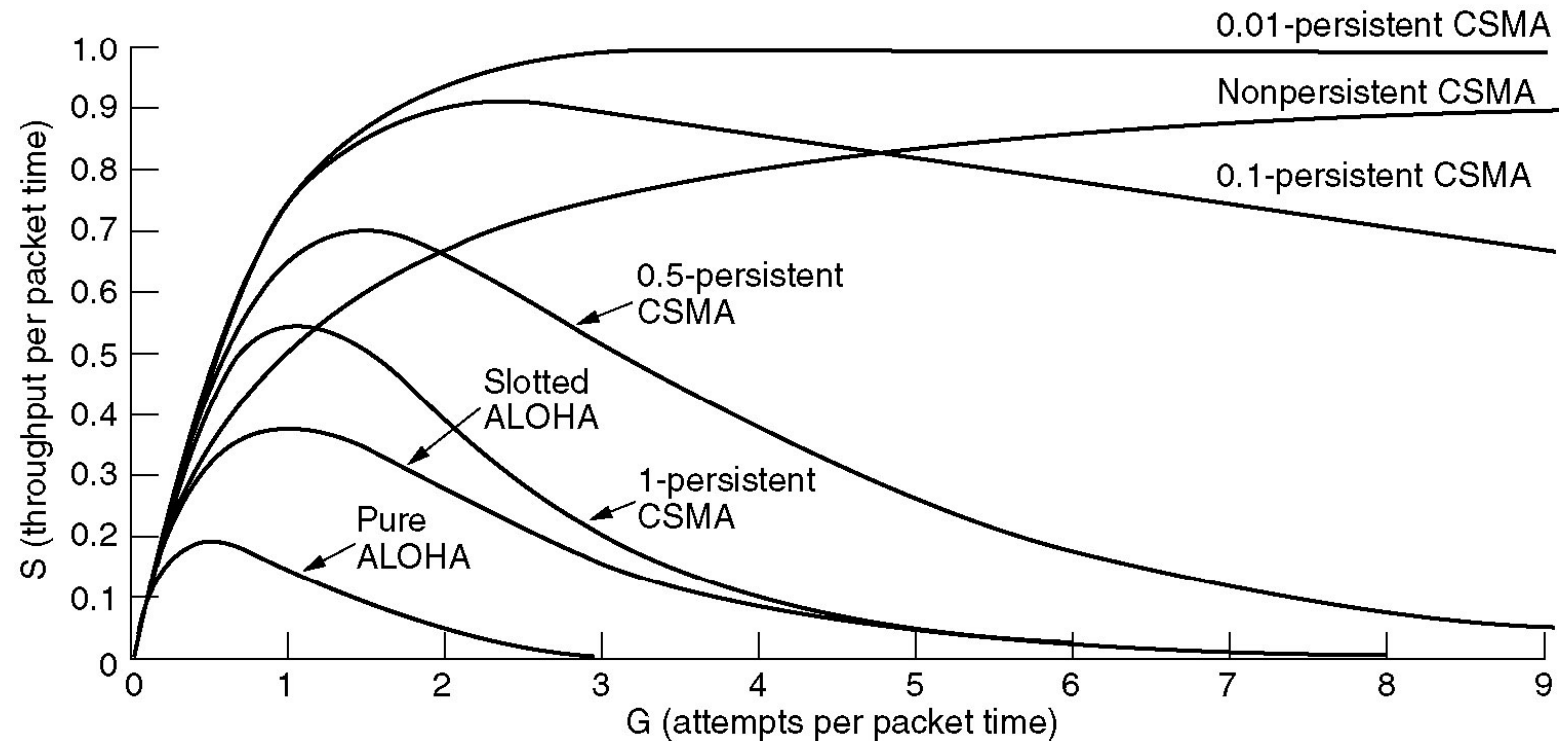


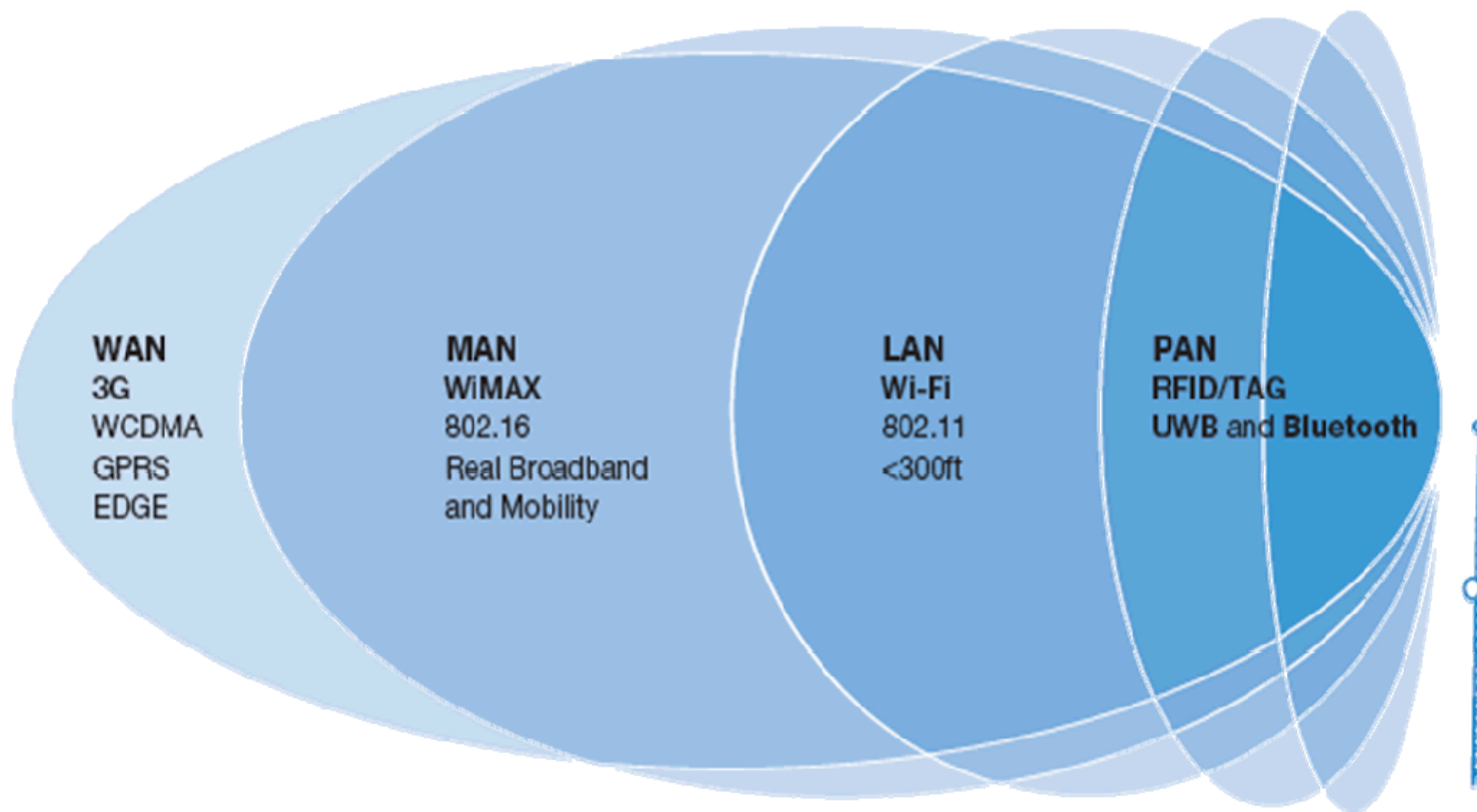
Aula anterior

- Assuntos Introdutórios sobre MAC
 - Alocação Estática de Canal
 - Alocação Dinâmica de Canal
 - MAC wireless (802.11)

