Aastra SIP-DECT™

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Agenda:

- Who is Aastra?
- DECT Overview
- Aastra SIP-DECT™ System Components and Architecture
- Design Considerations
  - Wireless Propagation
  - Capacity Planning
- SIP-DECT and Asterisk

Aastra Technologies Limited

- **Enterprise telecommunication equipment company**
- **Full range of voice solutions, servers, gateways, terminals and advanced software applications**
- **Headquarters in Toronto, Canada**
- **1700 employees Worldwide**
- **Stock Exchange**
  - **TSX.AAH**
- **Balance Sheet (Q1/07):**
  - **Cash - $123 million (no debt)**
- **Operation (2006):**
  - **Revenue - $601 million**
  - **Net profit - $42 million**

Aastra Growth and Time Line

January 2000	» Assets of **Nortel Networks** Access Solutions Division
May 2001	» **Nortel** Centrex and ISDN Terminals
September 2001	» **Lucent** Digital Video Division
December 2001	» **Ericsson** Cable Modem
May 2002	» **Nortel** CVX & CSG Division
September 2003	» **Ascom** PBX System Division
March 2005	» **EADS Telecom** PBX System Division
August 2005	» **DeTeWe**

DECT Technology

DECT: What is it?

- **Digital Enhanced Cordless Telecommunications**
- Cordless Technology designed for:
  - High capacity cellular structured access network
  - Network wide mobility
  - Reliable - high quality and secure - radio access
  - Robustness even in hostile radio environments
  - Speech transmission quality comparable to the wired telephony service
  - Cost efficient implementation of system components
  - Allowing for implementation of a wide variety of terminals
- Unlicensed use, frequency dedicated to DECT
- Voice concepts designed in from the very beginning
- Mature Standards used extensively in Europe for 10+ years.

DECT: Some History

- Activities started 1986 in ESPA (European Selective Pager Association)
- 1987: Many key events:
  - EC Green Paper on Common Market
  - “Battle of technologies”
  - CEPT decides on frequency band and radio access technology
- 1988: newly created ETSI takes over activities
- 1992: first set of standards approved
- 1993: first products hit the market
- 1995 until now: Constant extension of features:
  - DECT / GSM Integration
  - Medium and high data rates
  - Packet mode
  - Messaging SMS, EMS, MMS
  - DECT / 3G Integration

DECT in North America

- DECT protocol has been adapted to the 2.4 GHz unlicensed frequency with a limited spectrum (WDCT). Available in NA for many years.

- Las Vegas, NV, January 5 2006.

  The DECT Forum, the globally acting industry association embracing suppliers and operators of DECT based terminals, announces today the availability of DECT 6.0 cordless telephony in the USA. DECT communication products utilize the appropriate frequency band of 1920 - 1930 MHz which has been allocated recently by the Federal Communications Commission (FCC) for Unlicensed Personal Communications Services (UPCS).

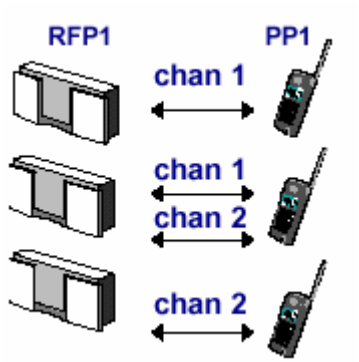
FAQ for WDCT and DECT

- **WDCT and the 480i & 57i CT:**
  - Worldwide Digital Cordless Telecommunications (WDCT) standard which is a variant of DECT standard.
  - Adaptation to DECT to comply to FCC & Industry Canada regulations. “NA standard”.
  - 2.4 GHz range
  - 95 channels Time Division Multiple Access (TDMA)
  - Audio is transmitted at 32 kbps using the G.726 ADPCM coding ITU standard
  - No roaming support
  - Uses pseudo random channel hopping algorithm to jump between the 95 channels in the 2.4 GHz range to provide security and maintain voice quality for audio calls.

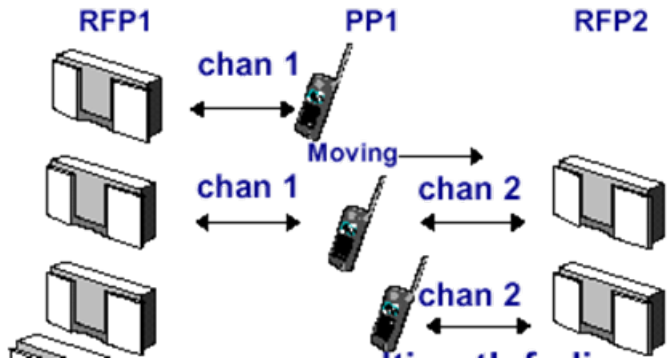
- **DECT and SIP DECT product:**
  - Digital Enhanced Cordless Telecommunications standard
  - 1.9 GHz range
  - 120 channels for Europe, 60 channels for NA
  - Time Division Multiple Access (TDMA)
  - Audio is transmitted at 32 kbps using the G.726 ADPCM coding ITU standard
  - Full roaming support with inter cell handover
  - Uses FDMA/TDMA/TDD technology
  - DECT uses dynamic channel allocation. DECT selects the least interfered channel at call setup, and stays on that channel unless a hand-off occurs. While on that channel, if a significant number of BER occur, the DECT phone will perform a intra-cell handoff to another channel.

DECT Handover

- Seamless handover: no communication disruption
- Intracell or intercell handover
- Initiated by the handset based on the quality of the current link



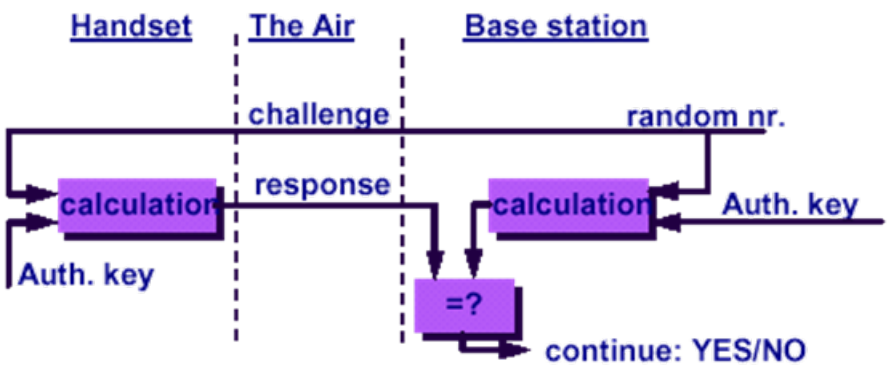
Intracell handover
(DECT & WDCT)



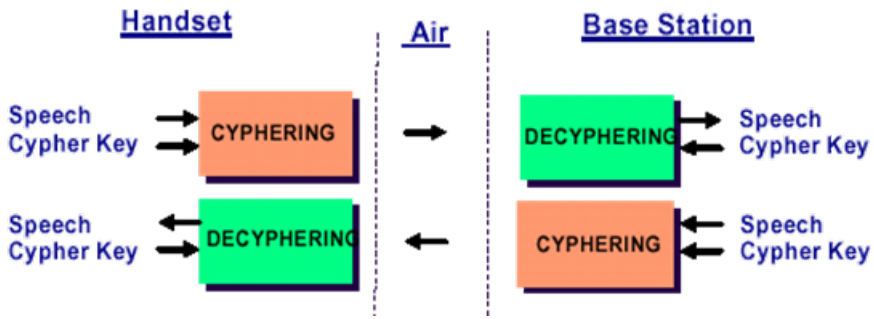
Intercell handover
(only DECT)

DECT/WDCT Authentication/Encryption

- Authentication
  - standard procedure at every call set-up
  - the base station checks the secret authentication key without sending it over the air.
  - the base station sends a random number to the handset that is called the ‘challenge’
  - the handset calculates a ‘response’ by combining the authentication key with the random information and transmits the ‘response’ to the base station

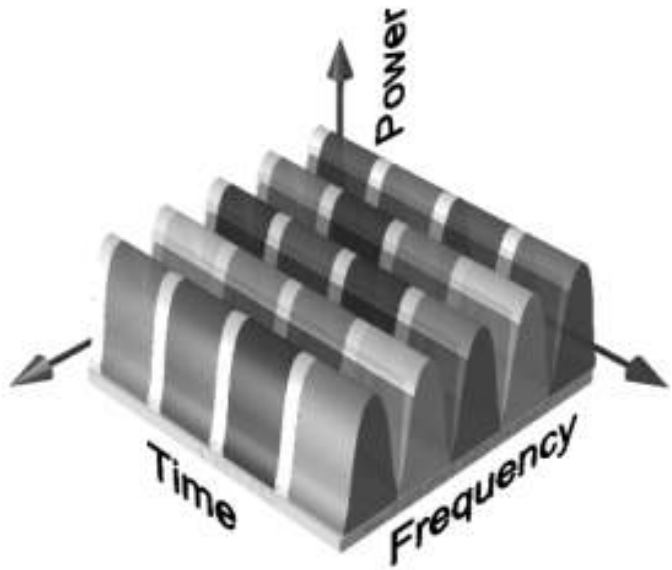


- Encryption
  - during authentication, both sides also calculate a cipher key.
  - this key is used to cipher the data sent over the air.
  - at the receiving side the same key is used to decipher the information
  - the ciphering process is part of the standard.



