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# HIPERLAN

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# What is HIPERLAN?

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**HIPERLAN - High Performance Radio LAN**

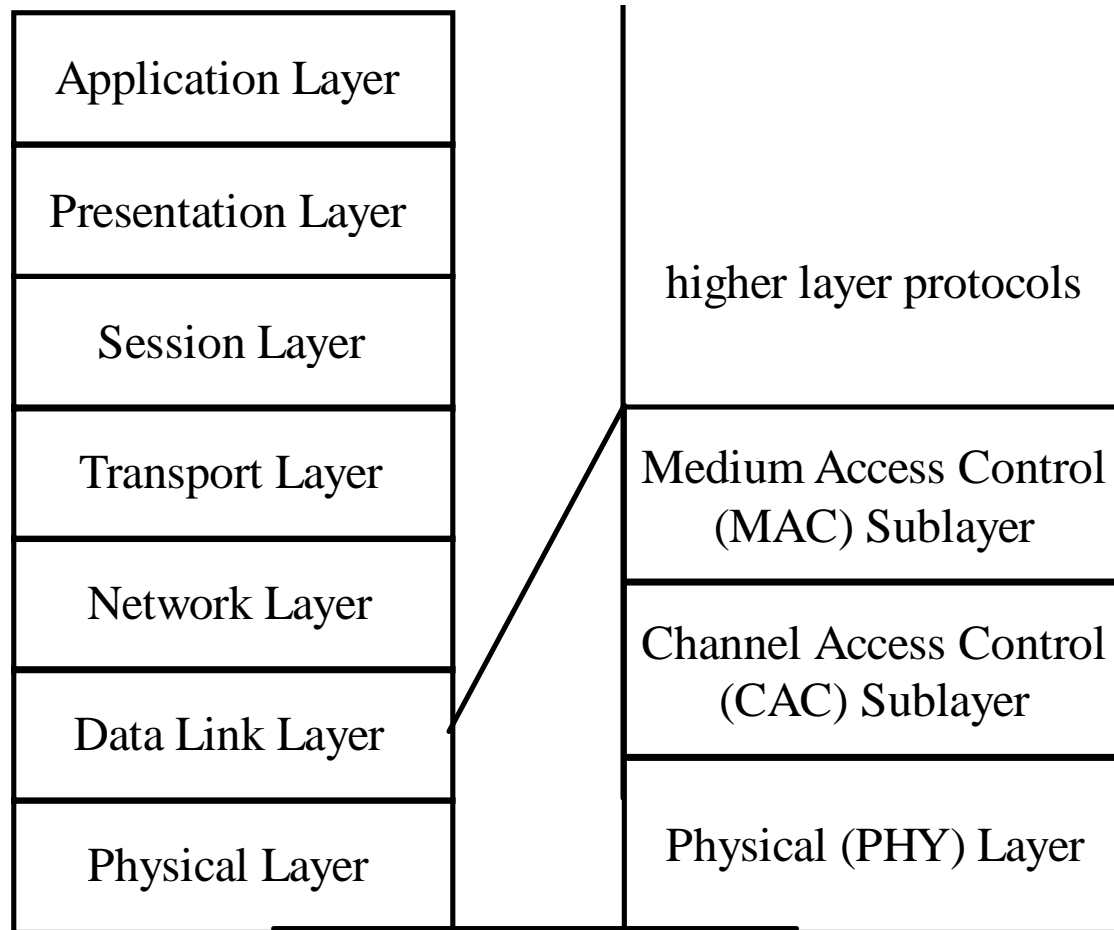
**HIPERLAN is a new standard for Radio LANs developed in Europe by ETSI**

**HIPERLAN is an interoperability standard which specifies a common air interface MAC and PHY layers in OSI model**

**HIPERLAN will be a family of standards  
HIPERLAN 1 is described in detail**

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# HIPERLAN - reference model



