FortiFone - FON-D72 User Guide

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FortiFone FON-D72 User Guide
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Change log

Date	Change description
2020-11-10	Initial release of the FortiFone FON-D72 User Guide.
2020-11-25	Updated Estimating number of base stations based upon handsets on page 10. Removed references to version 6.0.0. The version number is not required for this guide.
2021-04-09	Added Configuration on FortiVoice on page 23.

Introduction

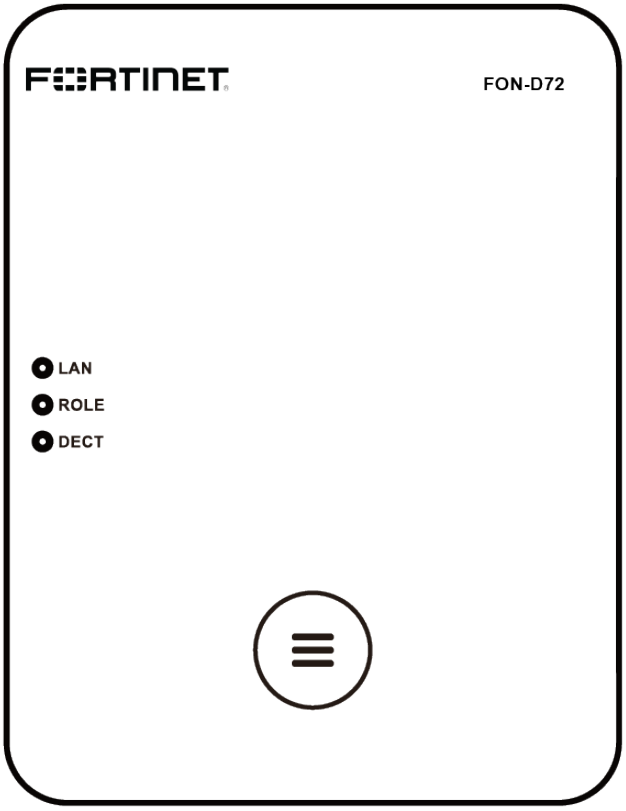
This user guide includes information about configuring and using your FON-D72 IP phone.

This section contains the following topics:

Phone features

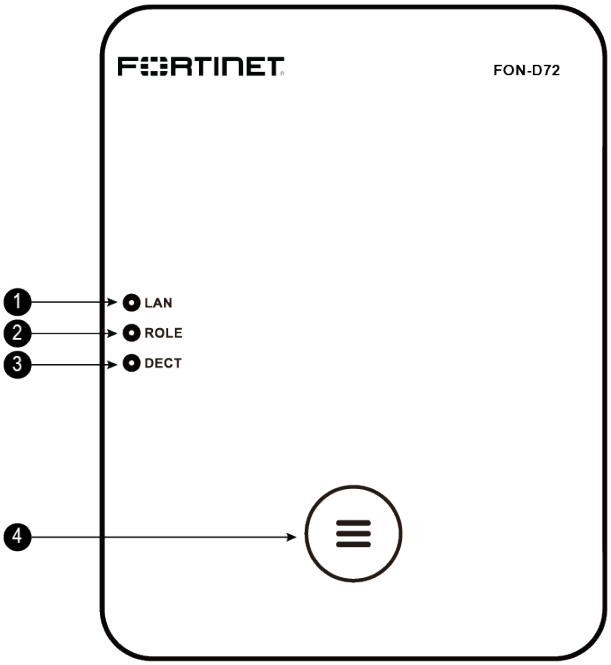
- Up to 8 concurrent calls per base, up to a maximum of 100.
- Up to 8 handsets per base, up to a maximum of 100.
- Supports up to 30 FON-D72-B bases, increasing the amount of calls, handsets and range that the FON-D72 is capable of.
- PoE support for the bases eliminates the need for a power adapter.

FON-D72-M/B base stations



FON-D71-H handset

Phone buttons



Button	Function
1. LAN LED	Indicates the LAN connection status: • Solid green – successful connection to LAN. • Slow flashing green – no IP address available/assigned or no connection to LAN. • Off – no power.
2. ROLE LED	Indicates the role of the base: • Orange – the role is DECT Manager. • Green – the role is Base. • Slow flashing orange – active calls on the DECT Manager.
3. DECT LED	Indicates the power status of the base station: • Green – DECT Manager and Base are active and synced. • Slow flashing green – active calls on Base. • Off – DECT Manager and Base are not synced or offline.
4. Device key	Hold for 20 seconds to restore factory defaults.

Requirements

A FON-D72 configuration requires the following:

- 1 x FON-D72-M
- 1 x FON-D72-B
- 1 x FON-D71-H

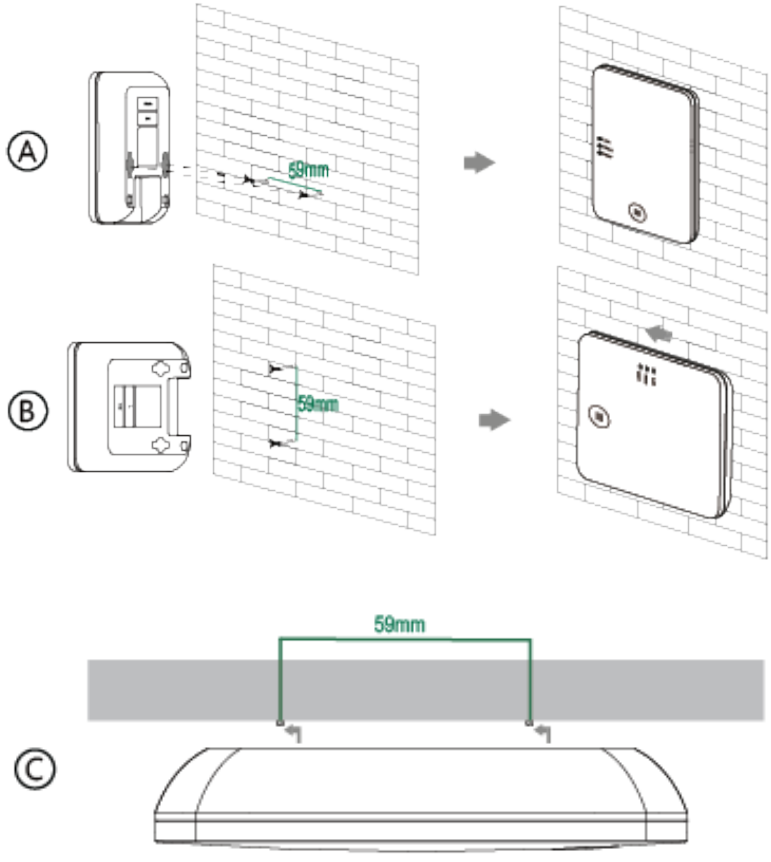
Installation

The installation chapter contains the following sections to help install your phone:

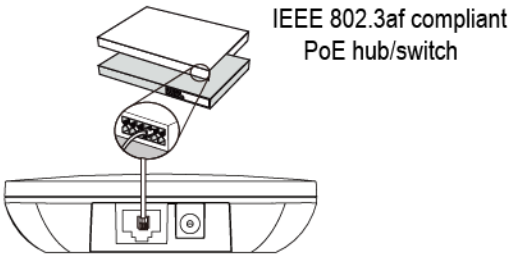
- Mounting the base station
- Connecting the base station
- Setting up the phone

Mounting the base station

The base station can be wall mounted using two screws set 59 mm apart. The base station may be mounted upright (A), sideways (B) or on the ceiling (C). The recommended installation height for a base station is between 1.8 and 3 meters, depending on the room height.



Connecting the base station



To connect the base station

1. Connect an Ethernet cable to the Internet port on FON-D72-M and FON-D72-B.
2. Connect both bases to an IEEE 802.3af compliant PoE hub or switch.

Setting up the phone

For instructions about configuring an extension, see the FortiVoice Phone System Administration Guide. After the extension is created, the FON-D72 can be configured as an internal and external extension.

For use as an internal extension

The FON-D72 supports plug and play installation.

To configure as an internal extension

1. Configure the FON-D72 extensions on FortiVoice.
2. On the FON-D71-H handsets press the *Reg* softkey. The handsets will display their name and extension number on screen.

For use as an external extension

To configure as an external extension

1. Enter the IP address of the FON-D72-M into a web browser.
2. Enter "**admin**" as the username and "**23646**" as the password.
3. Go to *Settings* > *Auto Provision*.
4. In the Server URL, enter the public IP address or FQDN of FortiVoice and click *Confirm*.
5. On the FON-D72-H handsets, press the *Reg* softkey. The handsets will display their name and extension number on screen.

To allow the base stations to take signal measurements and determine their optimal placement, make sure to complete the registration of at least one handset.

Deployment

The base stations in a FON-D72 multi-cell network must synchronize with each other to ensure a seamless handover while roaming. For a successful deployment of the multi-cell network, take measurements for the optimum positions of the base stations.

There are three key deployment tasks:

1. Estimating number of base stations based upon handsets on page 10
2. Estimating number of base stations based upon area on page 11
3. Calculating base station layout and measurements on page 12

Estimating number of base stations based upon handsets

The following requirements must be considered when estimating how many base stations are needed and deciding where they should be placed:

- DECT radio coverage of the entire site.
- Number of connection channels to avoid capacity bottlenecks.
- Base station overlap for synchronization to guarantee roaming and handover.

The following table shows the maximum number of connection channels and handsets that can be handled in relation to the number of FON-D72-B base stations:

FON-D72-B	Connection channels	Active handsets
1	8	8
2	16	16
3	24	24
4	32	32
5	40	40
6	48	48
7	50	50
8	50	50
9	50	50
10	50	50
11	88	88
12	96	96

FON-D72-B	Connection channels	Active handsets
13	100	100
14	100	100

The capacity of the multi-cell system must be high enough to guarantee that subscribers can be reached in high-density traffic. The capacity of the multi-cell system is determined by the following:

- Number of connection channels available. Connection channels are used for phone calls and for list access actions (when the handset accesses the History or Directory).
- Grade of service (GoS) determines the number of connections that may not be achieved due to the system being at full capacity. With a grade of service of 5%, it is permissible for 5% of 300 calls (15 connections) not to be established. This means that only 285 connections have to be achieved.

To calculate the number of connection channels required, use the following formula:

(<Number of calls per hour> – (<Number of calls per hour> x <GoS%>)) x <Average length of call per hour> / 60 min.

As an example, you set the GoS at 5% and you require 300 calls per hour at an average length of 5 minutes each. The equation would be: (300 – (300 x 5%)) x 5/60 = 23.75. This means that 24 connection channels would be required, and you would need 3 base stations.

Since the traffic volume is not normally evenly distributed over the site to be covered, the traffic volume must be calculated for each area (offices, hotspots, stairwells) to determine the number of base stations that need to be installed.

Estimating number of base stations based upon area

Estimate the approximate number of base stations according to the total area of expected DECT coverage.

The calculation for this is:

Number of base stations = <size of coverage area (in square meters)> / 800

The suggested distance between two base stations depends on the physical path between the base stations.