DECT Physical Layer

- **Key Attributes:**
  - Frequency division multiple access (FDMA)
  - Time division multiple access (TDMA)
  - Time division duplex (TDD)
  - Dynamic Channel Selection and Allocation



Aastra SIP-DECT™ overview

Aastra SIP-DECT™ solution

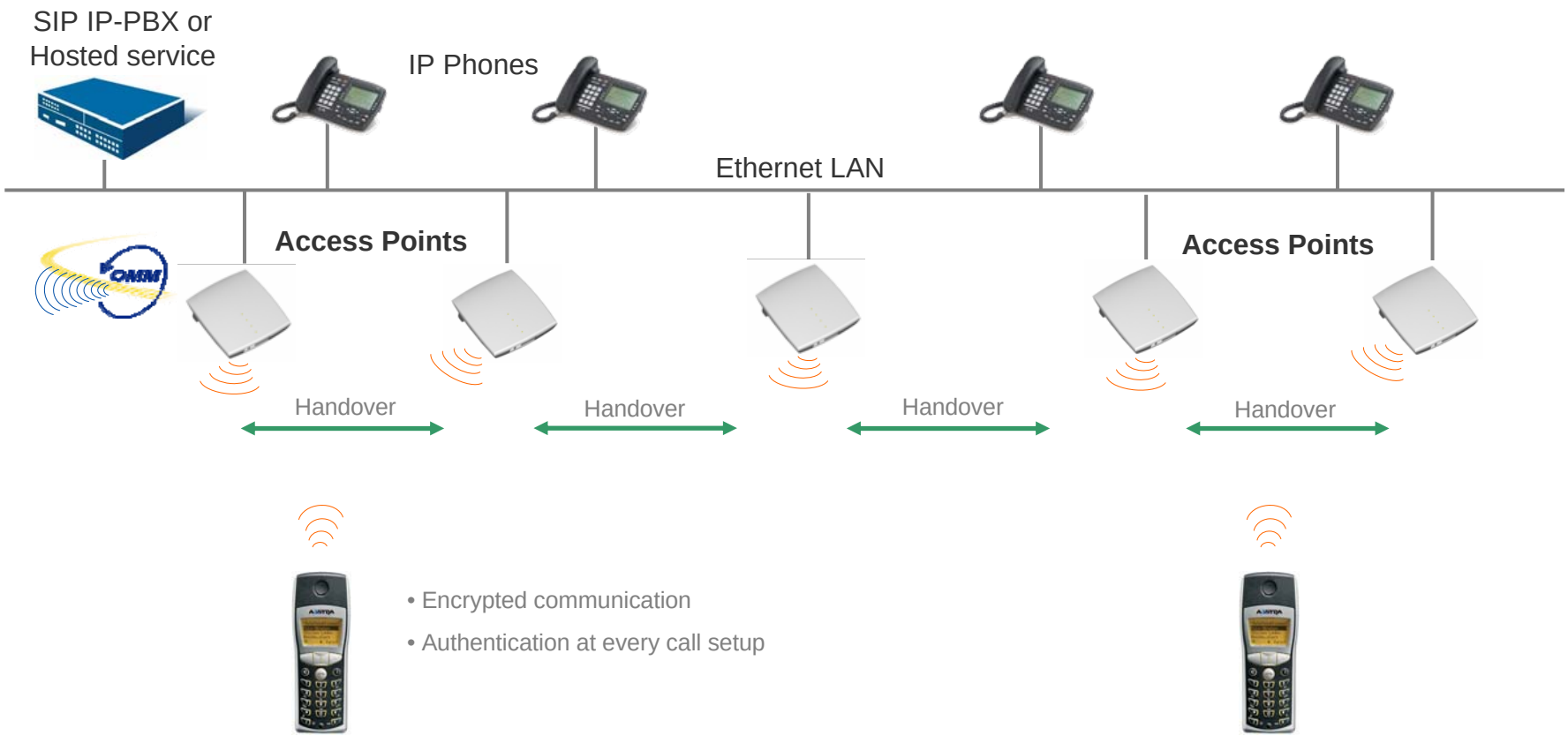
- Cordless SIP deployment using DECT
  - DECT standard in the 1.920-1.930 GHz range
  - Users are provisioned as SIP extensions
  - Fully featured enterprise class Handset
  - Indoor & Outdoor access points (RFP's)
  - Seamless handover between access points
  - Automatic roaming & registration of handsets
  - Digital quality - automatic best channel selection
  - DECT Authentication/Encryption
- No PBX required in the remote offices / locations
- Network size depends on the IP-infrastructure
  - 256 Access Points with upto 512 Handsets

Access Point RFP32

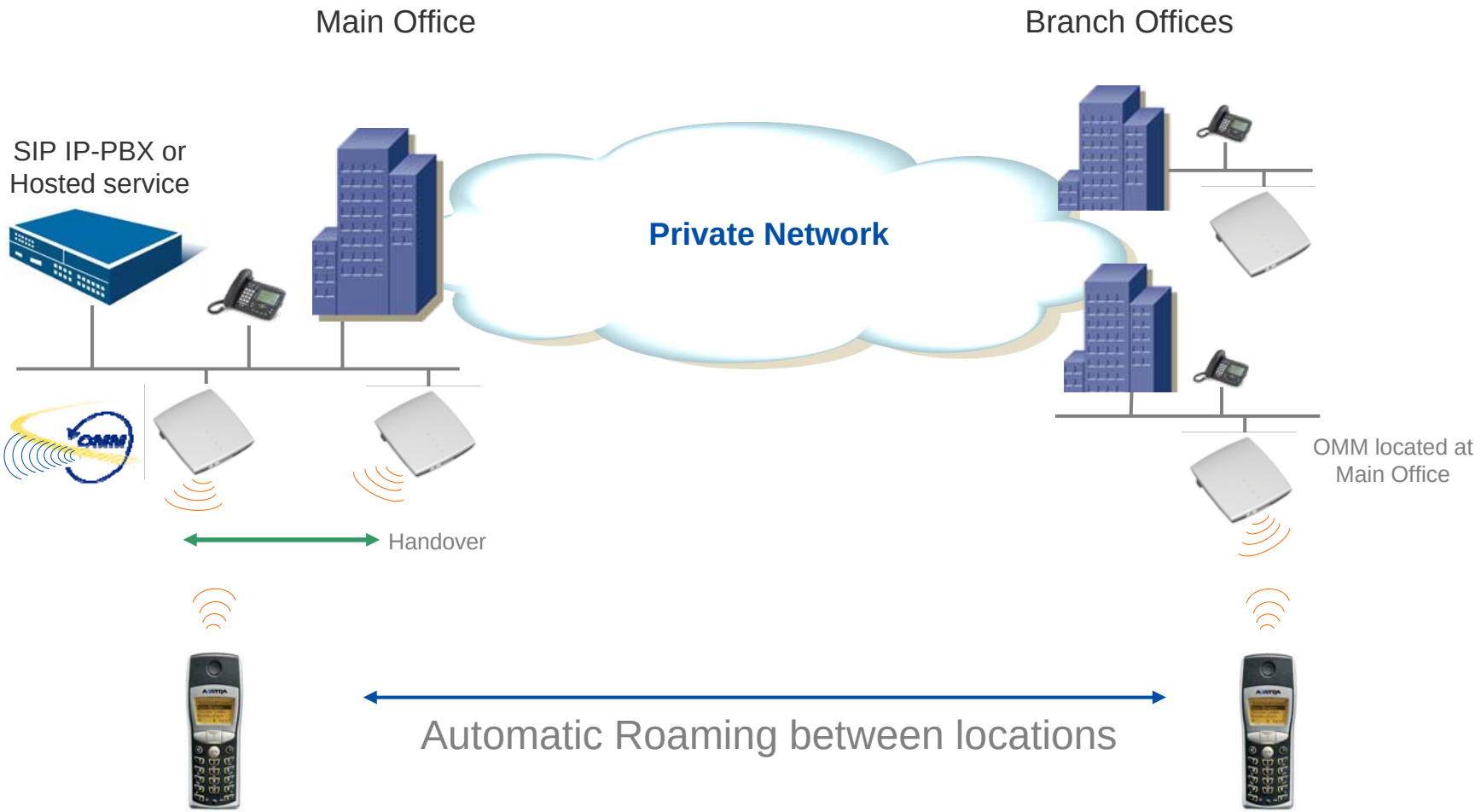
Example Market & Configurations

- Typical Single site
  - Virtually any business with a warehouse or stock room; Retail stores; Garages; Golf clubs, Gyms, Marinas, Supermarkets, etc
- Typical Multi-site
  - University campus, Hospital, Schools, Banks with branch offices, Government Agencies …
- Typical Multi-Network
  - Enterprises with multiple locations like Aastra; retail chains with stores in major cities

