



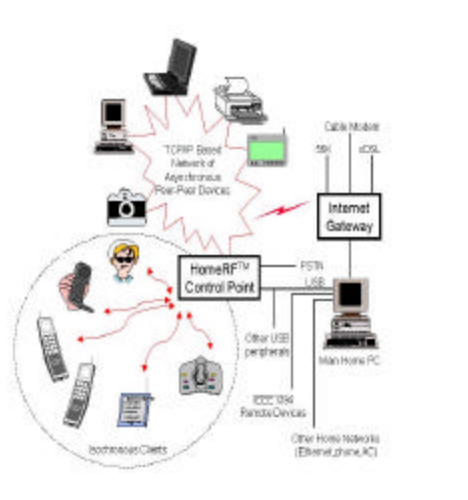
# HomeRF<sup>TM</sup> Working Group

## 3rd Liaison Report

# HomeRF<sup>TM</sup> Mission Statement

To enable the existence of a broad range of **interoperable consumer devices**, by establishing an **open industry specification** for unlicensed RF digital communications for PCs and consumer devices **anywhere, in and around the home.**

# Vision for Home Networking



# Membership Roster

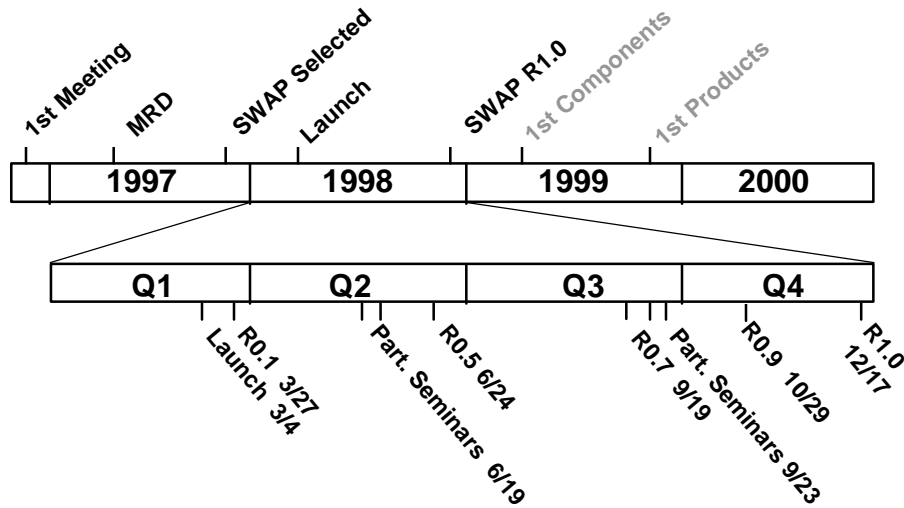
{Updated September 11, 1998}

- |  |   |
|--|---|
| <b>3COM</b>                            | <b>Harris Semiconductor</b>               |
| <b>Advanced Micro Devices</b>          | <b>Hewlett-Packard Company</b>            |
| <b>Aironet Wireless Communications</b> | <b>Hosiden Corp.</b>                      |
| <b>Alps Electric Co., Ltd.</b>         | <b>IBM</b>                                |
| <b>Broadcom Corporation</b>            | <b>Intel Corp.</b>                        |
| <b>Butterfly Communications</b>        | <b>Intellon</b>                           |
| <b>Casio Computer Corp.</b>            | <b>Kansai Electric Co., Ltd.</b>          |
| <b>Cisco Systems</b>                   | <b>LG Electronics, Inc.</b>               |
| <b>Compaq Computer Corp.</b>           | <b>Matsushita Electric Industrial Co.</b> |
| <b>Ericsson Enterprise Networks</b>    | <b>(Panasonic)</b>                        |
| <b>Fujitsu Ltd.</b>                    | <b>Microsoft</b>                          |

# Member Roster (Cont.)

- |                                       |                                |
|---------------------------------------|--------------------------------|
| Mitsubishi Electric Corporation       | Rockwell Semiconductor Systems |
| Motorola                              | Samsung Electronics, Inc.      |
| National Semiconductor                | ShareWave, Inc.                |
| NEC Corporation                       | Sharp Corporation              |
| Nortel                                | Siemens                        |
| Oki Electric Industry Co., Ltd.       | Silicon Wave Inc.              |
| Philips Consumer Communications (PCC) | Symbionics                     |
| Primax Electronics, Ltd.              | Symbol Technologies            |
| Proxim                                | Texas Instruments              |
| RF Monolithics, Inc.                  | WebGear                        |

