

How to Deploy SME VoIP System (Capacity Planning/Deployment)

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Document History

Revision	Author	Issue Date	Comments
0.1	MYA	28-Sep-2010	Initial Version
0.4	JMG	08-Nov-2011	Misc. updates
1.0			

Introduction

In this document we briefly describe the elements involved in planning and designing a typical SME VoIP system. Network planning and deployment process vary from region to region and this document provides the simplified design procedure.

Network deployment begins with the collection of network requirements of capacity, coverage and quality.

Intended Audience

The target audience for this document includes network administrators and anyone that will plan and design a typical SME VoIP network.

Abbreviations

For the purpose of this document, the following abbreviations hold:

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:	mu-law Pulse Code Modulation
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
STUN:	Session Traversal Utilities for NAT
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)

References

- [1]: How to Setup SME Network Version 0.3
- [2]: Adding Multiple Base station to Network Version 0.4
- [3]: Detail Description of Deployment Kit Version 0.1

Network Requirements

Network requirement is essential to determine elements necessary to achieve the overall expectations of the customer. Typical network requirements includes (but not limited to):

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

Deployment Considerations

The following radio related considerations must be examined before deploying a typical SME VoIP System. These includes (but not limited to):

Building Penetration:

When a signal strikes a building it is diffracted or absorbed; therefore to some extent the signal is reduced. The amount of absorption is dependent of the kind of building and its environment, the amount of solid structure. This is an important consideration in coverage planning.

Interference Sources:

Signals from receiving antennas are weakened by virtue of interference from other signals. These signals may be from the same network or other man-made objects. A well planned SME VoIP system installation should identify potential interference sources for optimal placement of Base stations and repeaters.

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 amount 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 30-40m.

Capacity Planning

This is where the Network provider estimates how many calls will be initiated in a typical window/time frame and how many users will be initiating them.

Based upon the expected usage patterns and voice codes requirements the cell capacity can be estimated using the table below:

Traffic (Erlang)	Narrowband base		Wideband base	
	No of users		No of users	
GoS	1%	2%	1%	2%
0.05	65	74	19	23
0.10	34	38	10	13
0.15	23	26	7	9
0.20	18	20	6	7

The maximum cell capacity is indicated in the table below:

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

The total capacity in the coverage area of a base station and one or more repeater's, is always limited to the capacity of the base station.

Site Planning / Cell Coverage

The actual cell coverage in an installation can be determined using a special handset feature, which can establish an audio loop back connection to a specific base station.

Setting up the base

The base can be used in two ways for the deployment:

1. As a standard base station connected to an Ethernet Network.
2. As a standard base station, where the Ethernet connection is not used.

Setting up the handset

Before starting the deployment measuring make sure the handset is fully charged. As well manually read the MAC address on the base labels on the back side for the base to be used with the handset. The handset does not need to be pre-registered to a particular base.

1. Press "Menu" key followed by the keys: *47* to get the handset into find bases menu.

2. Use the cursor down/up to select the base MAC address for the base
3. Press right softkey “ok” to select the base. Press left softkey “Cancel” to cancel the operation.
4. The handset display will show the “RSSI” level of the base.
5. By pressing “hook off” key (green key) an audio loopback connection will be established with the base station.
6. By plugging in a headset modified for a 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 reading the RSSI levels of the display.
7. Alternatively press the center softkey “Tone” to send a tone to the base – and get the tone playback for the earpiece/speaker or plugged in headset. Press softkey “Tone off” to stop the tone play.

Handset coverage planning

The purpose of this section is to shortly describe how to plan the base position and handset coverage from this position.

- Place the RTX86xx base station exact at the desired position and power on the base.
- Set up the handset as described in section 1.3.
- Use the building plan drawing and check the base station coverage using the handset and headset music signal. Mark up the acceptable spots and non-acceptable spots on the plan drawing. As well note the RSSI level from the base.

Placing 2nd base station

In order to place the 2nd base station:

- Place the 1st RTX86xx base station exact at the desired position, and power on the base
- Set up the handset as described in section 1.3.
- Use the building plan drawing and check the base station coverage using the handset RSSI levels. Mark up the acceptable spots and non-acceptable spots for placing the 2nd base station on the plan drawing. Acceptable spots are spots where the handset shows RSSI levels better than -75 dBm.

Typically, installations such as office buildings, hotels and hospitals should be equipped with both base stations and repeaters on several floors to create uniform and complete radio coverage. 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 Network

The SME system can operate using a variety of the IP network settings, allowing it to be configured for different networks.

The base station can be configured for either dynamic IP-adr retrieval using DHCP or setup for usage of a fixed IP-adr. The default operation is dynamic retrieval.

