The Flexi Zone Pico Indoor BTS supports the following synchronisation mechanisms:

- Integrated GPS/GLONASS receiver
- Synchronous Ethernet (ITU-T G.8261)
- Timing over Packet according to IEEE 1588v2

6.1 GPS / GLONASS

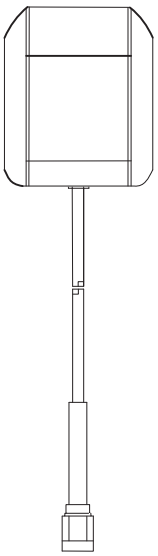
This section provides a brief overview of the GPS followed by a summary of BTS GPS antenna installation requirements and guidelines for optimizing antenna installations.

Instead of using the transport network for carrying the Primary Reference Clock (PRC) traceable synchronization reference, it is possible to use a distributed PRC architecture. In this case, every site in the network has a GPS-based or other synchronization source which provides a PRC traceable synchronization reference signal for RAN NEs. It is also possible to use a combination of distributed and hierarchical master-slave architecture.

In some cases, other Network Elements (for example transmission nodes) at the same site provide the synchronization reference for RAN Network Elements through external synchronization interfaces.

For installations requiring an external PRC signal, it is recommended to use the indoor puck-style GPS/GLONASS antenna included in-box.

Figure 10 Indoor GPS antenna



6.2 Requirements for GPS antenna installation

Scope

The synchronization of the Flexi Zone Pico BTS (FZP) transmissions is primarily provided by a Global Positioning System (GPS) timing receiver. A high degree of reliability can be expected from the BTS GPS timing receiver but the overall receiver performance is heavily dependant on the GPS antenna installation. To realize the expected GPS performance, the GPS antenna installation must meet requirements regarding antenna placement, cabling, lightning protection and interference suppression.

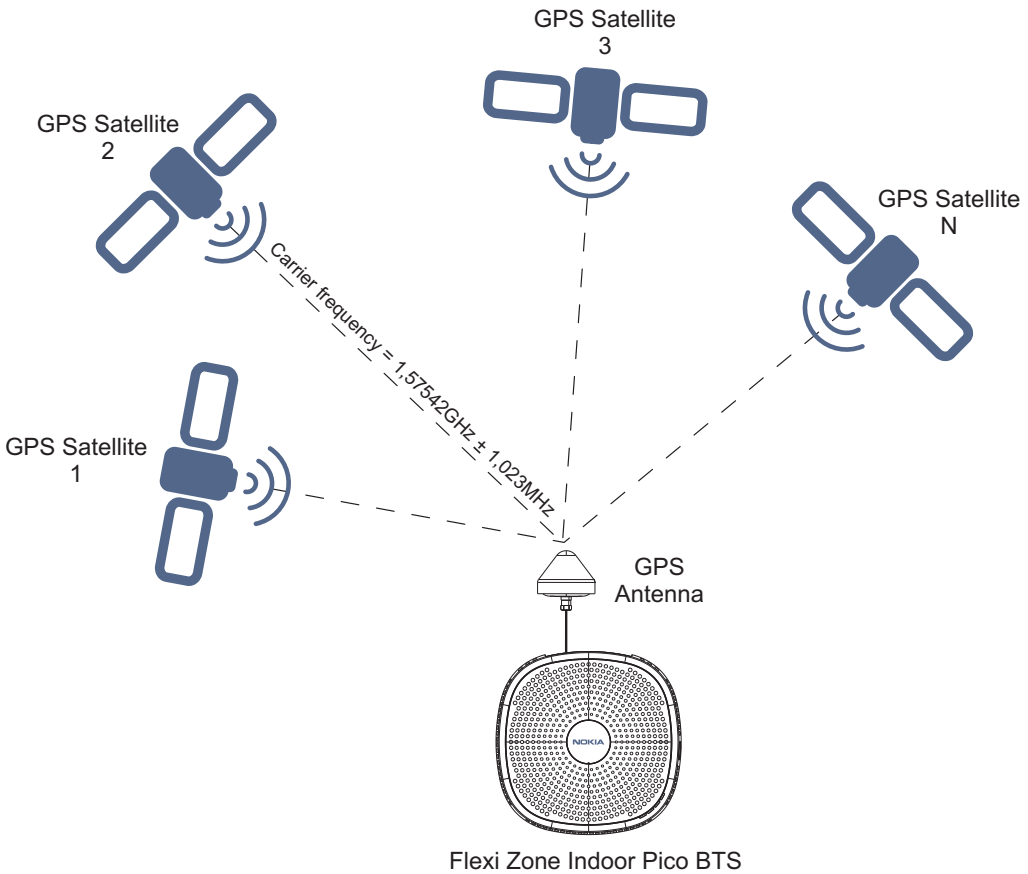
The Global Positioning System

The C/A (Coarse Acquisition) GPS is a space based radionavigation system that provides precise three dimensional (3D) positioning and time of a day information to civilian users.

Satellite Constellation

The GPS is designed to operate with a minimum constellation of 21 operational and three active spare (24 total) satellites. The GPS satellite constellation is organized with six orbital planes each with an inclination of 55° to the equator and an altitude of 20 200 kilometers. GPS satellite orbits are non-geosynchronous and complete one orbit in approximately 12 hours. GPS receiver is exposed to a varying (but predictable) constellation of satellites which are constantly moving across the sky.

Figure 11 Cell site satellite visibility



Minimum four satellites are in view, anywhere on the Earth, with an unobstructed view. Typically six to eight satellites are in view with the current GPS constellation.

GPS RF Carrier

All C/A GPS satellites employ 1.023 MHz wide spread spectrum modulation on a common carrier frequency of 1.57542GHz. GPS transmissions received at the surface of the Earth should have a minimum RF signal strength of -160 dBW.

6.2.1 General antenna positioning requirements

GPS antenna placement is one of the most critical factors in realizing reliable BTS synchronization. The GPS antenna integrated in the FZP allows direct reception of the GPS transmissions when operated in locations with suitable satellite visibility. In cases where the FZP must be operated in a location that does not provide suitable satellite visibility, the GPS antenna can be detached and positioned in a more optimal position using coaxial cable.