Typical Single-site deployment

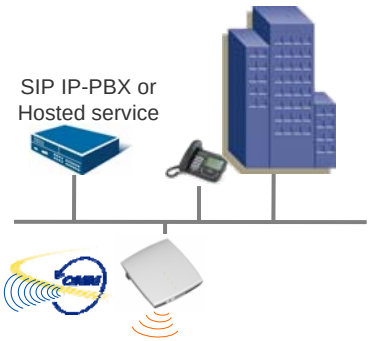


Typical Multi-site deployment

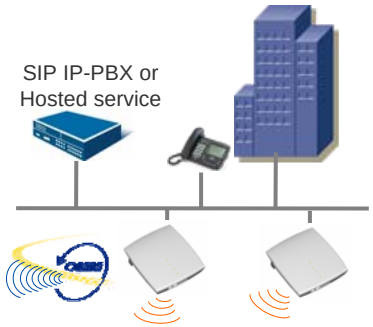


Typical Multi-Network scenario

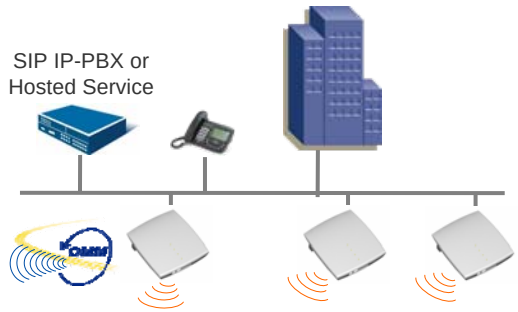
Network A



Network B

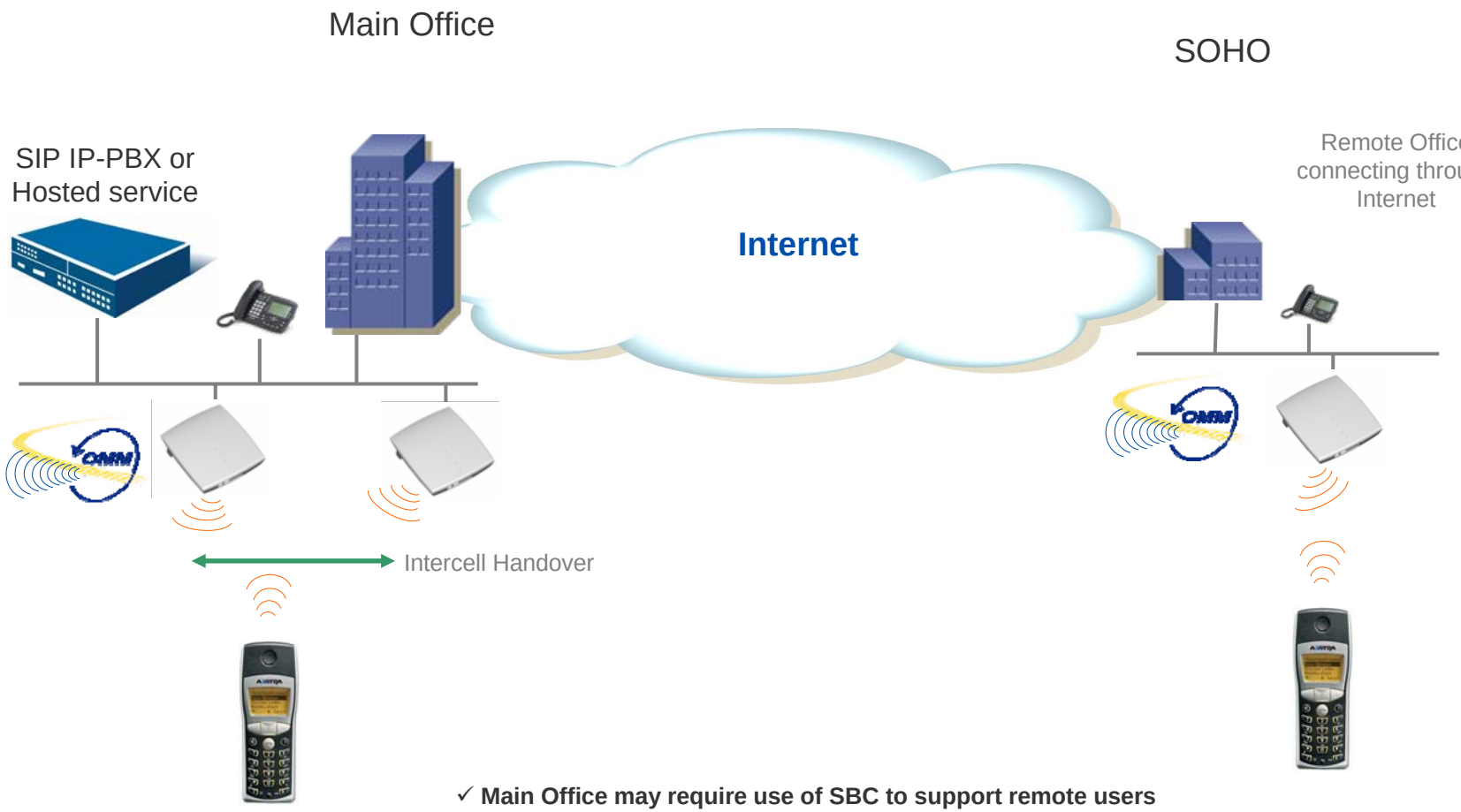


Network C



Automatic Subscriptions with up to 10 different networks

Typical SOHO scenario



- ✓ **Main Office may require use of SBC to support remote users**
- ✓ **Same user extension can be provisioned on both OMMs**

Aastra SIP-DECT™ System Components & Architecture

Aastra SIP-DECT™ System Components

Indoor Access Point
RFP 32

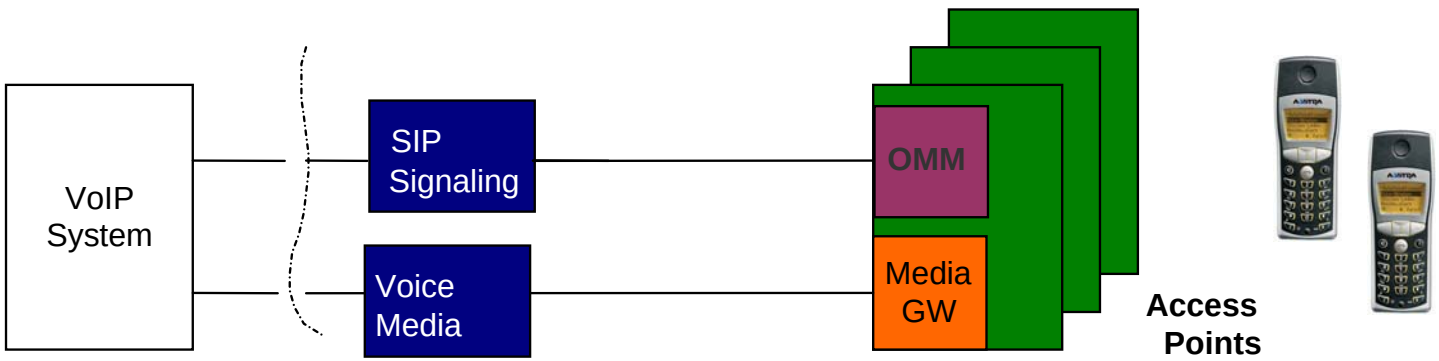
Outdoor Access Point
RFP 34

DECT 142
Handsets

Open Mobility Manager
(OMM) Software

Aastra SIP-DECT™ Access Points

- 2 Models of Access Points – Indoor RFP32 & Outdoor RFP34
- Radio Fixed Parts (RFP's**)** are access points that connect to a LAN via 10/100 Ethernet. RFP is a DECT standard terminology for access point.
- Access Points act as media gateways between the VoIP and DECT wireless networks.
- Convert the VoIP media (RTP packets) to wireless DECT
- Every Access Point contains a media gateway to convert VoIP to DECT
- One Access Point in a network hosts the controlling OMM software.



