



HomeRF: Bringing Wireless Connectivity Home

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Where does wireless fit?

Part of the home intranet mix

Why wireless? Portability and “No new wires”

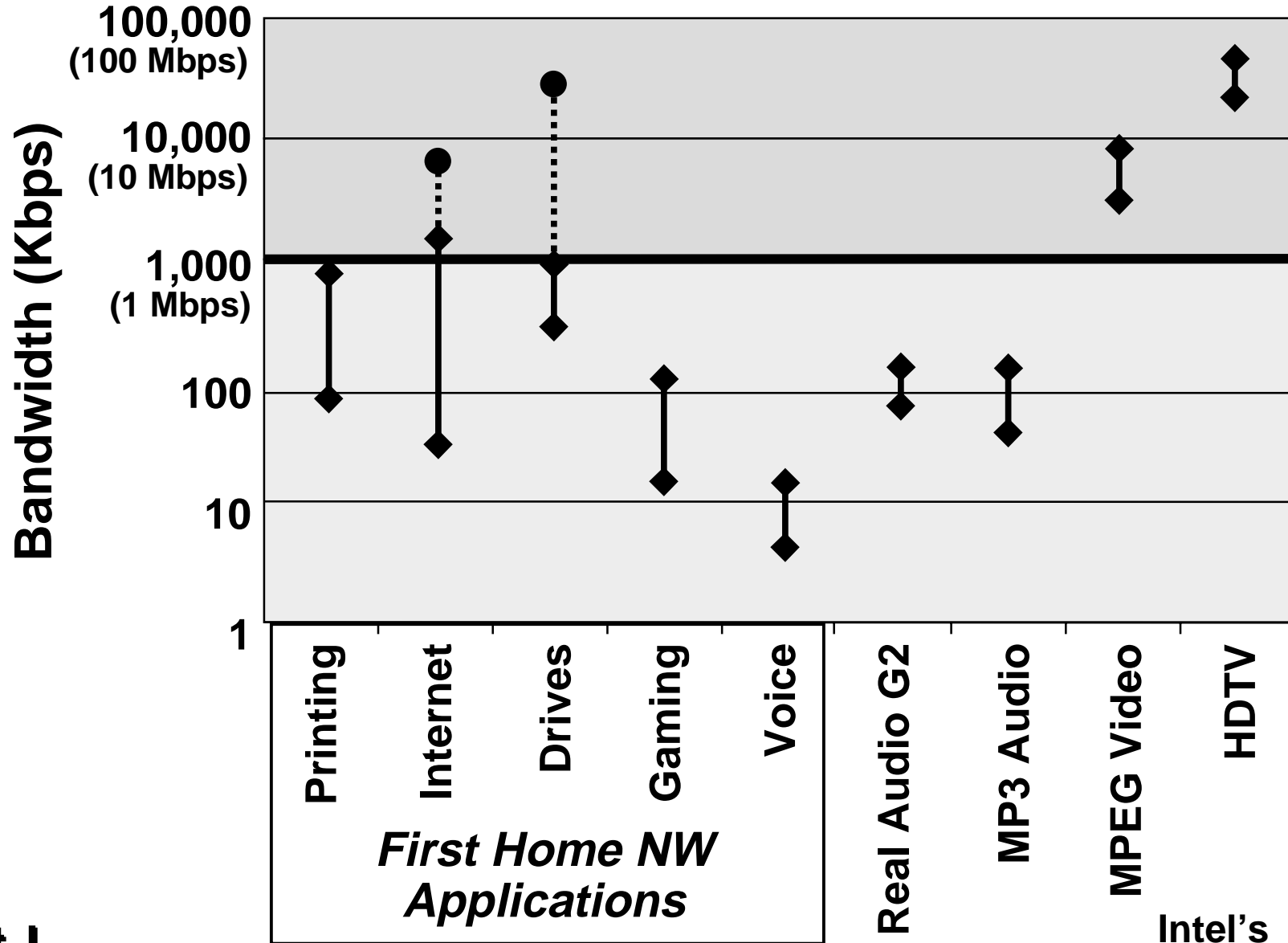
- Core home networking capabilities, including internet, anywhere in and around the home
- Share wireless voice and data
- Review incoming messages
- Activate other home electronic systems by voice
- Needed in countries where phone lines cannot be used

Home Networking Solutions Designed for the Home User

- “No new wires”
- Simple to Install
- Easy to Use
- Low Cost: ~\$200 for 2 PCs
- Bandwidth To Support Common Home Applications
- Industry Standards



Home Networking Needs 1 Mbps

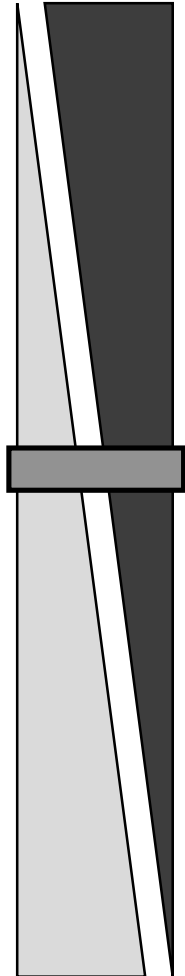


HomeRF™ Working Group Mission Statement

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.