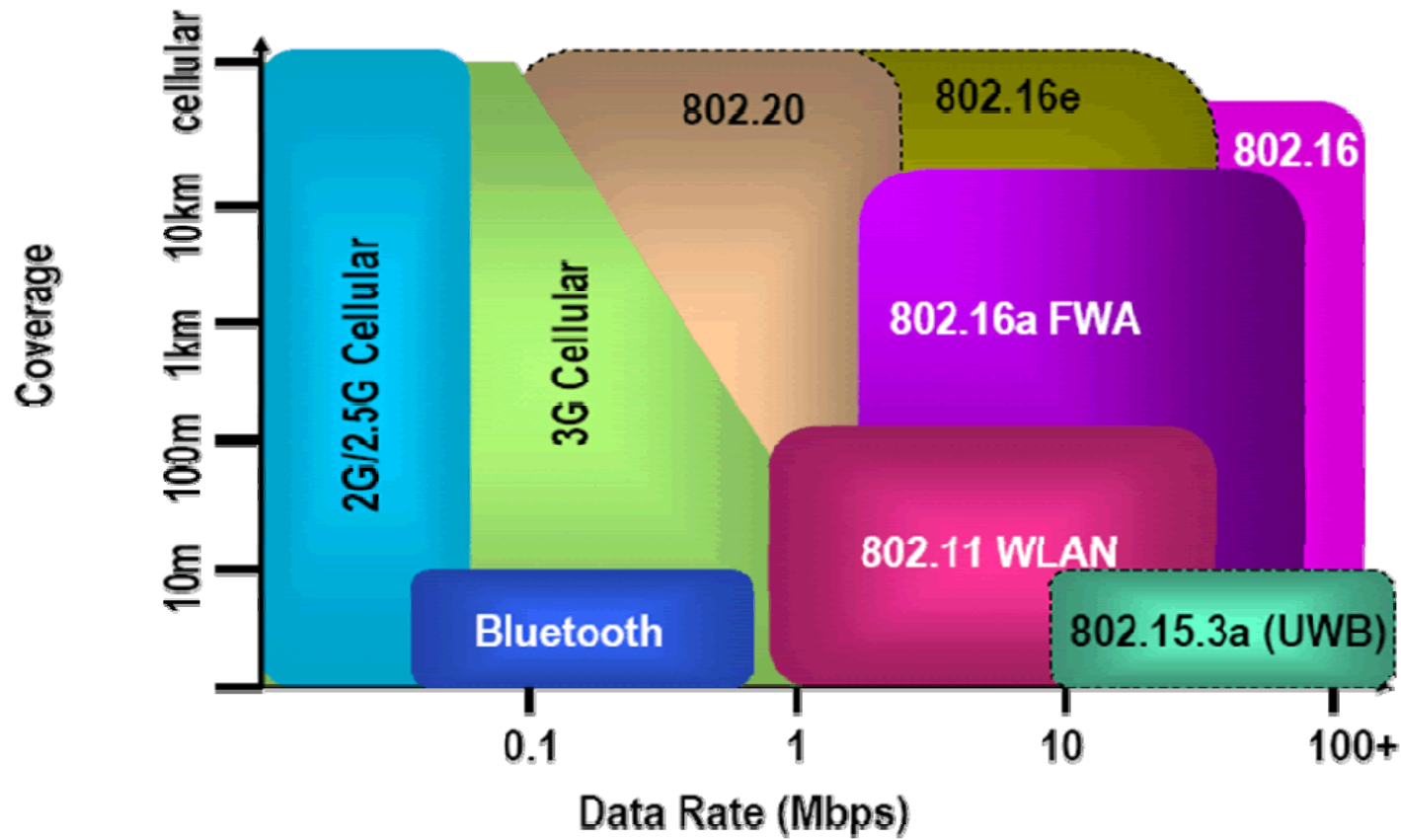
CSMA Persistente e Não-persistente



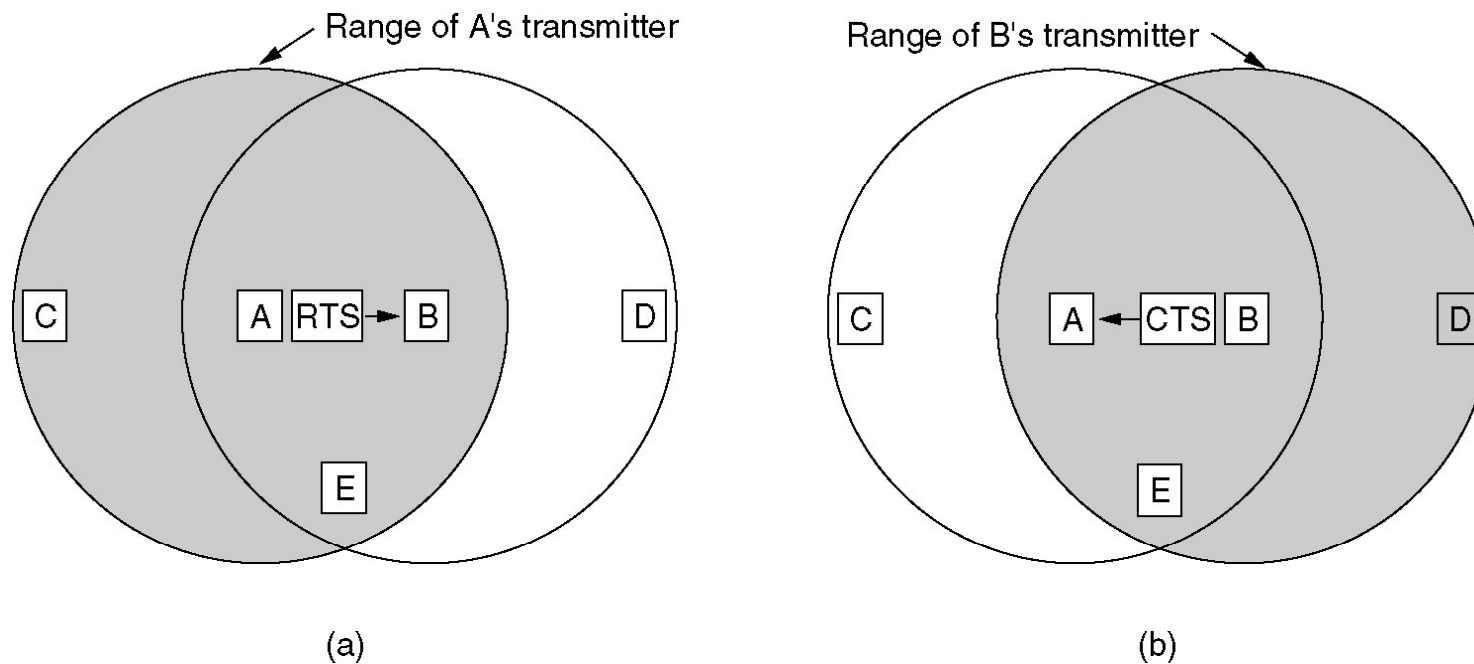
Abrangência Wireless



Cobertura X Taxa de transmissão



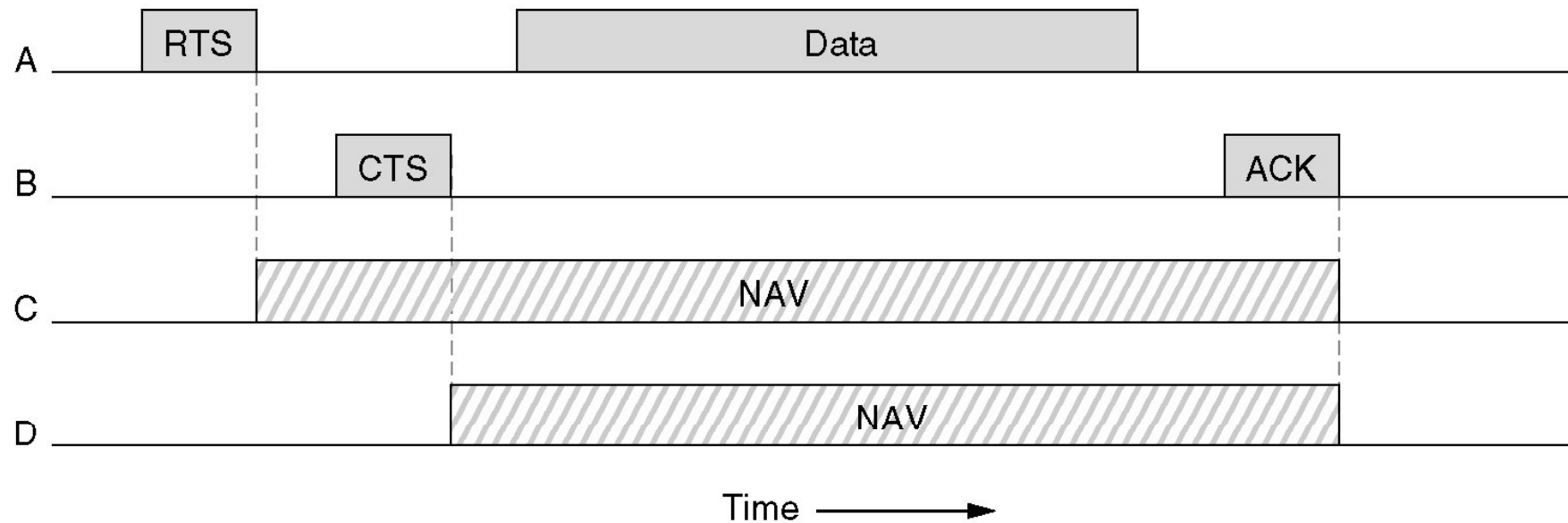
Protocolos de LAN sem Fio (2)



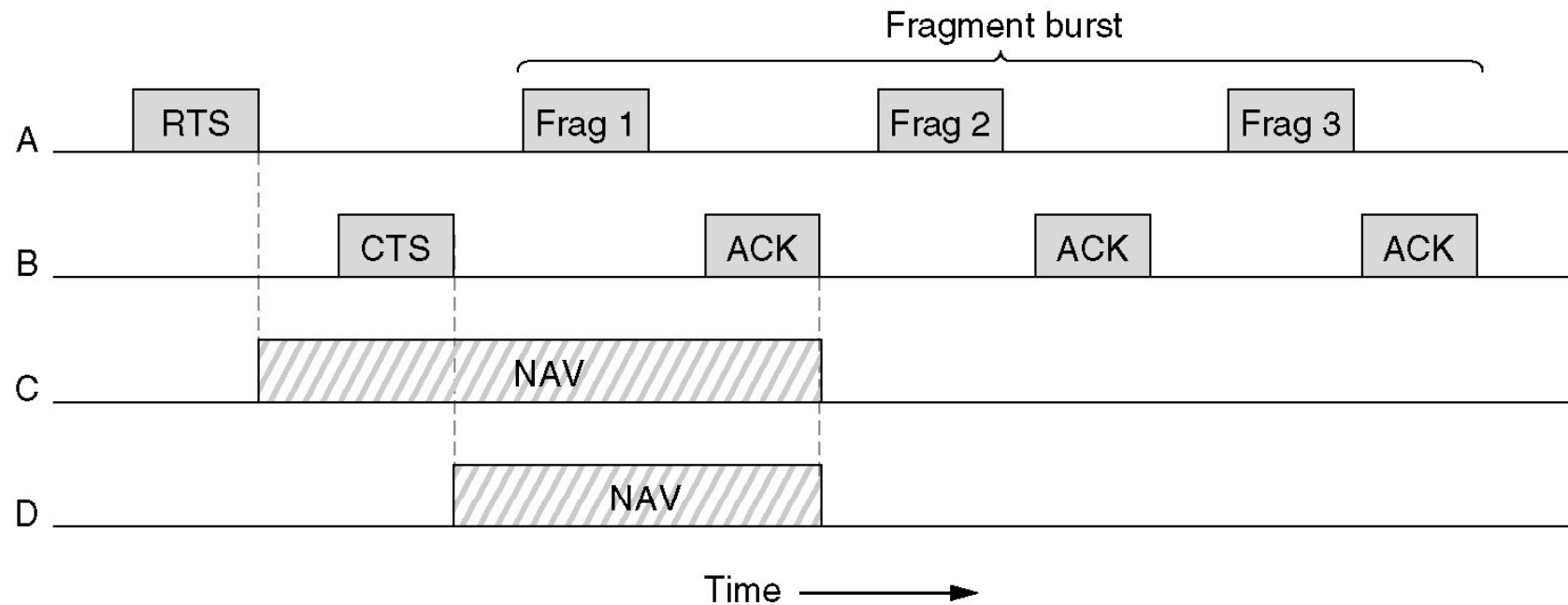
O protocolo MACA. (a) A enviando um RTS para B.

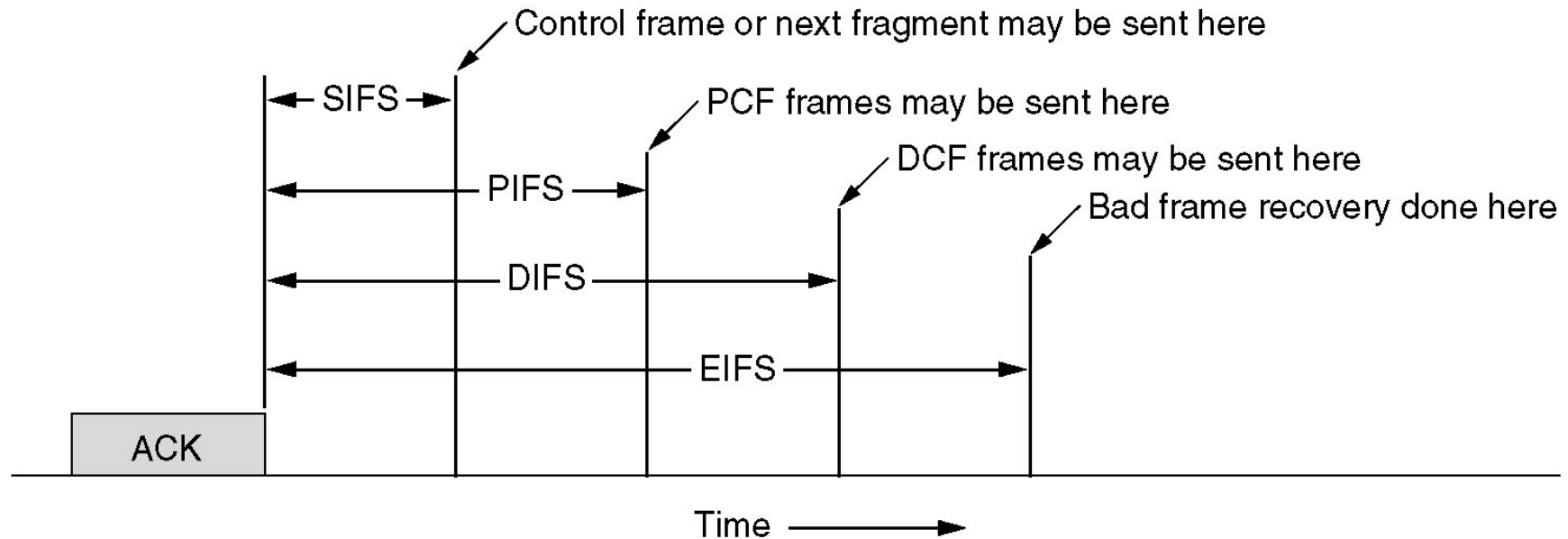
(b) B respondendo com um CTS para A.

O Protocolo de Subcamada MAC 802.11



O Protocolo de Subcamada MAC 802.11





- **SIFS: Short InterFrame Spacing**
 - Usado para garantir prioridade para uma conversa (fragmentos), inclusive para o receiver enviar CTS ou ACK (control)
- **PIFS: PCF InterFrame Spacing**
 - A Estacao Base pode enviar um beacon ou poll frame (convite para quem quiser usar o meio)
- **DIFS: DCF InterFrame Spacing**
 - Qualquer estacao pode tentar alocar o canal para transmitir
 - Pode haver colisao
- **EIFS: Extended InterFrame Spacing**
 - Usado para reportar recebimento de frames danificados

802.11 usa OFDM

- Orthogonal Frequency Division Multiplexing.
- Estudos começaram nos anos 70.
- Baseado no conceito de múltiplas portadoras.