Access Point Features

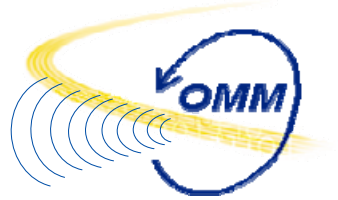
- Hardware (Indoor & Outdoor models)
  - Ethernet 10/100 Base T interface
  - PoE (Power over Ethernet) 802.3af
  - 8 simultaneous voice channel capacity
  - 2 additional hand-in voice channels
  - 2 signaling/synchronization channels
  - 3 LED's indicating operating states
  - Frequency range 1.920-1.930 GHz.
  - 100mW output power (+20dBm)
  - 5 non-overlapping frequency channels
  - Dynamic Frequency Allocation
- Hardware (Indoor Access Point)
  - Optional 120v AC power adapter
  - Wall mounting kit
  - 2 internal space diversity antenna's
- Hardware (Outdoor Access Point)
  - 2 external space diversity antenna's
  - Optional wall mounting or mast mounting kits
- Software (Indoor & Outdoor models)
  - Network Boot, SW-Download / Update
  - TFTP for s/w load & updates
  - Codec G.711, G.723, G.729AB
  - Support of QoS via DiffServ, ToS-Flag (VLAN Tagging)
  - Jitter compensation
  - Echo Cancellation
  - Voice Activity Detection with comfort noise
  - IPV4, ARP, ICMP, DNS, SNTP, DHCP, RTP, RTCP
  - DECT encryption between access point and handset
  - DECT authentication between access point and handset
- Configuration & Management
  - Web interface for configuration and management (OMM)
  - Configurator tool for static IP configuration

SIP-DECT Access Point Characteristics

All Aastra DECT devices conform to FCC & Regulatory Canada directives.

- **FCC 15.323 & FCC 15.319 measured and released.**
- **US: NTP = 100mW (+20dBm)**
- **Frequency range: 1920 - 1930 MHz**
- 5 Carriers available in the FCC / IC permitted band of 1920-1930Mhz
- **DECT-channel TX Frequencies**
  - 0 1928,448
  - 1 1926,720
  - 2 1924,992
  - 3 1923,264
  - 4 1921,536
- 24 slots per carrier
  - 8 slot-pairs or channels for voice
  - 2 slot-pairs or channels for Hand-in,
  - 2 slot-pairs for Signalling/Synchronization

OpenMobility Manager Software (OMM)



- The **OpenMobility Manager** (OMM) software administrates all handsets and the mobility features (roaming, connection handover, media stream). It is the signaling interface to the SIP call server or IP PBX

Complete DECT Management:

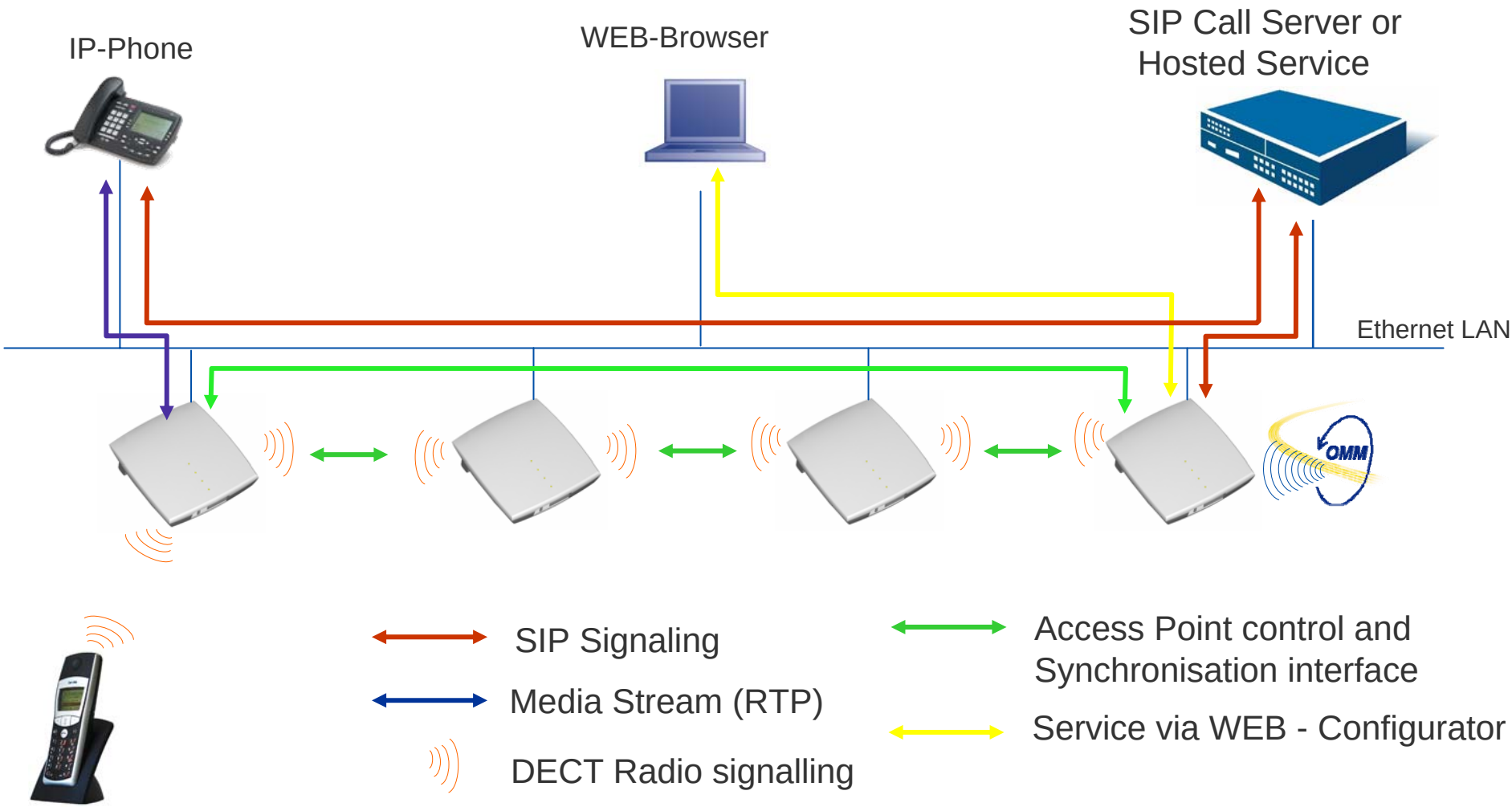
- Handsets subscription and Registration
- Identity Handling
- Authentication
- Support for Handover, Roaming
- Management of media streams between
- Control of synchronization of the Access Points

IP Interface & Management

- SIP signaling from OMM to the SIP call server
- Provisioning of SIP extensions (handsets)
- Provisioning of SIP Proxy, Registrar, Port numbers
- Codec preferences
- Silence suppression, DTMF, RTP port range
- Web user accounts & Time zone set-up
- Handset management & provisioning

- OMM runs on any Access Point, no other hardware required
- OMM interfaces with IP PBX via SIP with RTP streams going direct to access points

Call Control and Media Paths



Aastra DECT 142 Handset Call Features

- Call Forward: always, busy, no answer (phone side)
- Call Transfer: blind, consultation
- Call waiting
- MWI
- Caller ID with name
- DND
- Speed dial quick call key assignment
- Call Hold with visual indication, reminder tones
- Single line support without 3 way call
- Call logs: dialed, missed, received
- Personal directory (local only) 100 entries
- Redial list
- Missed call indicator
- Call blocking/filtering
- Ringing “melodies” 30
- Single and Continuous Ring
- Loud Speaker (hands-free mode)
- Speaker / Earpiece Volume Adjustment
- Ringer Volume Adjustment
- Vibrate Mode
- Keyboard lock
- Alarm/Reminder
- Microphone Mute
- Auto-answer (for headset use)
- Auto answer pickup from charger
- Country specific tones
- Multiple Languages *English, French, German, Italian, Spanish, Dutch, Portuguese*
- Site Survey mode to aid installation

