Mobile Networking
IEEE 802.11 Hands-On Exercise Preparation

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IEEE 802.11 MAC Fairness

Is the 802.11 MAC fair?

And if so, in respect to what?

- Delay?
- Jitter?
- Throughput?
- Anything else?

Does Bianchi say anything about fairness?

IEEE 802.11 MAC Fairness

Does Bianchi say anything about fairness?

Not directly, but ….

> The key approximation in our model is that, at each transmission attempt, and regardless of the number of retransmissions suffered, each packet collides with constant and independent probability p. It is intuitive that this assumption results more accurate as long as W and n get larger. p will be referred to as *conditional collision probability*, meaning that this is the probability of a collision seen by a packet being transmitted on the channel.

I.e., at each transmission attempt, a frame is successfully transmitted with probability (1-p).

IEEE 802.11 MAC Fairness

Does the collision probability dependent on the frame length?

→ **No!**

Does the collision probability depend on the access mechanism (basic access vs. RTS/CTS)?

→ **No!**

IEEE 802.11 MAC Fairness

We can now express the probability τ that a station transmits in a randomly chosen slot time. As any transmission occurs

At steady state, the probability to transmit in a randomly chosen slot time is the same for all stations!

IEEE 802.11 MAC Fairness

Is the 802.11 MAC fair?

And if so, in respect to what?

- Delay?
- Jitter?
- Throughput?
- Anything else?

→ In 802.11, each node has the same chance to successfully access the channel!

IEEE 802.11 MAC Fairness

What influence has the frame length?

- Collision: The longest colliding frame determines the collision time.
  (→ Bianchi investigates differences between the basic access and RTS/CTS mechanisms)

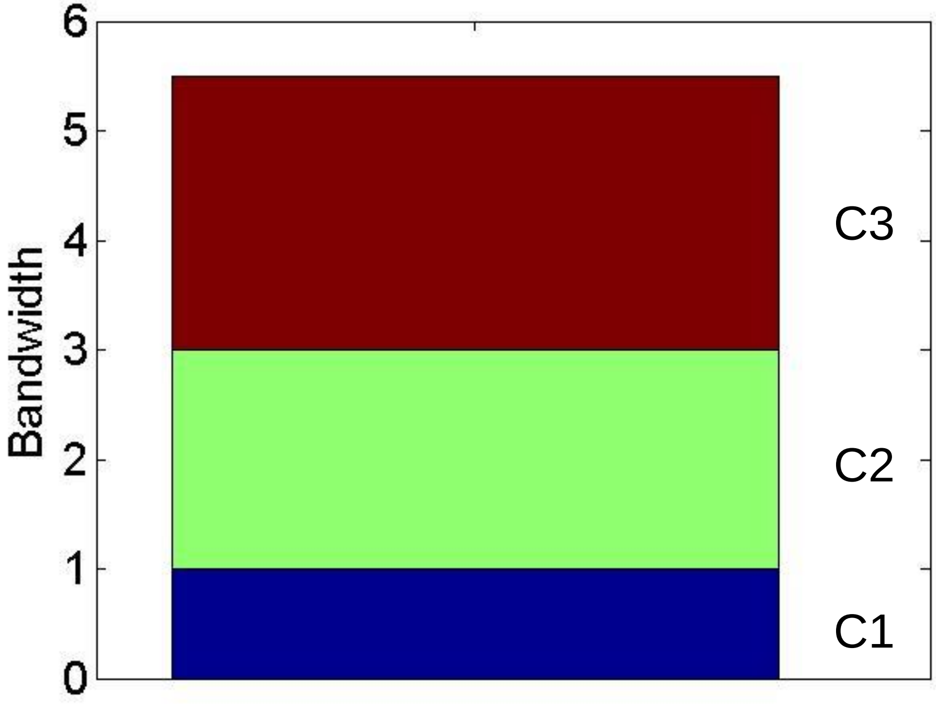
- Success: The frame length determines the amount of transferred data.
  (→ The frame length can tune the throughput!)

UDP: contending mobile stations

Suppose total saturated throughput = 6 Mbits/s.

Unsaturated, same frame length:

C1 = 1 Mbits/s, C2 = 2 Mbits/s, C3 = 2.5 Mbits/s

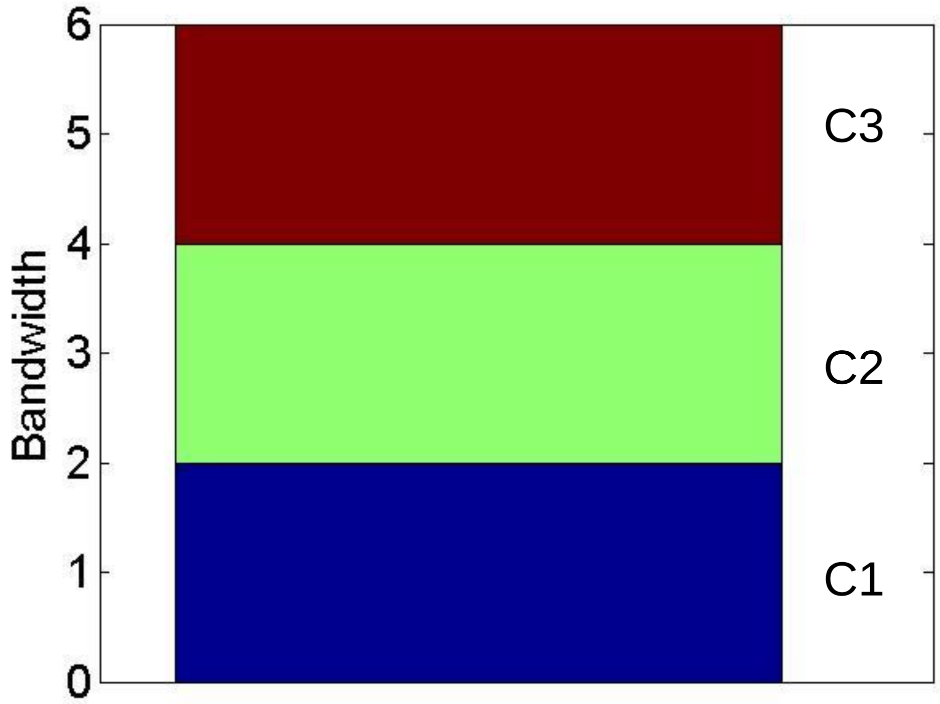


UDP: contending mobile stations

Suppose total saturated throughput = 6 Mbits/s.

Saturated, same frame length:

C1 = 3 Mbits/s, C2 = 3 Mbits/s, C3 = 3 Mbits/s

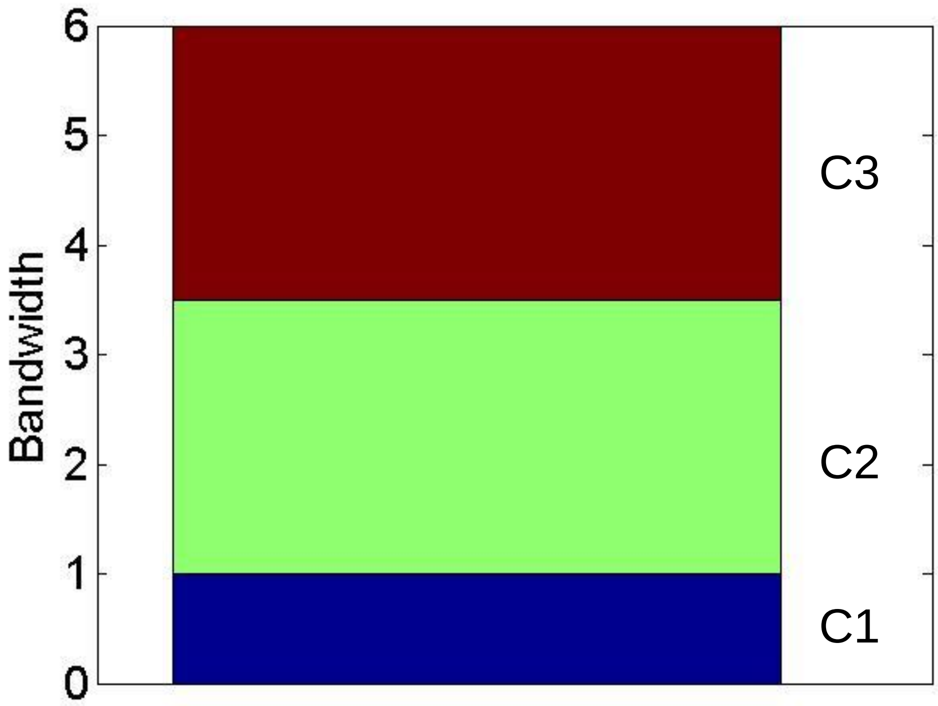


UDP: contending mobile stations

Suppose total saturated throughput = 6 Mbits/s.

Saturated, same frame length:

C1 = 1 Mbits/s, C2 = 5 Mbits/s, C3 = 10 Mbits/s

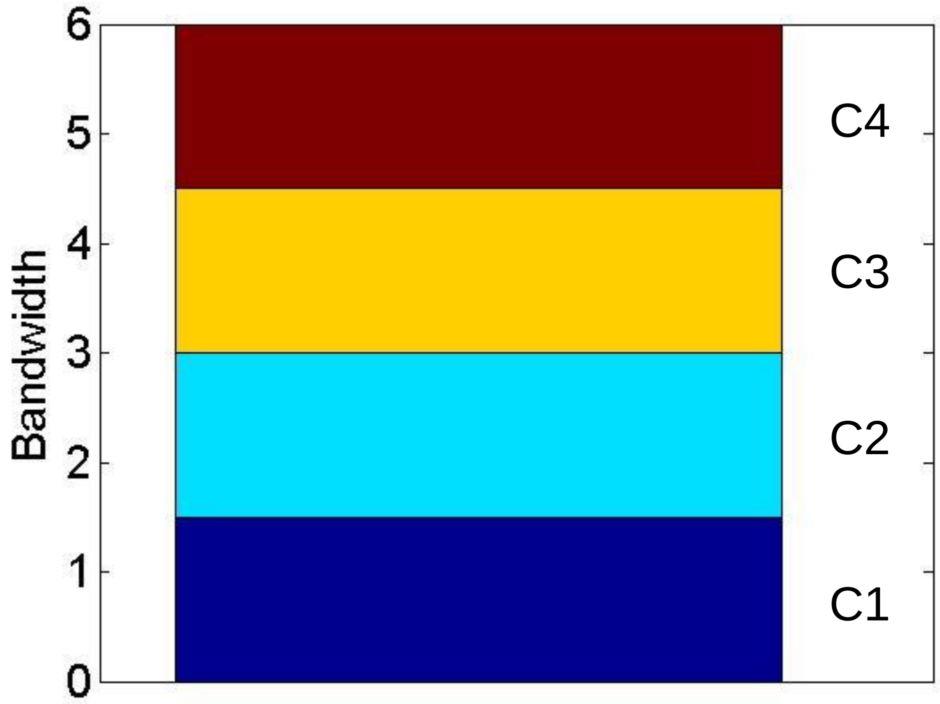


UDP: contending mobile stations

Suppose total saturated throughput = 6 Mbits/s.

Saturated, same frame length:

C1 = 3 Mbits/s, C2 = 6 Mbits/s, C3 = 12 Mbits/s, C4 = 8 Mbits/s



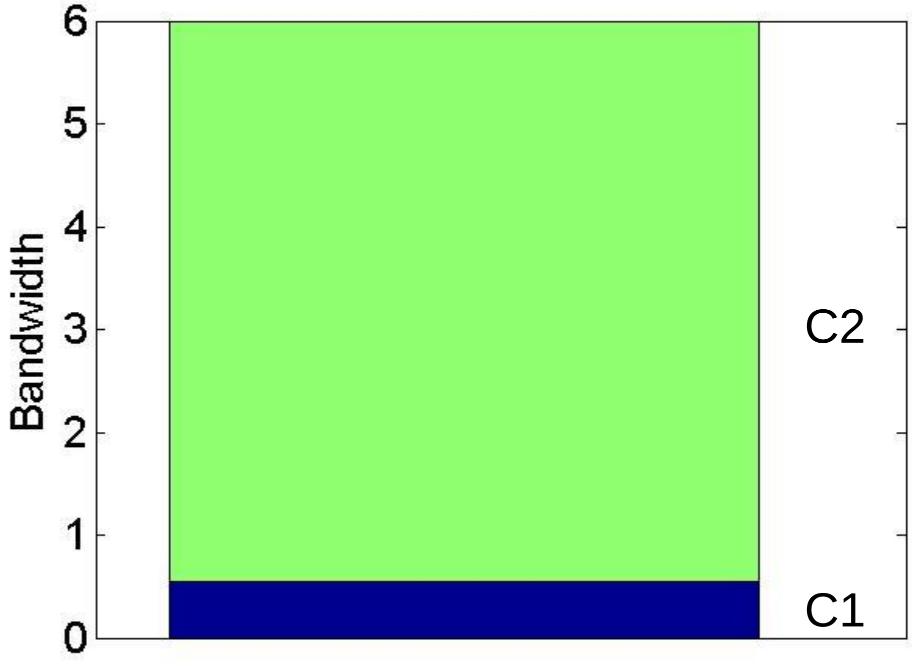
UDP: contending mobile stations

Suppose total saturated throughput = 6 Mbits/s.

Saturated, different frame lengths:

C1 = 10 Mbits/s, frame length = 50 bytes

C2 = 10 Mbits/s, frame length = 500 bytes



Bit Rate Terminology

- **Gross bitrate**
  - AKA: raw bitrate, data signaling rate, uncoded transmission rate
  - Total number of bits transmitted on the PHY per time unit
  - Does not subtract any coding overhead and protocol overhead
- **Net bitrate**
  - AKA: information rate, useful data rate, coded transmission rate
  - Amount of useful information transferred per time unit
  - Net bitrate ≤ gross bitrate * coding rate (FEC)
- **Throughput**
  - Achieved useful bitrate in a computer network
  - Precise definition depends on the context
  - Typically excludes protocol overhead of at least layer 1 and 2
- **Goodput**
  - Achieved useful bitrate from an application's point of view

Bit Rate Terminology

- **Shannon capacity:** Theoretical maximum that can be achieved
  - *C:* is the capacity of the channel in bits per second

$$C = B \log_2 (1 + SNR)$$

Which data rate is limited by the Shannon capacity?

→ **Net bitrate**

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