OFDM

- A técnica de transmissão é muito utilizada em:
 - Sistemas de TV Digital
 - Redes Wireless 802.11 a/g/n e 802.16
 - xDSL



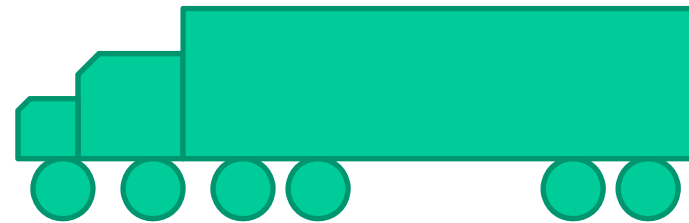
Idéia do Sistema OFDM

- Idéia Básica

- Uso de um grande número de sub-portadoras paralelas com baixa banda, instanciadas em uma única portadora de grande banda para transportar informações.



Idéia do Sistema OFDM

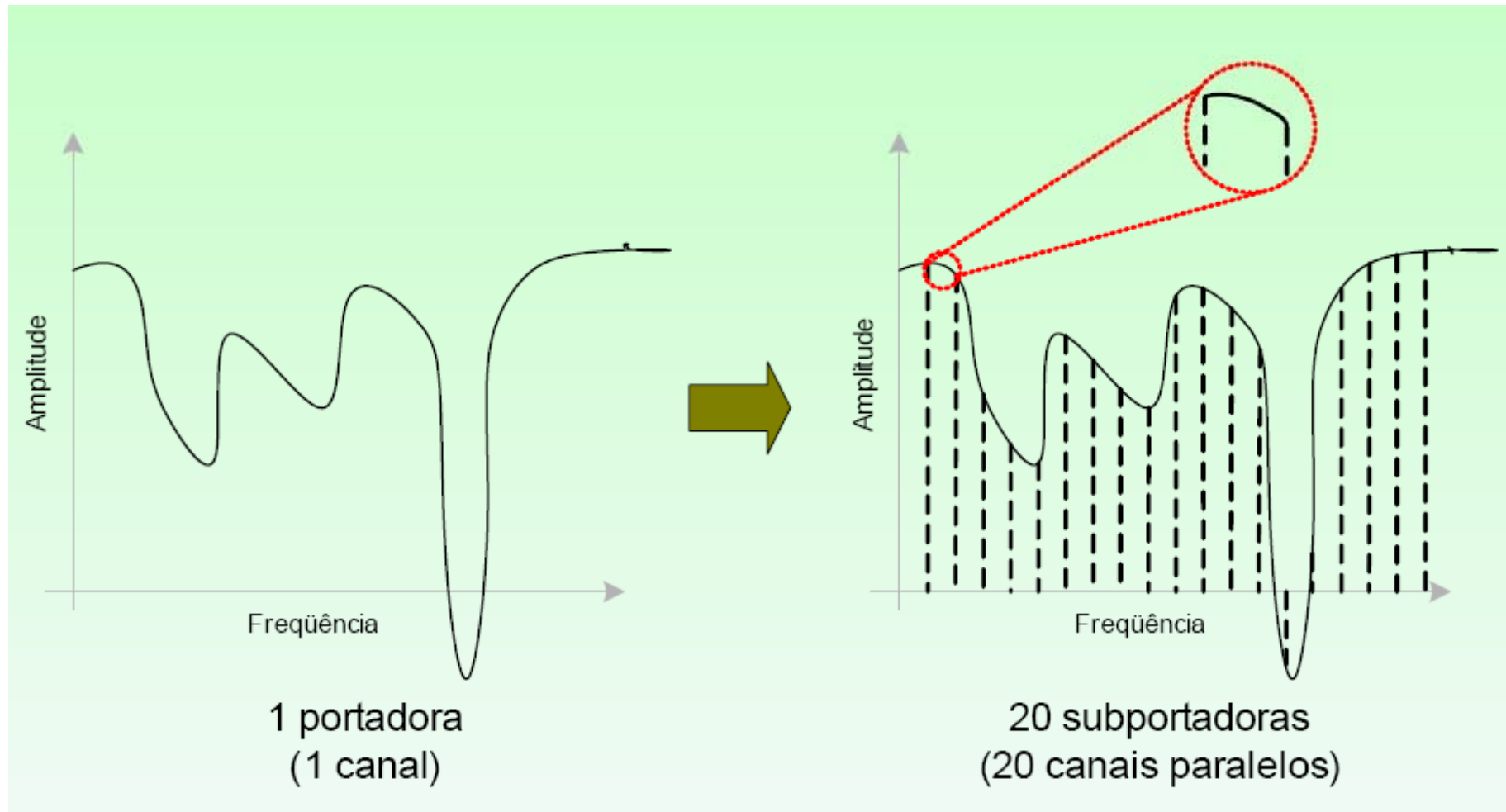


FDM



OFDM

Idéia do Sistema OFDM

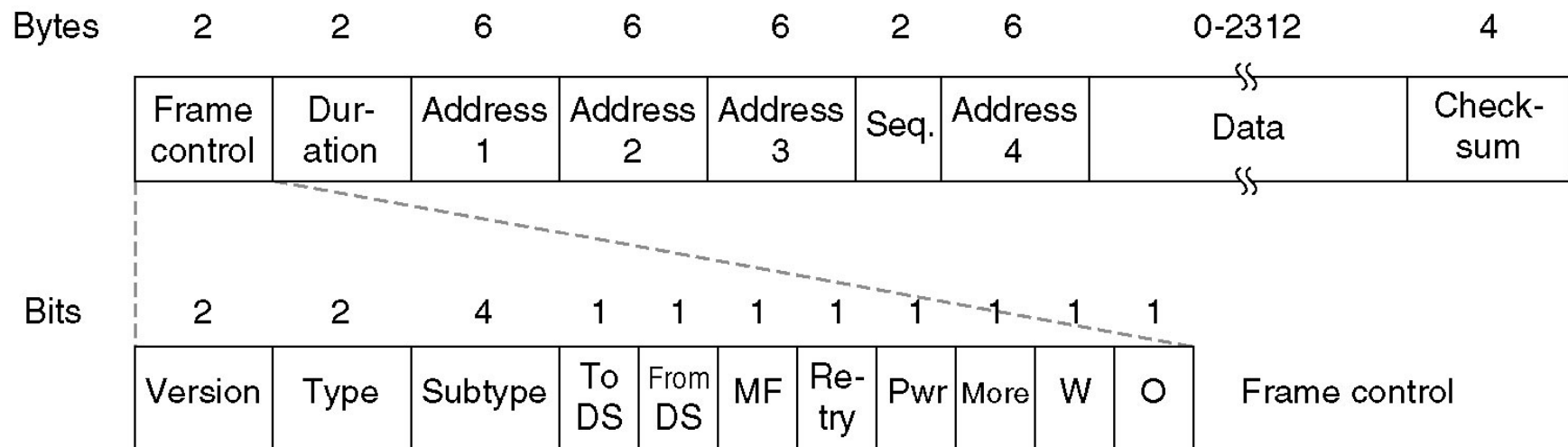


Nesta aula....

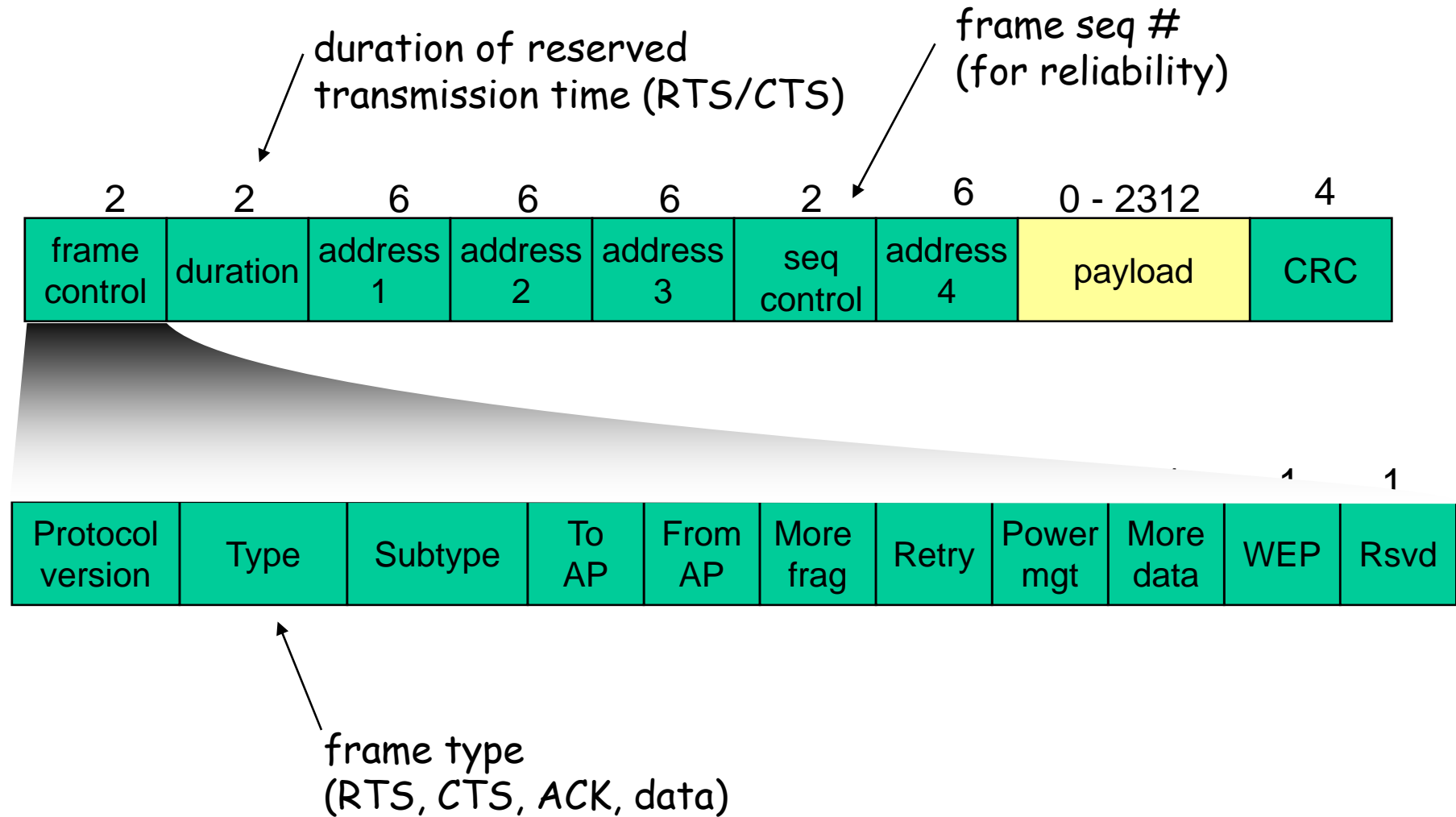
... continuaremos avaliando a pilha 802.11
(em suas várias versões)... e outros W-MACs (se der tempo)

- Frame 802.11 e endereçamento
- Serviços
- MIMO (multiple input, multiple output)
- WiMax e Bluetooth