Consideration of several (often conflicting) factors is required in determining the optimal GPS antenna position. The GPS antenna position should be chosen to provide a maximum view of the horizon in all directions. However, sacrifices in antenna visibility are often necessary when considering other factors such as RF interference from nearby transmit antennas or potential antenna damage. For example, placement of the GPS antenna atop a cellular tower would likely provide a maximum satellite visibility but also increase the probability of lightning damage or interference from nearby cell site transmit antennas. Changing environmental conditions such as dense foliage or continued tree growth are also an important factors.

In most cases suitable compromises can be made to obtain the necessary GPS satellite visibility and protection of antenna hardware.

Note: For units mounted with the connectors facing up or in extremely dusty environments, it is recommended to cover the unused GPS port.

Required Antenna Visibility

A line of the sight view is required between the GPS antenna and any satellites used in determining a timing solution. Before the GPS receiver can provide accurate timing information, it has to first determine the location of its antenna in 3D space. Information from minimum four satellites is required to determine the 3D antenna location. After the GPS receiver has determined its antenna location, it can continue to provide accurate timing information with as few as one satellite in a view.

Note: The LTE2063: GNSS Manual Location Entry for Flexi Zone feature introduces a Global Navigation Satellite System (GNSS) Manual Location Entry which allows a GNSS phase and time synchronization with connectivity to only one GNSS satellite. The feature is used for BTS site locations that are not optimal for satellite reception.

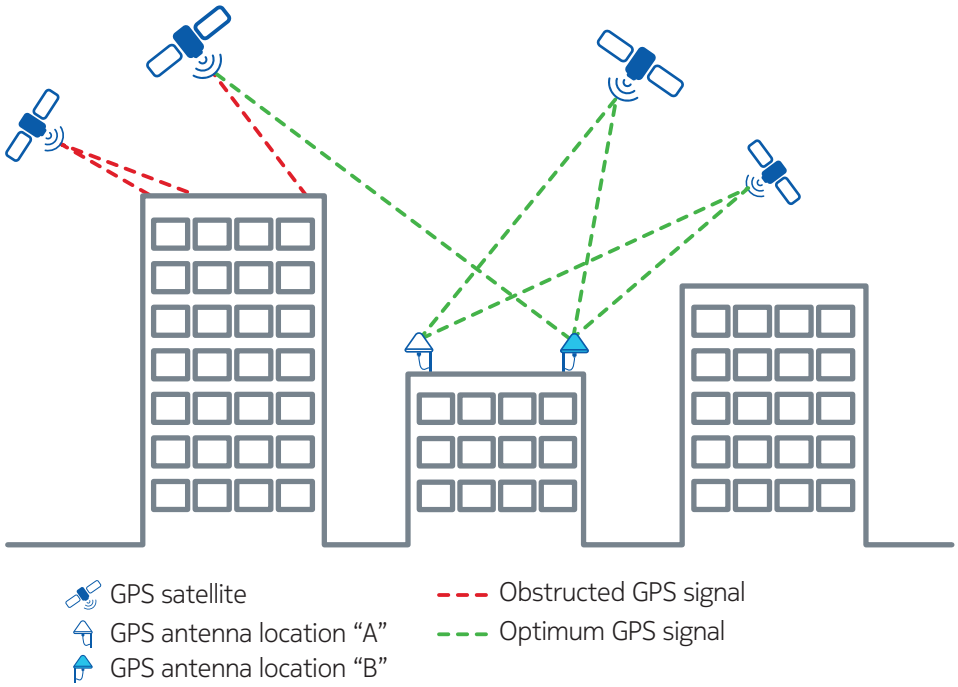
Because GPS satellites operate in non-geosynchronous orbital patterns, the GPS antenna can receive GPS signals from most any direction. The minimum GPS constellation guarantees that minimum four GPS satellites are in a view from any location on the Earth with an unobstructed view to the horizon. Typically, six or more satellites are visible which allows some obstructions of the GPS antenna visibility if necessary.

Antenna Placement Optimization

While the ideal GPS antenna installation provides an unobstructed view in all directions to within 20° of the horizon. Practical limitations of cell site locations allows only for a fraction of the desired visibility. Reductions in GPS antenna visibility can result in

increased BTS initialization times or in reporting numerous alarms from affected BTSs. Even small improvements in visibility can have a large impact on the receiver performance.

Figure 12 Maximizing GPS antenna visibility

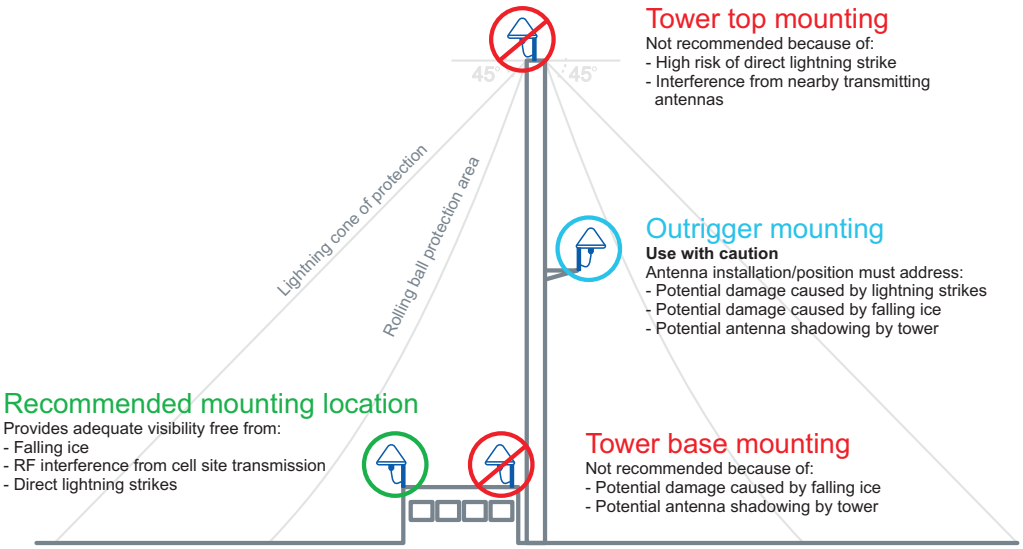


Lightning Protection

The GPS antenna position should be chosen to minimize the damage potential due to a direct or nearby lightning strike. In cell site installations employing an antenna tower, it is recommended to mount the GPS antenna near the tower base (but not where it can be impacted by the falling ice) which acts as a lightning rod. Since higher antenna elevations yield means higher probability of damage due to lightning, the GPS antenna cannot be at or near the highest elevation of its surroundings.

