Multicell Deployment Guide

v 1.02

M900 Base Station

FW 4.50 and higher

TABLE OF CONTENTS

Introduction

This document describes how to set up a multicell DECT system. It addresses DECT and wireless aspects, as well as network requirements and capacity planning.

For base station and handset setup and administration please see the M900 Admin and Installation Guide at .... and the User Manual M70 /M80 /M90 Handsets at ...

Intended audience

This document is intended for networking professionals and network administrators who are planning and designing a multicell DECT solution and for network administrators and IT support personnel who install, configure, maintain, and monitor the multicell DECT system.

To be able to use this document we assume that the following prerequisites are met:

- You understand network deployment in gesneral;
- You have a working knowledge of basic TCP/IP/SIP protocols, network address translation, etc.
- A proper site survey of the area/building(s) where the multicell DEC system is to be set up has been performed, and you have access to the plans.

Abbreviations

Abbreviations used in this document:

DHCP:	Dynamic Host Configuration Protocol
(T)FTP:	(Trivial) File Transfer Protocol
IOS:	Internetworking Operating System
NAT:	Network Address Translator
PCMA:	A-law Pulse Code Modulation
PCMU:	µ-law Pulse Code Modulation
RPN:	Radio Fixed Part Number
RSSI:	Received signal strength indication
RTP:	Real-time Transport Protocol
RPORT:	Response Port (Refer to RFC3581 for details)
SIP:	Session Initiation Protocol
SME:	Small and Medium scale Enterprise
SRTP:	Secure Real-time transport protocol
STUN:	Session Traversal Utilities for NAT
TLS:	Transport Layer Security (for SIP encryption
VLAN:	Virtual Local Access Network
TOS:	Type of Service (policy based routing)
URL:	Uniform Resource Locator
UA:	User Agent
UTC:	Coordinated Universal Time (similar to GMT format)

DECT deployment assessment

DECT deployment assessment is essential and includes, but is not limited to the following considerations:

- the geographical area to be covered;
- the type or architecture of building and/or topology, etc. This includes the material and the thickness of walls.
- the estimated traffic in each coverage area;
- the blocking criteria in each coverage area.

Deployment considerations

The following radiation-related considerations must be examined before deploying a typical Snom M900 system. These include, but are not limited to:

- **Building penetration**. When a signal strikes a surface, it is diffracted or absorbed; therefore to some extent the signal is reduced. The amount of absorption depends on the kind of building and its environment, i.e., the amount of solid structure. This is an important consideration in coverage planning.

  Note: The structure of the building will have an impact on coverage range.

- **Interference sources**. Signals from receiving antennas are weakened by interference from other signals. These signals may be from the same network or other objects. A well-planned DECT multicell installation should identify potential interference sources for optimal placement of base stations and repeaters.

  Note: Other DECT systems or devices transmitting in similar frequencies weaken reception. Set up base stations sufficiently close to each other to allow for such an eventuality.

- **Radio/cell range**. The suggested distance between two base stations depends on the physical path between the base stations. If the path loss is lessened, e.g. by minimizing the number of walls/obstacles in the path, then signals from base stations will cover more distance. In a typical office building the suggested distance between two base stations is 20–40 m.

  Note: Fewer obstacles between two base stations increase the possible distance between two base stations.

- **Range.**
  - Office areas: Up to 40 meters
  - Office areas with obstructions like elevator shafts, stairwells, 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
  - Outdoors without obstructions: Up to 200–300 meters (base station for indoor installation only)

Capacity Planning

Each base station has a maximum limit of parallel calls.

	Narrow band	Wide band
Base station	8 calls	4 calls
Repeater	5 calls	2 calls

To avoid a congested DECT network, the capacity should be planned in advance. Due to different usage patterns, the number of base stations required to fulfil the demand of voice channels may vary. The total capacity in the coverage area of a base station is always limited to the capacity of a single base station.

Site planning / cell coverage

In many cases, expensive tools and expert help may not be necessary to determine cell coverage and quality in an installation. The M-series handsets (M70, M80, M90, M65, M85) have a built-in RSSI meter that indicates the strength of the signal received from the base; this feature can be used to determine the ideal and/or necessary locations for base stations in single-cell or multicell installations.

Use a building plan and check the base station coverage using the handset signal strength indication (RSSI level) from each base station.

Using the handset to determine cell coverage and quality

Finding the IP address of the base station

1. Press the menu key on the handset. The main menu is shown on-screen (Fig. 1).
2. Type ***47*** on the handset's keypad.
3. The handset will detect all base stations within range and show their MAC addresses on the display (Fig. 2). If the handset has detected more than one base, compare them with the MAC address on the type label of your base station to identify and select the right one.

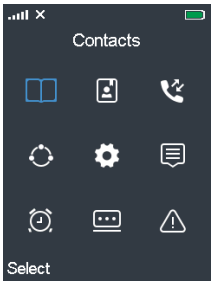


Fig. 1

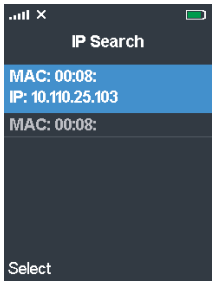


Fig. 2

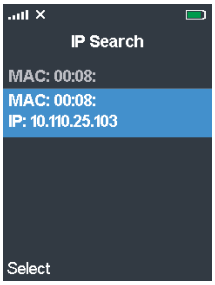


Fig. 3

Fig. 4

Fig. 5

4. If necessary, scroll to the MAC address of your base station. The selected item is highlighted in blue and expands to also show the IP address of the base station (Fig. 2 and 3).

Finding RSSI and RFPI

5. Press the function key underneath **Select** (Fig. 2 and 3). The selected base station's RFPI and RSSI are shown on the display (Fig. 4).
   - RFPI: The Radio Fixed Part Identity is a unique identifier frequently transmitted by the base station.
   - RSSI: The Radio Signal Strength Indicator measures the received signal strength in dBm (decibel milliwatts)

Testing the audio signal

6. Press the green key to establish an audio loopback connection to the base station, as indicated by the message <<HOOK OFF>> (Fig. 5). You can now speak into the microphone of the handset to hear the echo of your voice in the front loudspeaker.

   Note: By plugging in a headset modified for an MP3 player connection, audio from the handset/ MP3 player will be looped back to the handset earpiece. This makes it possible to listen to audio at the same time as you are reading the RSSI levels of the display. Press the OK key (the center of the navigation key) to send a 1 kHz soundbite from the base station.

Placing the base stations

1. Place the first M900 base station at the desired position and power it up.
2. Using the building plan, check the base station coverage using the handset RSSI levels and mark the acceptable and non-acceptable spots for placing the second base station on the plan.

   Note: Acceptable spots are locations where the handset shows RSSI levels better than -075 dBm (i.e., -074 dBm, -073 dBm, etc.) and where you verified via audio loopback that the reception is clear. Poor RSSI levels will result in poor audio quality and/or dropped calls; the value should never be below -90dBm (i.e., -91 dBm, -92 dBm, etc.).