# HomeRF™ Timeline



## Applications & Usage Scenarios



## PC-Enhanced Cordless Telephone

- Interoperable Cordless Telephone with Digital Voice Quality
- Caller ID with PC Lookup
- Lowest Cost Call Routing (Internet Telephony)
- Voice Mail Retrieval
- Email viewing or read back as Text to Speech (TTS)
- PIM Functionality
- Speech Input to PC (Voice commands)
- Remote I/O Access to Other PC Subsystems
- Home Automation Control Center
- Endless Software-Based Applications To Be Written

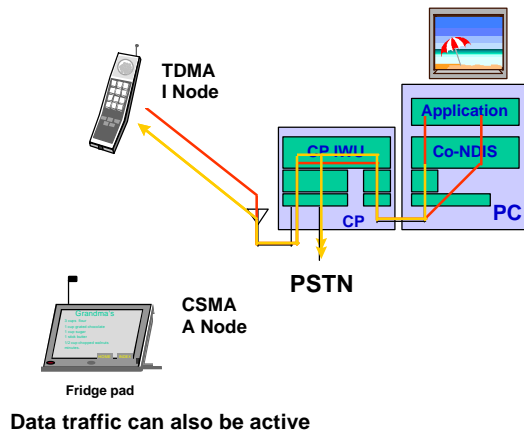
## Mobile Viewer Appliance

- Portable device built around inexpensive color display
- Extension of main Home PC ...
- ... and/or gateway to the Internet
- Limited input functionality and local processing power
  - Relies heavily on central resources on PC or Internet
  - TCP/IP networking represents efficient link to host device/gateway
  - speech could be a primary data input method
- Known by many names - “Fridgepad”, “Infopad”, “Netviewer”, etc.

## Resource Sharing

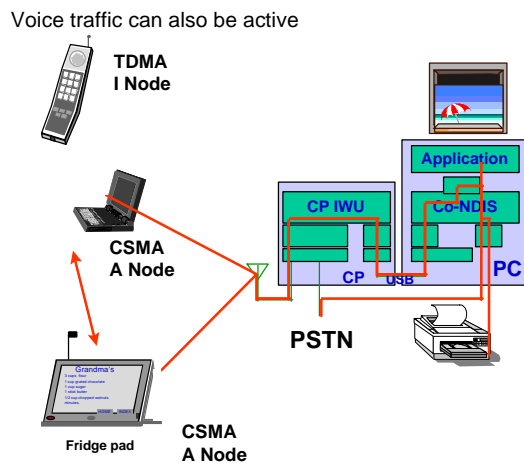
- Multi-PC homes can share files/modems/printers
- PC’s and other new devices can share an ISP connection
  - Only one PSTN line and ISP account required
  - Perfect for evolving big pipes such as UDSL or cable modem
- Peer to peer communication enables interactive entertainment and information sharing
- Multi-player games and/or toys based on PC or Internet resources

## Usage Scenario - Voice Control



- Handset initiates voice transfer to PC
- Application accepts streaming audio from CP
- Application performs speech recognition and sends commands back down stack
- For automatic call placement, CP dials number and connects handset
- Handset - PSTN connection remains until call teardown

## Usage Scenario - ISP Sharing



- PC initiates ISP connection (modem, ISDN, UDSL, Cable, etc.)
- Applications on host PC can access ISP immediately
- Remote CSMA nodes access ISP through NAT and TCP/IP
- Remote CSMA nodes can also share files and printers
- Ad hoc peer-peer transfers between nodes do not require resources of "server" PC