**OSI  
Reference Model**

**HIPERLAN  
Reference Model**

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# Origins of HIPERLAN

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## **Early wireless LANs operating in the ISM bands (900MHz and 2.45GHz)**

Low data rate (~1Mbps) - an indirect result of the FCC spread spectrum rules part 15.247

Severe interference environment - from unlike wireless LANs and other ISM band systems

Lack of standards - IEEE 802.11 was initiated to satisfy this need but it was taking time to develop

**ETSI set up RES10 to develop a standard that would be equal in performance to wired LANs such as Ethernet**

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# HIPERLAN 1 - history

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- ETSI set up RES10 group - mid 1991
- RES10 start work on standard - early 1992
- CEPT allocate spectrum - early 1993
- RES10 complete draft standard - mid 1995
- ETSI publish final standard - late 1995
- RES10 start work on type approval - early 1996
- HIPERLAN passes public enquiry - mid 1996

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## HIPERLAN 1 - spectrum

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**CEPT identified vacant spectrum at 5GHz  
5.00-5.25GHz was allocated worldwide  
to aviation authorities on a primary basis  
for MLS but only 5.00-5.15GHz was used  
CEPT allocated 5.15-5.25GHz to  
HIPERLAN on a secondary basis with its  
status as non-interference, non-protected  
An extension of the band from 5.25-  
5.3GHz is available in most countries**

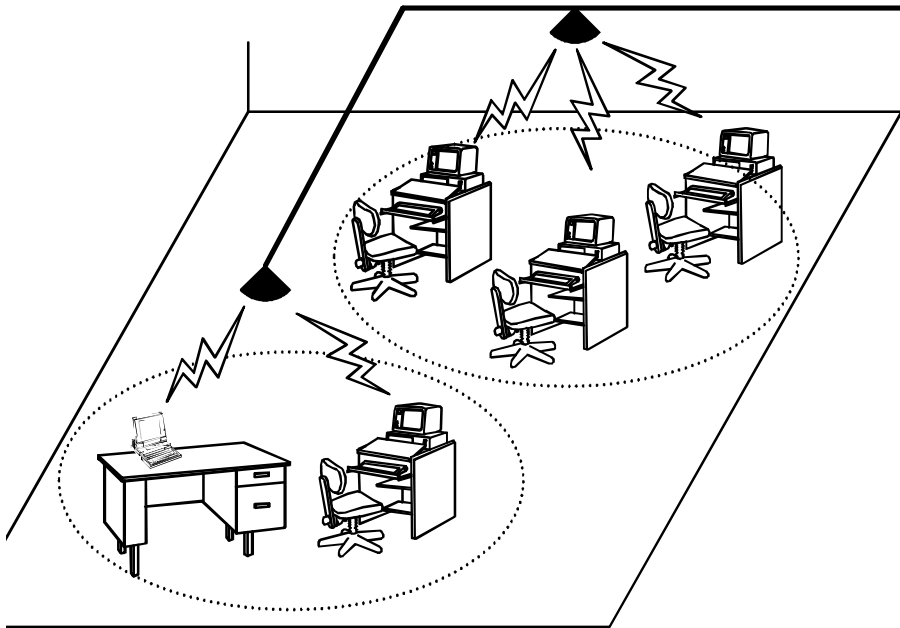
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# HIPERLAN - applications