   - Typically, installations such as office buildings, warehouses and hospitality should be equipped with both base stations and repeaters on several floors to create uniform and complete radio coverage.
   - **Do not link two or more multicell base station via repeater**. Use repeaters only to extend the coverage of a single base station. If Ethernet is available, use a multicell base station rather than a repeater.
   - Open areas can be covered with a sparse network of base stations. In such applications, the base stations and/or repeaters cover an extended range due to the extended line-of-sight radio propagation capability.

IP configuration

The M900 can operate using a variety of IP network settings, allowing it to be configured for different networks. It can be configured for dynamic IP address retrieval using DHCP or for using a fixed IP address. The default configuration is dynamic IP-address retrieval using DHCP.

The base station can also be configured for using a virtual LAN (VLAN), which is the recommended configuration as a dedicated VLAN for voice traffic in a corporate network can provide the optimal Quality of Service (QoS). No VLAN tag is enabled as default. VLAN can be configured during boot up via DHCP Option 132 (VLAN ID) and Option 133 (VLAN QoS).

Dedicated QoS settings in the IP packets for support of DiffServ and ToS can be enabled using the base station configuration page or Snom Provisioning.

The communication between the base stations is either IP multicast or peer-to-peer communication. IP multicast is the preferred option as it generates the least traffic, but it requires either a single IP subnet or IP multicast pass-through in the network switches.

Repeater placement recommendations

The antennas in the base stations are close to omnidirectional; there is no need to consider how the base stations face each other when deploying them. Recommendations for placement strategies:

- **Around corridors**. Base stations/repeater should be deployed vertically preferably at corridor intersections where propagation patterns follow the corridor patterns. In case there are high objects in the area, the base station/repeater should be installed above those objects.
- **Multi-story buildings**. Base stations and repeaters can be installed on opposite sides of the floors to take advantage of the floor-to-floor coverage. The coverage design cannot rely entirely on floor-to-floor propagation; each case must be verified due to variations in local attenuation patterns.
- **Large halls**. Base stations and repeaters can be deployed in large halls that contain a central open space area with windows to the other areas. This provides a good coverage for the rooms in the inner circle on all floors. In large halls, base stations/repeater should be installed vertically in the middle of the space below the ceiling.
- **Mounting positions**. When Base stations and repeater are mounted vertically on a wall, the radio coverage in front of these devices is twice as large as the coverage at the rear. The base stations should always be mounted higher that the obstructive objects in the area – e.g. minimum higher than 2m above floor. Repeaters should be installed in the middle of corridors and small rooms.
- **Metallic structures/objects**. Base stations and repeaters should not be deployed near large metallic objects. This includes metallic in shelves in warehouses.
- **Reinforced concrete structures**. These structures reduce signal strength dramatically inside the building. They reduce the radio coverage range of base stations and repeaters and therefore require a higher number of base stations or repeaters in the building. Lighter types of construction materials require fewer base stations since attenuation figures are considerably lower.

DECT deployment limitations

The M900 system is a very powerful DECT system. Unlike most competitors it does not require special controllers or licenses for building your DECT network. An installation can be extended with additional M900 base stations.

Due to the highly integrated system and the sharing of resources there are some limitations and things to consider while planning or extending an existing installation.

- One base station is the primary base station which will organize and manage the installation and synchronize the secondary and lower-level base stations within the network topology.
- Outgoing from the primary base station, up to 23 additional base station levels can be installed, i.e., up to 24 levels in a line (row) including the primary.

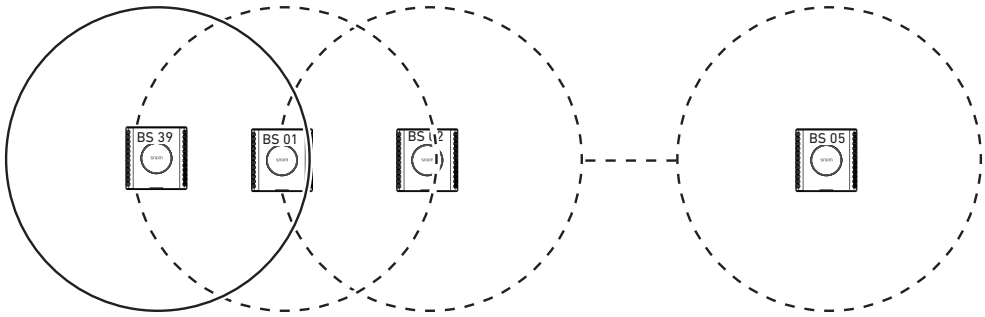
- Each base station can handle 8 narrow-band or 4 wide-band calls in multicell operation.
- Single-cell base stations can hold up to 30 users. In a multicell installation, users exceeding 8 per unit will be distributed between base stations.

DECT network deployment considerations

To deploy a multicell DECT network, there are some requirements to follow and some limitations to consider. A multicell DECT network is based on a primary/secondary architecture. The primary base station will ensure that all the secondary ones receive the network layout. This means the secondary cells are synchronized and "aware" of each other to allow seamless handover for the handsets.

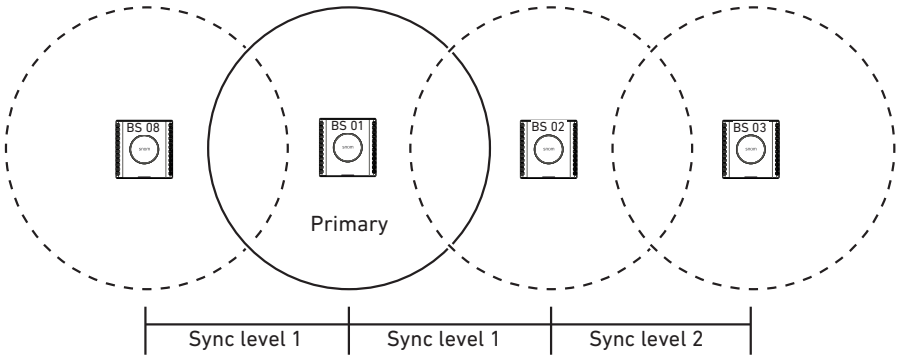
A maximum of 24 sync levels are supported. Starting from the sync primary (level 1), you can deploy and cascade secondary base stations on 23 levels. For example, if you want to cover a long corridor, you would set up the primary base station in the middle, allowing the levels to cascade in both directions.

Case #1: Synchronization chain with one primary sync.