The base station can also be configured for usage of a virtual LAN (VLAN), which is the recommended configuration, as a dedicated VLAN for voice traffic in a corporate network will provide the most optimal Quality Of Service (QoS). No VLAN tag is enabled as default.

Dedicated QoS settings in the IP packets for support of DiffServ, ToS and also be enabled using the base station configuration page.

The communication between the base stations and be configured as 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.

Base station/Repeater Placement Strategy

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

There is no one strategy for deploying base stations. These are some recommended Base station and/or Repeater 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-Storey 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 (e.g. hotels).

In large halls, Base stations/repeater should be installed vertically in the middle of the space below the drop 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 than 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.

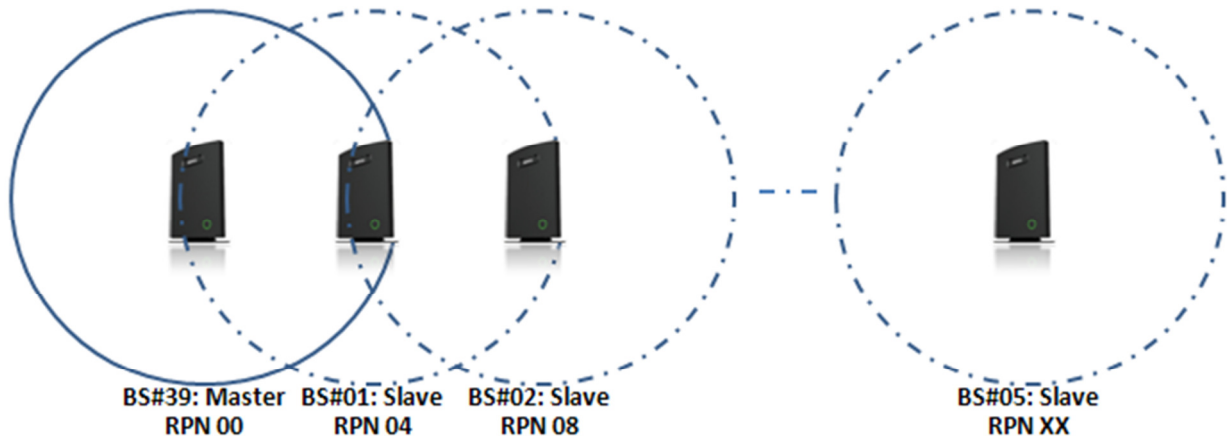
Reinforced Concrete Structures:

These structures have a high attenuation factor inside the building. They reduce the radio coverage range of the 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.

Deployment of SME VoIP Network

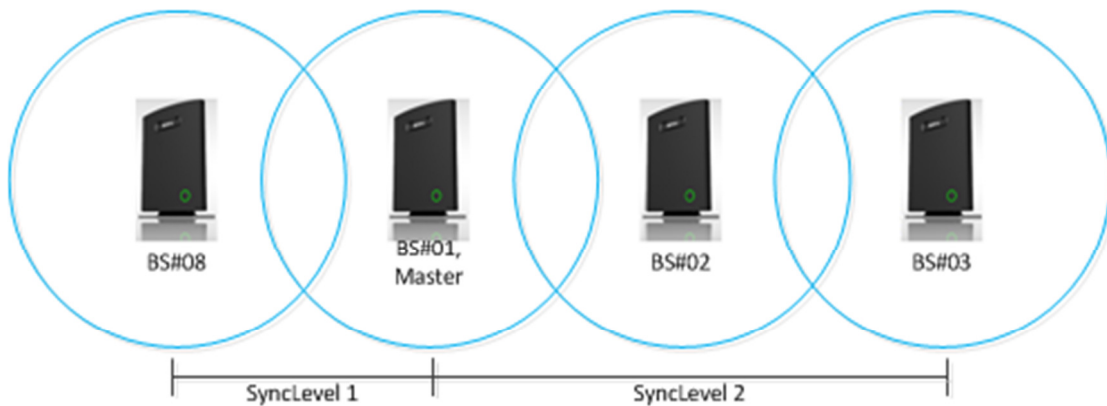
In this chapter we provide short description of practical cases of how SME VoIP network can be deployed.

Case ##1: Synchronisation Chain with One Master Sync.