Establishing SWAP-CA

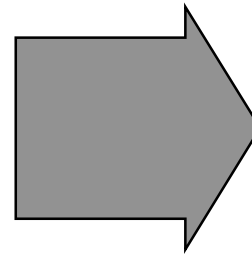
Shared Wireless Access Protocol - Cordless Access



Standards body
e.g., ITU, IEEE, ANSI

Industry leadership
and dedicated forum
e.g., IrDA, TAPI, USB

It happened one day
e.g. ISA, Soundblaster™



SWAP-CA

70+ Member Companies

Broad, cross industry support

- **Communications**
- **Consumer Electronics**
- **Home Control/Home Automation**
- **Networking**
- **Peripherals**
- **Personal Computer**
- **Semiconductors/Components**
- **Software**

Partial Membership Roster

(70+ companies are now Participants)

- 3COM
- Alps
- Advanced Micro Devices
- Aironet
- Apple
- Broadcom Corporation
- Butterfly Communications
- Casio
- Cirrus Logic
- Cisco Systems
- Compaq
- Ericsson Enterprise Networks
- Fujitsu
- Harris Semiconductor
- Hewlett-Packard
- Hosiden
- IBM
- Intel
- Intellon
- Interval Research
- Industrial Tech. Research
- iReady Systems
- Kansai Denki
- LG Electronics
- Matsushita Electronics
- Matsushita Works
- Microsoft
- Mitsubishi
- Motorola
- National Semiconductor
- NEC Corporation
- Nortel
- Oki
- Ositis Software
- Primax
- Philips Consumer Communications (PCC)
- Proxim
- Raytheon Wireless Solutions
- RF Monolithics
- RF Micro Devices
- Rockwell Semiconductor Systems
- Samsung Electronics
- Sharp
- ShareWave
- Siemens
- Siemens Microelectronics
- Silicon Wave
- Symbionics
- Symbol
- Texas Instruments
- WebGear