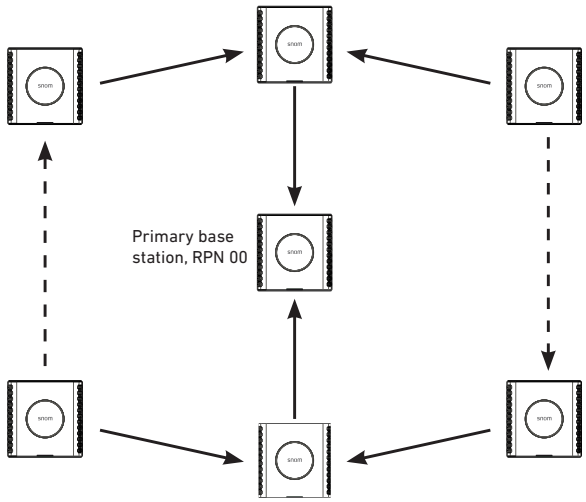


BS 39: Primary base station, RPN 00
BS 01: Secondary base station, RPN 04
BS 02: Secondary base station, RPN 08
BS 05: Secondary base station, RPN xx

- The synchronization chain must always overlap with other base stations in order to latch each other.
- A maximum of 24 sync levels (including the primary) can be used in a deployment.
- The secondary base stations and the repeaters are connected to the sync primary through the synchronization chain.
- If one of the base stations or repeaters in the sync chain is broken or not working, then the units that follow the non-working device are cut off from the sync chain, and air-interface synchronization can be lost. When the air interface synchronization is lost, handover between the two clusters is not possible.
- Sync level concept:



Case #2: Synchronization chain without alternative sync paths

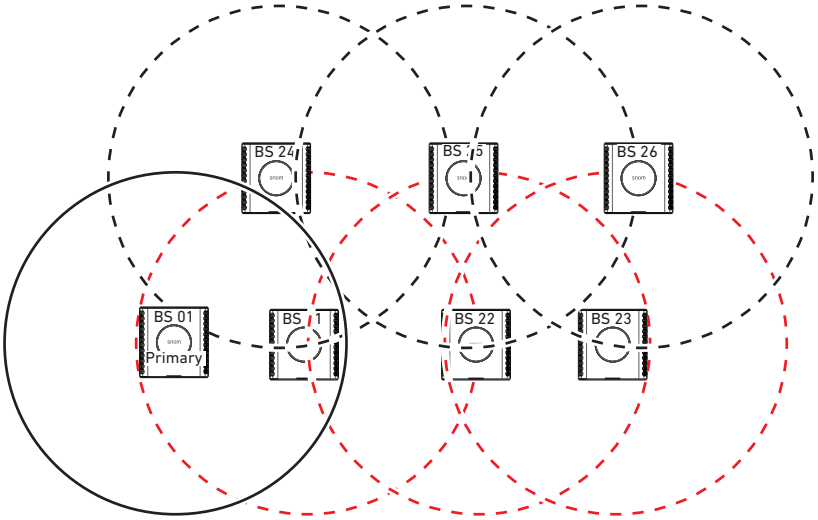


***Continuous line**: Shows the primary sync paths, with the relevant base stations chained in the multicell network.*
***Dotted line:** Alternative sync paths if base station within range.*

Depending on the system setup, we recommend placing the primary sync source in the middle of the building and to assign numbers/addresses, radio ID (RPN), etc. to each base station or repeater for easy identification.

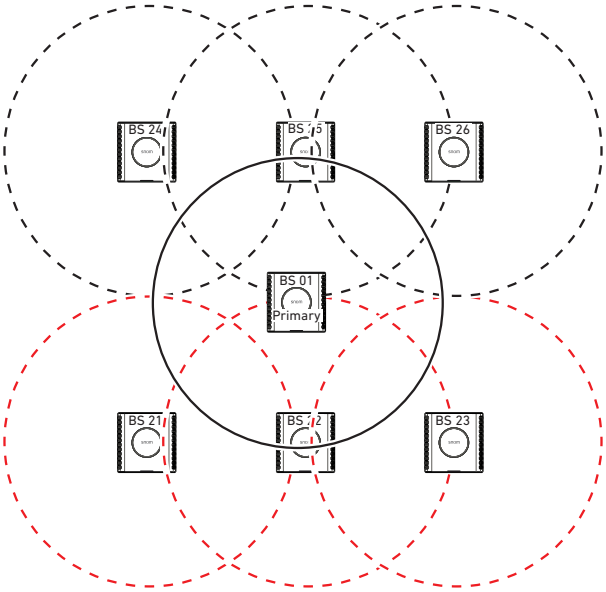
Case #3: Synchronization chain with alternative sync paths

The illustration below shows a multicell network with alternative synchronization paths. When one base station fails, handovers of handsets to other active cells can still be performed except in the area covered only by the failed base station.



Case #4: Synchronization chain without alternative sync paths

In this setup, the failure of one base station will affect the further levels of the topology.



- If BS 25 fails, BS 24 and BS 26 cannot reach primary base station BS 01 directly or via another base station and are cut off from the sync chain.
- If BS 22 fails, BS 21 and BS 236 cannot reach primary base station BS 01 directly or via another base station and are cut off from the sync chain.

Installation

Start with the intended primary base station. Update and reset all base stations prior to installing them in a multicell setup.

Note:

- Secondary base stations must be reset to defaults.
- They cannot contain any (SIP) server inputs.
- Disable the plug-and-play option in the Network menu to prevent an automated setup of a (SIP) server if you have related DHCP options running in your network.

Setting up the system

By default, the system uses the first registered base station as the primary base station. For the information on setting up a SIP server, creating user accounts, and registering handsets, see the M900 Admin and Installation Guide on https://service.snom.com/.

Settings for this unit

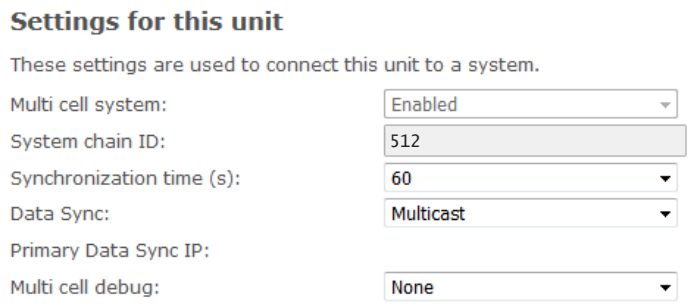


Fig. 1

Setting	Default value	Description
Multicell system	Disabled	Enable this option to allow the base station to be set in multicell mode (can be set either as primary or secondary in the multicell chain system – refer to MAC units in Chain section for details). **Valid Inputs**: Disabled, Enabled **NOTE**: The base station must be rebooted after the multicell system is enabled.