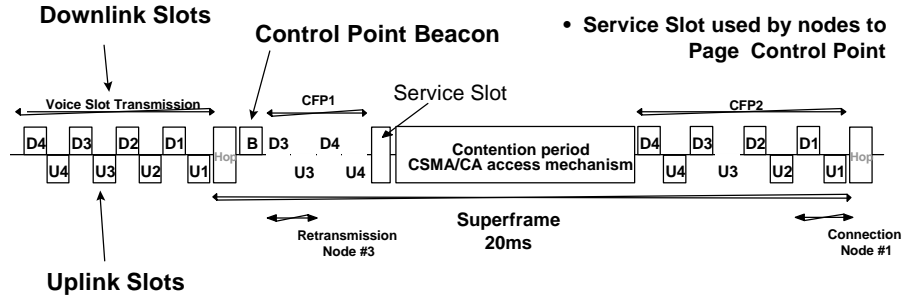
## Technical Parameters



## MAC Features

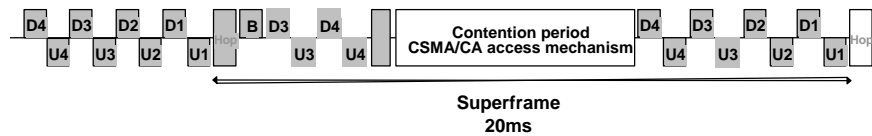
- MAC provides good support for voice and data by using both TDMA and CSMA/CA access mechanisms
- Support for 6 high quality voice connections
  - ADPCM codec
  - Integration with DECT
- Excellent integration with TCP/IP networking protocols
  - Packet structure optimized for easy integration with Ethernet
  - Supports broadcast, multicast and fragmenting
- High data throughput - 1 Mb/s or 2 Mb/s
- Data security - None/Medium/High levels of encryption
  - 24-bit Network ID and optional data compression
- Extensive power management for ultra-portable devices

# MAC Superframe



- Structure of the Superframe is controlled by the Beacon
- Pairs of TDMA slots are allocated by the Control Point
- Voice data transmitted in the slots in Contention Free Period 2
- Any voice data to be retransmitted is sent:
  - In CFP1, after a Hop
  - giving frequency & time diversity and low latency

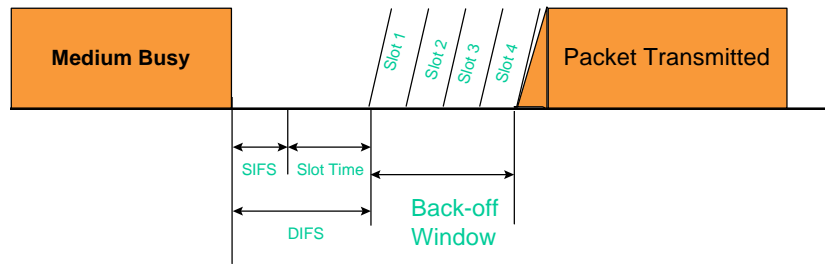
# SWAP MAC - Support for Data



- During the contention period the access protocol is CSMA/CA - Collision Sense Multiple Access/Carrier Avoidance
- An efficient protocol for data transfer in small networks and very tolerant of microwave oven interference
- With no voice connections the contention period occupies the whole Superframe