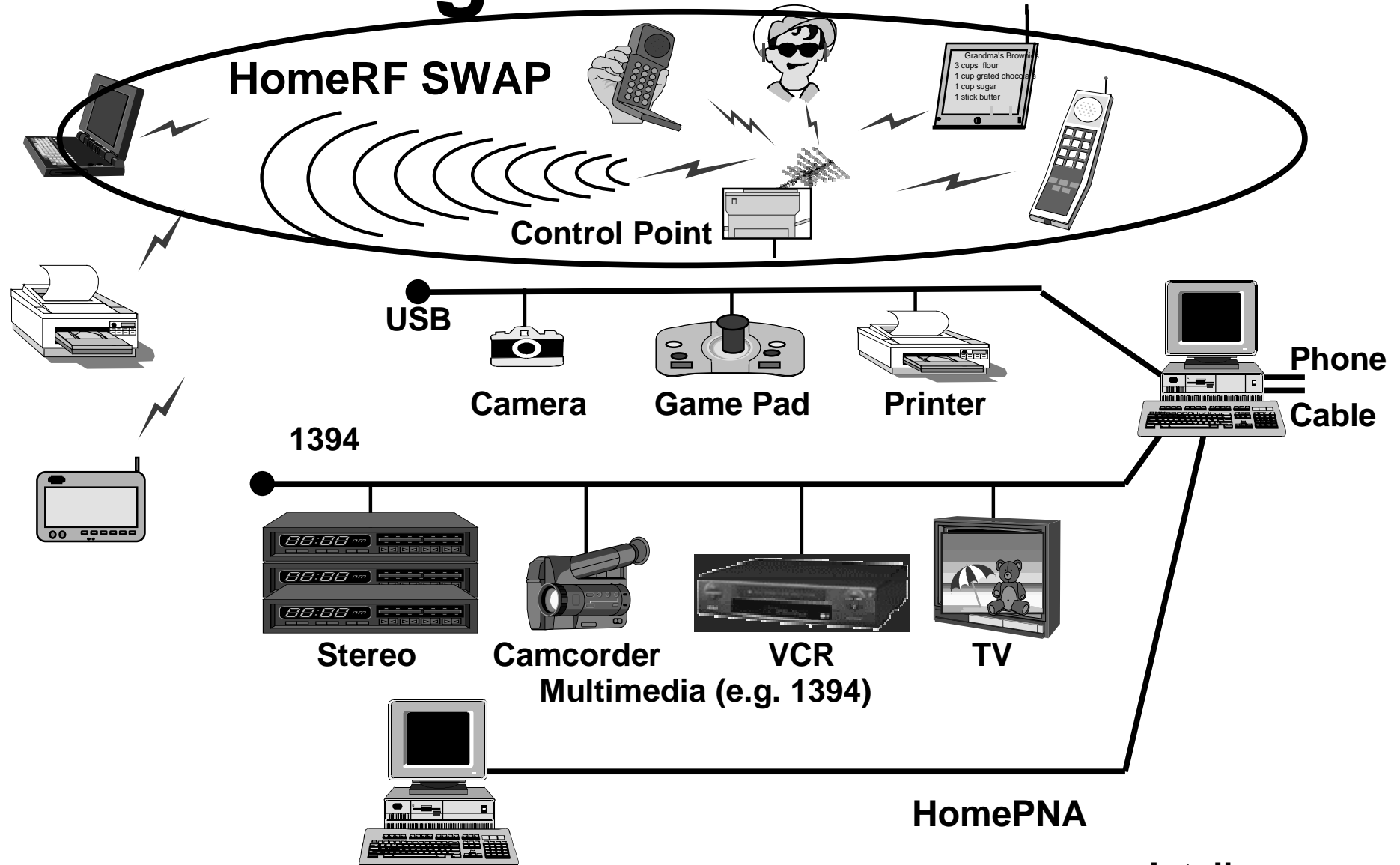


SWAP Product Development

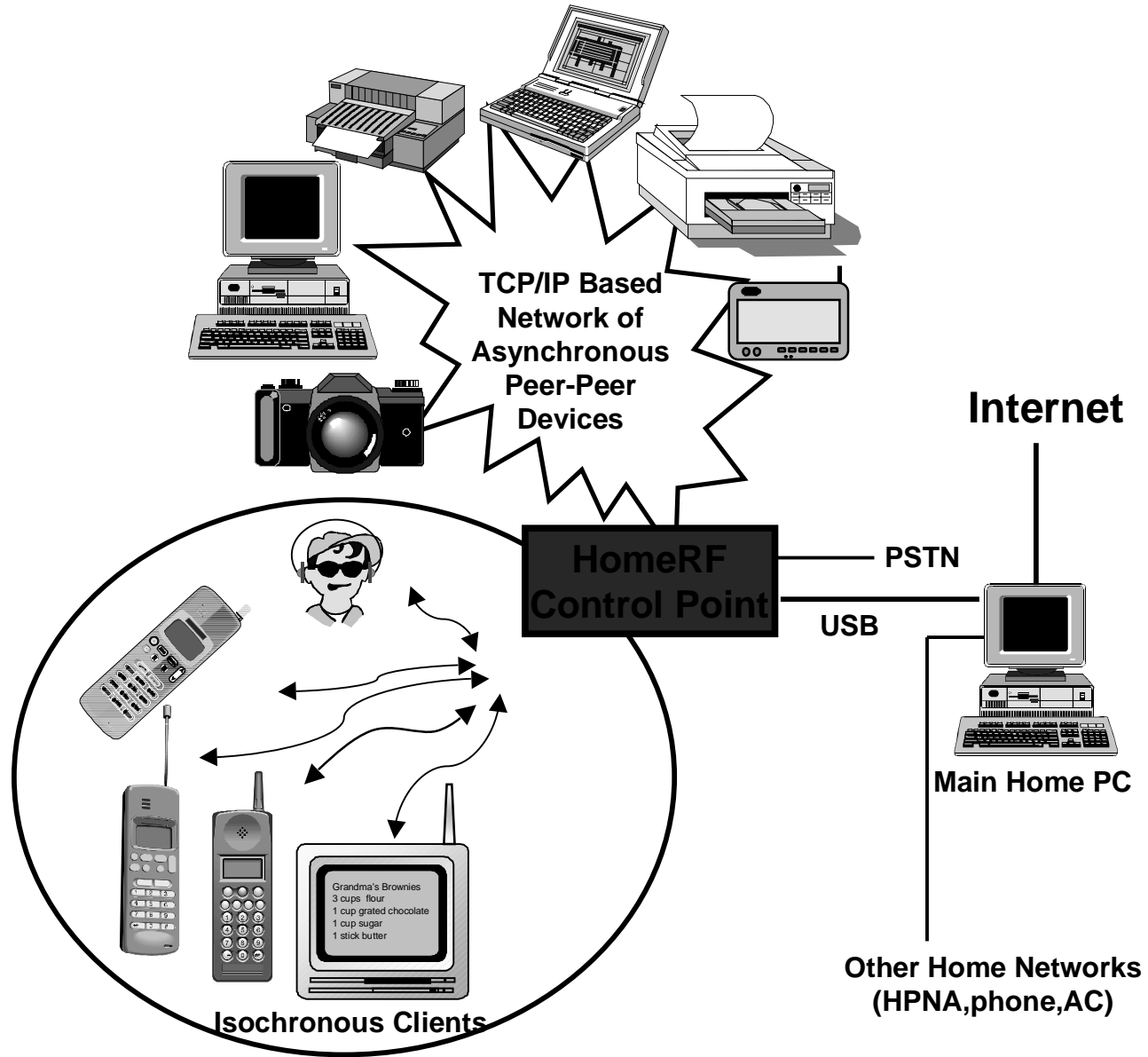
The following member companies are developing SWAP products:

- Butterfly Communications
- Compaq
- Hewlett-Packard
- IBM
- Intel
- iReady
- Microsoft
- Motorola
- Proxim
- OTC Telecom
- RF Monolithics
- Samsung
- Symbionics

Enabling the Vision



The SWAP Network



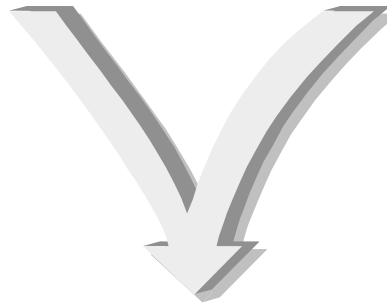
HomeRF Origins

802.11

**Uses CSMA/CA
Good for Data**

DECT

**Uses TDMA
Good for Voice**



SWAP

TDMA + CSMA/CA

Good for Voice & Data

Optimized for small networks (in home)

Simplified radio & protocol to reduce cost

Both voice and data are important for home RF

Why a new protocol?