The GPS antenna cabling must be grounded at the cell site master ground point. If the GPS antenna has to be positioned on or close to the cell site tower, the antenna and cabling have to be bonded to the tower to avoid lightning flashover.

Figure 13 GPS antenna placement considerations



Antenna Blockage

It is recommended to:

- choose proper GPS antenna position to minimize debris or snow accumulation on the antenna surface.
- use a conically shaped radome for GPS antennas to minimize the likelihood of blockage due to debris or snow buildup.

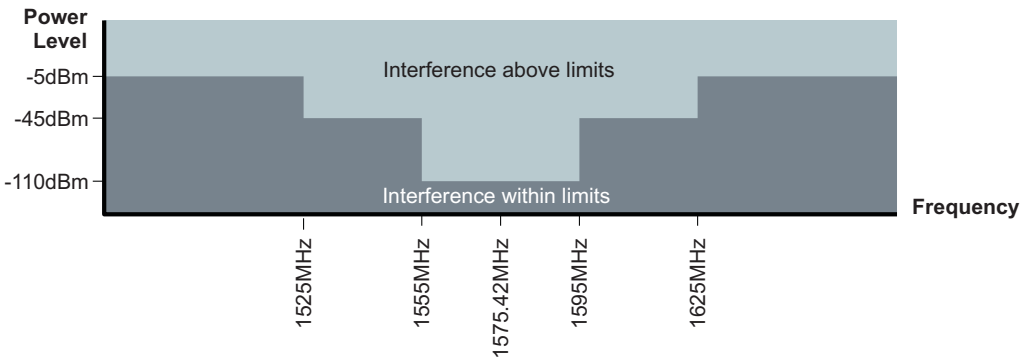
Mounting the GPS antenna on a pole or mast at an elevation above any potential snow or debris buildup is a common solution. Pole or mast mounting also allows temporary ice accumulation to quickly dissipate after sever weather conditions subside.

RF Interface

It is recommended to avoid placing the GPS antenna in the direct radiation path of cellular or other transmit antennas. To minimize interference potential, the GPS antenna has to be positioned at a different elevation and as far as possible from nearby transmit antennas. The graph presented in Figure 14: Maximum GPS receiver interference power level vs. frequency can be used to identify the maximum interference source power levels presented at the GPS antenna surface (assuming that a Nokia recommended GPS antenna is in use and RF signal presented to the GPS receiver meets all level and noise figure requirements).

Different interference rejection performance can be experienced with other (non-Nokia recommended) GPS antenna types or when the GPS receiver is not provided with the required (minimum or maximum) RF signal levels.

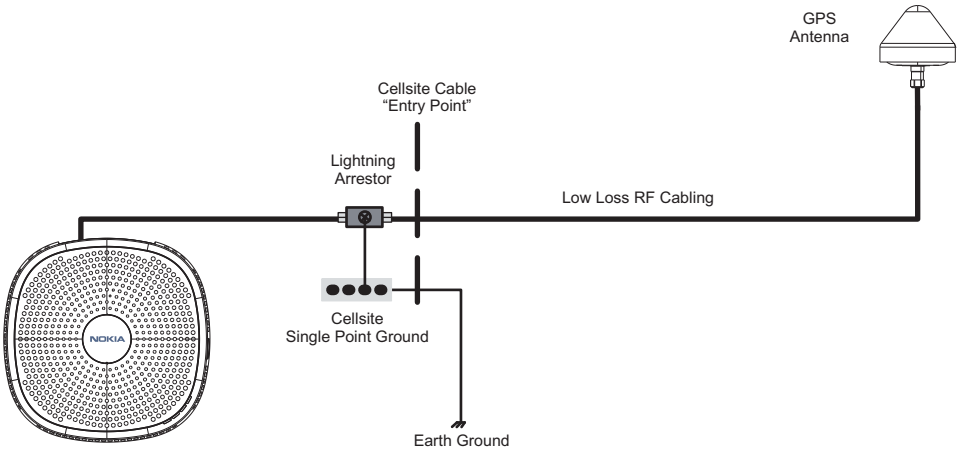
Figure 14 Maximum GPS receiver interference power level vs. frequency



6.2.2 Remotely positioned antenna operation

The Flexi Zone Indoor Pico BTS (FZP) supports direct GPS antenna mounting. Figure 15: Remote RF GPS/GLONASS antenna configuration diagram depicts the connections and hardware where it is necessary to position the GPS antenna separately from the FZP.

Figure 15 Remote RF GPS/GLONASS antenna configuration diagram



Active GPS antenna

The GPS antenna is used to capture and amplify transmissions from multiple GPS satellites in view while providing adequate band signals rejection. The FZP GPS antenna consists of an antenna element, pre-selector filter and Low Noise Amplifier (LNA).

The antenna element must be capable of receiving transmissions from multiple GPS satellites in view throughout their orbit. A suitable GPS antenna has a nearly uniform gain throughout a 360° azimuth and to within 20° above the horizon. Extending antenna gain to elevations of less than 20° offers little benefit in terms of satellite tracking and can make the GPS receiver more vulnerable to terrestrial interference sources.