Setting	Default value	Description
System chain ID	512	This is an identifier (in string format, e.g., 2275) that is unique for a specific multicell system. The system chain ID can be modified by provisioning only. The chain ID is used as a SIP account for check sync; it therefore **cannot have the same identifier** as a SIP account in use, e.g., for an extension. The default value is 512, which means extension 512 cannot be used unless the chain ID is modified. **Note**: There can be several multicell systems in the network. Up to 24 levels of base station chains are permitted in a setup. **Valid inputs**: Up to 5 digits.
Synchronization time(s)	60 sec.	This specifies the period in seconds when elements/ nodes (e.g. base stations) in a specific multicell system will synchronize to each other. If no keep-alive packets are received within a period of 2*NETWORK_SYNC_TIME, the base will be indicated as lost in the multicell configuration. The parameter is also used with the **Auto create multi primary** feature.
Data sync.	Multicast	Select between multicast and peer-to-peer data synchronization mode. Multicast uses UDP. The multicast port range and IP addresses used are calculated from the chain id. ◦ Port range: 49200 – 49999 ◦ IP range: 224.1.0.0 – 225.1.0.0 For multicast operation multicast/IGMP must be enabled on your switch(es). If it isn't, use peer-to-peer mode.
Primary data sync. IP	Blank	IP of base station data sync source – the base handling the data synchronization. When using multicast this base IP is selected automatically. The **data sync** feature uses the port range 49200 – 49999 **NOTE**: When using peer-to-peer mode, the IP of the base station used as data sync source MUST be defined. **NOTE**: Using peer-to-peer mode with a firmware version below 306 limits the system's automatic recovery feature as there is no automatic recovery of the **data sync**. source in peer-to-peer mode.

Setting	Default value	Description
Multi cell debug	None	When this feature is enabled the system catalogs low level multi-cell debug information or traces. **Options**: • **Data Sync**: Writes header information for all packets received and sent to be used to debug any special issues. Generates LOTS of SysLog signaling and should only be enabled for shorts periods when debugging. • **Auto Tree**: Writes ***states and data related to the*** Auto Tree Configuration feature. • **Both**: Both **Data Sync** and **Auto Tree** are enabled. • **Ieee1588 debug:** When the system is using LAN sync. **NOTE**: Debugging should not be enabled in a normal running system. Enable it only for debugging purposes.

1. On the web interface of the M900, click **Country** in the menu on the left side of the web interface to open the **Country/Time Settings**. Enter the relevant time parameters on this page and click **Save and reboot**. Make sure that the time server is working; the multicell feature will not work if it isn't.
2. Click **Multicell** in the menu on the left side of the web interface to open the **Multicell Settings**. Per default, the multicell system is disabled.
3. Select Enabled in the drop down menu of **Multi cell system**.
4. Enter the relevant values for **System chain ID** and **Synchronization time (s)** respectively.

   The system chain ID, for example 2275, is a geographically unique DECT cell identity allocated to bridge several base stations together in a chain.In one multicell installation all base stations must have the same system chain ID.

   The synchronization time (s) parameter is the window/period of time in seconds a specific base station synchronizes to the primary base station unit. The default is 60 (seconds).
5. Click **Save**.
6. Click **Home/Status** in the menu on the left side of the web interface to open the **Welcome** page.
7. Click **Reboot**.
8. Repeat steps 1–8 for each base station you want to add to the multicell system. It can take up to 5 minutes synchronization time to add a base station to a multicell system.

   The **Multicell Settings** page now shows the base stations synchronized together. By default, the system uses the first registered base station as the primary base station.
9. In the **DECT system settings** enable or disable the **Auto configure DECT sync option source tree** (see description in the table below).

   Note: Enabling this setting allows the network to automatically synchronize the multicell chain/tree.

   The DECT system RFPI parameter is normally recorded by the system (Fig. 2).

DECT system settings

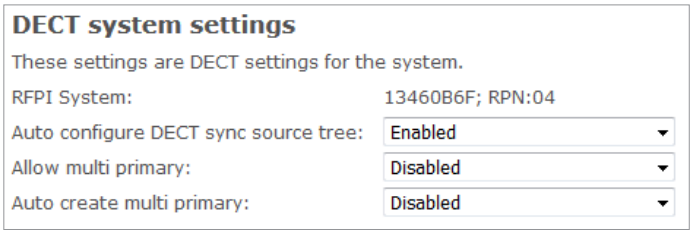


Fig. 2

Setting	Default value	Description
RFPI system		This is a radio network identity accessed by all base stations in a multicell system. It is composed of 5 octets, actually 5 different variables combined together.
Auto configure DECT sync source tree	Enabled	Enable this to allow the system to automatically synchronize the multicell chain/tree. **Note**: Must be enabled in order to allow a new primary to recover in case the original primary goes into faulty mode.
Allow multi primary	Disabled	This feature is used for multi-location setups. Allows two or more primaries in the same system. The two cells will be unsynchronized, and handover will not be possible. If **Auto Configure DECT sync source tree** is disabled, this setting is not available.
Auto create multi primary	Disabled	Enable this to allow the system to automatically synchronize the multicell chain/tree. **Note**: Must be enabled in order to allow a new primary to recover in case the original primary goes into faulty mode.

Note: To run a system with two separate primaries in two locations, **Allow multi primary** and **Auto configure DECT sync source tree** must be enabled. To add the second primary, it must be configured manually as a primary. Alternatively, the "Auto create multi primary" must be enabled.

After installing the multicell installation, you can switch to manual configuration of the synchronization source tree by disabling the **Auto configure DECT sync source tree** setting.

For the information on adding extensions to the system, see the M900 Admin and Installation Guide on https://service.snom.com/.

Parameters

The parameters of the **Settings for this unit** and the **DECT system settings** are described in the previous chapter, on page 11 and page 14, respectively.

Multi cell Settings

Multi Cell Status

System Information: Keep Alive
Last packet received from IP: 10.110. . 06-Feb-2020 10:49:20
Sync Data from IP: 10.110. .

Settings for this unit

These settings are used to connect this unit to a system.

Multi cell system: Enabled
System chain ID: 9001
Synchronization time (s): 60
Data Sync: Multicast
Primary Data Sync IP:
Multi cell debug: None

DECT system settings

These settings are DECT settings for the system.

RFPI System: 1346 ; RPN:04
Auto configure DECT sync source tree: Enabled
Allow multi primary: Disabled
Auto create multi primary: Disabled

Base station settings

Number of SIP accounts before distributed load: 4
SIP Server support for multiple registrations per account: Disabled (used for roaming signalling)
System combination (Number of base stations/Repeaters per base station): 254/0

Save and Reboot | Save | Cancel

Base Station Group

DECT sync source recovery: Restore saved tree / Save current tree

	ID	RPN	Version	MAC Address	IP Address	IP Status	DECT sync source	DECT property	Ieee1588 state	Base Station Name
☐	0	00	450.13	000413 3	10.110. .	Connected	Select as primary	**Primary**	LAN:Primary	Kitchen-6-M900
☐	1	01	450.13	000413E 5	10.110. .	Connected	Primary:RPN00 (-∞dBm)	Locked	LAN:ID:0	Printer-6-M900
☐	2	02	0	000413B 1	0.0.0.0	**Connection lost!**	(any) RPN		DECT:RPN:any	
☐	3	03	450.13	000413B 2	10.110. .	Connected	Primary:RPN00 (-∞dBm)	Locked	LAN:ID:0	SRV-6-M900
☐	4	04	450.13	000413B60053	10.110. .	This Unit	Primary:RPN00 (-∞dBm)	Locked	LAN:ID:0	Printer-7-M900
☐	5	05	0	000413B 4	0.0.0.0	**Connection lost!**	(any) RPN		DECT:RPN:any	

Check All / Uncheck All
With selected: Remove from chain

DECT Chain

Primary: RPN00: Kitchen-6-M900
- Level 1: RPN01: Printer-6-M900
- Level 1: RPN03: SRV-6-M900
- Level 1: RPN04: Printer-7-M900

Warning: RPN02.
Warning: RPN05.