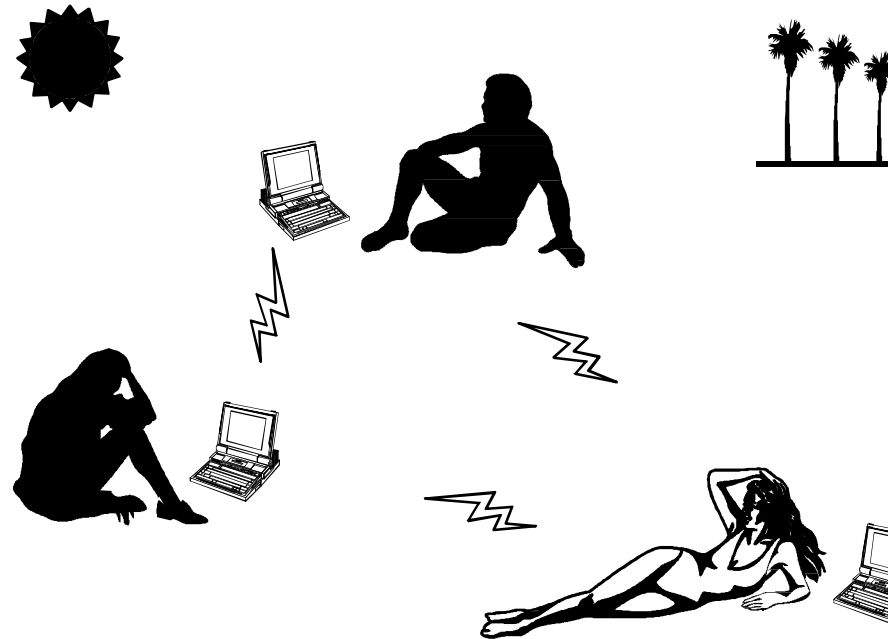
## Early ideas

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with infrastructure



without infrastructure



Others include - many vertical applications, wireless docking  
public access to the NII, home networks

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# HIPERLAN 1 - requirements

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- Short range - 50m
- Low mobility - 1.4m/s
- Networks with and without infrastructure
- Support isochronous traffic
  - audio 32kbps, 10ns latency
  - video 2Mbps, 100ns latency
- Support asynchronous traffic
  - data 10Mbps, immediate access



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# HIPERLAN 1 PHY - specifications

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**High transmission rate - 23.5294Mbps**

**Modulation - non diff GMSK, BT = 0.3**

**Error control - FEC, BCH(31,26)**

**Packet failure rate - 0.01 (4160 data bits)**

**Low transmission rate - 1.470588Mbps**

**Modulation - FSK, freq dev = 368kHz**

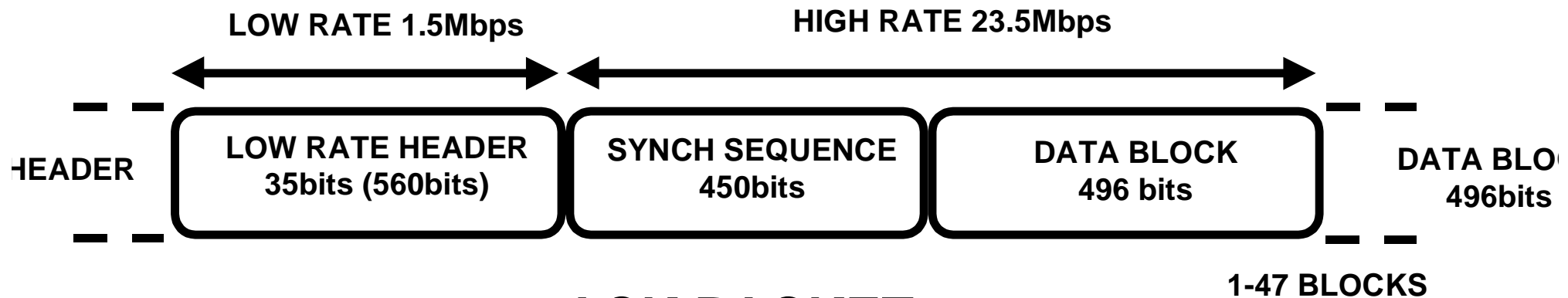
**Channelisation - 5 channels, 5.15-5.30GHz**