An active antenna is used to minimize antenna system noise figure and to maximize usable antenna cable lengths. The FZP supplied antenna incorporates an LNA and GPS bandpass filtering. The active antenna LNA is powered by a +4.6VDC ±0.5V bias provided from the FZP through the GPS antenna cabling.

The Nokia recommended GPS / GLONASS antennas have proven quality with good field performance and meet all quality and field performance requirements along with criteria outlined in the table below. While it is possible to use other antennas, considerable care must be exercised when selecting alternatives to ensure full BTS compatibility for all conditions.

Table 10 Recommended GPS / GLONASS Antenna Specifications

	Requirement / Recommendations
Gain	+25 dB (recommended)
Noise Figure	<2.5 dB (recommended)
Operating Frequency	GPS: 1575.42 MHz with less than 3 dB attenuation at a +1.2 MHz offset from center (Required)
	GLONASS: 1602 MHz with less than 3 dB attenuation at a +8 MHz offset from center (Required)
Filtering	>40 dB attenuation at +50 MHz offset from L1 center (Recommended))
LNA Supply Voltage	Operation with a supply voltage of +4.6 VDC +/- 0.25 V (Required)
LNA Supply Current	<30 mA (Required)
Azimuth Coverage	360° (Required)
Elevation Coverage	10° to 90° (Required)
Operating Temperature	0°C to +40°C (Recommended)

RF Cabling

A wide range of coaxial cable types can be used between the GPS antenna and BTS connection. In choosing the GPS antenna cable all RF, physical installation and environmental requirements must be considered. The GPS antenna cable must have a characteristic impedance of 50Ω and must meet the signal loss requirement outlined in GPS Antenna System RF Requirements for the installation length.

The chosen antenna cable must support:

- all installation requirements such as:
  - the minimum cable bend radius
  - operating temperature range
- special insulation requirements such as:
  - ultra-violet light resistance
  - armor jacketing for rodent proofing
  - plenum ratings

Signal loss and minimum bend radius information for commonly used GPS antenna cable types is presented in the table below.

Table 11 Antenna Cable Loss / Bend Radius Data

Cable Type	Loss/length at 1575MHz	Minimum Bend Radius	Cable Diameter
RG-142	0.56 dB/m	51mm	4.95mm

Table 11 Antenna Cable Loss / Bend Radius Data (Cont.)

Cable Type	Loss/length at 1575MHz	Minimum Bend Radius	Cable Diameter
LMR-400	0.17 dB/m	25.4mm	10.3mm
FSJ4-50	0.15 dB/m	32mm	13.2mm
LDF4-50	0.091 dB/m	125mm	16mm

It is recommended to properly terminate and weatherproof all cable connections. Poor cable terminations or weather-proofing can result in the degraded performance over time and eventual failures.

Cable length requirements

The GPS cable length limit depends on multiple factors:

- location of the GPS antenna
- type of the RF GPS cable
- splitters and connectors

Lengths vary based on the above parameters. The parameter, defining proper cable length, is the signal strength at the inputs of the GPS receiver. The signal strength must meet the sensitivity requirements as shown in the table below.

Table 12 GPS sensitivity requirements

Parameter	Action type	Sensitivity
GPS Sensitivity*	Tracking	-161 dBm
	Hot Acquisition	-161 dBm
	Cold Acquisition	-147 dBm
	Reacquisition	-161 dBm

* - Values are valid at room temperature 25^{o} C [77^{o} F]

DC Block

It is not recommended to tie the active GPS antenna ports from multiple FZPs directly to each other. If a distribution is used for GPS, a DC block has to be used to prevent the voltage from being back-fed into the Pico from other Pico units or distribution current sources.

Lightning Arrestor

A surge arrestor always has to be employed at the GPS antenna cable building or outdoor BTS enclosure entry point to protect cell site equipment and for operator safety. The surge arrestor has to be connected to the cell site single point ground using a low impedance conductor. The surge arrestor should have a low insertion loss within the GPS L1 band and must be capable of passing the antenna LNA 5VDC supply voltage. The Polyphaser DGXZ+06NFNF-A surge arrestor is recommended by Nokia due to its low clamping voltage and high surge handling capabilities. The DGXZ+06NFNF-A has the following performance specifications:

Table 13 Lightning arrestor performance specifications

Parameter	Specification
Frequency Range	800MHz to 2500MHz
VSWR	<1.1:1
Insertion Loss	<0.1dB over frequency range
Turn-on Voltage	+6.5V_{DC}
Turn-on Time	4µS for 2kV/µS
Maximum Surge	20kA per IEC 61000-4-5 8/20µS Waveform
Throughput Energy	<175µJ for 3kA, 8/20µS waveform
User Voltage	+6.0V_{DC} MAX
Operating Temperature Range	-50°C to +85°C

GPS Antenna System RF Requirements

To realize optimal GPS receiver performance the total GPS antenna system gain and noise figure at the FZP antenna input must meet the following requirements:

- Total Antenna System Gain (G): +10dB > G > +28.5dB (Within the GPS L1 band (1575.42MHz +1.023MHz)
- Total Antenna System Noise Figure: < 4.0dB

Operation outside of these limits can negatively impact receiver operation. Potential negative impacts include increased cell site initialization times, the intermittent GPS signal reception and a reduction in receiver interference immunity.

Antenna System Gain

The total antenna system gain can be calculated by summing the gains and losses (in decibels) of all antenna system elements using the following equation:

$G = G_{Antenna} + G_{Cable\ 1} + G_{Lightning\ Arrestor} + G_{Cable\ 2}$

As an example the antenna system gain of a hypothetical cell site GPS installation using the following elements (pictured in Figure 16: GPS Antenna Loss Budget / Noise Figure Calculation) is calculated as follows:

$G_{Antenna}$ = +25dB (Antenna)

$G_{Cable\ 1}$ = -7.7dB (50m FSJ4-50 cable (0.15dB/m * 50m + $0.2dB_{connector\ loss}$)

$G_{Lightning\ Arrestor}$ = -0.1dB (Polyphaser DGXZ+06NFNF-A)

$G_{Cable\ 2}$ = -0.65dB (3m FSJ4-50 cable (0.15dB/m * 3m + $0.2dB_{connector\ loss}$)

G = +25dB - 7.7dB -0.1dB -0.65dB

G = 16.55dB

The calculated gain of this hypothetical GPS antenna system is +16.55dB, which is within the required gain range of +10dB to +28.5dB. If the resulting gain were less than +10dB, antenna system modifications (such as using a lower loss cable) to increase the overall gain would be required.