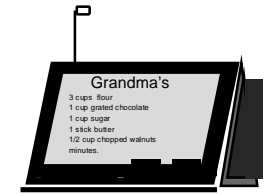
- **It handles voice like DECT or PHS, but...**
 - ◆ Frequency hopping
 - ◆ 20 ms frames (better for data)
 - ◆ interleaved up and down links
 - ◆ Retransmission (single)
- **It handles data like 802.11, but...**
 - ◆ Relaxed PHY layer specs to reduce cost
 - ◆ Beacons to manage isochronous traffic
 - ◆ Simplified protocol (no PCF)

• IP data at up to 2Mb/s and supports cordless telephony

SWAP Features

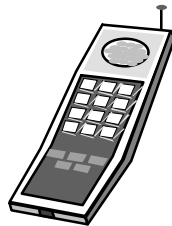
- **Range: >50 meters indoors**
- **Speed: dual speed - supports TCP/IP traffic at over 1Mb/s**
- **Voice: High quality voice channels with retransmission**
 - ◆ **High quality cordless telephones**
 - ◆ **Voice recognition**

Device Types



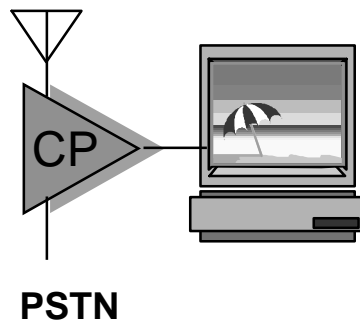
Fridge pad

Isochronous (I node)
> minimum latency -
telephones, etc.



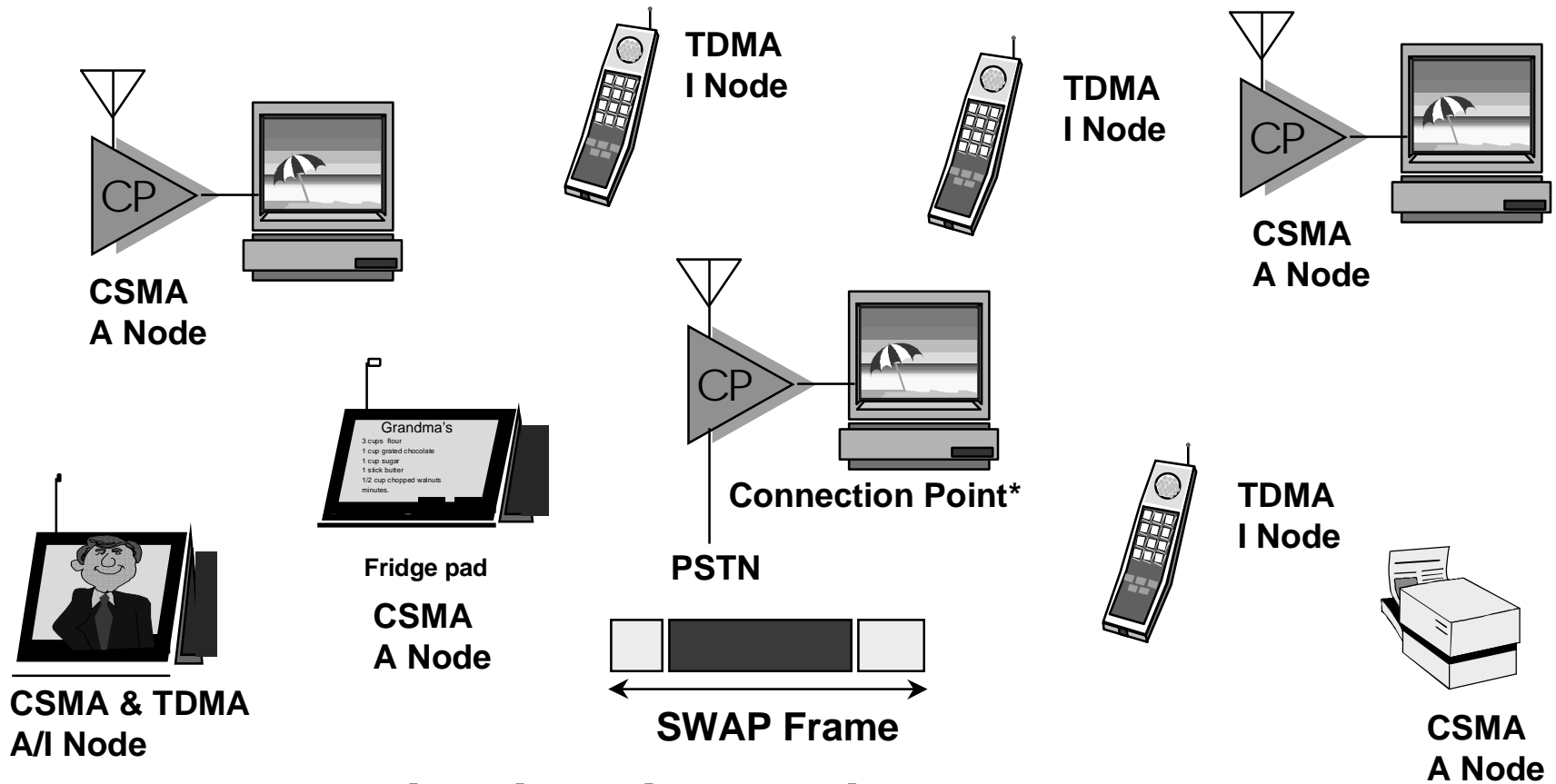
Cordless Telephone

Asynchronous (A node)
> TCP/IP traffic



- CP - Connection point...can manage a network or act as an A node
 - Can be **USB**, PCI, PC-Card, Device Bay, etc.
 - CP can place calls even when PC is down