**Transmit power - +10, +20, +30dBm**

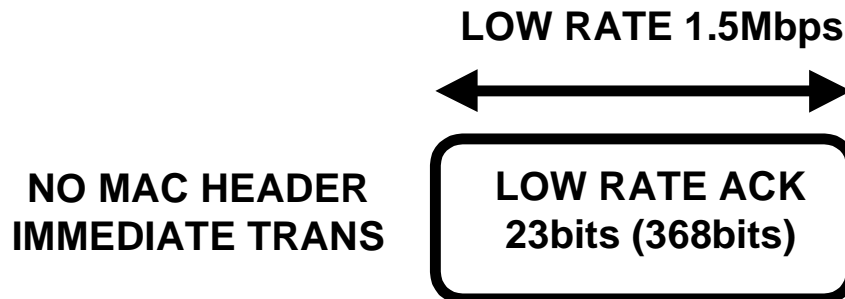
**Receive sensitivity - -50, -60, -70dBm**

# HIPERLAN 1 PHY - packets

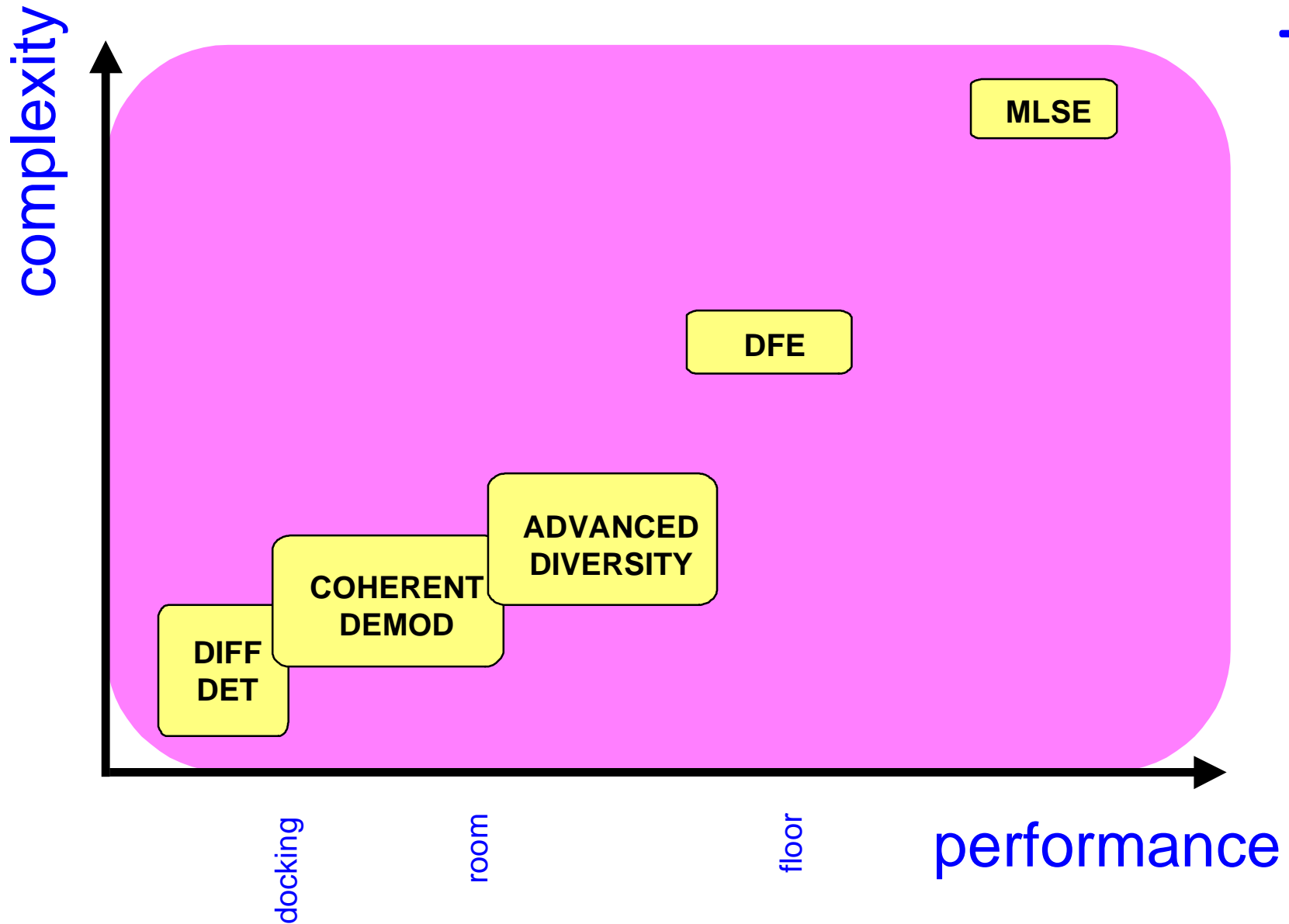
## DATA PACKET



## ACK PACKET



# HIPERLAN 1 - modem options



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# HIPERLAN 1 PHY - quirks

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## **A HIPERLAN can only use one Channel**

There is no mechanism for changing channel

## **Antenna diversity an option but...**

Must use same antenna for CCA

and transmission for correct MAC function

Must reduce transmit power by antenna gain  