Antenna System Noise Figure

The GPS antenna system noise figure requirement is seldom violated unless a non recommended GPS antenna is used or additional signal amplifiers are employed to compensate for large cable losses. The total antenna system noise figure can be calculated using the following equation:

$$f = f_1 + \frac{f_2 - 1}{g_1} + \frac{f_3 - 1}{g_1 \cdot g_2}$$

Where:

f = the total antenna system noise figure

f_1 = noise figure of stage 1

g_1 = gain of stage 1

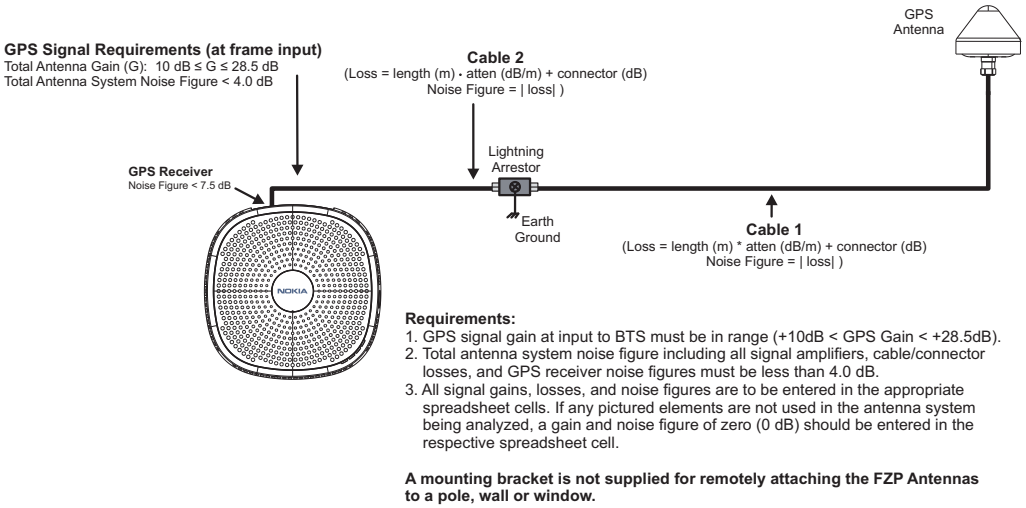
Note: All gain and noise figure values are absolute and not in decibels

The noise figure of the hypothetical GPS antenna system described in GPS Antenna System RF Requirements would be calculated as follows:

$$f = 1.535$$
$$NF(dB) = 10 \cdot Log(f) = 1.86$$

The calculated noise figure of this hypothetical GPS antenna system is 1.86dB which is below the required +4.0dB maximum. Violations in antenna system noise figure can be addressed by using lower loss antenna cabling, using signal amplifiers with lower noise figures and reducing the signal losses prior to any in-line signal amplifiers. Difficulties in satisfying antenna system noise figure requirements are usually caused by using long cable runs.

Figure 16 GPS Antenna Loss Budget / Noise Figure Calculation

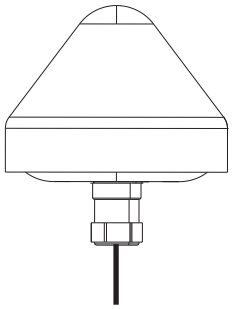


External GPS Antennas

Many different GPS antenna options are available for an outdoor GPS antenna. The guidelines in Table 9: Flexi Zone Pico Indoor external antenna requirements / recommendations also apply to an external GPS/GLONASS receiver. The Flexi Zone Micro GPS/GLONASS antenna (FAWG, 473100A) can suit this purpose. This antenna is

designed to mount directly to the female N connector on the FZM so does not include a cable or mounting feature. A mounting bracket would be needed with a bulkhead female N connector and a long run of cable. The best solution for deployment of a large number of FZPs with remote GPS is a single GPS antenna and a distribution network. Care must be taken to insure the DC block is in place. This DC block can be a separate item or included in the distribution network.

Figure 17 External GPS antenna



Distribution networks

In the case of large indoor deployments of FZP units utilizing GPS/GLONASS it is better to use a single GPS antenna with a distribution network. This equipment is not supplied by Nokia as it is site specific. It can be used to overcome the losses incurred with long cable runs and multiple splits to accommodate separate feeds into each FZP. Care must be taken when selecting the proper distribution amplifier. The key requirements are as follows:

- Active GPS/GLONASS antenna bias: The amplifier must provide 5 VDC for the active antenna.
- Port Impedance: All ports (IN/OUT) must be 50 ohms.
- DC Block: All output ports must supply a DC Block to protect the FZP GPS inputs.

GPS Networking Inc. is one of the vendors that provide this type of equipment which can meet these requirements. Below are some example part numbers:

- 8-Port: AL-DCB-S1X8-N/5/110
- 16-port Rack mount: RMAL-DCB-S1X16-N/5/110
- 32-port Rack mount: RMAL-DCB-S1X32-N/5/110

These models include the DC Block on all output ports, provide the 5 VDC for the active antenna, use N type connections and are powered via 110 VAC. For other AC power options the 110 in the part number above can be replaced with either 220 or 240 depending on the available local power. When using a distribution network, insure that all grounding and surge suppression requirements are followed.

For more information on GPS antenna requirements, see GPS Antenna System RF Requirements

6.3 Synchronous Ethernet and Synchronous Ethernet generation

According to G.8261, Synchronous Ethernet provides a SDH-like mechanism for distributing frequency information at Layer 1. The BTS receives the frequency information from the directly connected (next-hop) Ethernet switch or IP router through the Ethernet link.