Reboot chain | Force reboot chain | Reconfigure DECT Tree

Setting	Default value	Description
Multicell status		
System information	NA	This current multicell state of the base station whose WUI you are looking at.
Last packet received from IP	NA	IP address, followed by date and time received
Sync data from IP	NA	IP address of sync source
Base station settings		
Number of SIP accounts before distributed load	8	The maximum number of handsets or SIP end nodes that are permitted to perform location registration on a specific base station before load is distributed to other base stations. The parameter can be used to optimize the handset distribution among visible base stations. **Note**: A maximum of 8 simultaneous calls can be routed through each base station in a multicell setup. **Permitted input**: Positive integers (e.g. 6)
SIP Server support for multiple registrations per account	Disabled	Disable this option to allow using the same extension (i.e. SIP account) on multiple phones (SIP end nodes). These phones will ring simultaneously for all incoming calls. When a phone (from a SIP account group) initiates a handover from base station X to base station Y, it deregisters from base station X and registers to base station Y after a call. **Permitted input** **Disabled**: No SIP deregistration will be made when a handset roams to another base station **Enabled**: The old SIP registration will be deleted with a SIP deregistration when a handset roams to another base station
System combination (Number of base stations/ Repeaters per base station)	50/3	Select a basic base station configuration from the drop-down menu. The configuration cannot be modified after a system is established. It must be set during the initial multicell configuration. Options: **50/3**: 50 bases and 3 repeaters **127/1**: 127 bases and 1 repeater **254/0** : 254 bases and 0 repeater

Base station group	
Setting	**Description**
ID	Base unit identity in the chained network. **Permitted output:** Positive integers
RPN	The Radio Fixed Part Number is an 8-bit DECT cell identity allocated by the installer. The allocated RPN within the SME must be geographically unique. **Permitted output:** 0 to 255
Version	Base station current firmware version. **Permitted output**: positive integers with dot (e.g. 273.1)

Base station group	
Setting	**Description**
MAC address	Contains the hardware Ethernet MAC address of the base station. It varies from base station to base station.
IP status	Current base station behavior in the SME network. Possible outputs: **Connected**: The relevant base station(s) is online in the network **Connection Loss**: Base station unexpectedly lost connection to network **This Unit**: Base station whose web interface is currently being accessed
DECT sync source	With the setting **Auto configure DECT sync source tree** enabled, this tree will be generated automatically. If the setting is disabled, the tree can be configured manually, and the administrator must choose the relevant multicell chain level for each base station. The maximum number of multicell chain levels is 24. Format of the selection: **AAAAAxx: RPNyy (-zz dBm)** • AAAAAxx indicates the sync source of the base station. Can be "Primary" or "Level x" (Level 1, Level 2, etc.) • yy indicates the RPN of the sync source, i.e., 00,01, 02, etc. • zz indicates the RSSI level of the sync source as seen from the base station whose web interface is currently being accessed. • "(Any) RPN" indicates that the base station is not synchronized to another base station, e.g., loss of connection or the state after a reboot of the chain.
DECT property	Base station characteristics in connection to the current multi cell network. Possible output(s): **Primary**: Main base station unto which all other nodes in the chain synchronizes to. **Locked**: The base station is currently synchronized and locked to the primary base station. **Searching**: The base station is in the process of locating a primary/ secondary as specified in the **Dect sync source** **Free Running**: A locked base station that suddenly lost synchronization to the primary. **Unknown**: No current connection information from the base station **Assisted lock**: The base station has lost its DECT sync source and is using Ethernet for synchronization. **Sync. Lost**: The handset has an active DECT connection to the base station but the base station has lost its DECT sync source connection. The base station will continue to work as long as the call is active and will go into searching mode when the call has been terminated.
Ieee1588 state	Indicates whether the base station is the primary or a secondary sync source.
Base station name	Name of base station set on **Management Settings** page

DECT chain

Below the base station group table is the DECT chain tree, a graphical presentation table levels and connections of the base station group (Fig. 1 and 2). Repeaters are highlighted in green (Fig. 2), unconnected units in red (Fig. 3).

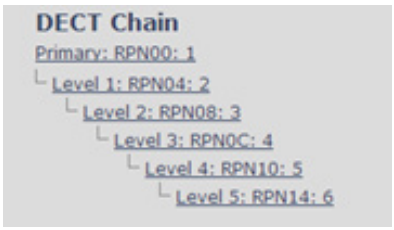


Fig. 1

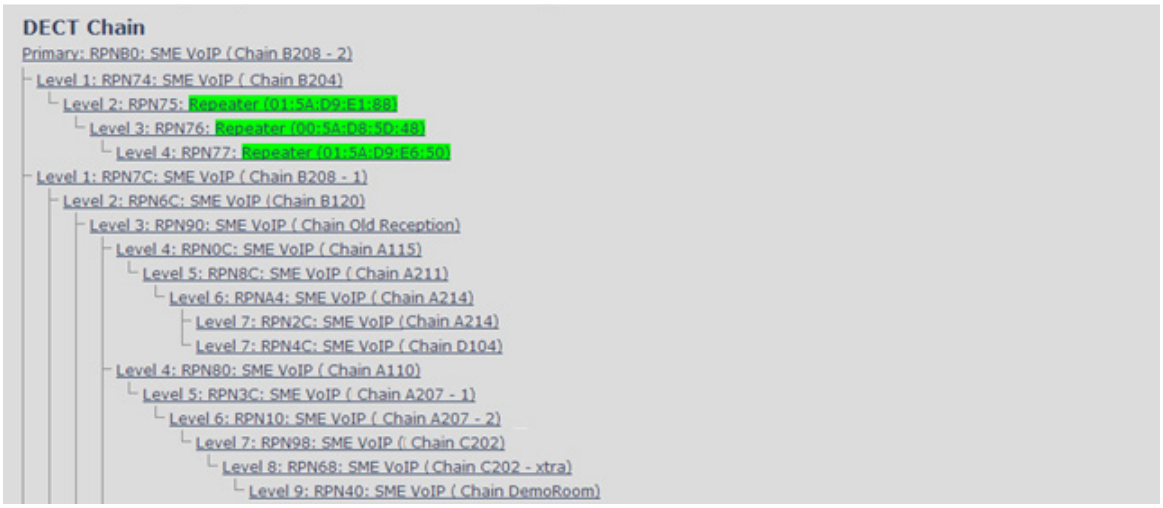


Fig. 2 - Part of DECT chain tree with repeaters

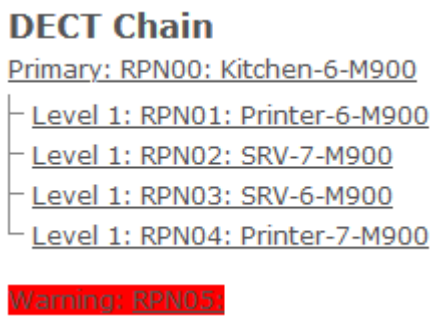


Fig. 3 - DECT chain tree with lost/unconnected unit

LAN sync–IEEE1588 (Precision Time Protocol (PTP))

The implemented standard is IEEE1588-2008. PTP is using multicast for message transport. A multicast IP and port have been standardized.