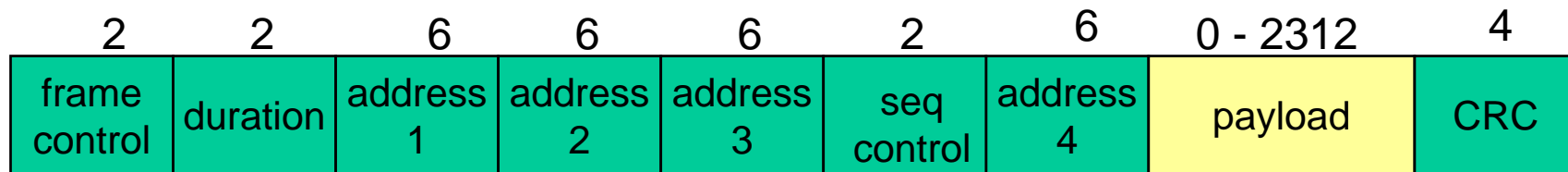
A Estrutura de Quadro 802.11



A Estrutura de Quadro 802.11



A Estrutura de Quadro 802.11: Endereçamento



Address 1: MAC address of wireless host or AP to receive this frame

Address 2: MAC address of wireless host or AP transmitting this frame

Address 3: MAC address of router interface to which AP is attached

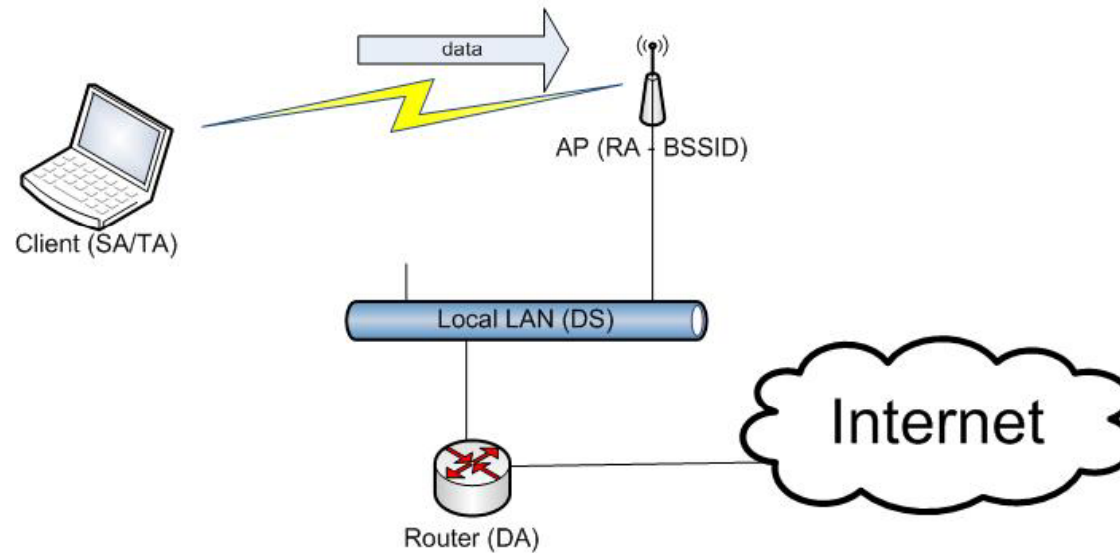
Address 3: used only in WDS mode

Endereços 802.11

To DS	From DS	Add 1	Add 2	Add 3	Add 4
0	0	DA	SA	BSSID	N/A
0	1	DA	BSSID	SA	N/A
1	0	BSSID	SA	DA	N/A
1	1	RA	TA	DA	SA

Endereços 802.11

To DS bit is set



To DS	From DS	Add 1	Add 2	Add 3	Add 4
0	0	DA	SA	BSSID	N/A
0	1	DA/RA	TA (BSSID)	SA	N/A
1	0	RA (BSSID)	SA/TA	DA	N/A
1	1	RA	TA	DA	SA

DA – Destination Address

SA – Source Address

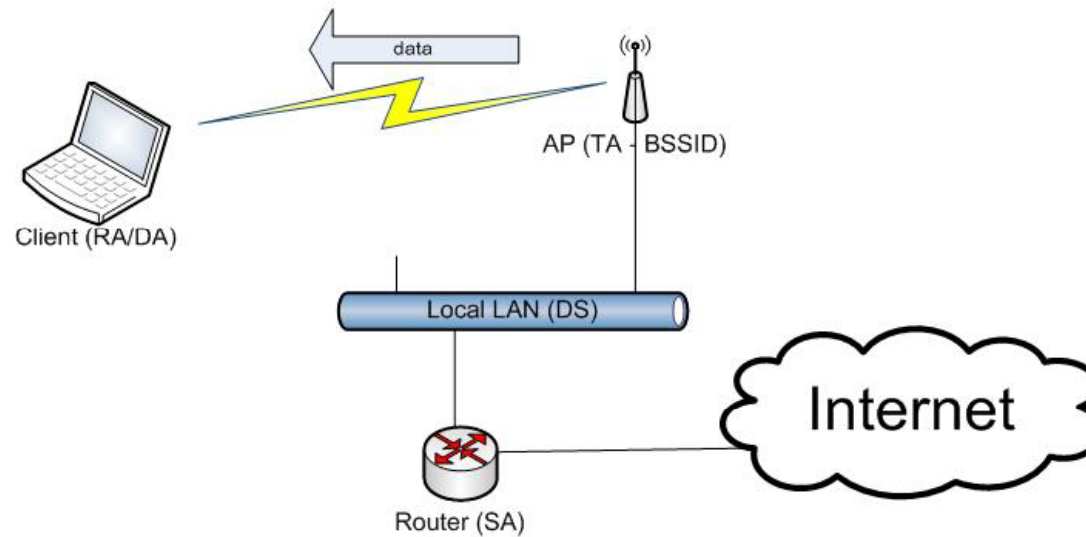
BSSID – Network Identifier (MAC address in infra mode)

RA – Receiver Address

TA – Transmitter Address

Endereços 802.11

From DS bit is set



To DS	From DS	Add 1	Add 2	Add 3	Add 4
0	0	DA	SA	BSSID	N/A
0	1	DA/RA	TA (BSSID)	SA	N/A
1	0	RA (BSSID)	SA/TA	DA	N/A
1	1	RA	TA	DA	SA

DA – Destination Address

SA – Source Address

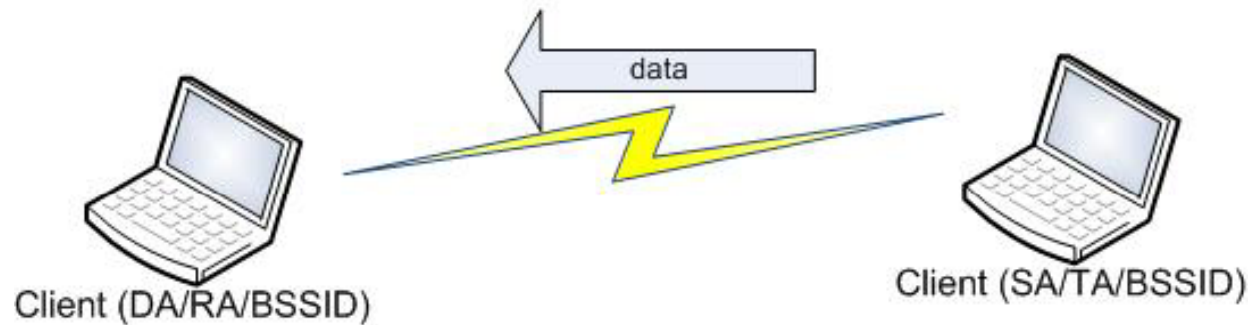
BSSID – Network Identifier (MAC address in infra mode)

RA – Receiver Address

TA – Transmitter Address

Endereços 802.11

**From DS and To DS
are cleared (Ad-hoc)**



To DS	From DS	Add 1	Add 2	Add 3	Add 4
0	0	DA	SA	BSSID	N/A
0	1	DA/RA	TA (BSSID)	SA	N/A
1	0	RA (BSSID)	SA/TA	DA	N/A
1	1	RA	TA	DA	SA

DA – Destination Address

SA – Source Address

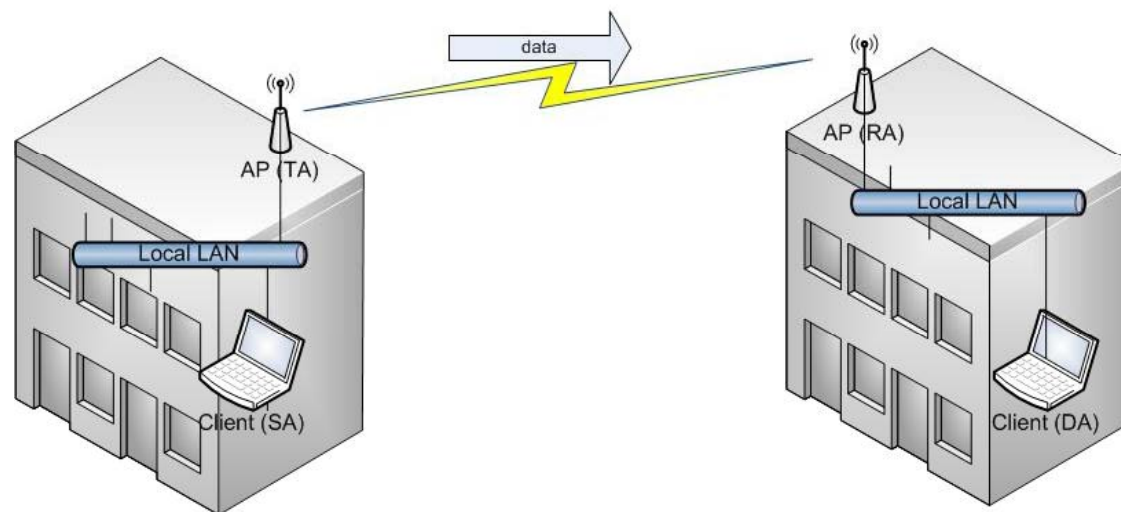
BSSID – Network Identifier (MAC address in infra mode)

RA – Receiver Address

TA – Transmitter Address

Endereços 802.11

From DS and To DS are set (WDS)



To DS	From DS	Add 1	Add 2	Add 3	Add 4
0	0	DA	SA	BSSID	N/A
0	1	DA/RA	TA (BSSID)	SA	N/A
1	0	RA (BSSID)	SA/TA	DA	N/A
1	1	RA	TA	DA	SA

DA – Destination Address

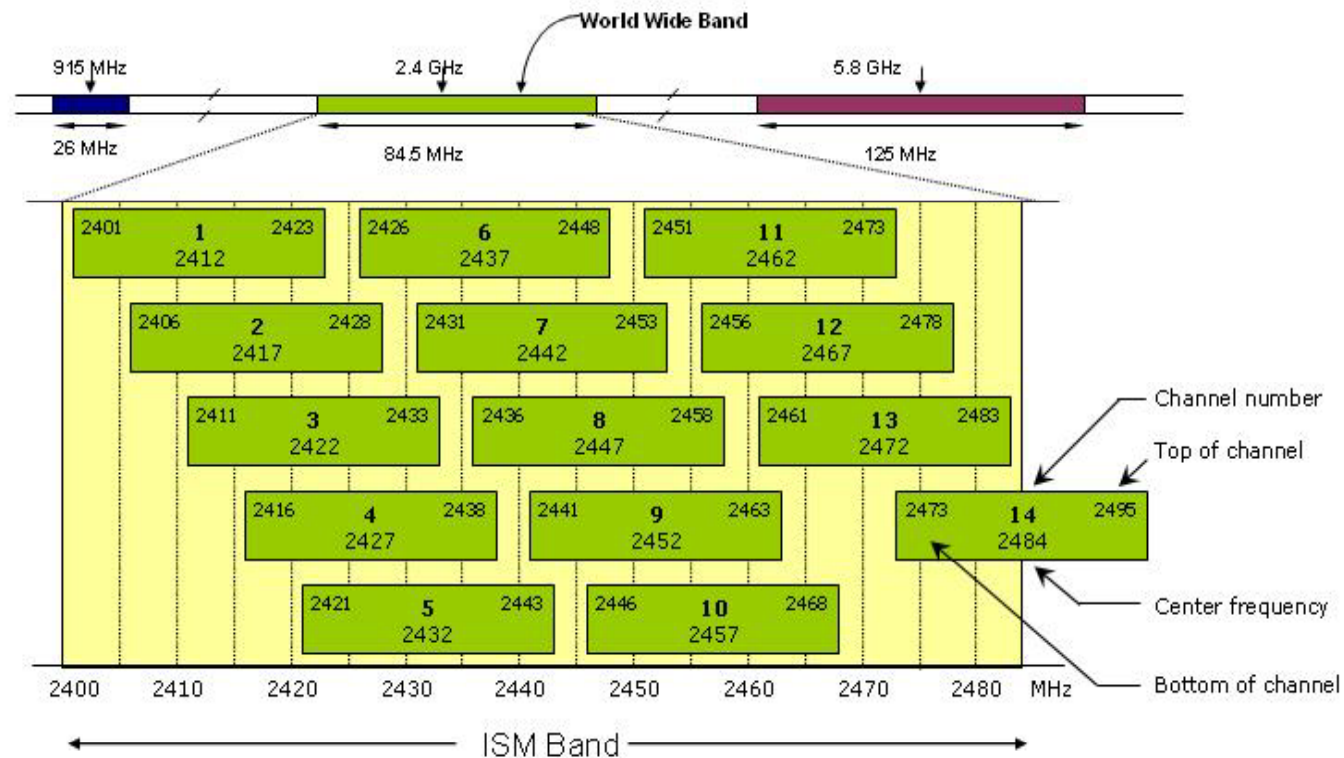
SA – Source Address

BSSID – Network Identifier (MAC address in infra mode)