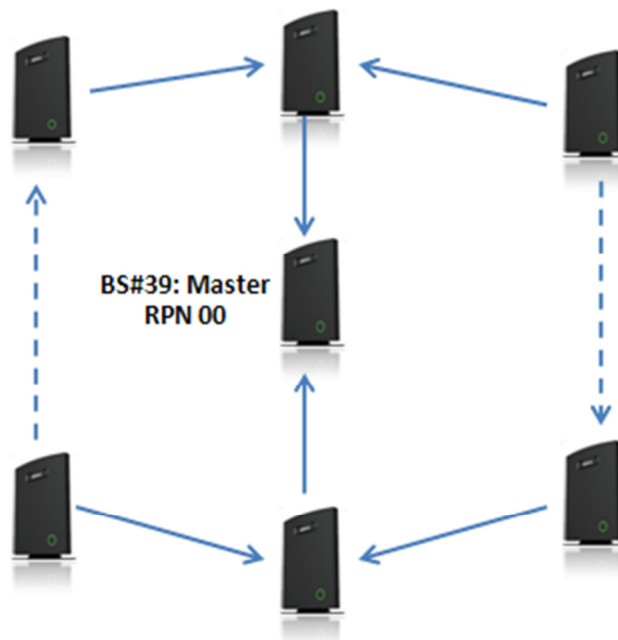


- The Synchronisation chain must always overlap with other Base stations in order to latch each other in Sync.
- In this illustration Base station ##39 is the Sync Master
- A maximum of 7 sync levels (Including the master bases) can be used in a deployment.
- The other slave base stations or repeaters are connected to the Sync Master through the synchronisation chain
- If one of the base or repeater units 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.

The sync level concept is illustrated below, where bases #08 and #02 are at sync level 1, and BS#03 is at level 2.



Case ##2: Synchronisation Chain without Alternative Sync Paths



- Assuming Master Sync source is Base station ##39. A maximum of 40 base stations can be deployed in one setup (depending on the network requirement not all base stations should be chained).
- A maximum of 7 sync levels can be used in any deployment.
- Depending on the system setup, it is recommended to place the Sync source Master in the middle of the building and to assign numbers/addresses, radio ID (RPN), etc. to each base station or repeater for easy identification.
 - Continuous line:** Shows the primary sync paths, with the relevant bases chained in the multi-cell network.
 - Dotted line:** Alternative sync paths.

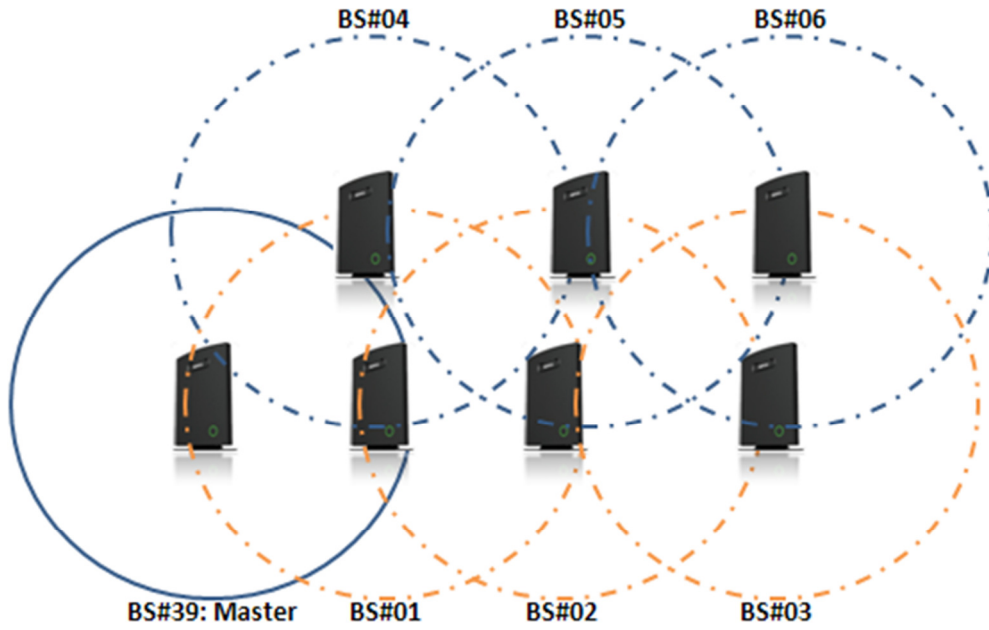
Case ##3: Synchronisation Chain with Alternative Sync Paths

The illustration below shows a multi-cell network with alternative Synchronisation paths. A failure of one base unit does not mean handset or users cannot perform handovers to other active cells.

BS#39 is the SYNC Master, if BS#05 is down, most user handovers can be formed via 3 other alternative cells (i.e. BS#06, BS#02 and BS#04) without any problems at all.