The following table lists the recommended distance between two base stations:

Area	Distance between two base stations
Office areas	Up to 40 meters
Office areas with obstacles such as elevator shafts, stairwells or metal walls	Up to 10 meters
Shop floors	Up to 60 meters
Exhibition halls or production areas without obstacles	Up to 100 meters
Underground garages	Up to 20 meters

As the base stations can interfere with each other, sufficient distance should be maintained between two base stations. The minimum distance depends on the circumstances. If there are no obstacles between them, the required distance

can be from 5 to 10 meters. If there are obstacles such as absorbent walls or absorbent furniture between them, 1 to 2 meters may be sufficient.

Calculating base station layout and measurements

The following section details the best base station layout and measurements for the best coverage.

Base station clusters

A cluster is comprised of a number of base stations within the DECT multi-cell system that synchronize with each other to enable handover, roaming, list access, and load balancing.

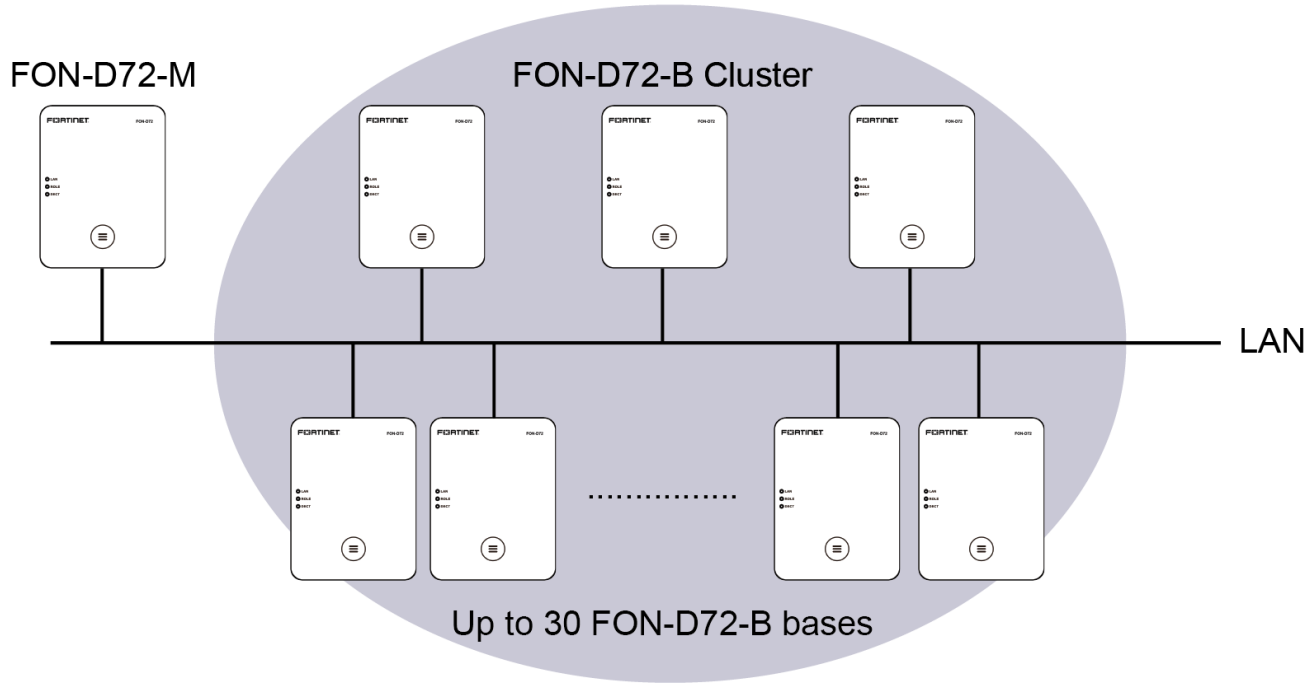
Handover: The DECT connection of a handset is passed to another base station during a call.

Roaming: A handset in idle status is connected to the multi-cell system via a new base station.

List Access: All menus accessed by a handset that interact with the base station (History and Directory).

Load Balancing: If the current base station is overloaded with active DECT or media connections, the DECT connection is set up with a neighboring base station with available resources to handle a call.

Handover and load balancing take affect only when the base stations are synchronized with each other.



Sync level

Each base station is assigned to a corresponding sync level. A base station always synchronizes with a base station that has a higher sync level. If several base stations with a higher sync level have been discovered, synchronization occurs with the base station that has the strongest signal. If no base stations with a higher sync level are detected, synchronization cannot occur.

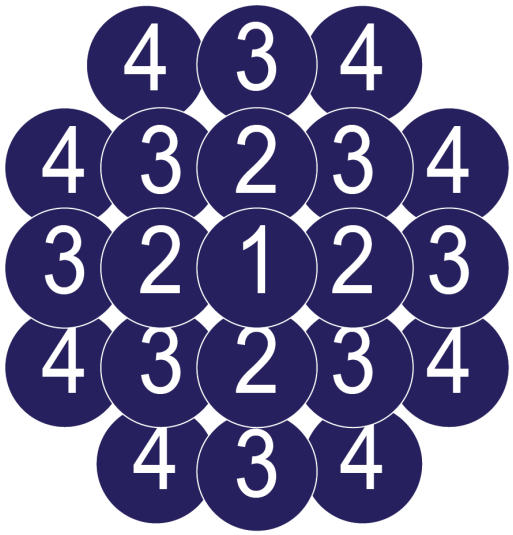
Sync level 1 is the highest sync level, it should be the base station that is in the center of your multi-cell network. This is to help prevent the possibility of synchronization loss.