Aastra DECT 142 Handset Physical Features

» Display (LCD)

- Illuminated 5-line graphic display (96x60 pixels)
- Variable 7 level display Contrast
- 2 soft key labels
- Backlight for display and key pad
- Status indicators Ringer off, signal strength, on/off hook, alarm, battery life, envelope, key lock
- Time Display
- User Name & Number
- Network Subscription

» Key Pad

- 12 “digit” keypad plus - 2 soft keys, on/off hook, loud-speaker, i-key (info), “C” and “R (also SOS)” key
- Key Lock (manual & auto)
- Key Click
- SOS Key (idle mode)

» Physical

- 2 Integrated Diversity Antennas
- Size (approx.) 146mm x 53mm x 28mm
- Weight 138 grams (inc. batteries)
- 2.5mm headset jack
- SIM Card for user profile and address

» Powering

- 3 AAA 750 mAh NiMH Batteries
- 120v AC Power adapter with cradle
- Low Battery Warning
- Silent Charging
- Up to 12 hours talk time, 120 hours stand-by, 5 - 6 hours recharge time

» Performance

- Frequency 1.92 – 1.93 GHz.
- 300,000 sq. ft. coverage area (open space)
- Coverage Warning indication
- Site Survey Mode
- MTBF 20 years

Aastra SIP-DECT™ Design Considerations

Basics of Wireless Propagation.- Path Loss

- Pathloss
  - Defined as the total loss from source to receiver
    - Measured in decibels (dB)

Transmitter

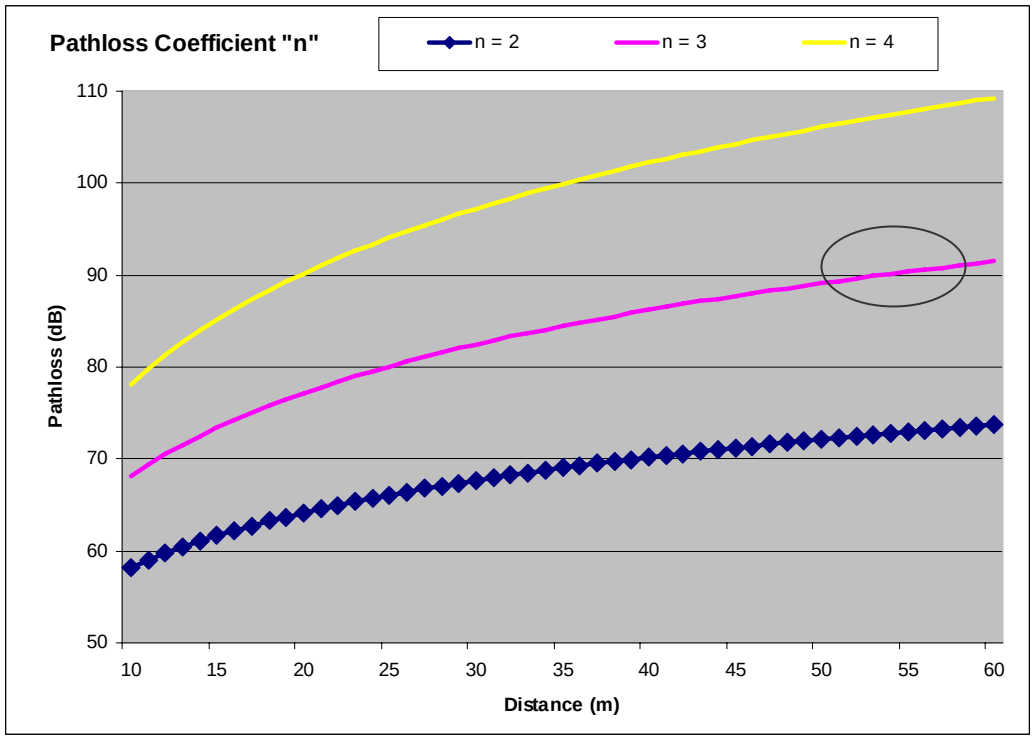
Receiver

Dusty window, rain, fog, some distance = Fraction of source power
Office clutter, building materials, moisture, organic tissue = Fraction of source power

Transmitter

Receiver

Basics of Wireless Propagation.- Path Loss



» **n = 2 is ideal free space**

Simplified Path Loss Model

- Ploss = 20log(f) + 10•n•log(d) - 27.55,

f = frequency in MHz

d = distance between transmit and receive antenna in meters

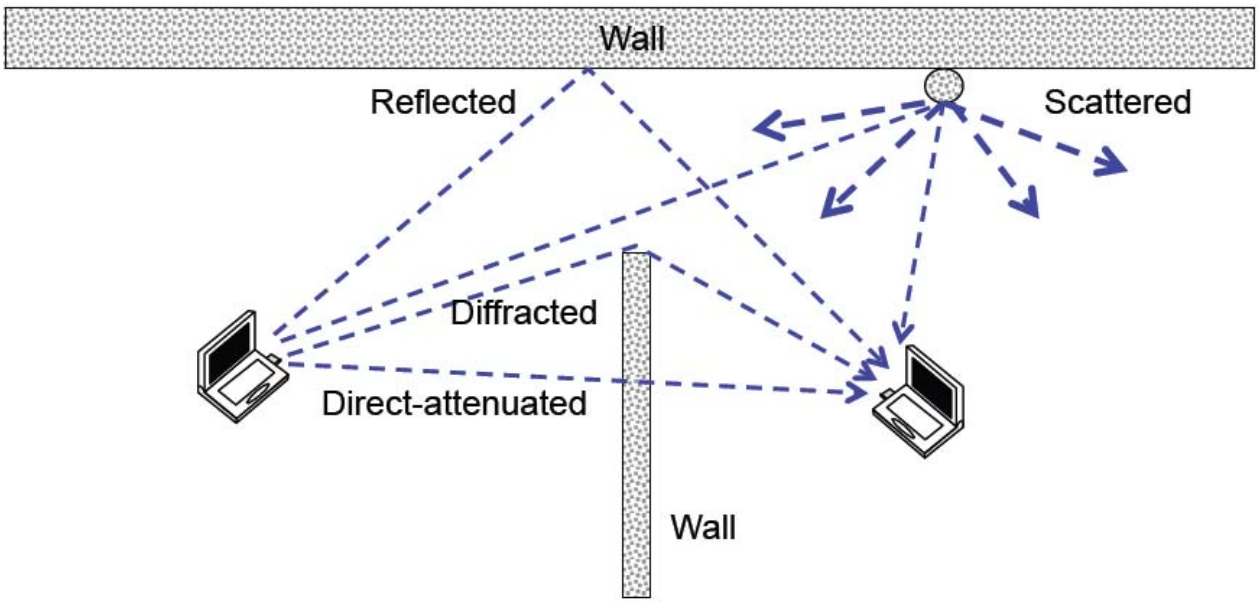
n = the pathloss coefficient (n=2 for free space, typically 3 to 4 for indoor propagation)

Locations	n (Avg)
Retail Store	2.2
Office, hard partitions	3.0
Office, soft partitions	2.6

Other factors affecting the signal

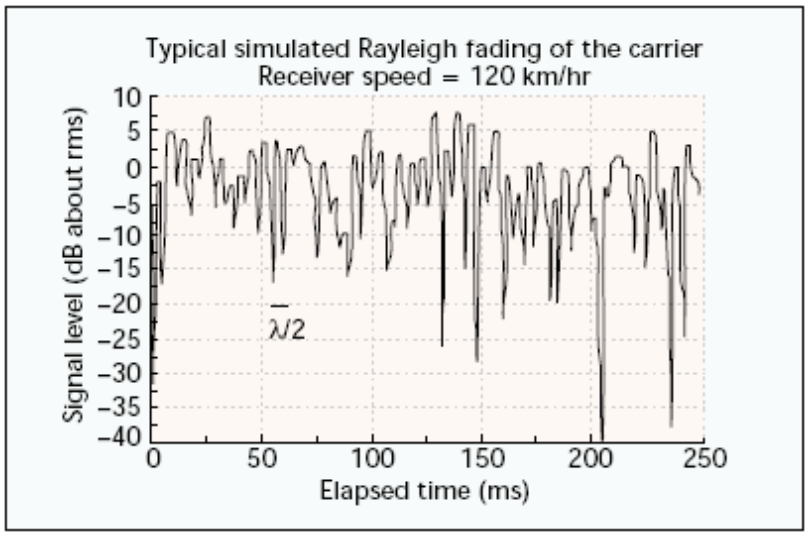
Multipath

- Signal reflections and refractions result in multiple delayed “replicas” of the signal arriving at the receiver
- Multiple “replicas” will add constructively (never without help) or destructively (always to varying degrees)