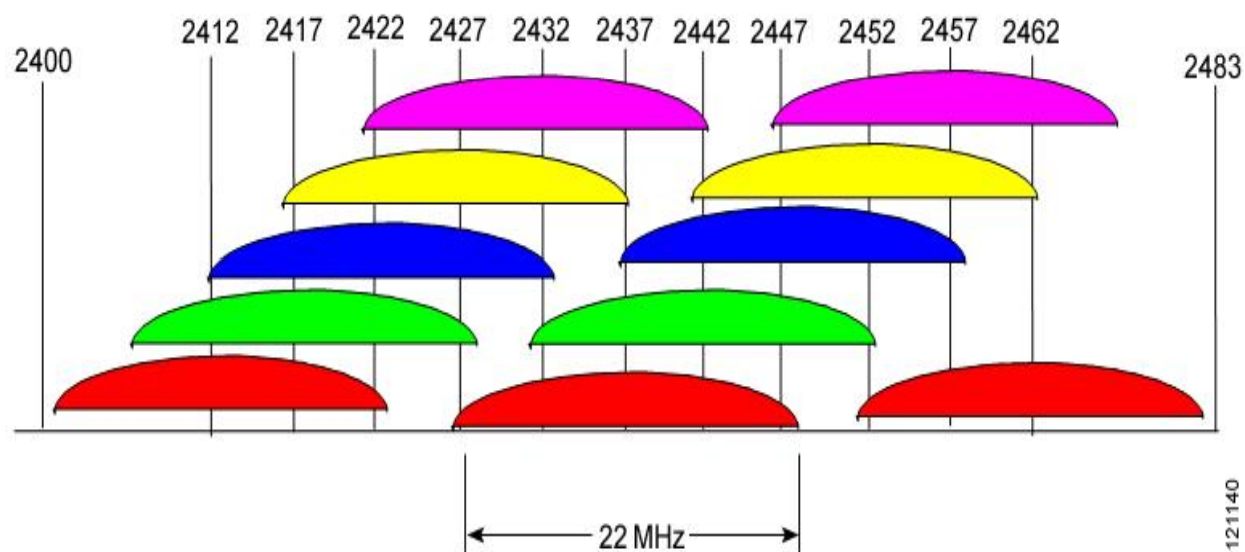
RA – Receiver Address

TA – Transmitter Address

Alocação de frequências no 802.11



Apenas canais frequências sem interferência



Serviços 802.11

Serviços de Distribuição

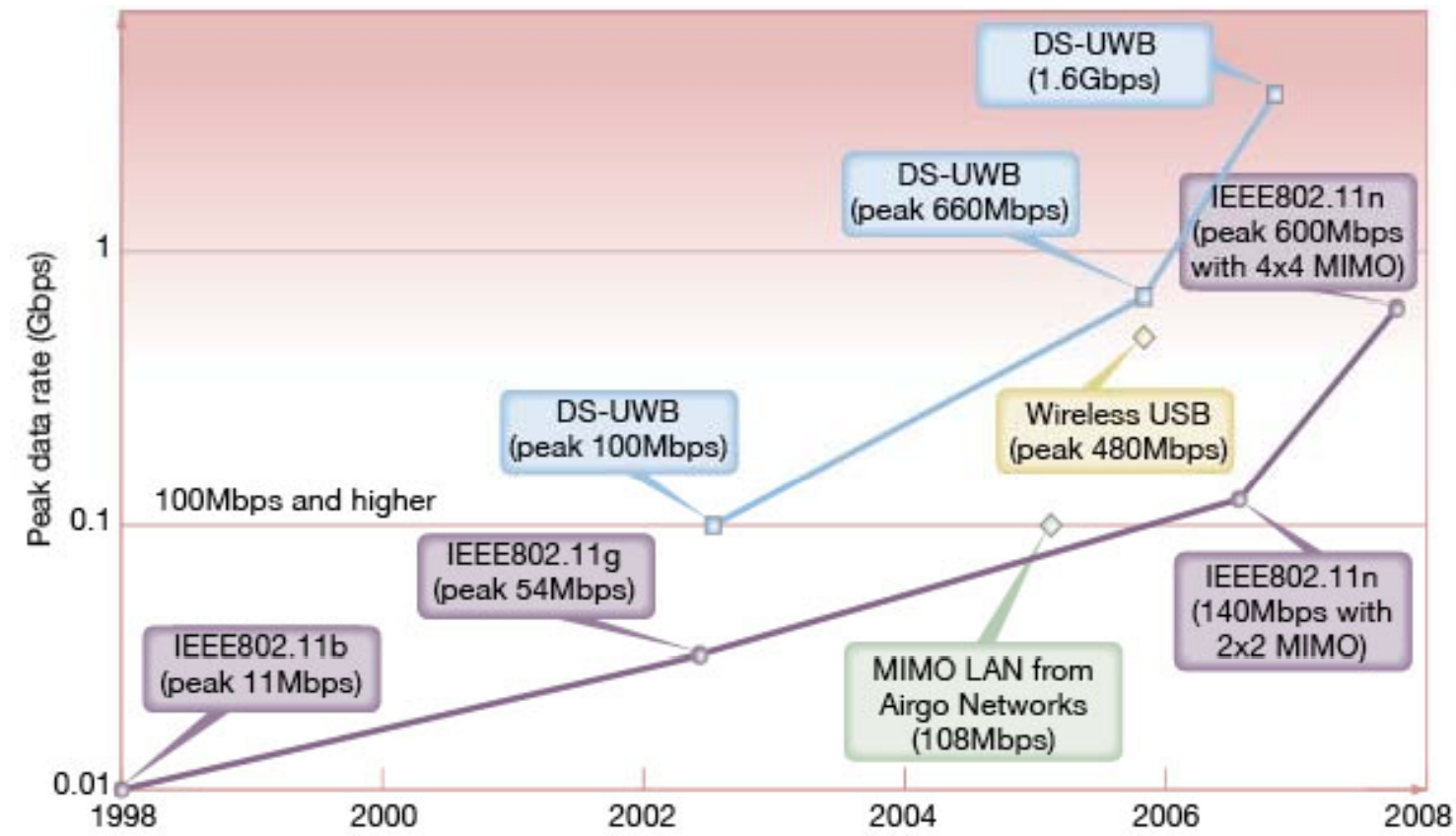
- Associação
- Desassociação
- Reassociação
- Distribuição
- Integração

Serviços 802.11

Serviços Intra-células

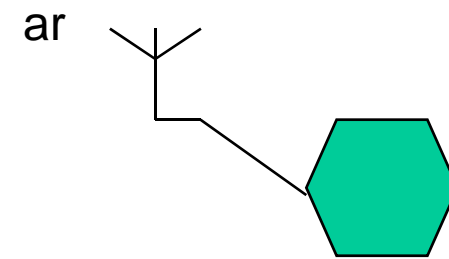
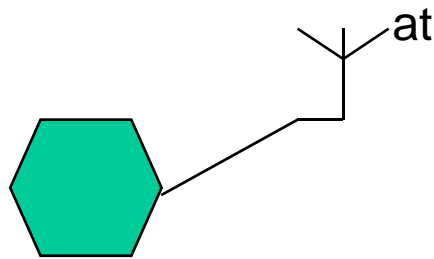
- Autenticação
- Desautenticação
- Privacidade
- Entrega de Dados

Sobre a tecnologia MIMO (802.11n)



Sobre a tecnologia MIMO

- SISO - Única entrada e única saída



Única antena para enviar e única antena para receber

Sobre a tecnologia MIMO

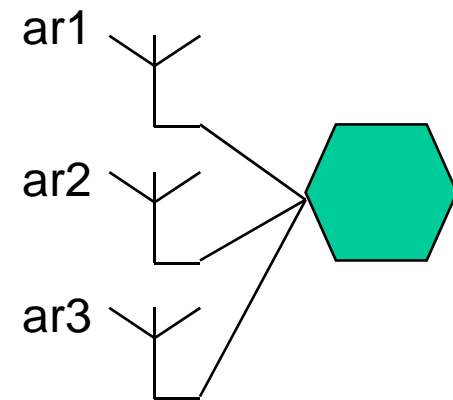
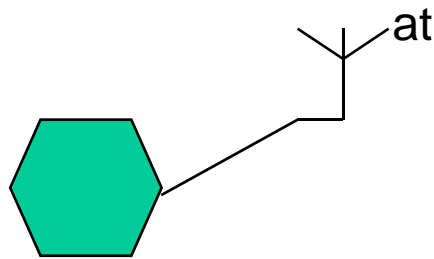
- SISO - Única entrada e única saída



Única antena para enviar e única antena para receber

Sobre a tecnologia MIMO

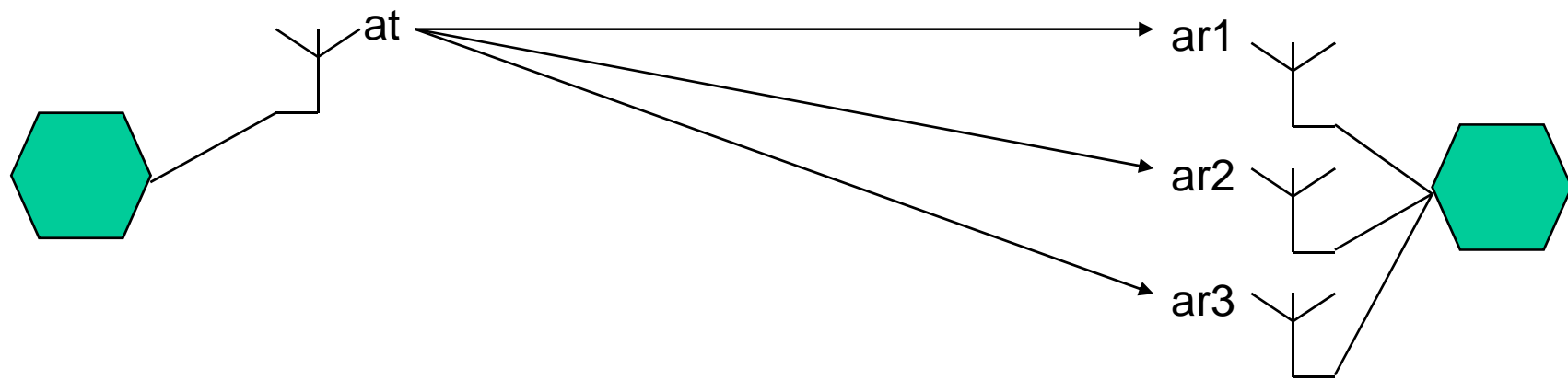
- SIMO - Única entrada e Múltiplas saídas