to maintain EIRP as specified by CEPT

## **Power saving with...**

Low rate header for modem power saving

Power saving cycle strategies sleep/wake modes

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# HIPERLAN 1 MAC - concept

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## **Fully distributed MAC**

**Networks with and without infrastructure**

**Permits multi-hop relaying via neighbours**

**Based on LBT - uses CCA**

**with adaptive threshold**

**EY-NPMA - Elimination Yield Non-pre-emptive**

**Multiple Access**

**Priority assertion using listen-talk**

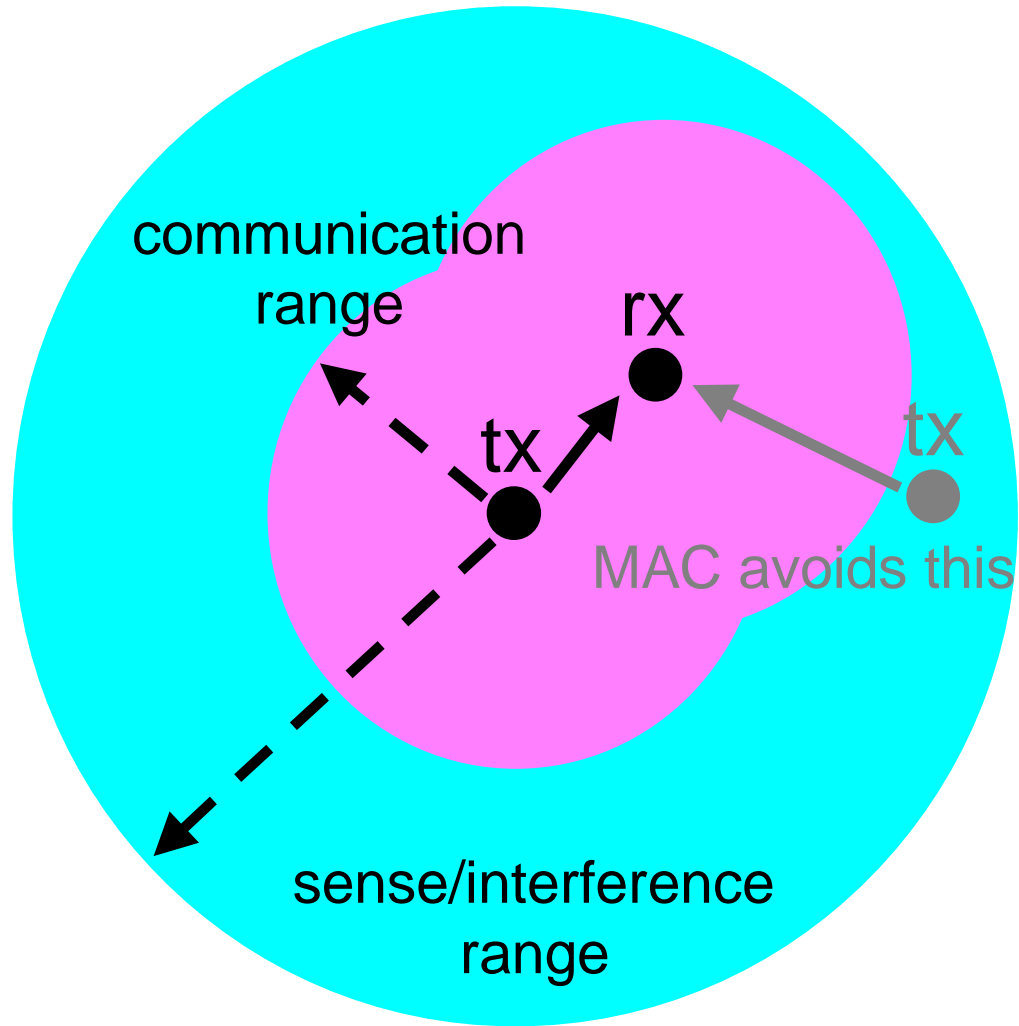
**Contention resolution using talk-listen**