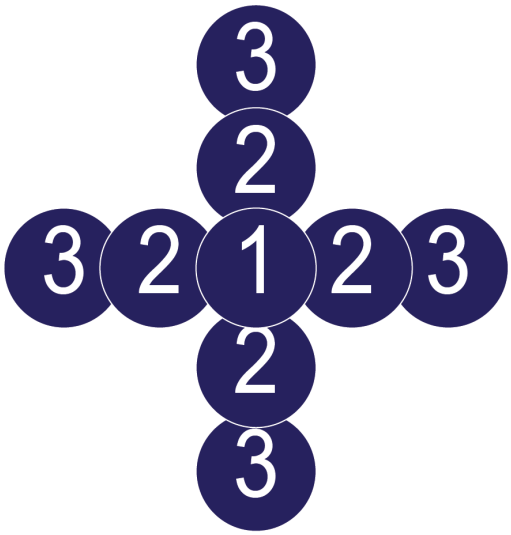
There can only be one base that is set to sync level 1. Keep this in mind when configuring the FON-D72 in FortiVoice.

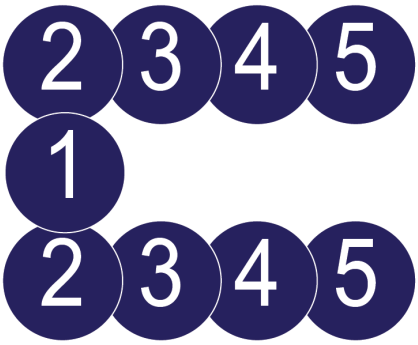
Correct:

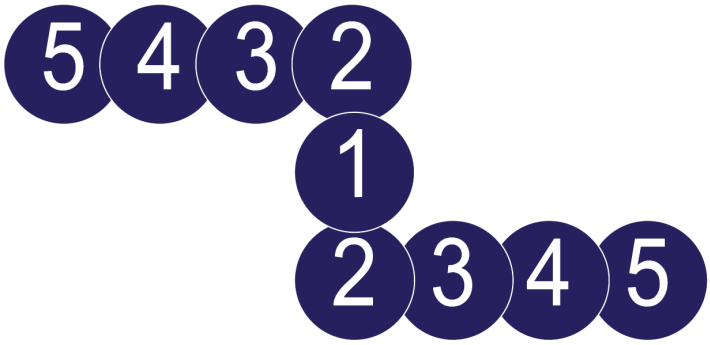
Incorrect:

The multi-cell network can be configured in numerous ways. Below are examples of multi-cell networks that maintain a strong synchronization between base stations:









Signal transmission

The ideal signal transmission of a base station is omni-directional. All registered handsets can be the same distance away from a base station in all directions, without interruption of the DECT signal.

Range can be influenced by a variety of environmental conditions. For optimal signal strength, it is best to first temporarily put base stations in place and measure the signal transmission.

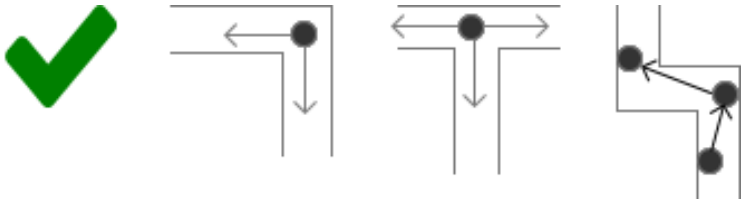
The following table gives a general guideline on the degree to which certain materials will reduce signal strength:

Material	Degree of attenuation	Example
Air	None	Open space
Wood	Low	Door, floor, partition
Plastic	Low	Partition
Glass	Low	Un-tinted glass, partition

Material	Degree of attenuation	Example
Tinted glass	Medium	Tinted-glass, partition
Living creatures	Medium	Crowds, plants
Brick	Medium	Walls
Plaster	Medium	Partitions
Ceramic	High	Tiles
Concrete	High	Load-bearing walls, floors, pillars
Metal	Very High	Reinforced concrete, metal cabinets

Consider the following tips when selecting positions for base stations:

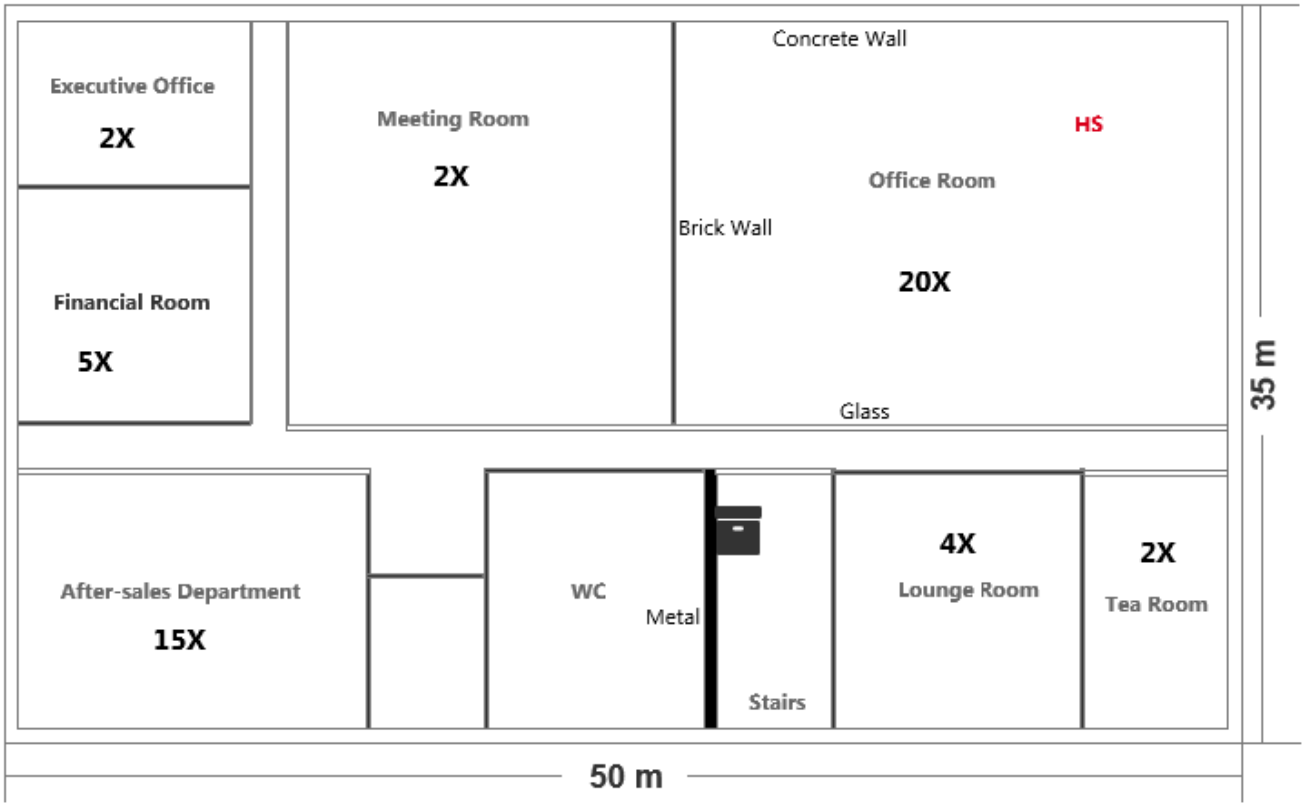
- Considering the coverage of wireless signals in the building, it is better to install the base stations at corridor intersections, like so:



- In a multi-story building, we recommend that you install additional base stations in the stairwells.
- Do not install the base in suspended ceilings, cupboards or other closed furniture. The DECT coverage will be significantly reduced depending on the materials used.
- Avoid installing base stations in the direct vicinity of cable channels, metal cupboards or other larger metal devices.

Creating a planning drawing

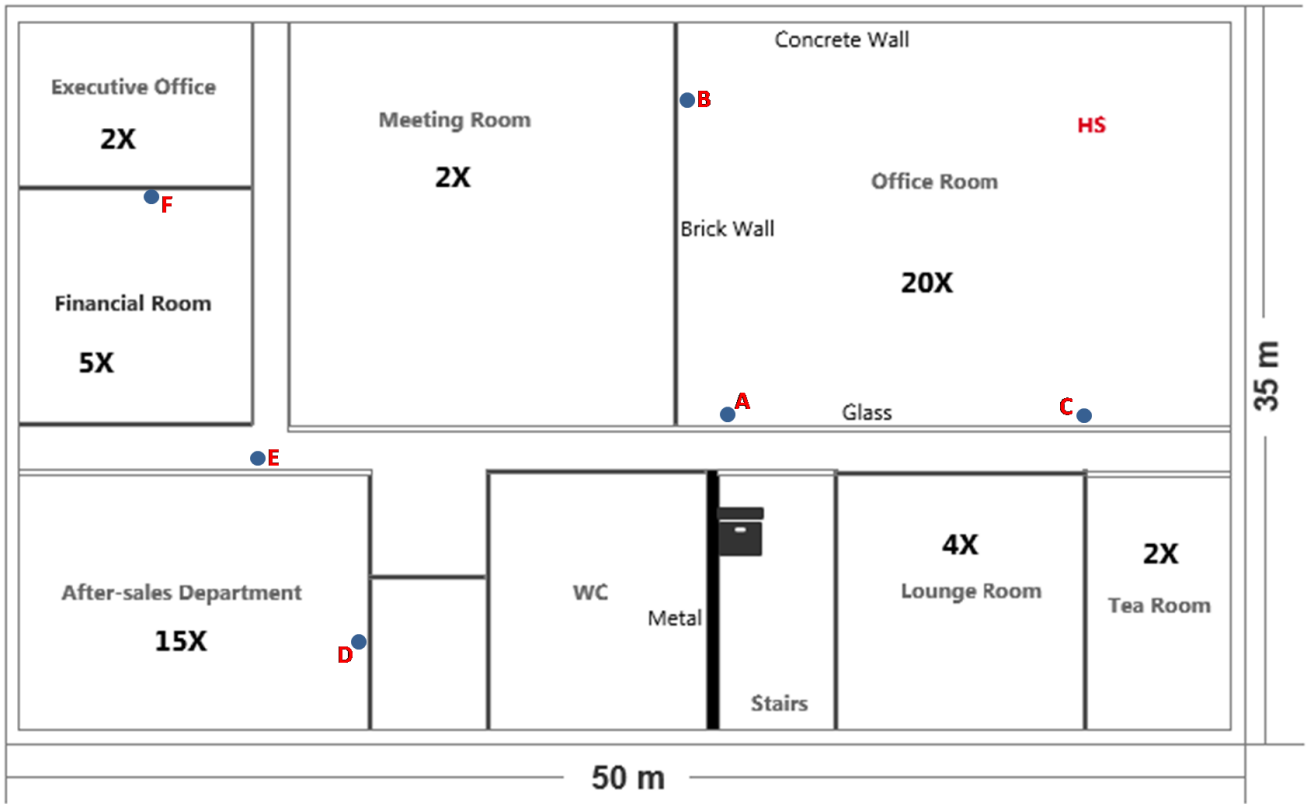
Create a planning drawing to determine the placements of the base stations. Enter the building dimensions, identify hotspot areas and any sources of interference.