Única antena para transmitir e várias antenas para receber

Sobre a tecnologia MIMO

- SIMO - Única entrada e Múltiplas saídas



Única antena para transmitir e várias antena para receber

Sobre a tecnologia MIMO

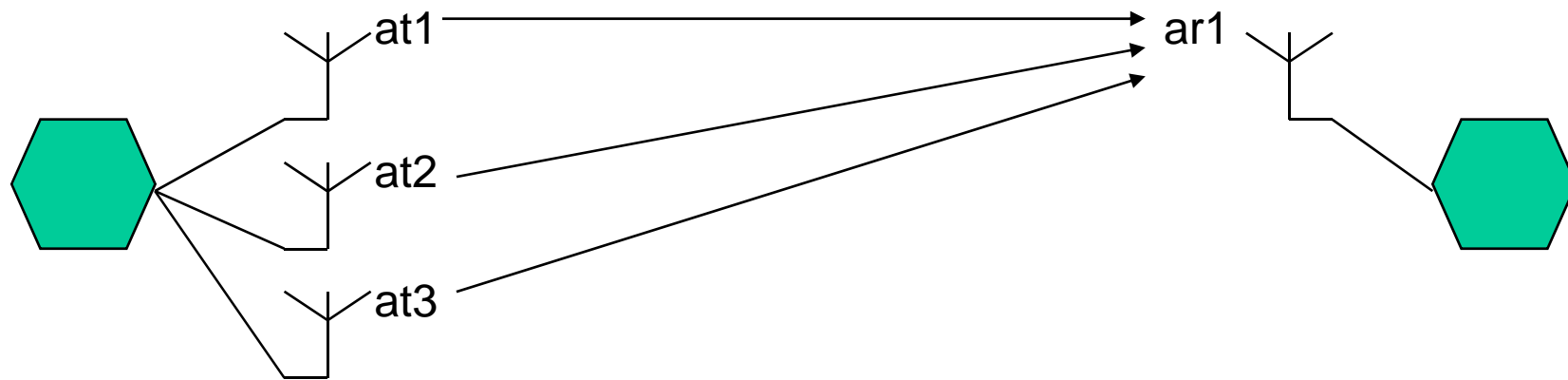
- MISO - Múltiplas entradas e única saída



Várias antenas para transmitir e única antena para receber

Sobre a tecnologia MIMO

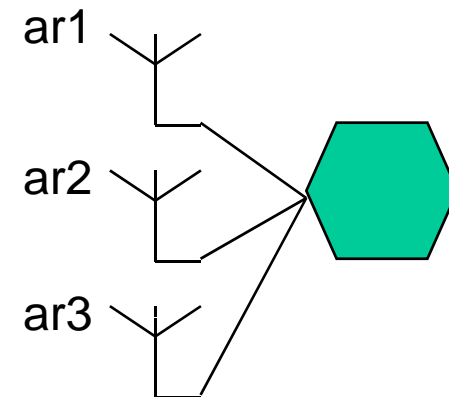
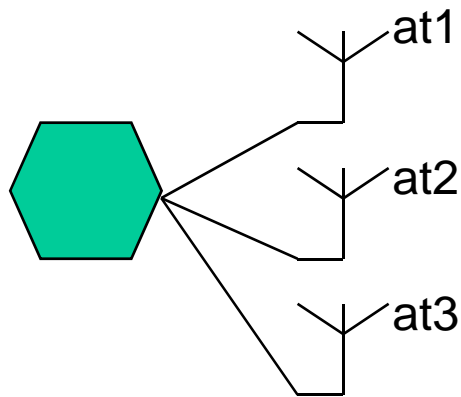
- MISO - Múltiplas entradas e única saída



Várias antenas para transmitir e única antena para receber

Sobre a tecnologia MIMO

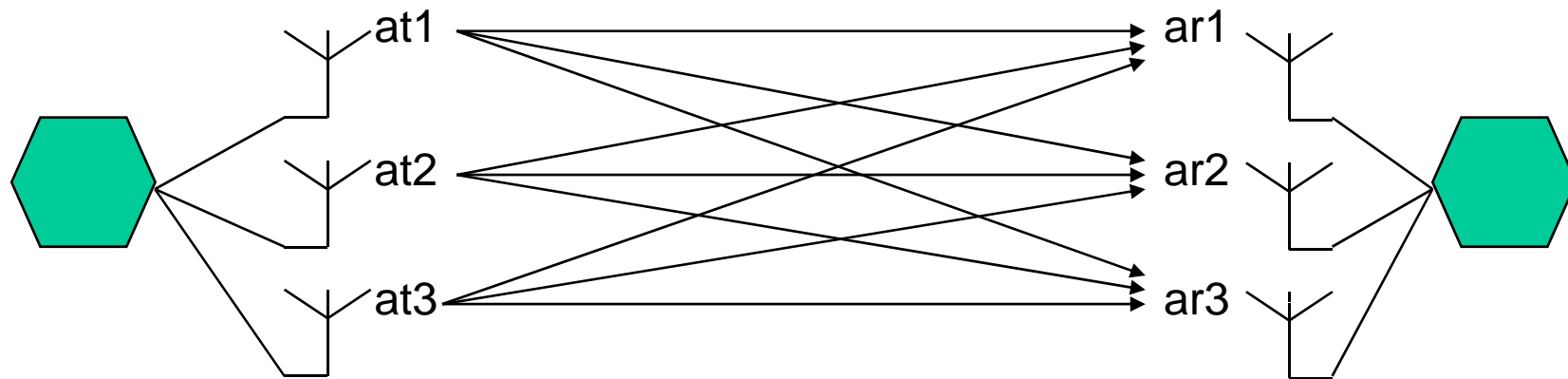
- MIMO - Múltiplas entradas e múltiplas saídas



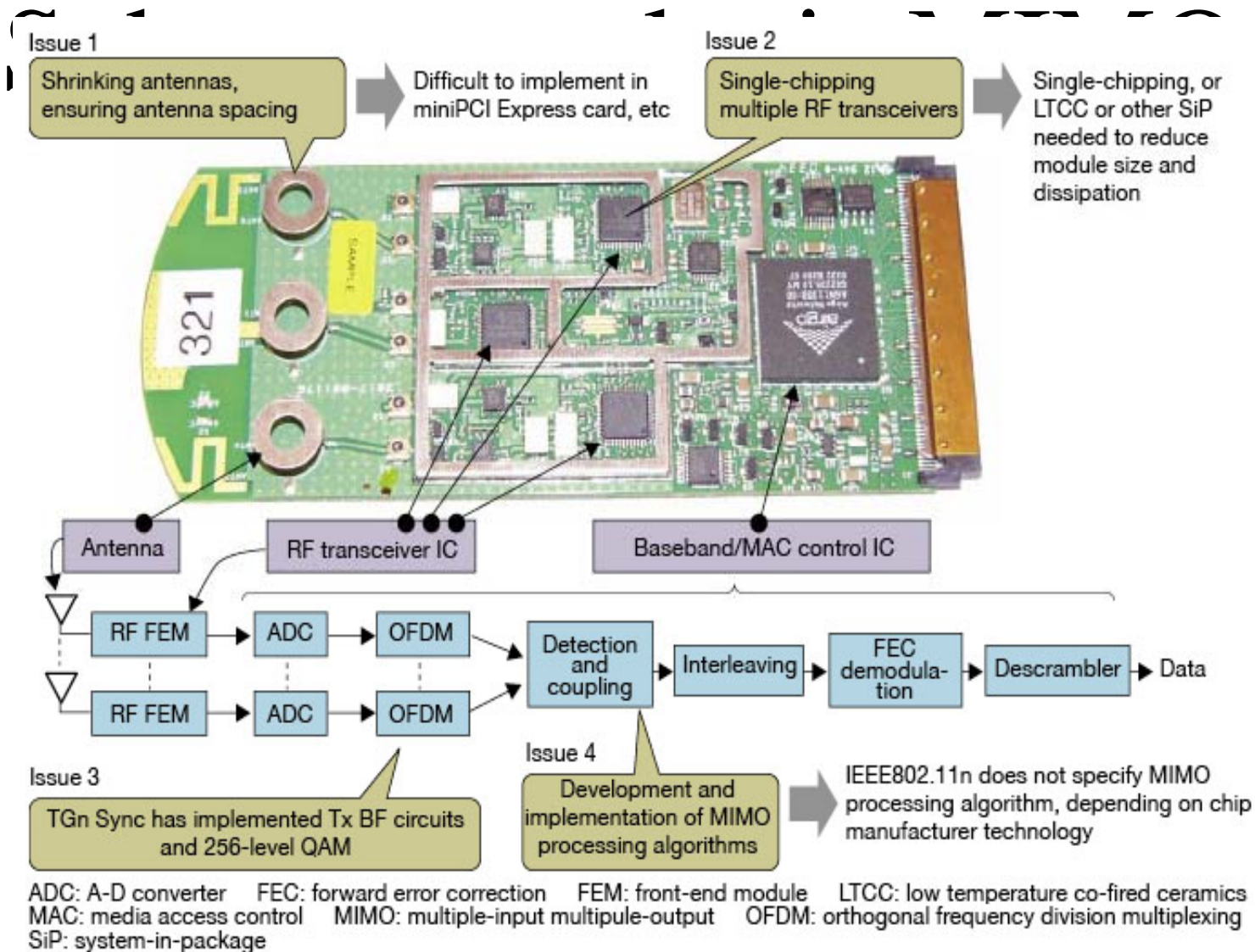
Várias antenas para enviar e várias antenas para receber

Sobre a tecnologia MIMO

- Múltiplas entradas e múltiplas saídas



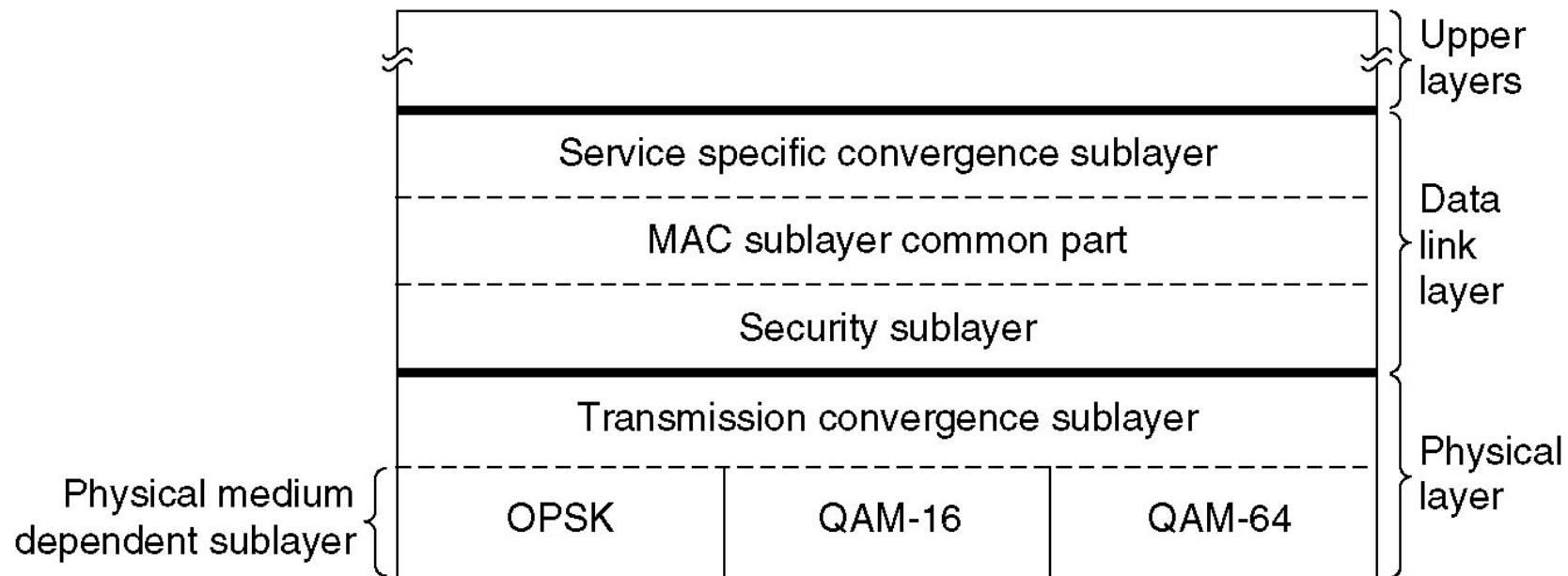
Várias antenas para enviar e várias antenas para receber