Topology



- It's a circuit switched, isochronous network
- It's a packet switched, asynchronous network
- It's both - I nodes get priority on bandwidth

PHY Features

- **Nominal 100 mW transmit power**
- **Minimum receiver sensitivity of -76 dBm (2FSK)**
 - ◆ **range >50 m in typical homes/yards**
 - ◆ **-85 dBm sensitivity typical**
- **Cost effective filter requirements**
 - ◆ **Use MAC to reduce PHY cost**
 - ◆ **Makes single-chip integration simpler**

MAC Features

- **MAC provides good support for voice and data**
- **Leverages existing DECT technology for voice**
- **Excellent integration with TCP/IP networking protocols**
 - ◆ **easy integration with Ethernet**
 - ◆ **Supports broadcast, multicast and fragmenting**
- **Data security - Basic/Enhanced levels of encryption**
 - ◆ **Basic: 24-bit Network ID and Frequency Hopping**
 - ◆ **Enhanced: Basic + LFSR algorithm**
- **Extensive power management for ultra-portable devices**

Optimizes existing technology for home use

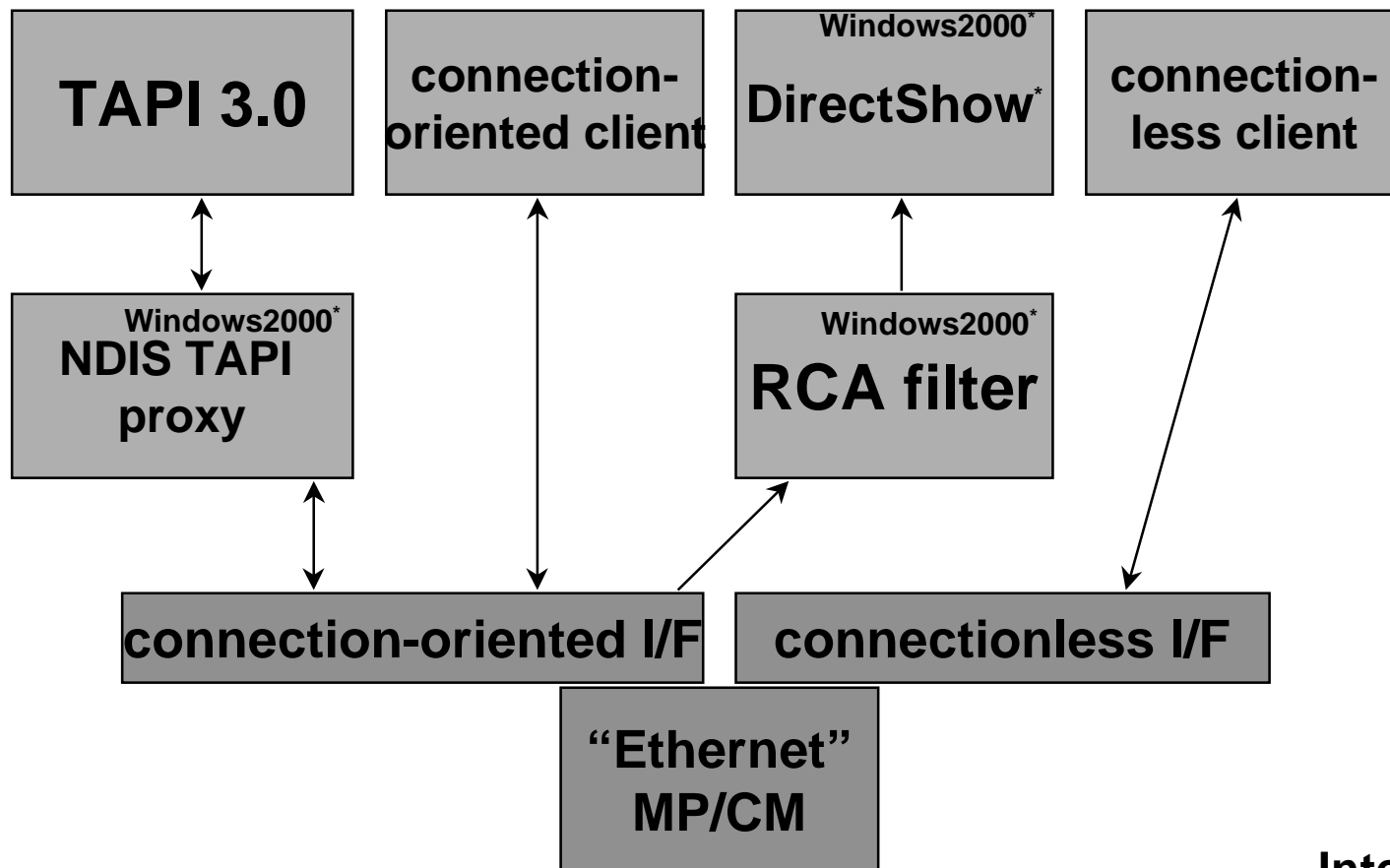
The PC interface

- **SWAP's PC connection is designed for use under Windows 98* , Windows2000* , and beyond**
 - ◆ **Wake on ring**
 - ◆ **Connection Oriented NDIS (NDIS 5...for Windows2000*)**
 - ◆ **A nodes appear as Ethernet devices**
 - ◆ **I nodes become Connection Oriented clients**