Other factors affecting the signal

- Fading
  - Mobility results in a changing multipath environment
  - Result is a varying signal level based on instantaneous sum of arriving signals



- **How do you overcome Multipath Fading?**
  - Antenna diversity to minimize impact
    - Two antennas spaced sufficiently apart, will receive different signals at any instant point in time
    - Receiver selects the best signal from either antenna
  - Include a Fade Margin in all deployments
    - Diversity reduces the impact but does not eliminate it
    - Balance of impact can be overcome by over designing the deployment

Summarized Link Budget

Parameter	Value	Unit
Tx Power	20	dBm
Rx Sensitivity (10^-3 BER)	-90	dBm
Fade Margin	19	dB
Diversity Gain	10	dB
Body Loss	10	dB
Link Budget	91	dB

- Link Budget mapped to Distance (coverage):
  - **Using the simplified Pathloss Equation, the max distance between an Access Point and a Handset in office environments should be approx. 55m**

Aastra SIP-DECT™ Basics of Capacity Planning

Capacity Planning

Erlang B Table

$$P = \frac{\frac{A^N}{N!}}{\sum_{X=0}^{N} \frac{A^X}{X!}}$$

Block% / RFPs	1%	3%	5%	7%	10%
1	3.1	4.0	4.5	5.0	5.6
2	8.9	10.5	11.5	12.4	13.5
3	15.3	17.6	19.0	20.2	21.8
4	22.0	24.9	26.7	28.2	30.2
5	29.0	32.4	34.6	36.4	38.8

Example:

- **1 RFP can service 3.1 Erlangs of traffic with 1% GoS (probability of blocking)**
- **3 RFPs can service 15.3 Erlangs of traffic with 1% GoS (probability of blocking)**

Capacity Planning

- Practical Application
  - Fact: Seldom possible to gain access to customer call statistics
  - Basic traffic assumptions can applied for general guidance
  - Industry “accepted” traffic models are as follows:
    - Light traffic: 0.1 Erlangs / user
    - Medium traffic: 0.15 Erlangs / user
    - Heavy traffic: 0.33 Erlangs / user
  - Further simplifications:
    - One RFP supports 8 simultaneous users. Equivalent to “8 Trunks “
    - 1 % Blocking Probability is acceptable (the grade of service)
  - Number of required RFPs can now be calculated …

Sizing your SIP-DECT Deployment

Light Traffic

	Number of Users																				
P(b)	**10**	**25**	**50**	**75**	**100**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**	**1400**	**1500**	**2000**	**2500**	**3000**
1%	1	1	2	2	3	4	6	7	8	10	11	12	14	15	16	18	19	20	22	28	35	41
2%	1	1	2	2	3	4	5	7	8	9	11	12	13	15	16	17	18	20	21	27	34	40
3%	1	1	2	2	2	4	5	6	8	9	10	12	13	14	15	17	18	19	20	27	33	39
4%	1	1	2	2	2	4	5	6	8	9	10	11	13	14	15	16	18	19	20	26	32	38
5%	1	1	2	2	2	4	5	6	7	9	10	11	12	14	15	16	17	18	20	26	32	38
7%	1	1	2	2	2	3	5	6	7	8	10	11	12	13	14	15	17	18	19	25	32	38
10%	1	1	1	2	2	3	4	6	7	8	9	10	12	13	14	15	17	18	19	25	32	38

Medium Traffic

	Number of Users																				
P(b)	**10**	**25**	**50**	**75**	**100**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**	**1400**	**1500**	**2000**	**2500**	**3000**
1%	1	2	2	3	3	6	8	10	12	14	16	18	20	22	24	26	27	29	31	41	50	60
2%	1	2	2	3	3	5	7	9	11	13	15	17	19	21	23	25	27	29	30	40	49	58
3%	1	1	2	3	3	5	7	9	11	13	15	17	19	20	22	24	26	28	30	39	48	57
4%	1	1	2	3	3	5	7	9	11	13	14	16	18	20	22	24	26	27	29	38	47	57
5%	1	1	2	2	3	5	7	9	11	12	14	16	18	20	21	23	25	27	29	38	47	57
7%	1	1	2	2	3	5	7	8	10	12	14	15	17	19	21	23	25	27	29	38	47	57
10%	1	1	2	2	3	4	6	8	10	12	14	15	17	19	21	23	25	27	29	38	47	57

Heavy Traffic

	Number of Users																				
P(b)	**10**	**25**	**50**	**75**	**100**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**	**1400**	**1500**	**2000**	**2500**	**3000**
1%	2	2	4	5	6	11	15	19	24	28	32	37	41	45	49	54	58	62	66	87	108	129
2%	1	2	4	5	6	10	15	19	23	27	31	36	40	44	48	52	56	61	65	85	106	127
3%	1	2	3	5	6	10	14	18	22	27	31	35	39	43	47	51	55	59	64	84	105	125
4%	1	2	3	4	5	10	14	18	22	26	30	34	38	42	46	50	55	59	63	84	105	125
5%	1	2	3	4	5	9	14	18	22	26	30	34	38	42	46	50	55	59	63	84	105	125
7%	1	2	3	4	5	9	13	17	21	25	30	34	38	42	46	50	55	59	63	84	105	125
10%	1	2	3	4	5	9	13	17	21	25	30	34	38	42	46	50	55	59	63	84	105	125

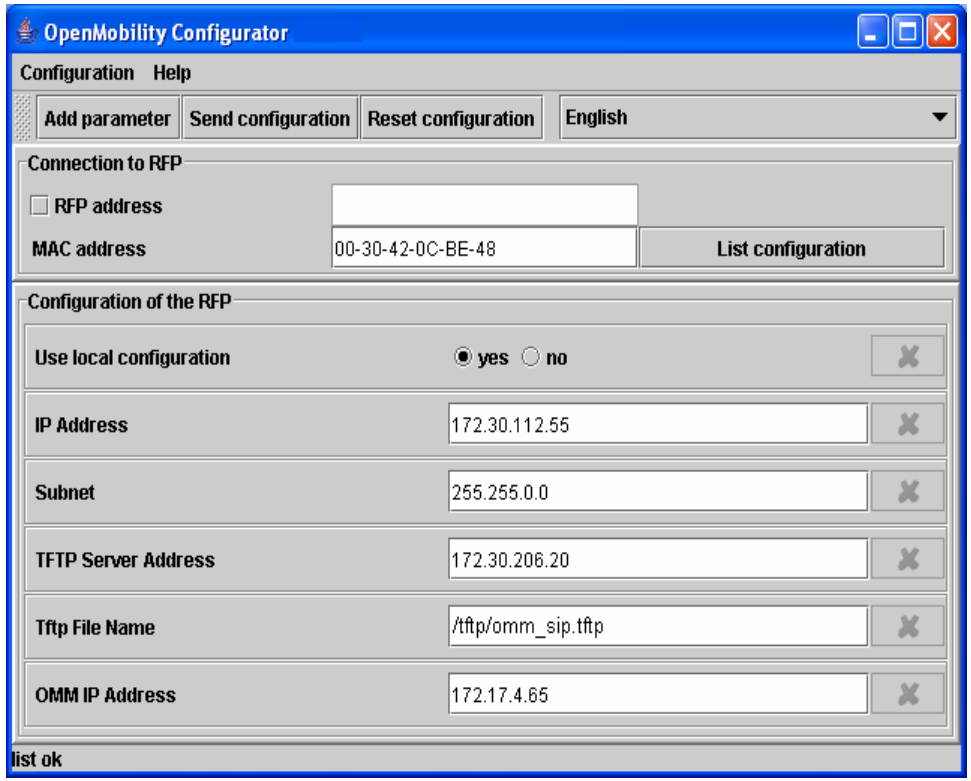
Aastra SIP-DECT™ System Configuration & Commissioning

System Startup (con't)