- PTP defines
  - a domain number embedded in each datagram, which makes it possible to run 128 parallel systems. PTP defines a PTP-Primary role (primary) and a PTP-Secondary role (secondary).
  - The role can be auto negotiated or forced by configuration.
- Only one primary device can be active within a PTP domain. The device with the primary role dictates the synchronization, and the devices with the secondary role try to follow as closely as possible.
- PTP uses the IP network to keep synchronization between the devices.

Overview

IEEE1588 network requirements

In order to minimize the impact from other devices on the network, the installation should comply with the following requirements for the network infrastructure, and it should use a backbone network.

- A maximum number of 3 cascaded Ethernet switches are supported between the primary device and secondary devices.
- Only switches fulfilling IEEE1588's requirements for Ethernet synchronization are recommended and officially supported.
- All base stations must be connected to a dedicated DECT VLAN.
- The DECT VLAN must be configured to the highest priority in all switches that are connected to the DECT infrastructure.
- The backbone network load should not exceed 50 percent of the total link capacity.
- The Ethernet switch must be able to use Differentiated Services Code Point (DSCP) as QoS parameter. DSCP is a packet header value that can be used, for example, to request high priority or best-effort delivery for traffic.
- The network must support multicast datagrams from IEEE1588.

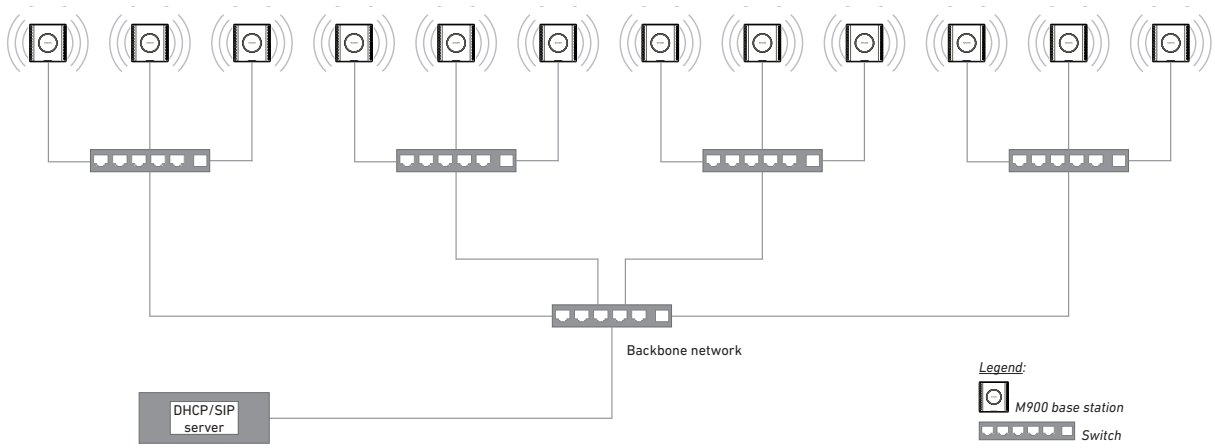


Fig. 1 – Good network topology

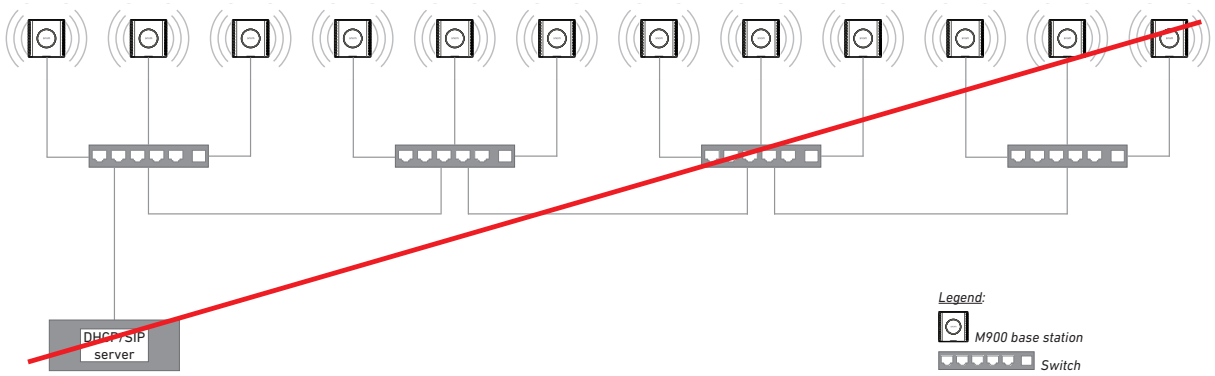


Fig. 2 – Bad network topology

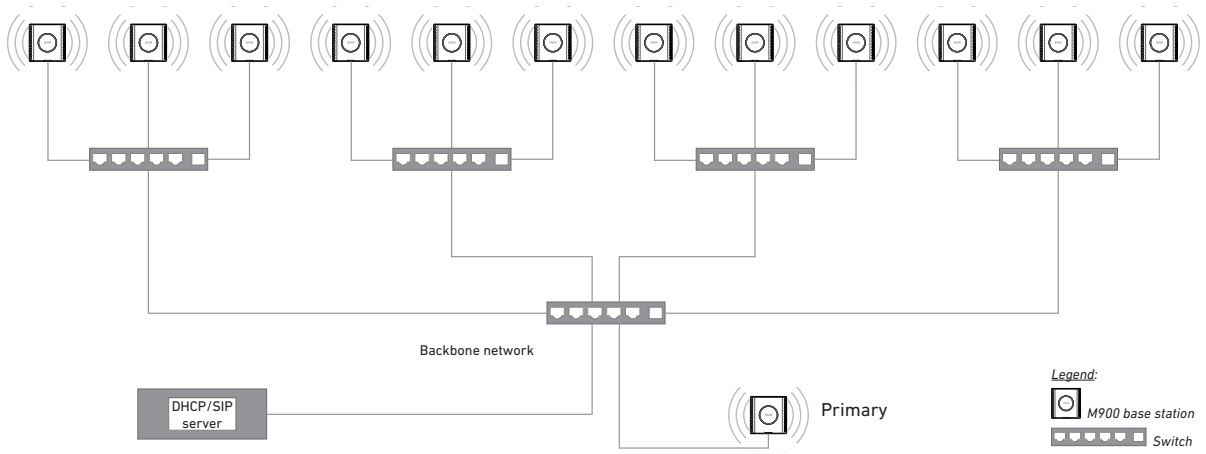


Fig. 3 – Best location for primary base station

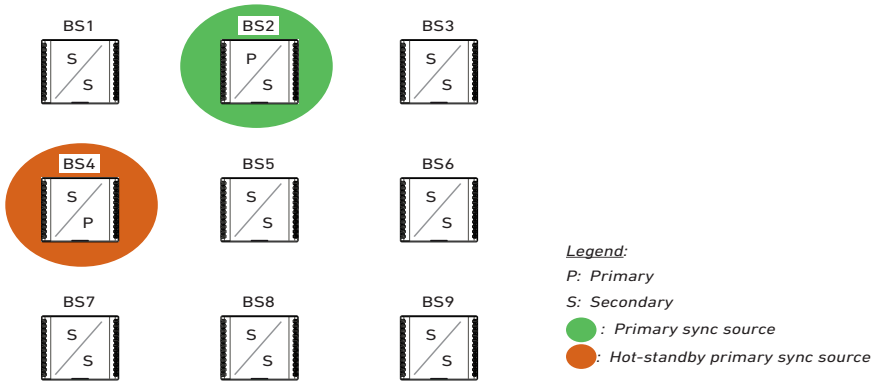
Network delays

PTP is sensitive to rapid changes in network delays. Possible causes of network delays:

- Rapid fluctuations in the network delay were caused by a backup job in another VLAN.
- The DECT VLAN was not configured to high priority.
- The sync offset between base stations was reaching critical levels.

IEEE1588 redundancy