Banda Larga Sem Fio

- Comparação entre 802.11 e 802.16
- A Pilha de Protocolos 802.16
- A Camada Física 802.16
- O Protocolo da Subcamada MAC 802.16
- A Estrutura do Quadro 802.16

A Pilha de Protocolos 802.16



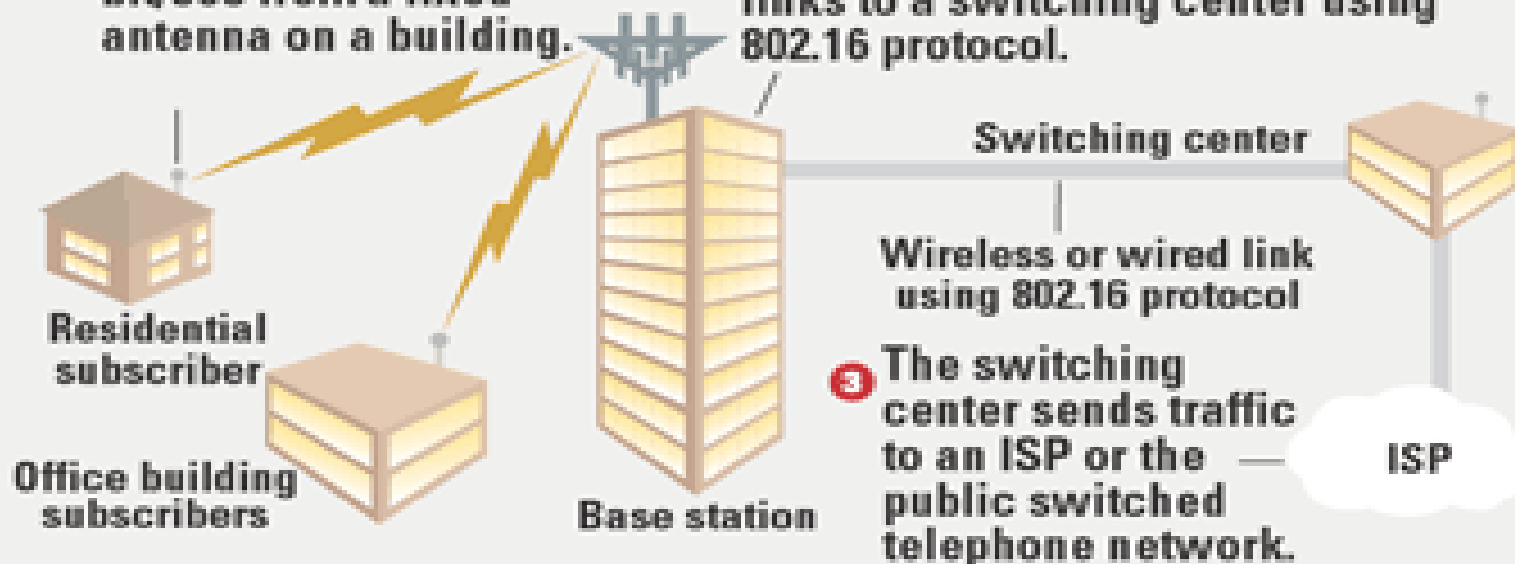
802.16

HOW IT WORKS

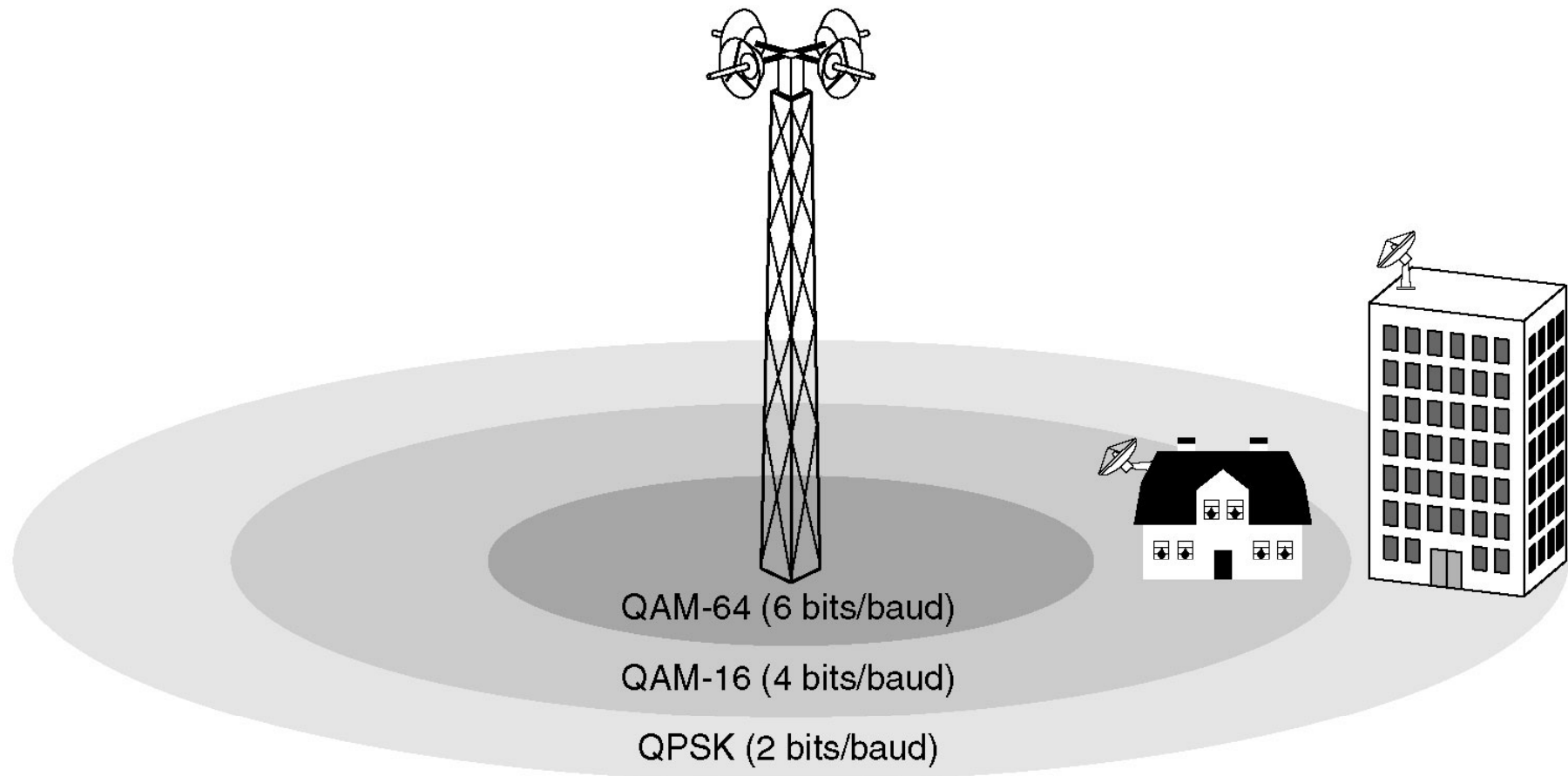
802.16

IEEE 802.16 standards define how wireless traffic will move between subscribers and core networks.

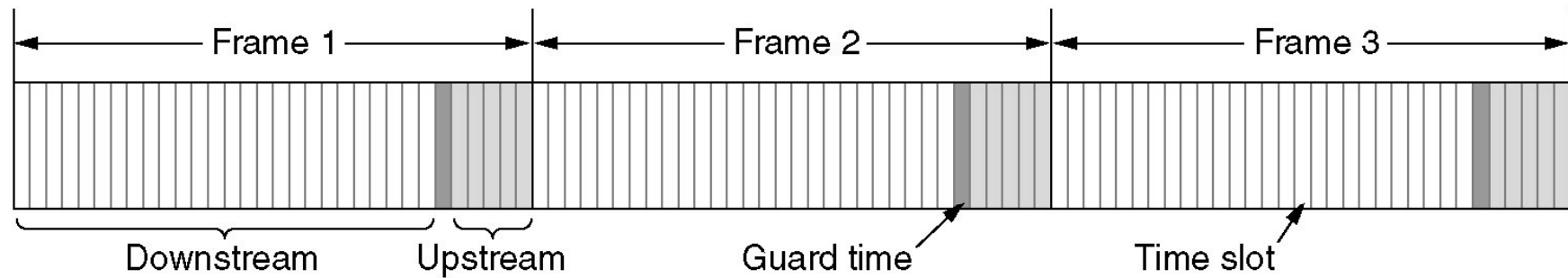
- 1 A subscriber sends wireless traffic at speeds ranging from 2M to 155M bit/sec from a fixed antenna on a building.
- 2 The base station receives transmissions from multiple sites and sends traffic over wireless or wired links to a switching center using 802.16 protocol.



A Camada Física 802.16



A Camada Física 802.16 (2)



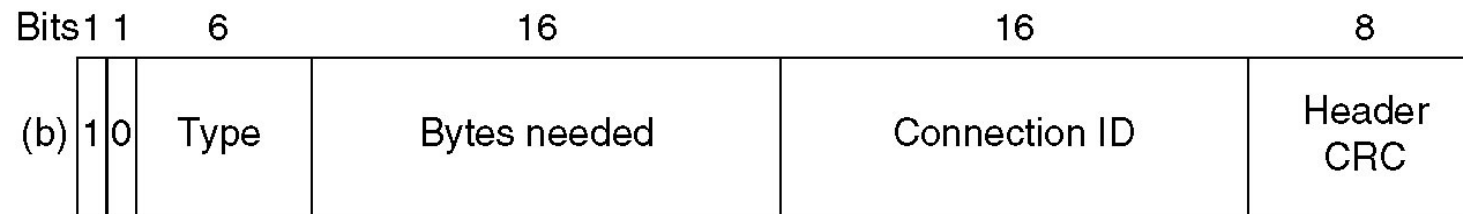
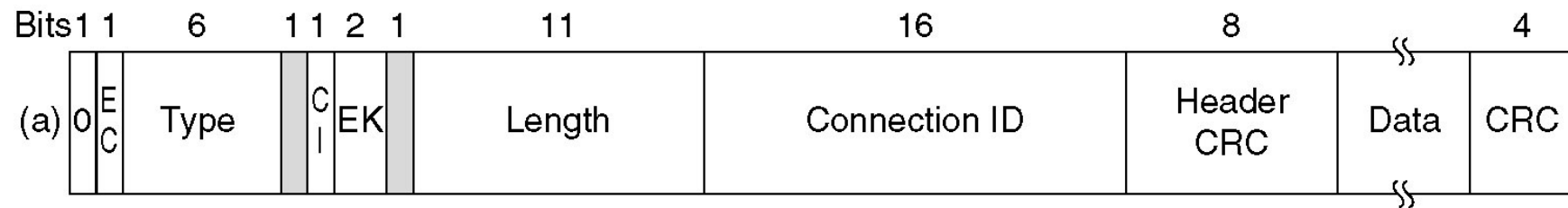
Quadros e slots de tempo para duplexação por divisão de tempo.