»OM Configurator Tool

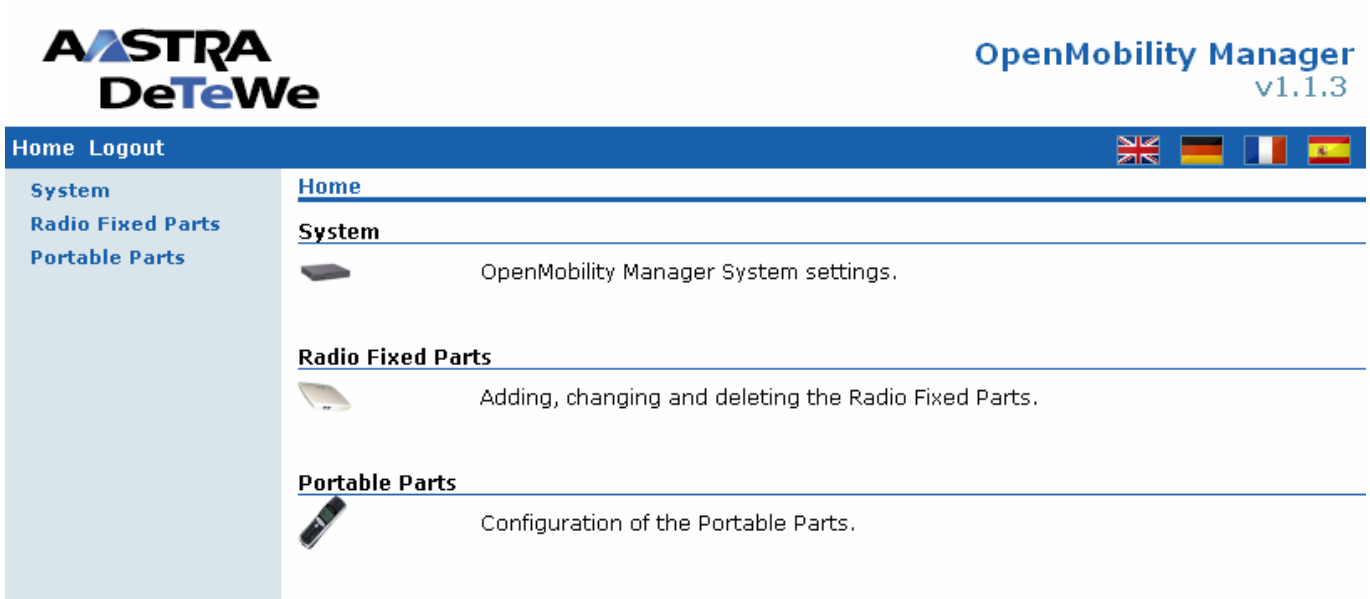
- The OM Configurator is used to manually configure network settings on the RFP.
- Requires Java Runtime Environment version 1.4 or higher.
- Additional network parameters are available via the "Add parameter" button. (see next slide)
- Once all parameters have been entered, press the "Send configuration" to commit changes to the RFP.
- All settings are stored on the RFP's internal flash.

Note: The PC running OM Configurator must be on the same LAN as the RFP for successful connection.



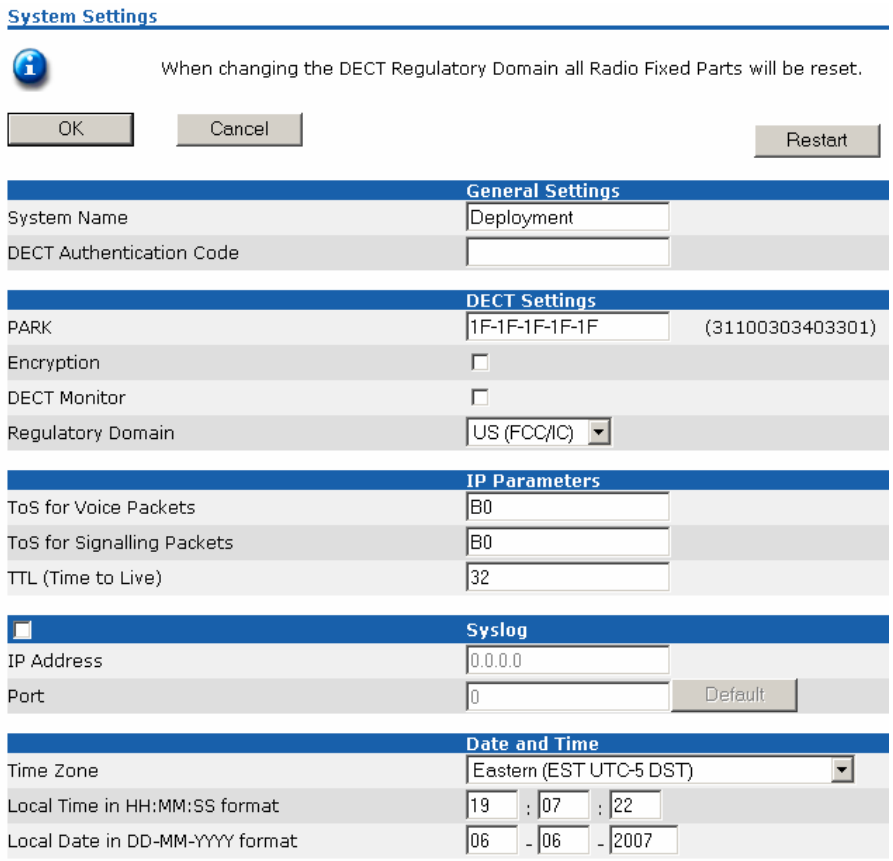
System Startup (con't)

- OMM Web Interface
  - Main Screen
    - After login, there are the following options available:
      - Configuration of general SIP-DECT System parameters.
      - Administration of the attached RFPs.
      - Administration of the PPs.



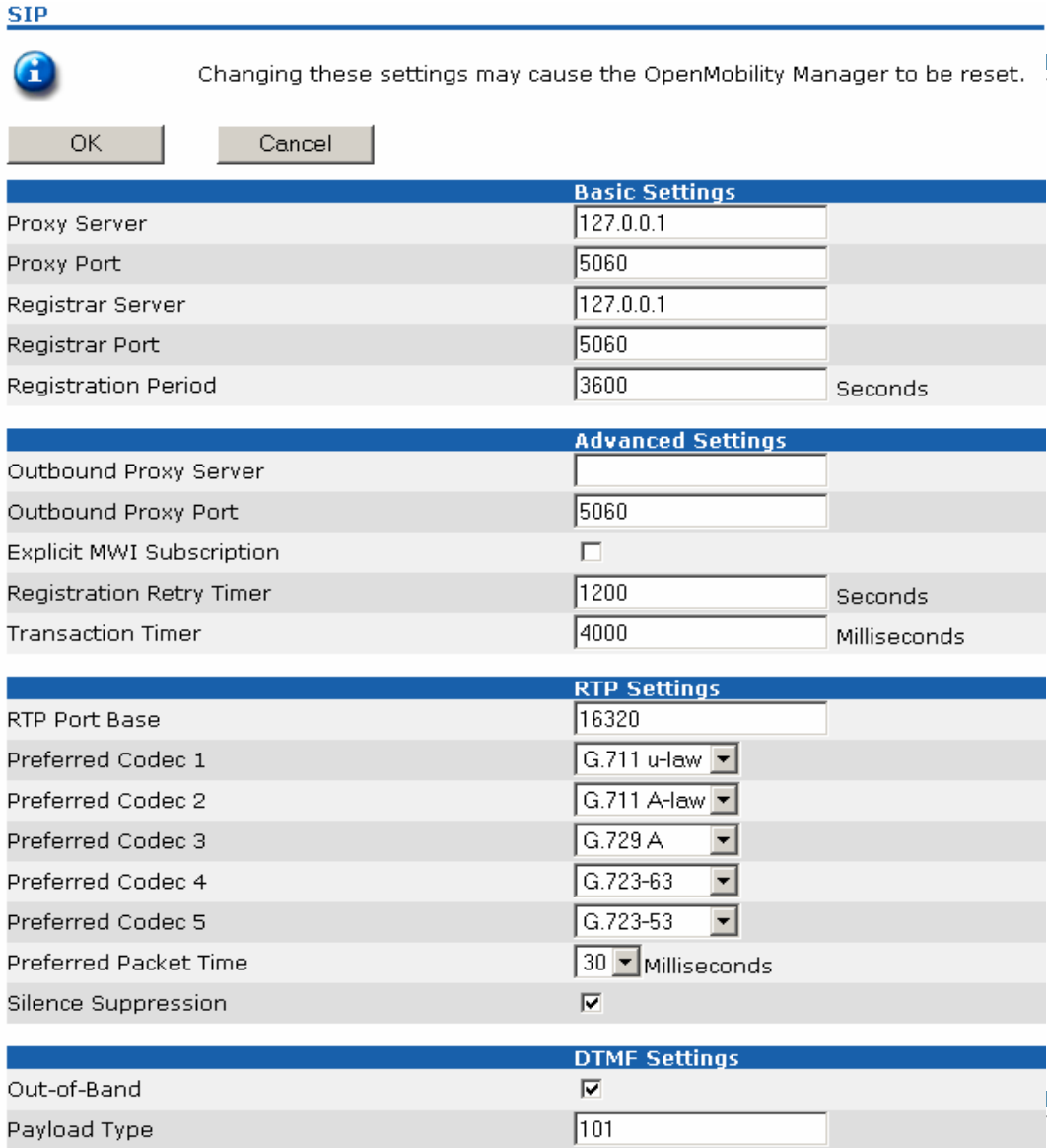
System Startup (con't)