To minimize the risk of losing sync when the primary device is experiencing a serious failure, set up an extra backup primary, running in hot-standby as fallback.



- Each base station has two instances of PTP running in separate domains.
- If sync is lost, each base station will automatically switch to the standby primary to maintain sync.
- If the failing primary device does not recover, a new primary device is auto-negotiated, and the other base stations will start using this device as sync source.

Sync deployment

When using DECT, each base station must be able to listen to another base station to maintain sync (see the illustration for "Case #3: Synchronization chain with alternative sync paths" on page 10). When using PTP, the distance between base stations can be greater since they do not need to listen to other base stations to maintain sync (Fig. 1, below).

> **Please note,** however: Whether you are using DECT or PTP, handsets must always be **within range of both** base stations for handover between those base stations.

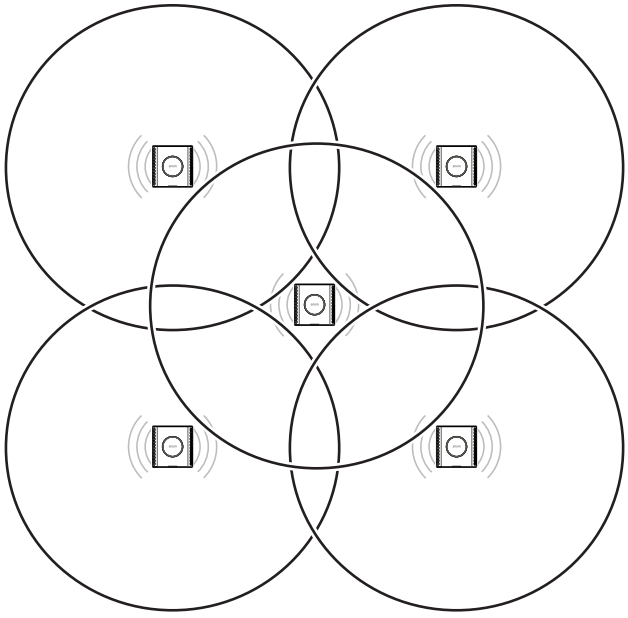


Fig. 1

LAN sync configuration

When LAN sync is being used, the status of the connected base stations is shown in the **Ieee1588 state** column of the **Base station group** on the **Multicell Settings** page (Fig. 1). The configuration is done on the **LAN sync** page (Fig. 2).

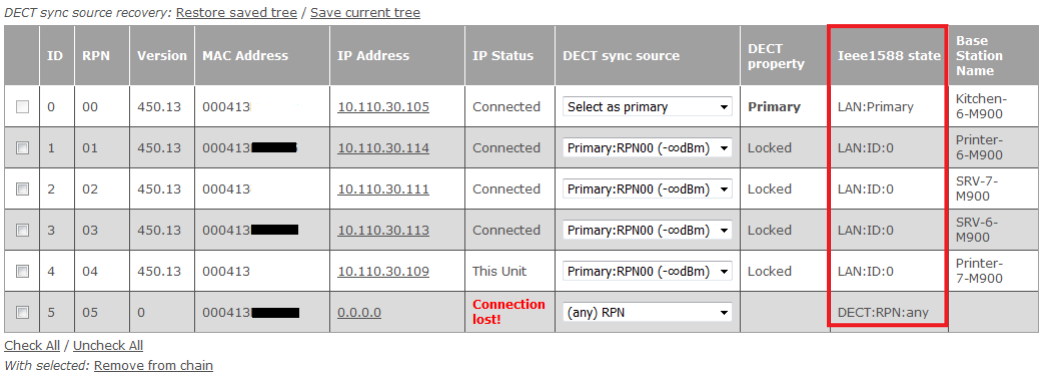


Fig. 1

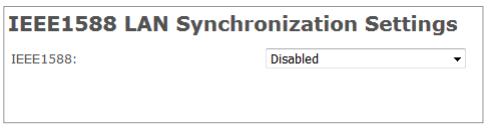


Fig. 2

1. Enable LAN synchronization in the drop-down menu of IEEE1588 (Fig. 2). The LAN sync settings appear (Fig. 3).

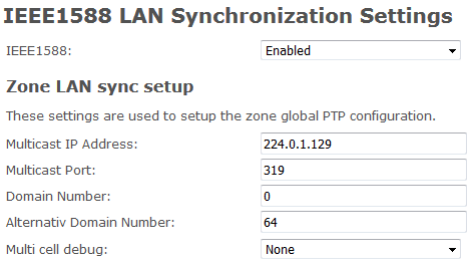


Fig. 3

2. Enter the applicable parameters as described in the below table and click **Save and Reboot**.

LAN synchronization parameters		
Setting	**Default value**	**Description**
Multicast IP address	224.0.1.129	IP address of the multicast group. • The IP address **must** start with 224.0.xx.xx. This cannot be changed. • To be compliant with IEEE1588, this port must be the default value. • Before setup, make sure no other device uses the given IP.
Multicast port	319	Defines the port that the system must communicate on. To be compliant with IEEE1588, this port must be the default value.