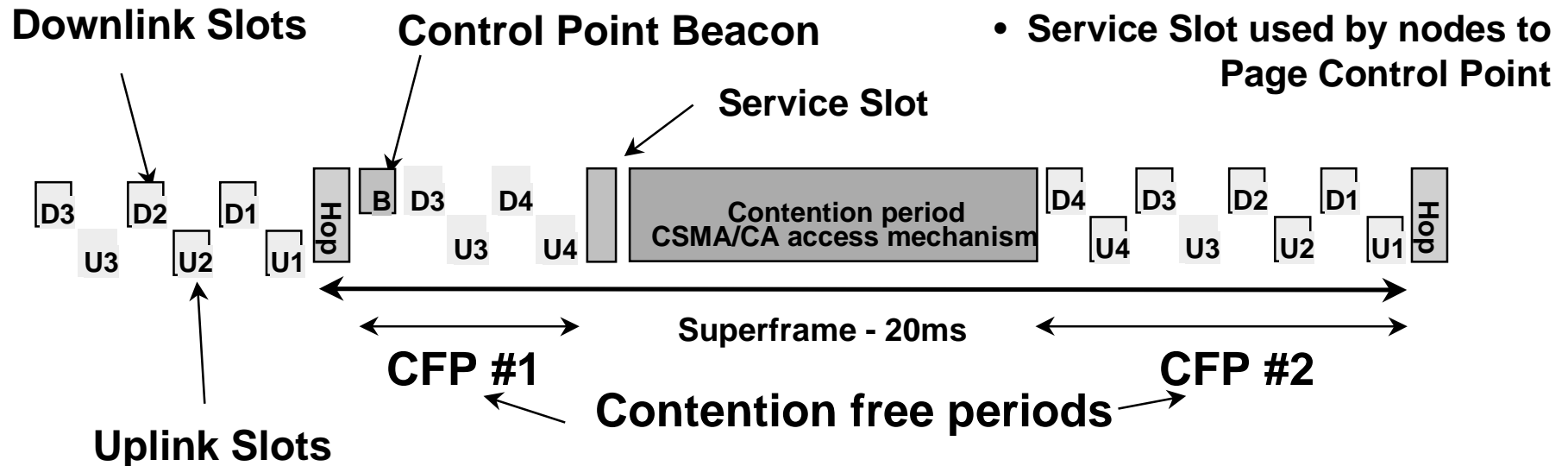
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PC Software Architecture Diagram



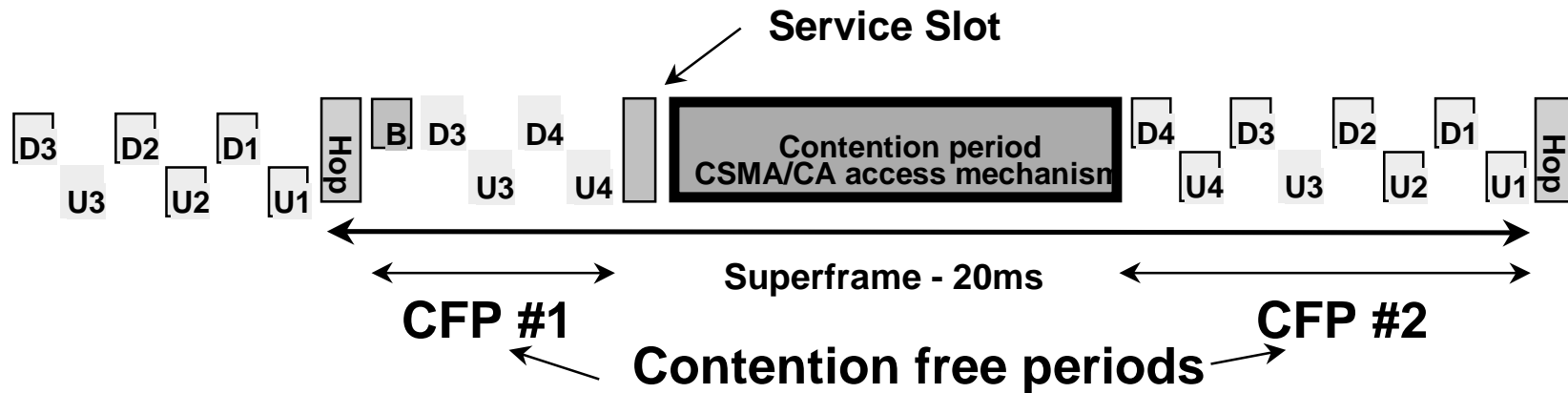
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Voice: Robust clarity