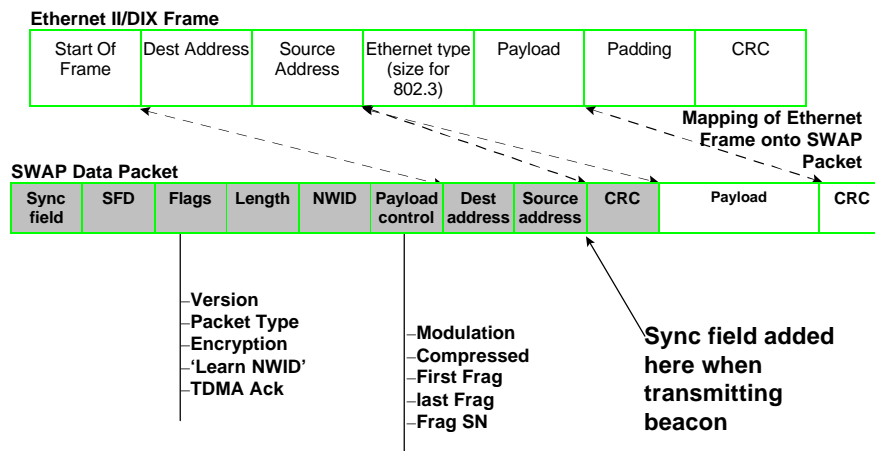


## CSMA/CA Access Mechanism

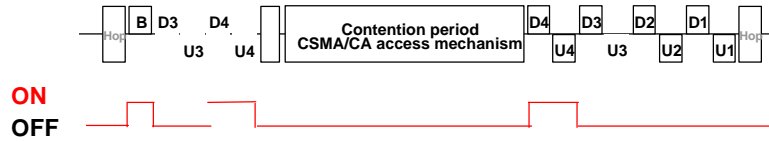


- CSMA/CA is an efficient protocol for data traffic, like ethernet
- Listen Before Talk
- Always back-off before a transmission or retransmission
  - Designed to provide fair access to the medium

## CSMA/CA Packet

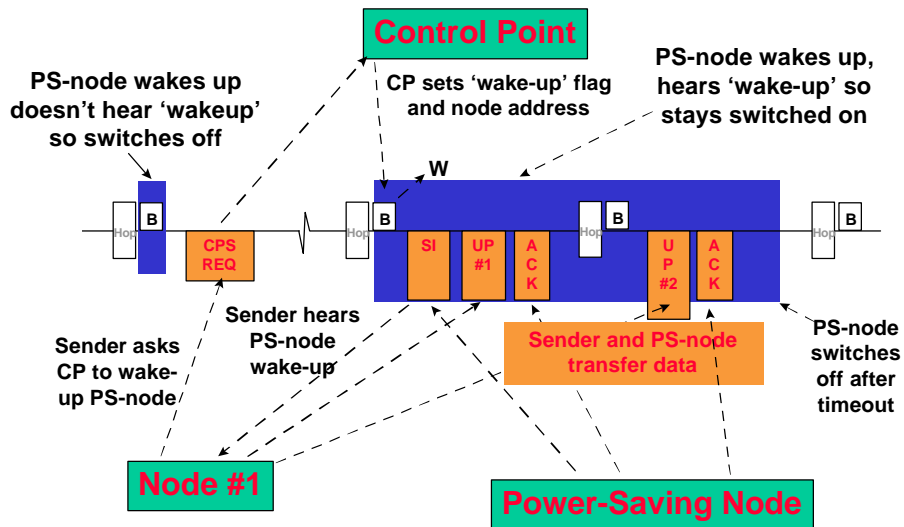


## Power Management - TDMA Nodes

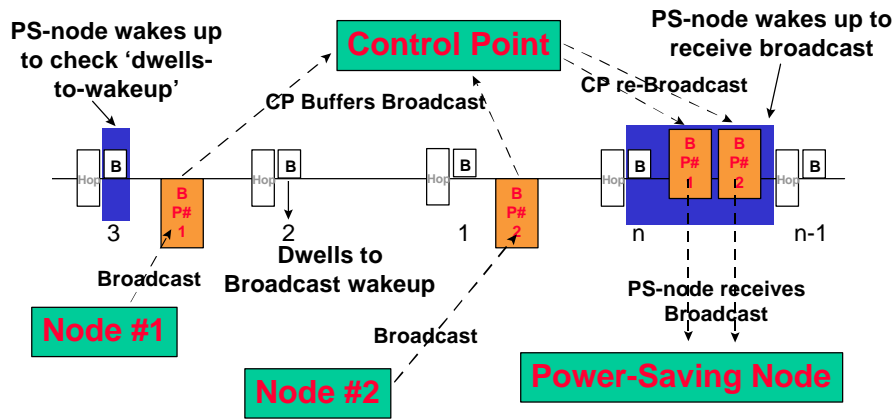


- Switch on periodically to receive a Beacon if they do not have an active connection
- If they have an active connection they switch on:
  - to receive the Beacon
  - switch on for any retransmissions in CFP1
  - switch on for transmissions in CFP2
- At all other times they can be switched off