- OMM Web Interface
  - System Settings Screen
    - System Name (Optional). Automatically transferred to the handsets during subscription. The handsets will display the system name in the idle screen.
    - DECT authentication code (Optional, used during initial PP subscription for added security).
    - PARK (Portable Access Rights Key)
    - DECT Encryption
    - Regulatory Domain must be set to "US (FCC/CI)"
    - ToS (Type of Service) for prioritization of voice and signaling (Optional).
    - IP address and port for Syslog messages (Optional).
    - Time Zone Setting
    - Time and Date. Note, if SNTP is not used, user is required to enter time and date info after each reboot.



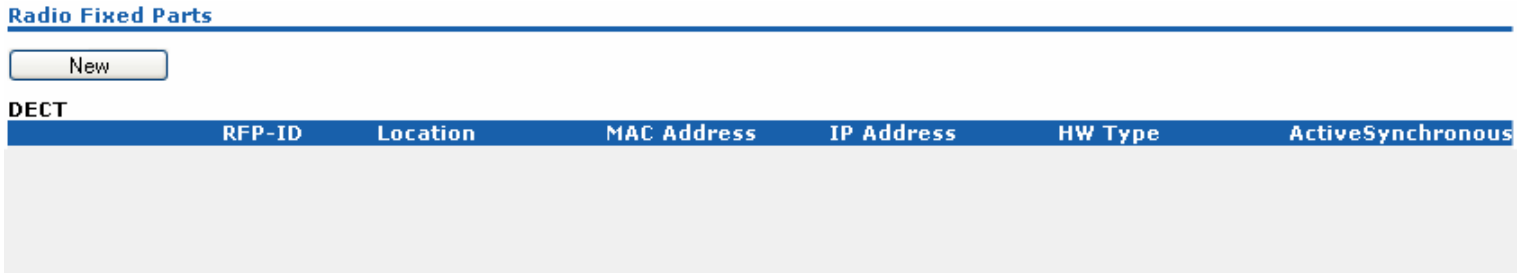
System Startup (con't)

- OMM Web Interface
  - SIP Settings Screen
    - Proxy Server IP Address
    - Proxy Port
    - Registrar Server IP Address
    - Registrar Port
    - Outbound Proxy Server
    - Outbound Proxy Port
    - Explicit MWI Subscription (server specific)
    - RTP Port Base
    - Preferred Codecs
    - Preferred Packet Time
    - Silence Suppression
    - Out-of-Band
    - Payload Type

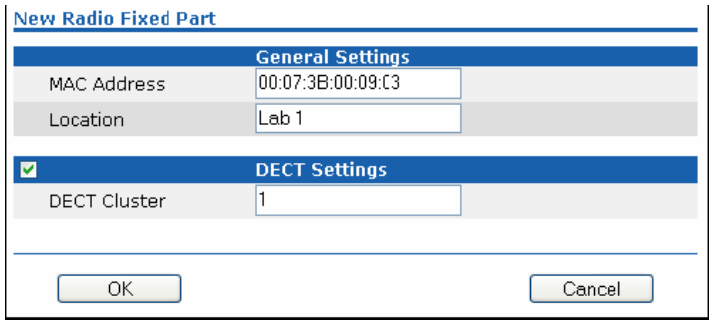


System Startup (con't)

- OMM Web Interface
  - Radio Fixed Parts Screen
    - New RFPs can be added to the system by pressing the "New" button. A popup window appears providing the configuration of a new RFP

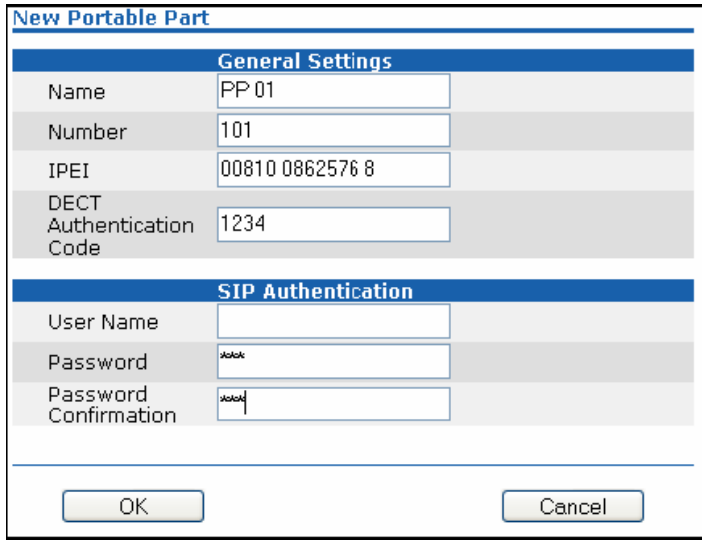


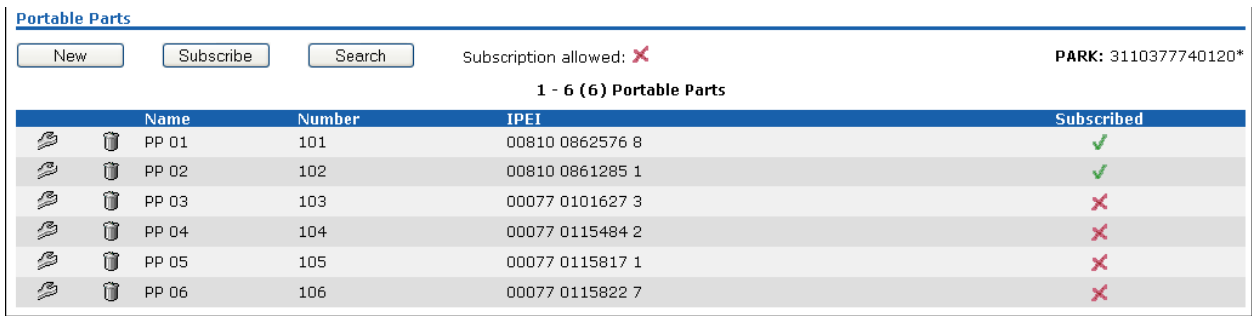
    - Enter the MAC address of the RFP in the MAC field (6 bytes hex format, colon separated)
    - Enter a descriptive name in the Location field
    - Enter a cluster number for the RFP. RFP's that are synchronized must be placed in the same cluster to facilitate handoff functionality.



System Startup (con't)

- OMM Web Interface
  - Portable Parts Screen
    - Enter the user name in the Name field
    - Enter the user extension in the Number field
    - Enter IPEI (International Portable Equipment Identity) This is a 13 digit code obtained from the PP within the Subscription menu
    - Enter the DECT Authentication Code (optional step)
    - Enter the SIP Authentication Name in the User Name field (usually in the form of an extension number)
    - Enter the SIP Authentication Password in the Password and in the Password Confirmation fields
  - Portable Parts Sample Screen





Aastra Interop with Asterisk™

Aastra – Asterisk™ Interoperability

- Aastra is a Digium's Premier Interoperability Partner – a top tier partnership
  - Interoperable with Asterisk Open-Source PBX and Digium's Asterisk Business Edition
  - *Products:* Classic IP, 5i Series, SIP-DECT / DECToverIP using SIP

- SIP-DECT features tested:
  - Message Waiting Indicator (MWI)
  - Call Hold
  - Blind/Consultative Transfer
  - Intercom Tx from Handset (dial *55, no auto-answer capability)
  - Distinctive ringing / priority alerting
  - Call park / pickup (via direct dialing: 700)

More Information

Visit WWW.SIP-DECT.COM for latest info and data sheets

Email	support@aastra.com
Downloads:	www.aastratelecom.com , go to support section
Forums:	http://www.trixbox.org/forums/aastra-endpoints

Other: http://www.dect.org/

Q&A

Any Questions?

- **Fire Away!**

Thank you!