- Superframe structure controlled by Beacon
- TDMA slot pairs allocated by the Control Point
- Voice data transmitted in the slots in CFP #2
- Any voice data to be retransmitted is sent:
 - In CFP1, after a hop
 - frequency/time diversity & low latency

Data transmission

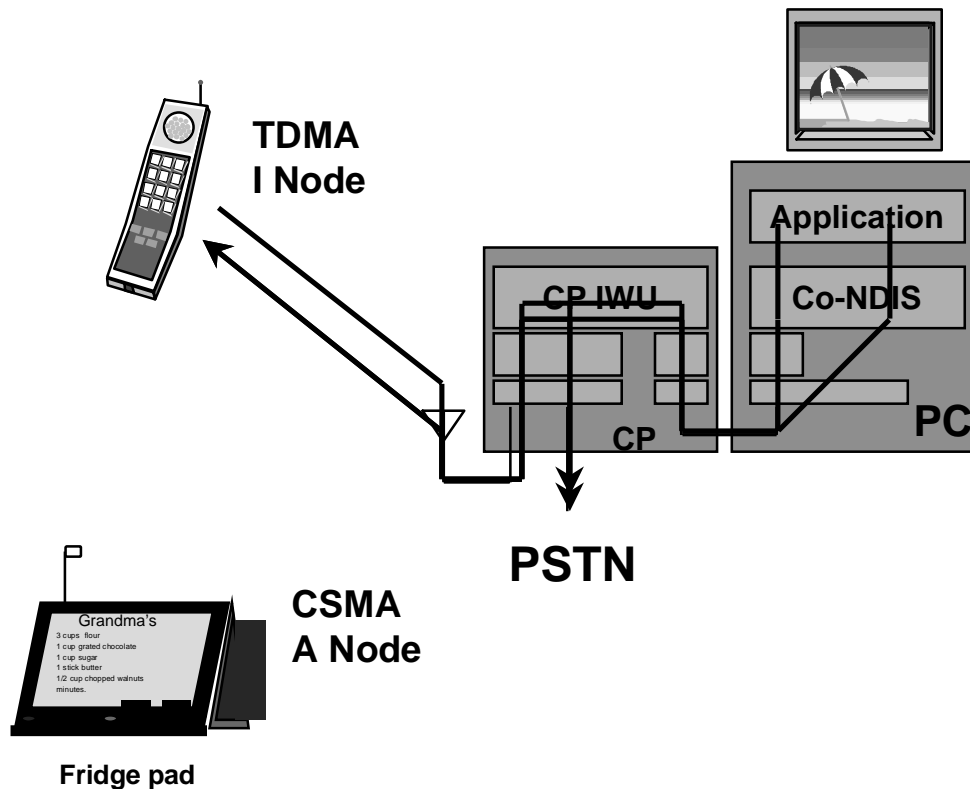


- CSMA/CA during the contention period
- Efficient for small networks
- Tolerant of interference
- Data for entire frame if no voice

Encryption Algorithm

- **Open, royalty free - published in open literature over 30 years ago**
- **Low gate count**
- **Fast “warm up”**
- **Required for CP in the US market, optional for other devices and geographies**
- **Robust**
- **Similar concept to GSM A5 algorithm, but “stronger”**