**Immediate packet acknowledgment**

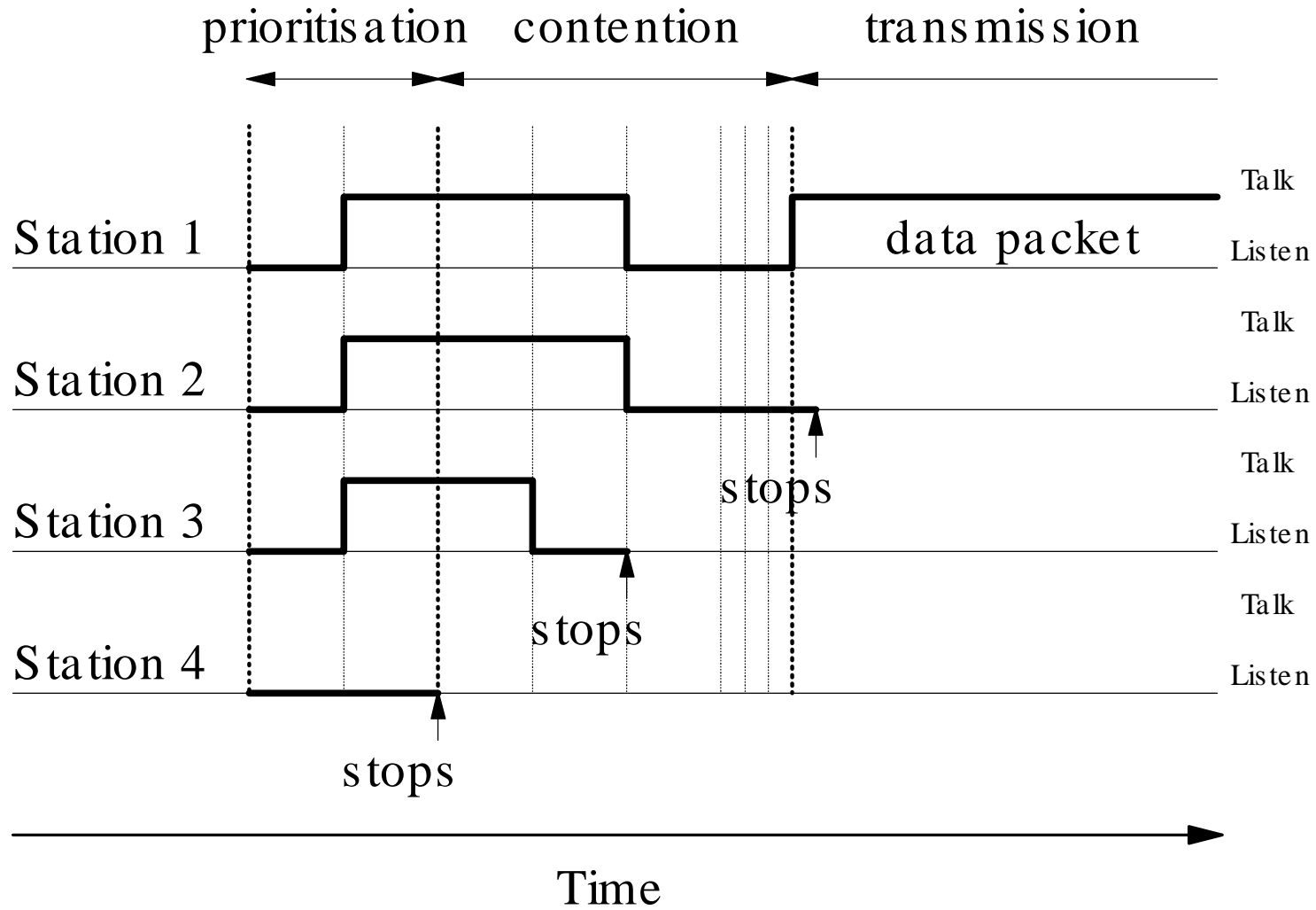
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# HIPERLAN 1 MAC - hidden nodes