LAN synchronization parameters		
Setting	**Default value**	**Description**
Domain number	0	The domain number is used to set the domain this specific base station belongs to. **Valid input**: 0-127
Alternative domain number	64	The alternative domain is used only when the primary sync source from the main domain fails. In this case, the base station will sync with the alternative domain. It must have a different value than the domain number. **Valid input**: 0-127
Multicell debug mode	None	Enable this feature if you want the system to catalog low level multicell debug information or traces. **Options**: **Data Sync**: Writes header information for all packets received and sent to be used to debug any special issues. Generates LOTS of SysLog signaling and should only be enabled for short periods when debugging. **Auto Tree**: Writes states and data related to the **Auto Tree Configuration** feature. **Both**: Both **Data Sync** and **Auto Tree** are enabled. **IEEE1588 Debug**: Writes IEEE1588 debug information **NOTE**: Use this feature only for debugging. Do not enable it on a normal running system as it will slow it down considerably.

LAN synchronization

To join two or more base stations in a multicell system, you need to have one handset added to the system. For the information on how to add handsets, see the M900 Admin and Installation Guide and the User Manual M70/M80/M90 Handsets.

3. The **LAN sync** page also has a base station group table (Fig. 4) where you can assign the preferred role of each base station (primary, alternate primary, secondary). The default setting is automatic assignment (Fig. 5).

Base Station Group

ID	Status	Prefered Role	Current Role	Sync Source	Alternativ Sync Source	Network Jitter [ns] (min/avg/max)	Network Delay [ns] (min/avg/max)	IP Status	Base Station Name
0	**Primary**	Automatic	Primary	LAN:Primary	LAN:ID:1	(0/0/0)	(0/0/0)	Connected	Kitchen-6-M900
1	Locked	Automatic	Secondary	LAN:ID:0	LAN:Primary	(460/573/639)	(21868/21897/21960)	Connected	Printer-6-M900
2	Locked	Automatic	Secondary	LAN:ID:0	LAN:ID:1	(409/476/563)	(20119/20141/20223)	Connected	SRV-7-M900
3	Locked	Automatic	Secondary	LAN:ID:0	LAN:ID:1	(314/327/469)	(12677/12684/12797)	Connected	SRV-6-M900
4	Locked	Automatic	Secondary	LAN:ID:0	LAN:ID:1	(420/508/579)	(20214/20257/20314)	This Unit	Printer-7-M900
5		Automatic	Off	DECT:RPN:any	N/A	(0/0/0)	(0/0/0)	**Connection lost!**	

Fig. 4

Base Station Group

ID	Status	Prefered Role	Current Role	Sync Source	Alternativ Sync Source	Network Jitter [ns] (min/avg/max)	Network Delay [ns] (min/avg/max)	IP Status	Base Station Name
0	**Primary**	Automatic (Disabled / Primary / Secondary / Automatic / Alt. Primary)	Primary	LAN:Primary	LAN:ID:1	(0/0/0)	(0/0/0)	Connected	Kitchen-6-M900
1	Locked		Secondary	LAN:ID:0	LAN:Primary	(465/505/1226)	(21839/21910 /22214)	Connected	Printer-6-M900
2	Locked		Secondary	LAN:ID:0	LAN:ID:1	(397/437/1168)	(20112/20116 /20508)	Connected	SRV-7-M900
3	Locked		Secondary	LAN:ID:0	LAN:ID:1	(320/330/1171)	(12687/12706 /13134)	Connected	SRV-6-M900
4	Locked	Automatic	Secondary	LAN:ID:0	LAN:ID:1	(407/434/1183)	(20188/20236 /20602)	This Unit	Printer-7-M900
5		Automatic	Off	DECT:RPN:any	N/A	(0/0/0)	(0/0/0)	**Connection lost!**	

Fig. 5

LAN sync (IEEE1588) base station group parameters	
Setting	**Description**
ID	Base station identity in the chained network. **Permitted output**: Positive integers
Status	Base station status within the multicell network. Possible output(s): **Primary**: The base station all other nodes in the chain synchronize with. **Locked**: The base station is synchronized and locked to the primary. **Searching**: The base station is in the process of locating a primary/secondary as specified in DECT sync source **Free Running**: IEEE primary is found and DECT synchronizing
Preferred role	You can assign a preferred role from the drop-down menu. Options: **Automatic** - the status of the base station is assigned by the system automatically. **Primary** - the base station is the primary sync source. **Alt. primary** - the base station is the hot-standby primary, i.e., it will take over as primary sync source when the primary base station fails. **Secondary** - the base station is synchronized from the primary or another secondary on the next-higher level.
Current role	The current status of the base station, i.e., primary or secondary.
Sync source	Shows which base station this specific base station is synchronized with
Alternative sync source	Alternative sync source in case the main sync source fails
NWK jitter [ms] (min/avg/max)	Measures how the IEEE1588 packets are received - the lower the jitter, the better.
MWK delay [ms] (min/avg/max)	Measures the time (in ms) it takes an IEEE packet to travel from the primary to the secondary base station.
IP status	Current base station behavior in the SME network. Possible outputs: **Connected**: The base station is online in the network **Connection Loss**: The base station has lost connection to network **This Unit**: Indicates the base station whose web interface your are accessing
Base station name	Name assigned to this specific base station on its **Management settings** page

Debugging

Debugging parameters of base station whose web interface you are accessing	
Setting	**Description**
Outlier	TBA
Status	
DECT to IEEE 1588	
Rejects by outlier	
Messages	
DECT	
Frequence trim	

This Unit Debug

Primary instance, Active, PTP_SLAVE	
Outlier	Filters ready 1/1, Init runtime 109 s, Init restarts 3, Ready count 3, Init sampels used 49/51 of 111/109
Status	Offset 96 -19/-11/-3 ns, Delay 20193/20204/20213 ns, Jitter 456/465/497 ns, Sync time 0 d 08:58:19
DECTtoIEEE1588	1335/9/0/0
Rejects by outlier	Average 9/3 ‰, Total 0/0 of 124/135
Messages	Sync and follow up received 135/135, Delay req send and received 124/124
Dect	Time diff 631 -600/7/631 ns
Frequency trim	Reg 0x2f0/2e5, Factory default 0x2e5, FrequencyTarget 0x2ef
Secondary instance, Inactive, PTP_SLAVE	
Outlier	Filters ready 1/1, Init runtime 380 s, Init restarts 0, Ready count 1, Init sampels used 84/157 of 349/379
Status	Offset 129 -93/-89/-23 ns, Delay 21590/21596/21677 ns, Jitter 388/394/450 ns, Sync time 0 d 01:48:00
DECTtoIEEE1588	3/0/0/0
Rejects by outlier	Average 3/1 ‰, Total 0/0 of 123/134
Messages	Sync and follow up received 134/134, Delay req send and received 123/123