1 Simulations

1.1 4x4 Crossbar

`Bestimmen und begründen Sie wie die Werte zustande kommen`

- `avg Input Queue Length`
  - Generated Packets
    - size: $s = 512\,\text{b}$
    - send interval: $t = \text{uniform}(1\,\mu\text{s}, 10\,\mu\text{s}) = 5.5\,\mu\text{s}$
  - Connection to XBar
    - data rate: 1 Gbps

$$r_{\text{generated}} = \frac{512\,\text{b}}{5.5\,\mu\text{s}} \tag{1}$$
$$\Rightarrow l_{\text{q,avg}} = 0 \tag{2}$$

- `avg End-to-End Latency`
  - (no delays inside buffers, because the generated data rate, even for all 4 apps, is lower than a single data rate channels maximum throughput)
  - minimum
    - App → C → Inport → C → Outport → C → App
    - delay for packet: $t_{delay} = 512ns$ (per `DatarateChannel` C)

$$\Rightarrow t_{e2e,min} = 1.536\,\mu\text{s} \tag{3}$$

  - maximum

    all apps send to same destinatino and arbiter has to do round robin for all packets → 4 times the delay for the datarate channel inside XBar

$$\Rightarrow t_{e2e,max} = 3.027\,\mu\text{s} \tag{4}$$

  - on avg, the mimal case is 7 times more likely.

    The minimal case can exist in 24 possible constellations (connecting each app to a different app). While the maximum case can only exist in 4 possible constellations (all apps sending to one of 4 apps).

$$\Rightarrow t_{e2e,avg} \approx (24 \cdot t_{e2e,min} + 4 \cdot t_{e2e,max})\,/28 = 1.7\,\mu\text{s} \tag{5}$$

    (This is a coarse estimation, otherwise the cases inbetween need to be consudered)

- `avg Arbiter Request Queue Length`
  - minimum

        * queue is empty, because all arbitration requests can be fulfilled instantly

$$l_{arbq,min} = 0 \tag{6}$$

    - maximum
        * que is filled with 3 waiting requests, because all apps are wanting to send their packets to the same output port

$$l_{arbq,max} = 3 \tag{7}$$

    - on avg (analogously to t_{e2e})

$$\Rightarrow l_{arbq,avg} \approx (24 \cdot 0 + 4 \cdot 3) / 28 = 0.42 \tag{8}$$

- `avg Arbiter Request Queue Time` ((36 * 512) + (8 * 1024) + (4 * 1536))/92
- `avg Output Buffer Queue Length`
- `avg Throughput`