- Number of handsets in each room are show in bold, for example: **15X**.
- Areas with high-density traffic are marked as hotspots (**HS**).
- The different lines indicate different building materials. The following table displays the loss of DECT signal through the various materials:

Building materials	Degree of attenuation
Metal	Very High
Concrete walls	High
Brick walls	Medium
Glass	Low

Now you can enter the preliminary placements of the base stations into the planning drawing:



This example shows the preliminary positions of base stations A, B, C, D, E and F. You will need to configure the corresponding sync level for each base station according to these positions. Start with the base station for which a subsequent change would mean the greatest effort, this will be the base station with sync level 1. Then move outwards from sync level to sync level.

Here we have set the following:

Sync Level 1: Base station A

Sync Level 2: Base station B, C and E

Sync Level 3: Base station D and F

For the office room hotspot, two additional base stations have been placed in parallel for optimal coverage and channel connections.

In this example, the other hotspot is the After-sales Department. Two base stations service this area, base station E is outside of the room but is behind a glass wall, which has little effect on the DECT signal.

Check to ensure that these placements are correct by taking measurements, as described in the Measuring signal strength section.

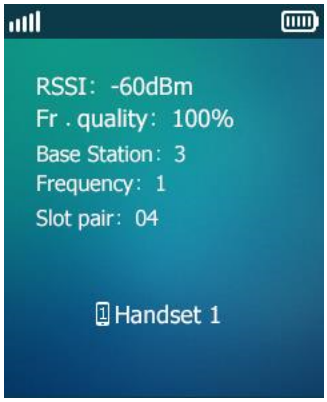
Measuring signal strength

Taking measurements can help determine where you may need to put additional base stations to have handover and synchronization.

To take measurements, you can use a registered FON-D71-H handset to measure the signal strength of the current position of a base station through the Metering Mode.

To enable Metering Mode:

1. Configure a FON-D72-M, FON-D72-B and a FON-D71-H with FortiVoice.
2. On the FON-D71-H idle screen dial *1234203#, which will allow configuration of the measurement setting.
3. On the FON-D71-H press the *OK* button.
4. Go to *Settings* > *Telephony* > *Metering Mode*.
5. Change Status to Enabled.
6. Select the RSSI unit to display (dBm is default)
7. Select the measurement interval. This has a value of 5 to 15 (0.8 second to 2 .4 seconds). The recommended value is 6.
8. Press the *Save* softkey.
9. Press the off-hook button to return to the idle screen and display the measurements.
10. Repeat steps 1 to 9 with a second FON-D71-H to check voice quality between two handsets while also taking measurements. The idle screen will display the following:



RSSI: Received Signal Strength Indication. The recommended value is -27 to -85 dBm. For guaranteed call quality and interference-free handover, a reading of -80 dBm. To guarantee synchronization between base stations, a reading of -85 dBm is needed.

Fr. quality: Frame quality. Percentage of packages received without error. Recommended value is 100%

Base Station: The RPN (Radio Fixed Part Number), identifying the base station that the handset is connected to.

Frequency: Carrier frequency of the signal received. Value range: 0 to 30.

Slot pair: Time slot for the reception channel on which the measurement was performed.