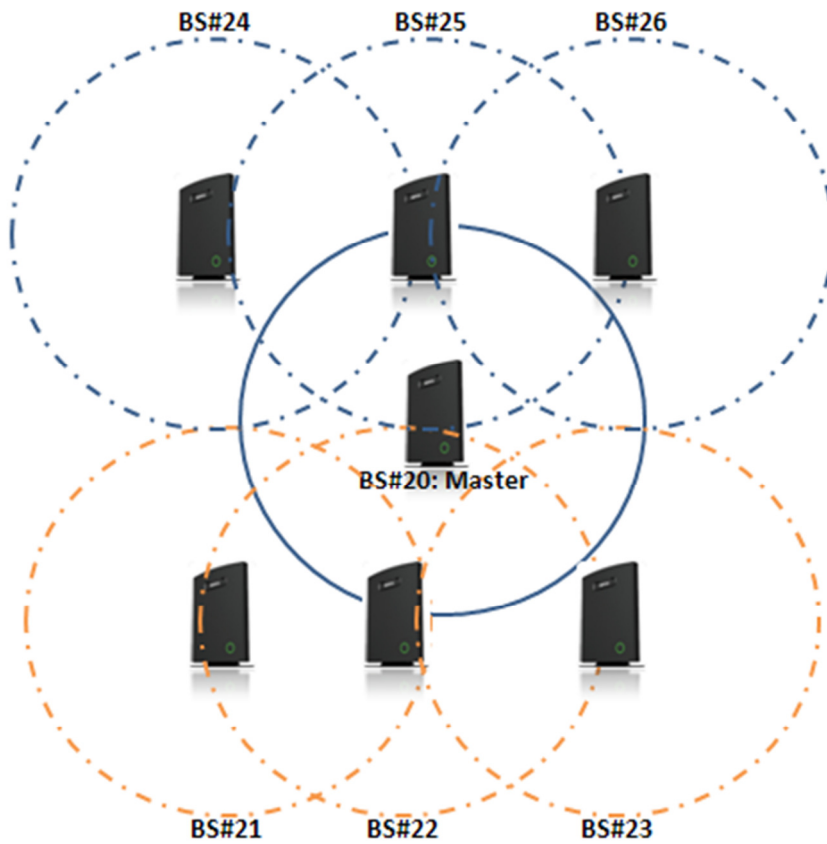
Furthermore observe the following:

- BS#04 and BS#01 are Primary with alternative sync to BS#39.
- BS#05 is primary sync to BS#04 while alternative sync is BS#01 or BS#02
- BS#03 is primary sync to BS#02 while alternative sync is BS#05 or BS#06, in that order



In the illustration below:

- BS#24 is primary sync to BS#25 while alternative sync is BS#20
- BS#22 is primary sync to BS#20 while alternative sync is BS#21 or BS#23, in that order



Verify Deployment

The actual synchronization RSSI may be read on the base webpage. It is recommended to have a RSSI value better than/equal to -75dBm, and never below -90dBm. Below is an example of this, which is a screen shot from the base station web page

Base Station Group

	ID	RPN	Version	MAC address	IP address	IP Status	DECT sync source	DECT Property	Base Name
<input type="checkbox"/>	0	00	110	00:08:7B:07:7C:C8	192.168.10.126	Connected	RPN: 68 (-47dBm)	Locked	SME VoIP (RTX Chain S104-1)
<input type="checkbox"/>	1	04	110	00:08:7B:07:91:CB	192.168.10.145	Connected	RPN: 68 (-52dBm)	Locked	SME VoIP (RTX Chain S104-2 Xtra)
<input type="checkbox"/>	2	08	110	00:08:7B:D7:91:3F	192.168.10.137	Connected	RPN: 48 (-73dBm)	Locked	SME VoIP (RTX Chain A110)
<input type="checkbox"/>	3	0C	110	00:08:7B:07:92:33	192.168.10.139	Connected	RPN: 14 (-43dBm)	Locked	SME VoIP (RTX Chain A115)
<input type="checkbox"/>	4	10	110	00:08:7B:07:92:50	192.168.10.129	Connected	RPN: 08 (-45dBm)	Locked	SME VoIP (RTX Chain A207)
<input type="checkbox"/>	5	14	110	00:08:7B:07:7C:FF	192.168.10.107	Connected	RPN: 08 (-62dBm)	Locked	SME VoIP (RTX Chain A211)
<input type="checkbox"/>	6	18	110	00:08:7B:D7:91:6E	192.168.10.105	Connected	RPN: 44 (-77dBm)	Locked	SME VoIP (RTX Chain A214)

Figure 1: Example of DECT synchronization chain