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# HIPERLAN 1 MAC - function



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# HIPERLAN 1 MAC - phase

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## **Prioritisation**

1-5 slots of 168bits (talk)

## **Contention**

Elimination - 0-12 slots of 212bits (talk),

1 slot of 256bits (listen),  $\text{prob}(\text{talk-listen}) = 0.5$

Yield - 0-9 slots of 168bits (listen),  $\text{prob}(n) = 0.1$

**Tx to Rx turn around time  $6\mu\text{s}$**

**256 contenders, 3.5% collision probability**

**Total of 0-5152bits (0-219 $\mu\text{s}$ ) MAC header**



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# HIPERLAN 1 MAC - priority

Priority is a function of lifetime and user priority

NORMALISED RESIDUAL LIFETIME	HIGH USER DEFINED PRIORITY	LOW USER DEFINED PRIORITY
$NRL < 10ms$	0	1
$10ms < NRL <$	1	2
$20ms < NRL <$	2	3
$40ms < NRL <$	3	4
$NRL > 80ms$	4	4

If lifetime expires packet is discarded in the  
MAC

Either best effort latency for isochronous  
traffic

Or best effort integrity for asynchronous traffic

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# HIPERLAN 1 MAC - performance

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**Simulations show that the HIPERLAN MAC can simultaneously support**

**25 audio links @ 32kbit/s, 10ms delivery**

**25 audio links @ 16kbit/s, 20ms delivery**

**1 video link @ 2Mbit/s, 100ms delivery**

**Asynch file transfer @ 13.4Mbit/s**

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# HIPERLAN 1 - testbeds

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## **Two European collaborative projects**

### **LAURA - not fully standards compliant**

Demonstrated some concepts

No ASICs developed

### **HIPERION - fully standards compliant**

ASICs designed for...

RF MCM with GaAs and Si by GPS

Modem, Codec, D/A, A/D by Apple

MAC controller by ARM

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# HIPERLAN 2 - WATM

## **Idea is to be compatible with ATM**

- Support QoS guarantees
- Efficiently handle ATM cells

**Requires additional spectrum in Europe  
Sharing rules under development by  
WINForum for NII/SUPERNET band  
in the US aim to support**