## Unicast - Power Saving CSMA/CA



## Broadcast - Power Saving CSMA/CA



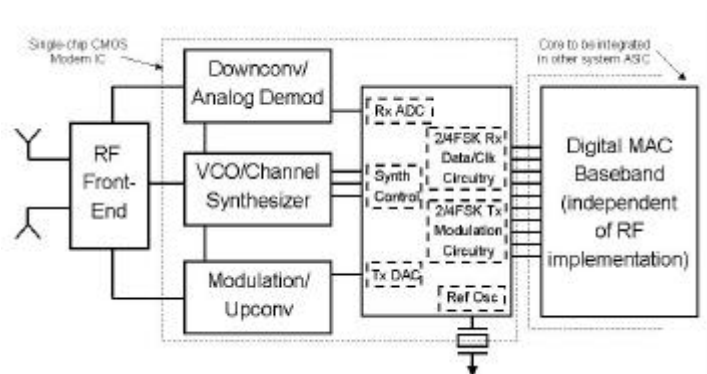
## PHY Features

- Nominal 100 mW transmit power (+16 to +20 dBm)
- Minimum receiver sensitivity of -76 dBm (2FSK)
  - 4 dB easier than IEEE 802.11 FH parameter
  - Range should exceed 50 m in typical homes & yards
  - Expect manufacturers (especially cordless telephones) to exceed specification considerably (-85 dBm) for longer range
- Optional lower power mode around 1 mW (0 to +4 dBm)
  - Range reduced to 10-20 m typically across household walls
  - Motivated for ultra-portable devices with limited peak current
- Exceptionally simple filter requirements - No Adjacent or Alternate channel specification
  - Move cost out of PHY by taking advantage of MAC
  - Makes single-chip integration more straightforward

## PHY Features (Cont.)

- Hopping time is 300  $\mu$  sec
  - Should allow use of conventional synthesizers
- Transceiver turnaround time is 25  $\mu$  sec
  - The toughest SWAP specification
  - This is easier than the IEEE 802.11 FH specification

## SWAP Partitioning



## SWAP vs. Other Connectivity Options

	Peak Data Rate	Relative Cost	Data Network Support	Voice Network Support	Range in home	Standby & Peak Currents
HiperLAN	23.5 Mb/s	High	TCP/IP	Via IP	> 30 m	TBD, >2A
IEEE802.11FH	2 Mb/s	Medium/High	TCP/IP	Via IP	> 50 m	~10 mA, ~400 mA
HomeRF™ (SWAP)	2 Mb/s	Medium	TCP/IP	Via IP & PSTN	> 50 m	< 1 mA, ~300 mA
HomePNA	1 Mb/s	Medium/Low	TCP/IP	Via IP & PSTN	All phone jacks	TBD
Bluetooth	1 Mb/s	Medium	Via PPP	Via IP & Cellular	< 10 m	< 1 mA, ~ 60 mA
IrDA	16 Mb/s	Low	Via PPP	Via IP	< 2 m line of sight & aimed	< 10 uA, ~ 300 mA

## HomeRF vs. Bluetooth

- |   |            |  |
|---|------------|--|
| <ul style="list-style-type: none"> <li>• Optimized for Home wireless voice &amp; data requirements</li> <li>• 50m in the home &amp; yard</li> <li>• 6 near line quality voice links</li> <li>• Unlimited device links/base</li> <li>• 2 Mbps raw data rate (4FSK)</li> <li>• 4 types: voice/Data/Both/Base</li> <li>• 2.4 GHz, 50 Hops/sec radio</li> <li>• Peer-to-Peer networking</li> <li>• “Native” TCP/IP support</li> <li>• Low power paging mode</li> <li>• Lower transmit power possible</li> <li>• Based on shipping 802.11 &amp; DECT technology</li> </ul> | <p>vs.</p> | <ul style="list-style-type: none"> <li>• Optimized for cellular phones &amp; mobile device requirements</li> <li>• 10m in shirt pocket/briefcase</li> <li>• 3 near-line quality voice links</li> <li>• 7 device links/base</li> <li>• 1 Mbps raw data rate (2FSK)</li> <li>• One type: Voice-Data-Base</li> <li>• 2.4 GHz, 1600 Hops/sec radio</li> <li>• Multipoint-to-point connections</li> <li>• Point-to-point TCP/IP support</li> <li>• Low power standby mode</li> <li>• Higher transmit power possible</li> <li>• Based on working prototype radio technology</li> </ul> |
|---|------------|--|