SyncE provides a high quality synchronization reference for base stations, comparable to SDH synchronization. The stability of the recovered frequency is independent of the network load or network impairments like delay variations.

In LTE, a co-located or another chained tail site can be synchronized with Synchronous Ethernet generation using SyncE.

Both BTS Synchronous Ethernet and Timing over Packet features can be activated simultaneously. The features can be set individually as primary and secondary synchronization sources. When both SyncE and IEEE1588 ToP are feasible in the priority configuration, the selection of ToP or SyncE as primary or secondary references is a key point in the design of the synchronization network and depends very much on the characteristics of the mobile backhaul network being used to access the BTS.

6.4 Timing over Packet

Timing over Packet (ToP) can be also considered as an example of master-slave architecture. The ToP master sends timing packets to ToP slaves. ToP slaves recover the timing reference from the received timing packets.

The transport network between the ToP Master and the ToP Slave embedded in the BTS must fulfill certain engineering rules to guarantee proper operation of ToP as synchronization source such that the stability of the frequency for the air interface meets 3GPP requirements (+/-50ppb). These engineering rules are related to the treatment of the IEEE1588 ToP packets in the network and SLA values for Packet Loss and Packet Delay Variation.

7 Flexi Zone Pico LED states

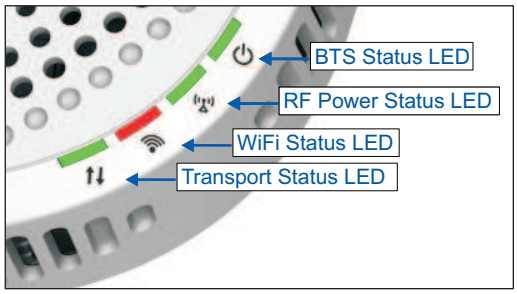
Explanation on Flexi Zone Micro and Flexi Zone Pico modules LED indications.

Additional acronyms explanation:

- TRSW - Transport Software
- POST - Power-On Self-Test
- FPGA - Field Programmable Gate Array
- BTSOM - BTS Operation and Maintenance interface

Flexi Zone Pico LED indicators are shown in the Figure 18: LED indicators.

Figure 18 LED indicators



For descriptions on module LED states, see Table 14: FZM and FZP LED indications.

Table 14 FZM and FZP LED indications

LED	Description	LED Control Owner *	Priority (1 is highest)	Color
Transport Status LED (Controlled by TRSW) NOTE : Transport Status LED depicts the Transport SW States	*Backhaul Link Status*			
	BTS is booting up, and the Platform SW is starting up. LED is being controlled by HW.	HW	1	OFF
	In the startup sequence, the Platform SW is up and it has taken the control of LED. This state continues until the TRSW become operational	Platform SW	1	Stable RED

Table 14 FZM and FZP LED indications (Cont.)

LED	Description	LED Control Owner *	Priority (1 is highest)	Color
	following Site Power-Up or Site Reset. Includes POST (in case of a power on scenario)			
	TRSW has taken control of Transport Status LED and is Initializing *or* Critical or Major Fault raised on TRSW	TRSW	2	Stable RED
	Critical or Major Fault raised on TRSW AND Bluetooth is ENABLED automatically	TRSW	2	Stable YELLOW
	MINOR or Degraded alarm exists on TRSW	TRSW	3	Blinking RED
	TRSW is ready (fully initialized) - No known Critical/Major/Degraded/Minor Transport faults present.	TRSW	4	Stable GREEN
RF Power Status LED (Controlled by HW)	*RF Transmission Status*			
	BTS is booting up, and the Platform SW is starting up. LED is being controlled by HW.	HW	1	OFF
	Platform SW has come up successfully.	Platform SW	1	OFF

Table 14 FZM and FZP LED indications (Cont.)

LED	Description	LED Control Owner *	Priority (1 is highest)	Color
	FPGA has taken control of the RF LED in the startup sequence	FPGA	1	Blinking GREEN
	RF Transmission OFF	FPGA	1	Blinking GREEN
	RF Transmission ON	FPGA	2	Stable GREEN
BTS Status LED (Controlled by BTSOM)	*BTS Status*			
	While BTS is booting up and Status LED is being controlled by HW	HW	1	Stable RED
	In startup sequence, Platform SW is up and is now controlling the Status LED. Includes POST (in case of a power on scenario)	Platform SW	1	Blinking YELLOW
	Startup: Indicates BTSOM has taken control of the BTS Status LED and is performing site initialization related activities with the iOMS (SW version inquiry, SW download, SCF download, HW Configuration upload, Alarm sync, etc).	BTSOM SW	2	Blinking YELLOW

Table 14 FZM and FZP LED indications (Cont.)

LED	Description	LED Control Owner *	Priority (1 is highest)	Color
	Indicates BTS and/or all CELLs are Blocked/Locked	BTSOM SW	3	Stable YELLOW
	Indicates BTS is Faulty: It signifies that at-least one Critical Fault is currently present on BTS. Note: Includes any type of BTS faults including Transport, U-Plane, and C-Plane faults.	BTSOM SW	4	Stable RED
	Indicates BTS is degraded: At least one Major Fault is currently active on BTS (while no Critical Faults are active) Note: Includes any type of BTS faults including Transport, U-Plane, and C-Plane faults.	BTSOM SW	5	Blinking RED
	Indicates a SW download is in progress during runtime operation (i.e. SW download is occurring outside of startup)	BTSOM SW	6	Blinking GREEN
	Indicates a Critical Failure occurred during Auto Connection (AutoConnection State is "Disconnected").	BTSOM SW	7	Stable RED

Table 14 FZM and FZP LED indications (Cont.)