- HIPERLAN 1 and HIPERLAN 2

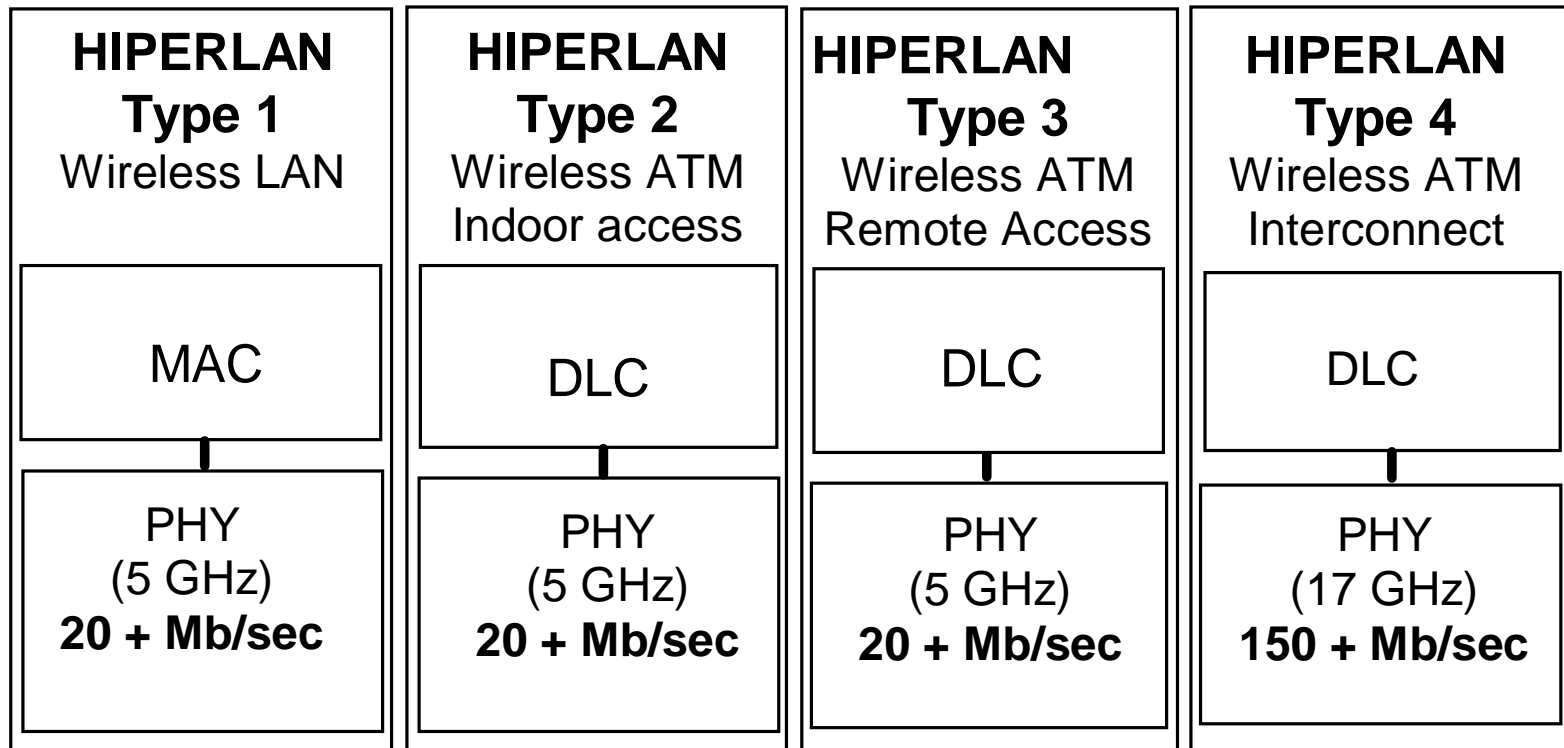
## **This effort involves interaction between**

- ETSI RES10, WINForum, ATM Forum

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# HIPERLAN family (ETSI RES10)

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# HIPERLAN vision (ETSI RES10)