Usage - Voice Control

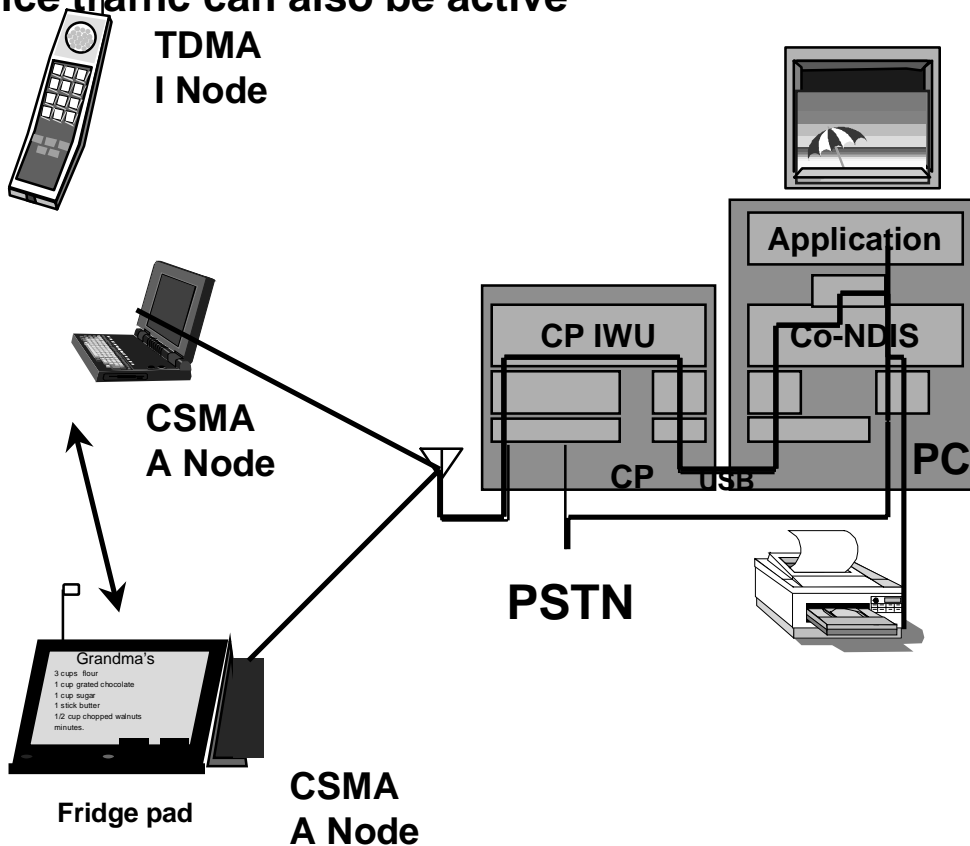


Data traffic can also be active

- 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

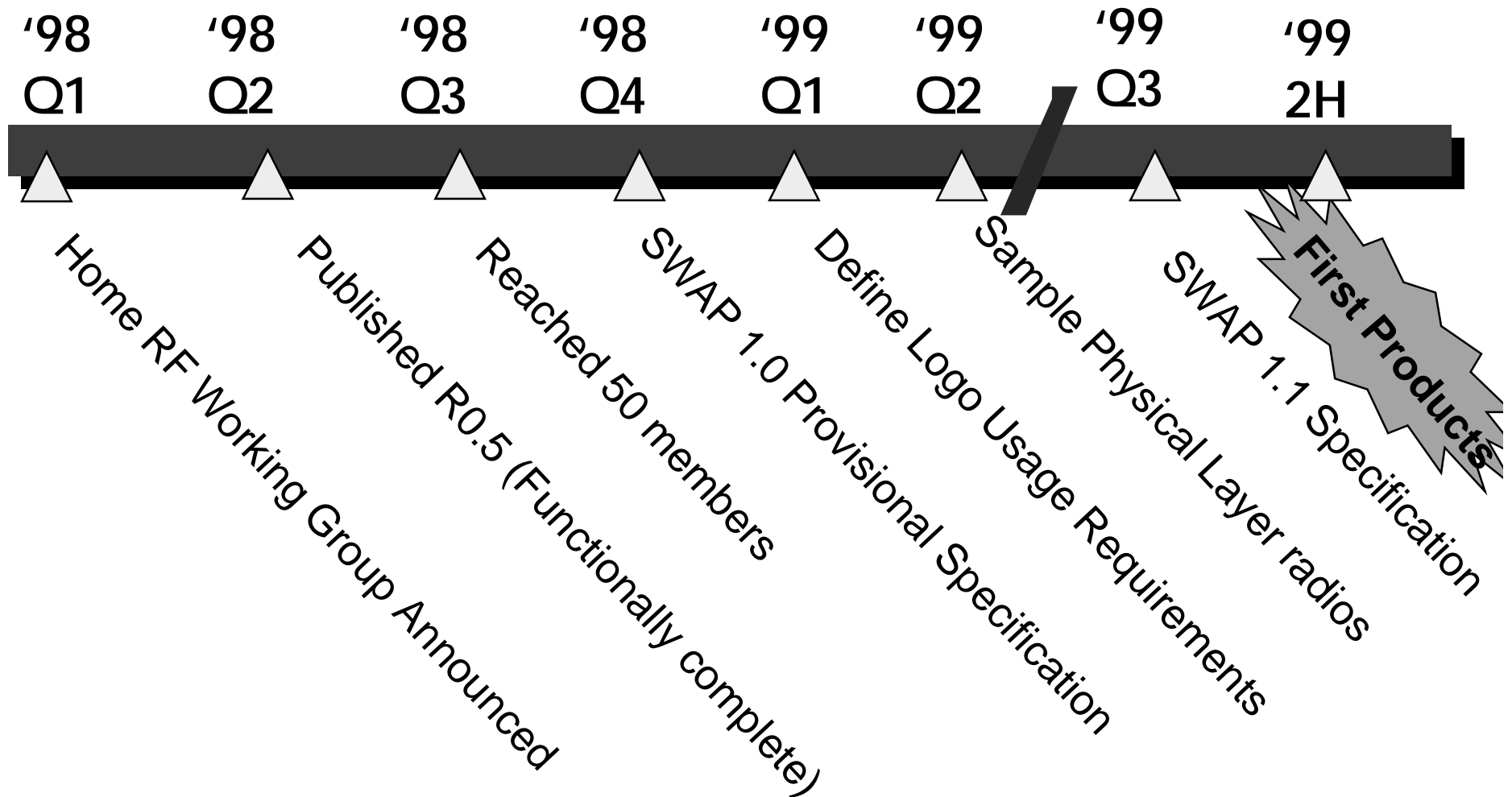
Usage - ISP Sharing

Voice traffic can also be active

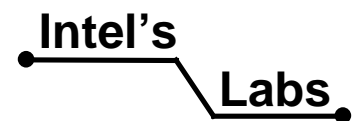


- PC initiates ISP connection (modem, ISDN, UDSL, Cable, etc.)
- Applications on host PC can access ISP immediately
- Remote A nodes access ISP through NAT and TCP/IP
- Remote A nodes can also share files and printers
- Ad hoc peer-peer transfers between nodes do not require resources of “server” PC

Timeline



www.homerf.org



HomeRF Summary



- Home RF Working group developing open, royalty free spec
- Over 80 member companies
- NOW is the time to begin implementation plans
- More info (including membership) at www.homerf.org
- \$4,800 membership fee