LED	Description	LED Control Owner *	Priority (1 is highest)	Color
	If failure is due to an iOMS rejection (unsuccessful AutoConnectionEstablishedReply message was received), condition will persist for 5 min until the Auto-Connection process is automatically retried. Note: If failure is due to iOMS connectivity being down (detected by Supervision on iOMS link), a Critical Fault will be active (SET).			
	Indicates Auto-Connection is in Progress (Until connection to Final iOMS is achieved)	BTSOM SW	8	Blinking YELLOW
	Indicates BTS is Uncommissioned Note: A "4030: EFaultId_NoCommDataAl" will be SET resulting in generation of a "7652 BASE STATION NOTIFICATION" alarm.	BTSOM SW	9	Stable YELLOW
	BTS in Test Dedicated State	BTSOM SW	10	Blinking GREEN

Table 14 FZM and FZP LED indications (Cont.)

LED	Description	LED Control Owner *	Priority (1 is highest)	Color
	Indicates either 1) a stable condition where at least one CELL is OnAir (indicated in conjuction with "RF Power Status" LED being Stable GREEN), or 2) a transitory condition where the BTS is fully configured and nothing is preventing a CELL from transitioning to onAir (indicated in conjuction with "RF Power Status" LED being Blinking GREEN).	BTSOM SW	10	Stable GREEN

For descriptions on Pico module Wi-Fi LED states, see Table 15: Flexi Zone Pico Wi-Fi LED states.

Table 15 Flexi Zone Pico Wi-Fi LED states

Wi-Fi LED state	Description
Off	Wi-Fi module not present
Blinking red	Wi-Fi module boot in progress
Stable red	2.4 GHz and 5 GHz fault
Blinking green	2.4 GHz or 5 GHz fault
Stable green	2.4 GHz and 5 GHz on

8 Transport

Transport protocol

Flexi Zone Pico Indoor BTS uses IP/Ethernet as a standard transport protocol. A copper or wire line Ethernet is the standard interface in BTS units.

When external transport solutions (such as wireless backhaul, GPON, etc.) are used, they communicate through the Ethernet connection on the BTS and the technology used is transparent to the BTS.

Flexi Zone Pico Indoor versions supports the following network interfaces depending on the technology:

- LTE
  - eNodeB to MME and Serving SAE Gateway with S1 interface
  - eNodeB to eNodeB with X2 interface
- WCDMA
  - IUB (100/1000 BASE-T)
  - RJ45 (the physical transport interface configuration)

The physical transport interface configuration available is RJ45.

Wire line Ethernet

Flexi Zone Pico Indoor BTS Base Module RJ45 socket supports 2 Gigabit Ethernet copper interfaces 100/1000 Base-T according IEEE802.3 clause 40.

9 Flexi Zone Indoor Pico Wi-Fi solution

The Smart Wi-Fi Connectivity solution offered by Nokia includes Ruckus Wi-Fi module integrated within the LTE or WCDMA Flexi Zone Indoor Pico BTS.

Flexi Zone Indoor Solution offers Wi-Fi as an integral part of mobile broadband experience. The Wi-Fi radio access is managed completely independent from the LTE/WCDMA solution. Specifically, the WiFi is integrated with an independent Wi-Fi Gateway, Wi-Fi O&M Solution and into the operator's network via the AAA and Radius servers.

9.1 Wi-Fi coverage

Optimal mounting locations for a maximum Wi-Fi coverage.

The location and orientation that you choose for the FZ Indoor Pico play a critical role in the performance of your wireless network. In general, it is recommended to install the module away from obstructions and sources of interference.

Due to the design tradeoffs required to produce a small, low-cost product, a minor amount of sensitivity degradation is expected from the Wi-Fi Tx under certain conditions and LTE/Wi-Fi band combinations. Care should be taken during deployment to configure the Wi-Fi network to use channels with as much frequency separation from the LTE band as possible.

For TDD band 40 variants, additional care should be taken during deployments due to its close proximity to/with the 2.4 GHz WiFi band. It is recommended to:

- disable 1-5 WiFi channels while operating in LTE band 40.
- fully disable the 2.4 GHz WiFi band while operating in the LTE channel above 2382.5 MHz.

WiFi channels can be disabled at the WiFi Smart Cell Gateway (SCG).

Care should also be taken to maximize the distance between Wi-Fi and other unlicensed devices to the FZP in order to minimize the opportunity for interference and performance degradation. If interference is observed or suspected from other RF devices, it is recommended to increase the distance between the FZP and interfering device as much as possible to preserve FZP performance.

Refer to **Ruckus Documentation** for further information on:.

- WiFi Module integrated within the FZP
- deploying high density Wi-Fi

Figures below show recommended ceiling location, wall location and corridor location.