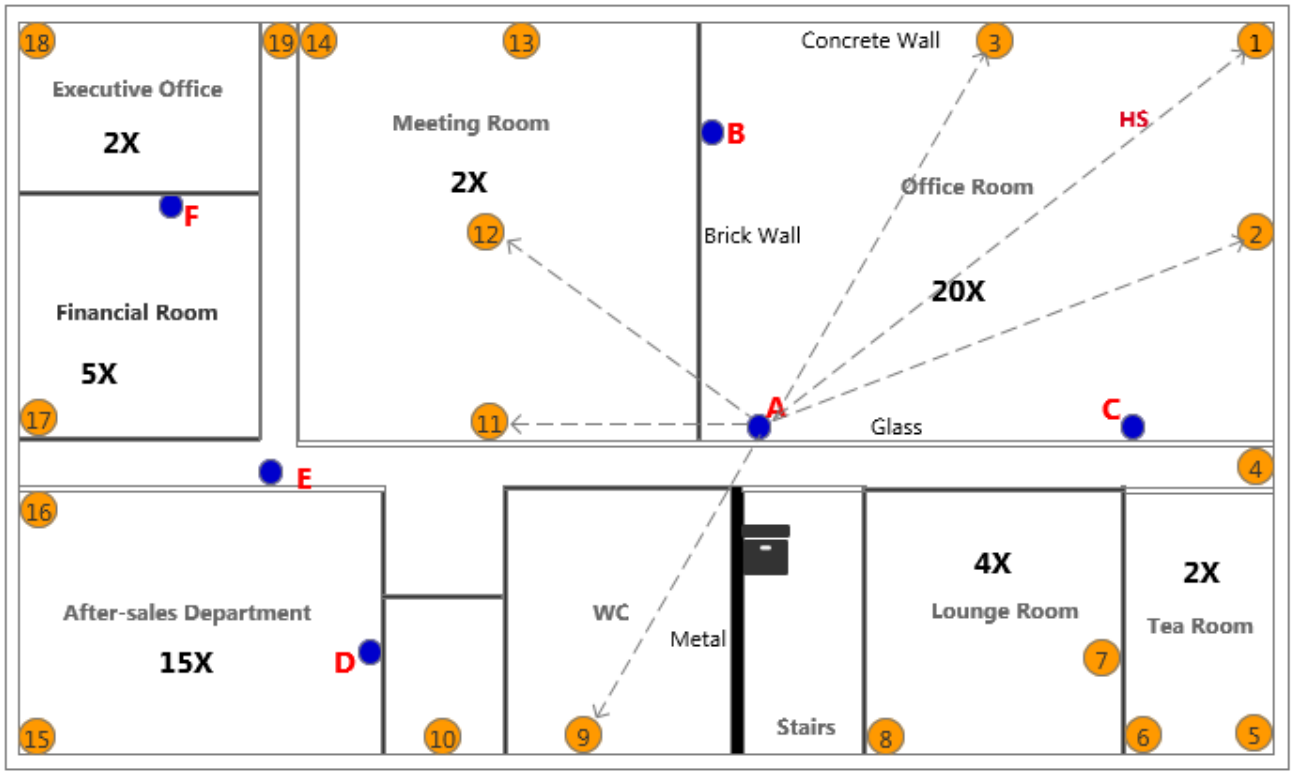
Measurement procedure

After the handsets have registered and Metering Mode is enabled, measurements can now be taken. It is recommended to keep a measurement log for reference:

1. Temporarily affix the measuring base station in the planned position where it will be installed.
2. Establish a call between the two measuring handsets, observing the signal, until the RSSI reaches -80 dBm. Make note of this within your reference log.

3. Check the voice quality within limit areas using the measuring handsets.
4. Record any deviations in the reception signal measurement of the voice quality within your measurement log.

The following image presents an example planning drawing:



The following table presents an example of measurement log results (in dBm/100%) for the above planning drawing:

Measuring point	Base A	Base B	Base C	Base D	Base E	Base F
1	-55	-52	-49			
2	-50	-54	-35			
3	-47	-30	-50			
4			-50		-50	
5			-62			
6			-61			
7			-57			
8			-64			
9	-63					
10				-52		

Measuring point	Base A	Base B	Base C	Base D	Base E	Base F
11	-57	-59			-55	
12	-60	-50				
13		-53				
14		-58				
15				-35	-52	
16				-34	-50	
17					-53	-40
18						-52
19					-40	

Measuring signal strength

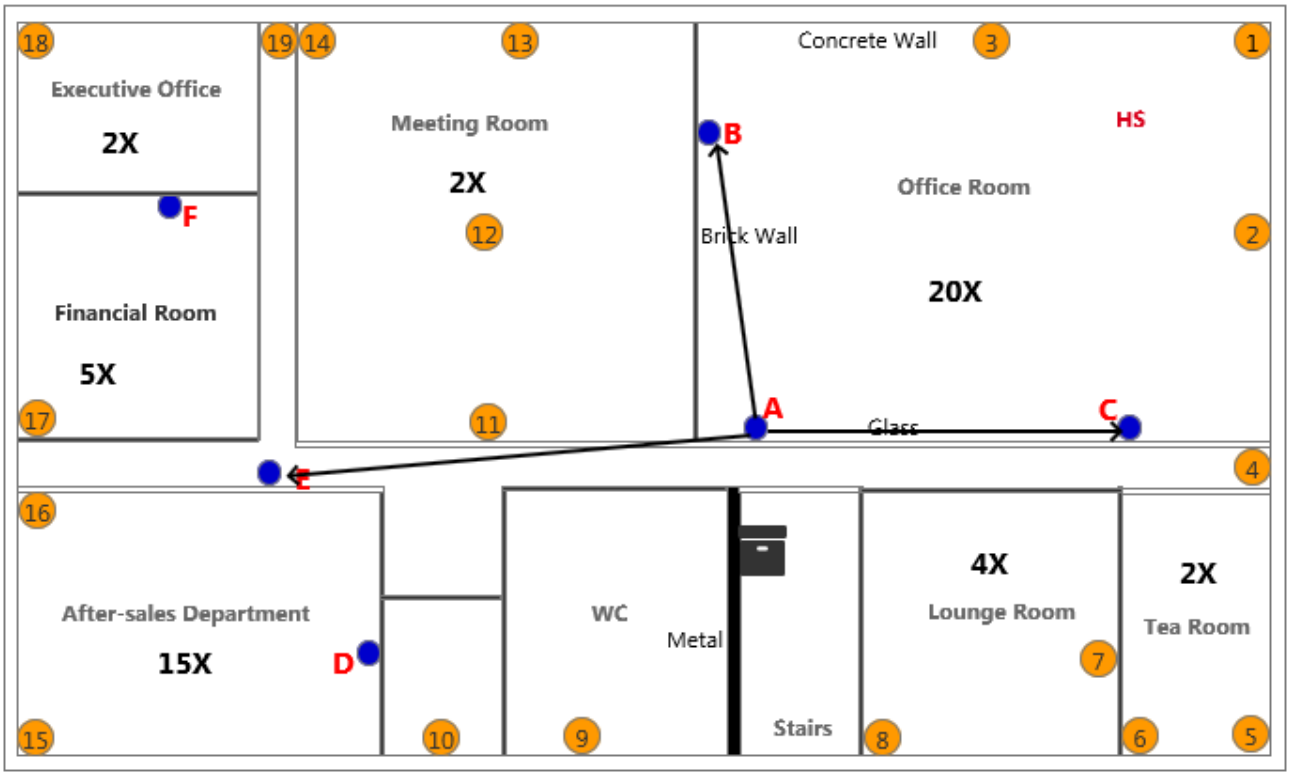
Measure the signal strength transmitted from the measuring base station and the planned position of the neighboring base station. This measurement is used to ensure that sufficient synchronization overlap is guaranteed.

For the base stations to be able to synchronize, we recommend that the signal value between the base stations be kept above -85 dBm.