O Protocolo da Subcamada MAC 802.16

Classes de Serviço

- Serviço de *bit rate* constante
- Serviço de *bit rate* variável em *real-time*
- Serviço de *bit rate* variável não *real-time*
- Serviço de melhor esforço

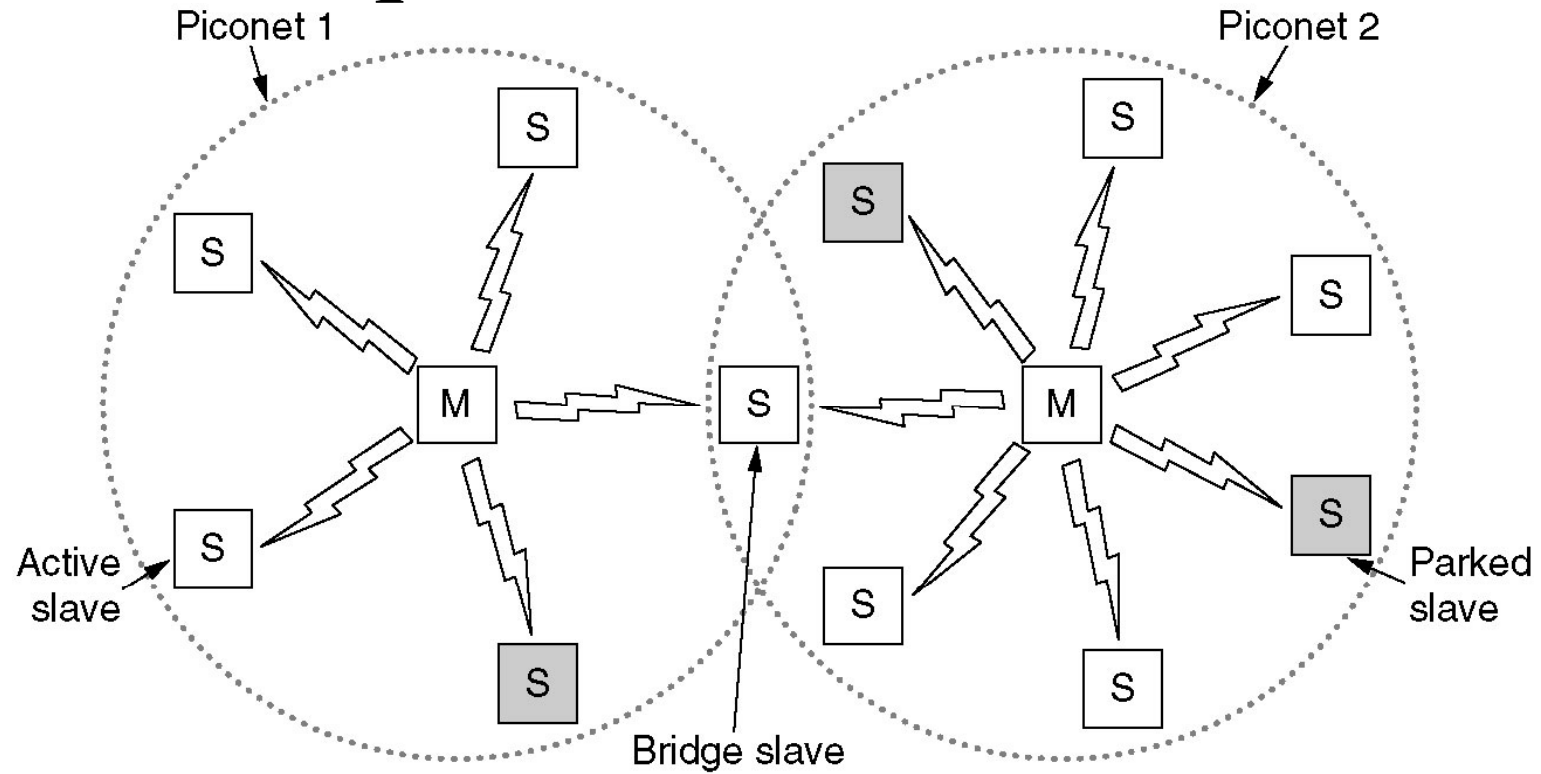
A Estrutura do Quadro 802.16



Bluetooth

- Arquitetura Bluetooth
- Aplicações Bluetooth
- A Pilha de Protocolos Bluetooth
- A Camada de Rádio Bluetooth
- A Camada de Banda Base Bluetooth
- A Camada L2CAP Bluetooth Layer
- A Estrutura do Quadro Bluetooth

Arquitetura Bluetooth



Bluetooth: 802.15

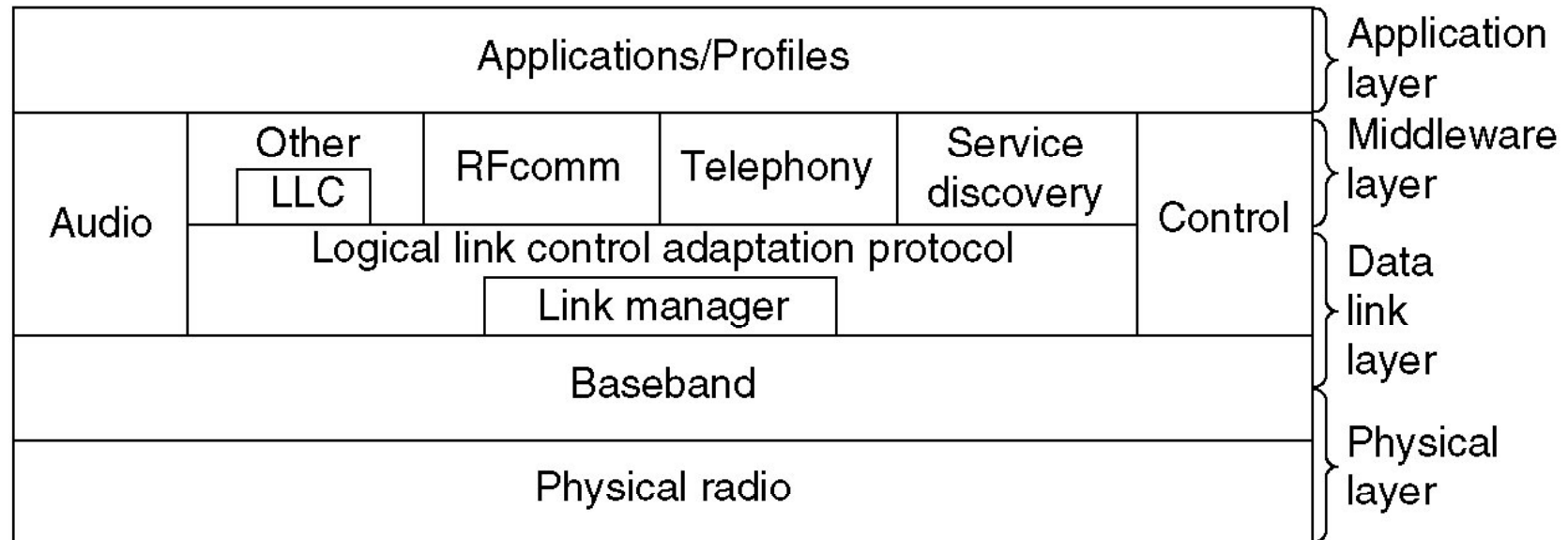
- Used to wirelessly transfer data among devices.
 - Original goal: get ride of the serial cable or USB cable.
 - Upload picture from you cellular phone to desktop PC
 - Wireless headphone...
- Short-range radio frequency (RF) technology
- Operates at 2.4 GHz
 - Interfere with 802.11
- Effective range of Bluetooth devices is 32 feet (10 meters).
- Data at the rate of 1 Mbps
- Compared to 802.11
 - Slow,Low Power, and Short range
 - Master / slave architecture, no collision



Aplicações Bluetooth

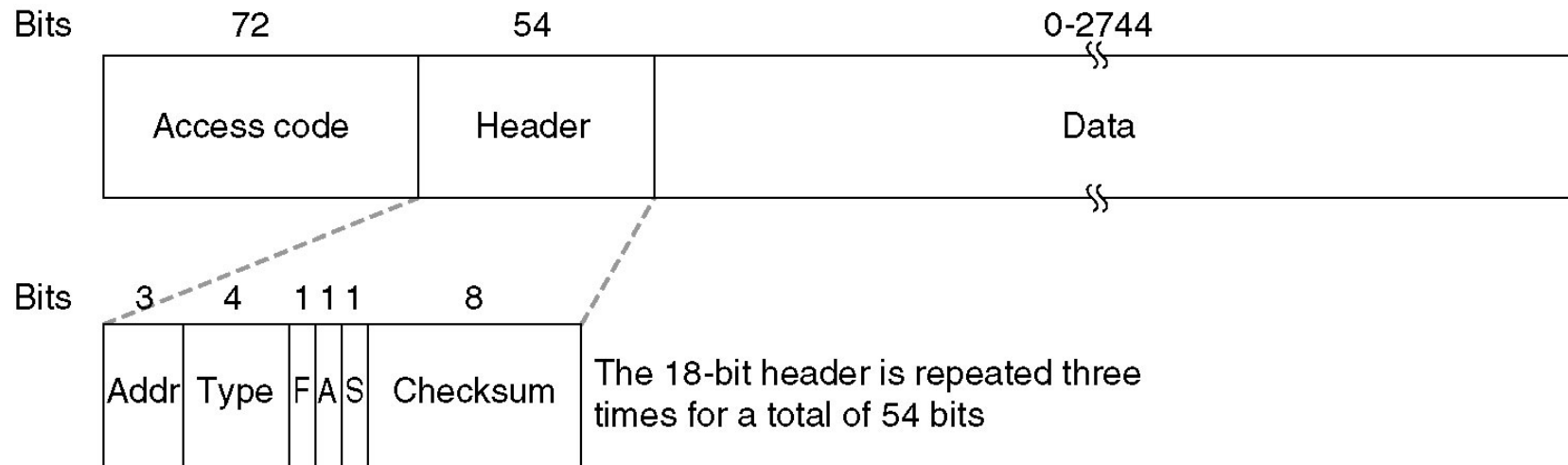
Name	Description
Generic access	Procedures for link management
Service discovery	Protocol for discovering offered services
Serial port	Replacement for a serial port cable
Generic object exchange	Defines client-server relationship for object movement
LAN access	Protocol between a mobile computer and a fixed LAN
Dial-up networking	Allows a notebook computer to call via a mobile phone
Fax	Allows a mobile fax machine to talk to a mobile phone
Cordless telephony	Connects a handset and its local base station
Intercom	Digital walkie-talkie
Headset	Intended for hands-free voice communication
Object push	Provides a way to exchange simple objects
File transfer	Provides a more general file transfer facility
Synchronization	Permits a PDA to synchronize with another computer

A Pilha de Protocolos Bluetooth



- TDM com 79 canais, de 1 MHz e 1 bit/ baud (1 Mbps)
- Frequency hopping a 1600 hops/s ou 625 μ S (dwell time)
- Normalmente o master usa os slots pares e os slaves os ímpares
- Baseband controla framing e aloca slots para eles.
Normalmente um frame ocupa 1, 3 ou 5 slots
- Settling time pode durar 260 μ S (overhead de 260 bits!)
- Range de 10 metros
- Mesma faixa do WiFi, 2.4 GHz - muita interferência

A Estrutura do Quadro Bluetooth



Um típico quadro de dados Bluetooth.

Quanto overhead tem num frame de 1 slot?

UWB (Ultra-wide-band)

- Tecnologia MB-OFDM (Multi-Band Orthogonal Frequency Division Multiplexing);
- Centenas de rajadas de sinais por segundo;
- Menos consumo de energia;
- Largura do canal: 528 MHz, 1,368 GHz e 2,736 GHz;
- Frequência: 3,1 GHz até 10,6 GHz;
- Modulação: QPSK.

Sumário

Method	Description
FDM	Dedicate a frequency band to each station
WDM	A dynamic FDM scheme for fiber
TDM	Dedicate a time slot to each station
Pure ALOHA	Unsynchronized transmission at any instant
Slotted ALOHA	Random transmission in well-defined time slots
1-persistent CSMA	Standard carrier sense multiple access
Nonpersistent CSMA	Random delay when channel is sensed busy
P-persistent CSMA	CSMA, but with a probability of p of persisting
CSMA/CD	CSMA, but abort on detecting a collision
Bit map	Round robin scheduling using a bit map
Binary countdown	Highest numbered ready station goes next
Tree walk	Reduced contention by selective enabling
MACA, MACAW	Wireless LAN protocols
Ethernet	CSMA/CD with binary exponential backoff
FHSS	Frequency hopping spread spectrum
DSSS	Direct sequence spread spectrum
CSMA/CA	Carrier sense multiple access with collision avoidance

Métodos e sistemas de alocação de canais para um meio comum.