Figure 19 Recommended ceiling location

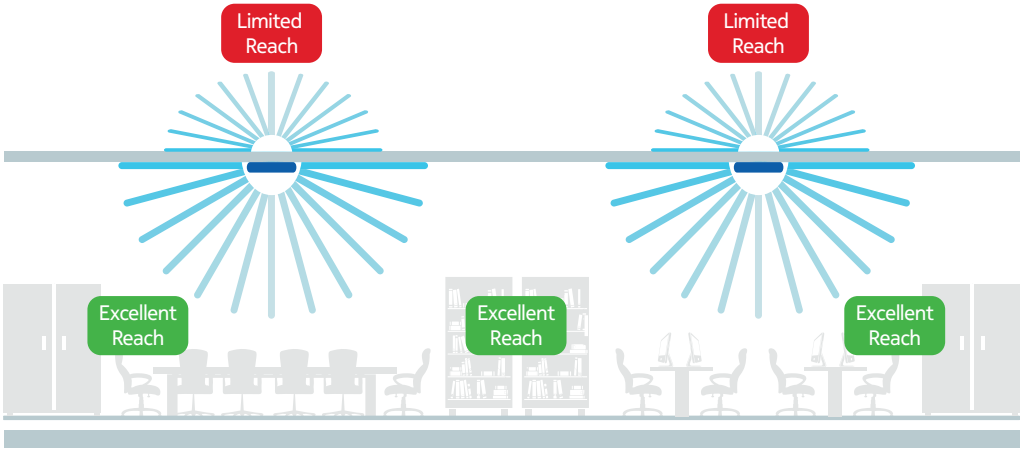


Figure 20 Recommended wall location

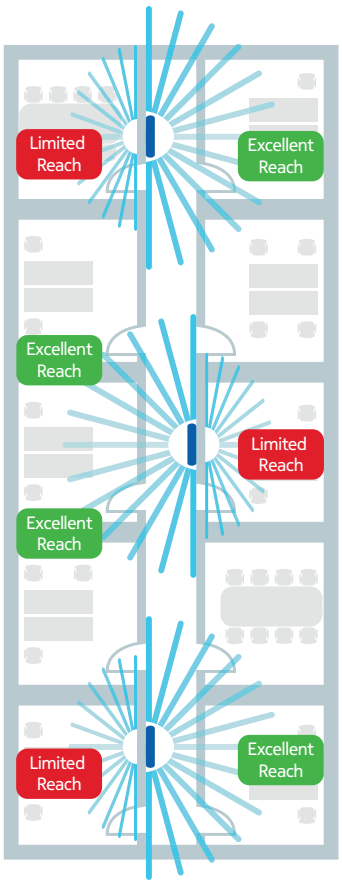
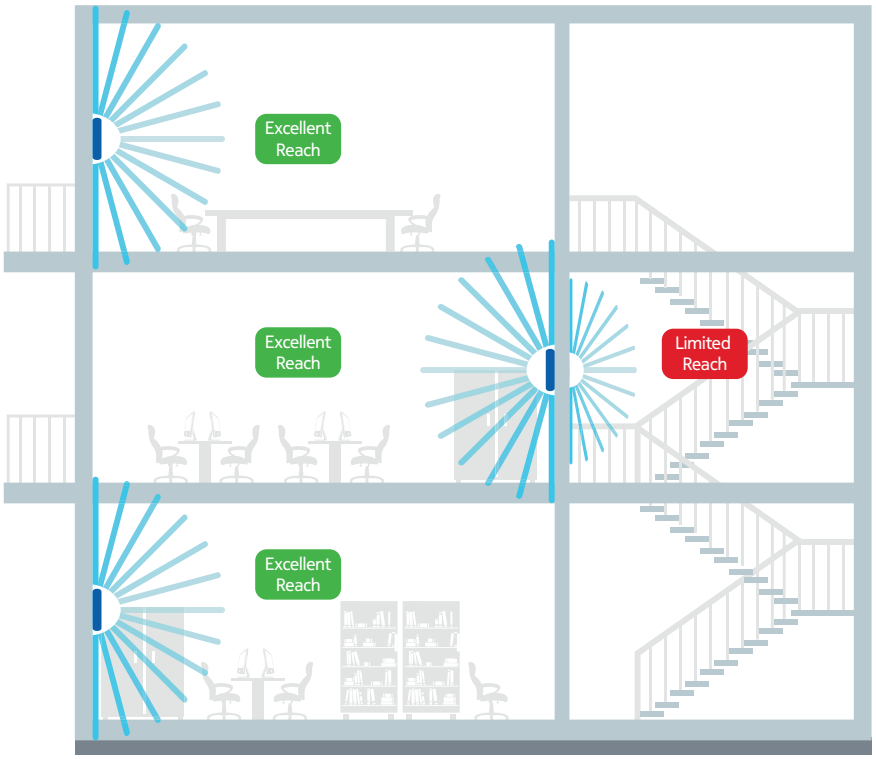


Figure 21 Recommended corridor location



10 Management and software

The *Flexi Zone Indoor Pico BTS* can be managed remotely via NetAct. Auto-connection and, in LTE, auto-configuration start automatically when the *Flexi Zone Indoor Pico BTS* starts. Please make sure the backhaul connection to the Core Network is in place for this to succeed.

The *Flexi Zone Indoor Pico BTS* can be managed locally through the RJ45 port. In LTE, it can be also managed through a Bluetooth connection. The Bluetooth connection eliminates the need for a wired connection to the *Flexi Zone Indoor Pico BTS* when it is installed in a difficult to reach location. NetAct can be used to manage the *Flexi Zone Pico Indoor Pico BTS* remotely.

Note: When the *Flexi Zone Indoor Pico BTS* is managed via Bluetooth connection, the 2.4 GHz Wi-Fi should be disabled for the best performance.

In LTE, the *Flexi Zone Pico Indoor BTS* utilizes an internal Bluetooth antenna. The useful range for Bluetooth is influenced by the installation and environment. If multiple Wi-Fi Access Points are operating nearby, the range can be reduced as 2.4GHz Wi-Fi operates in the same frequency spectrum. For maximum Bluetooth range a Class 1 dongle is required. The internal Bluetooth module consists of an on-board Bluetooth transceiver. The transceiver provides a 78 channel EDR 2.1 compliant Bluetooth interface used for remote MMI and maintenance operations. All required SW is loaded and installed onto the *Flexi Zone Indoor Pico BTS* Bluetooth Module as part of the overall *Flexi Zone Indoor Pico BTS* product software. Contact Nokia for additional details.

The BTS automatically detects the SW version number, HW product code, version number and serial number during the start-up. This data can be retrieved remotely. The BTS controls its internal operation, ensuring that any malfunctions or loss-of-service is detected and reported to the network management.

Software updates

New SW versions can be downloaded while the BTS is in operation. Software can be uploaded to BTS either locally, with the BTS Site Manager, or remotely from NetAct. Site visits are therefore unnecessary for routine operation and maintenance (O&M) tasks.

Typically, a local software download is done only when the NetAct connection is missing, for example, during the commissioning process. Software downloads can be run in the background of the BTS operation. The new software can be activated at any time. A reboot is required in order to activate the software.

The BTS only uses downloadable software. All software can be downloaded and updated from NetAct. As the procedure is centralized, upgrading SW for several BTSs can be performed simultaneously or individually.

The BTS keeps the current and previous software packages in its flash memory and can be updated at any moment. Updated software (current and previous) in the BTS can be seen through BTS Site Manager/NetAct.