For this procedure:

1. Leave the first-level base station at the planned position. Take the measuring handset to the planned position of the second-level base station.
2. Check to ensure that the RSSI is within -85 dBm and the frame quality is at 100%.
3. Record this within your measurement log.
4. Measure for all planned positions of base stations that will synchronize with the first-level base station.

The following image presents an example of planned base station positions:



The following table presents an example of measurement log results (in dBm/100%) for the above planned base station positions:

Measuring point	Base A	Base B	Base C	Base D	Base E	Base F
A		-37	-39		-61	
B	-35		-47			
C	-40	-45			-68	
D					-53	
E	-60	-70	-66	-50		-60
F					-60	

These results display that the signal strength is sufficient for synchronization everywhere. Base station F and D can only receive base station E with sufficient quality, and base station B, C and E can only receive base station A with sufficient quality.

With this example, a sensible sync level hierarchy would be:

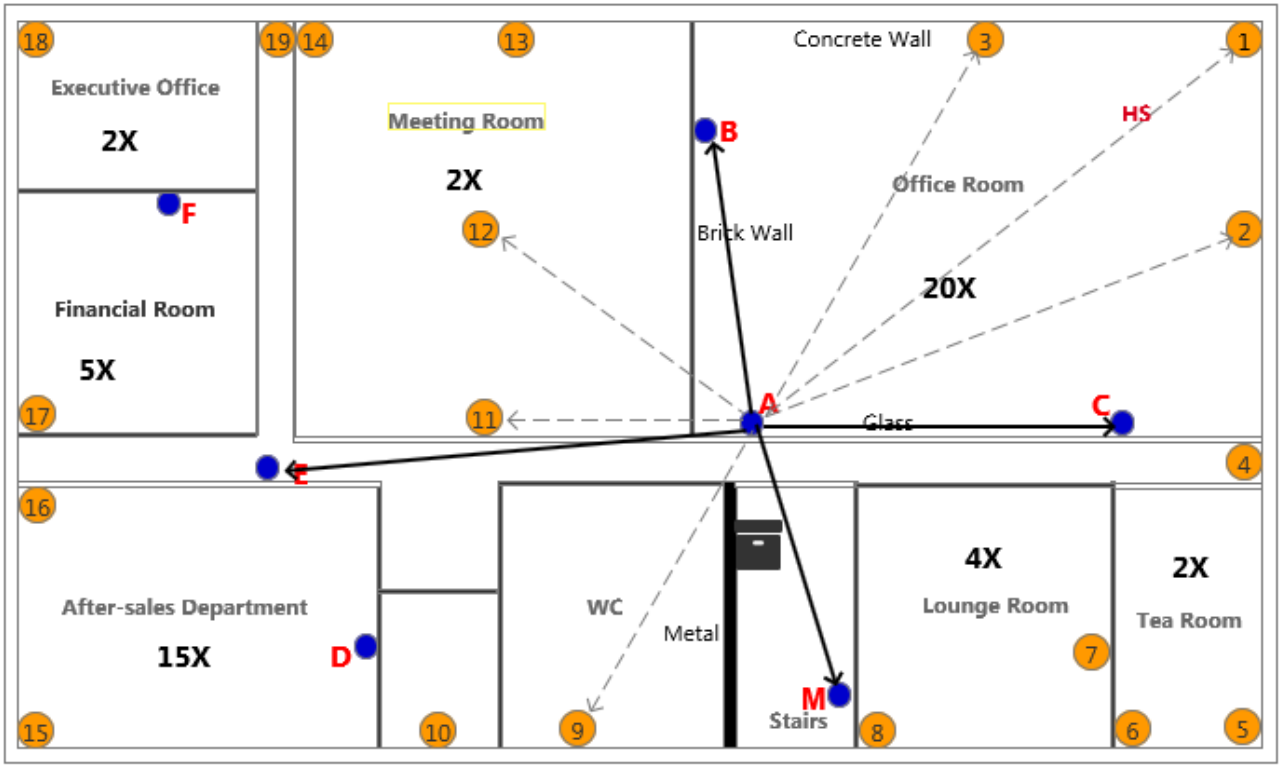
Sync Level 1: Base station A

Sync Level 2: Base stations B, C and E

Sync Level 3: Base stations D and F

Deploying in a multi-story building

To guarantee a seamless handover between floors, consider installing dedicated base stations in the stairwells. As shown here, base station M has been added into the planning drawing in the stairs:



In this configuration, also measure the signal strength within the stairwell to ensure that the base stations can synchronize.

Configuration on FortiVoice

For details about the configuration on the FortiVoice phone system, see the Configuring multi-cell FortiFone phones section in the FortiVoice Phone System Administration Guide, version 6.4.1 and later.

Troubleshooting

The following table contains a list of common problems and their solutions.

Symptoms	Corrective actions
Display is blank	Ensure that the phone is powered on and is charged.
LAN LED is blinking.	The base station has no IP address. 1. Ensure your DHCP server is online. This is typically your router. 2. Reboot the router or DHCP server. 3. If you are still experiencing issues, the phone may require advanced network configuration. Please contact your administrator.
No name and Extension Number is displayed	Your phone is not registered. 1. On the Extensions page of the FortiVoice interface, ensure the MAC address is correctly entered and the Phone Type is FortiFone-D72. Save your configuration and reboot the phone. 2. If your phone is an external extension, ensure the Server URL is correct. To verify, see For use as an external extension. 3. If your phone is configured as an external extension, check the network connection and firewall settings at the phone system location.
No audio during a call	1. Check the handset/headset connections. 2. Make sure the phone is properly registered with the phone system. 3. If your phone is configured as an external extension, check the network connection and firewall settings at the phone system location.