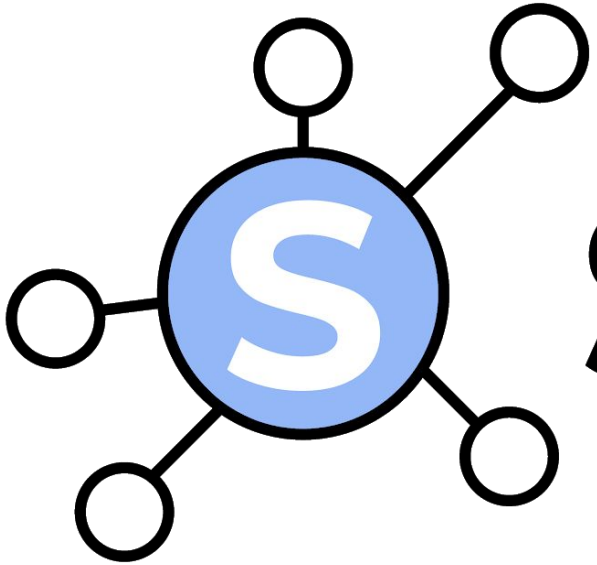


STEINWURF

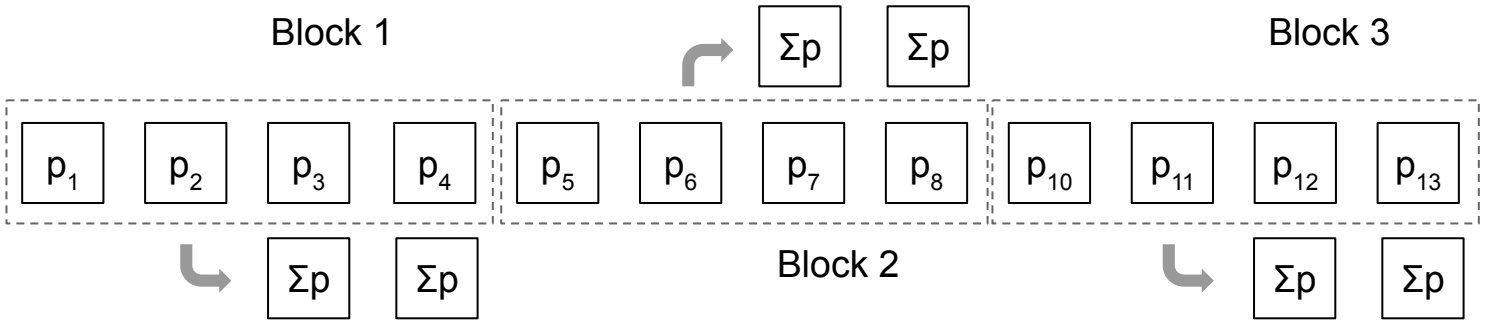
Repair patterns for sliding window codes

IETF 109 NWCRG

Background

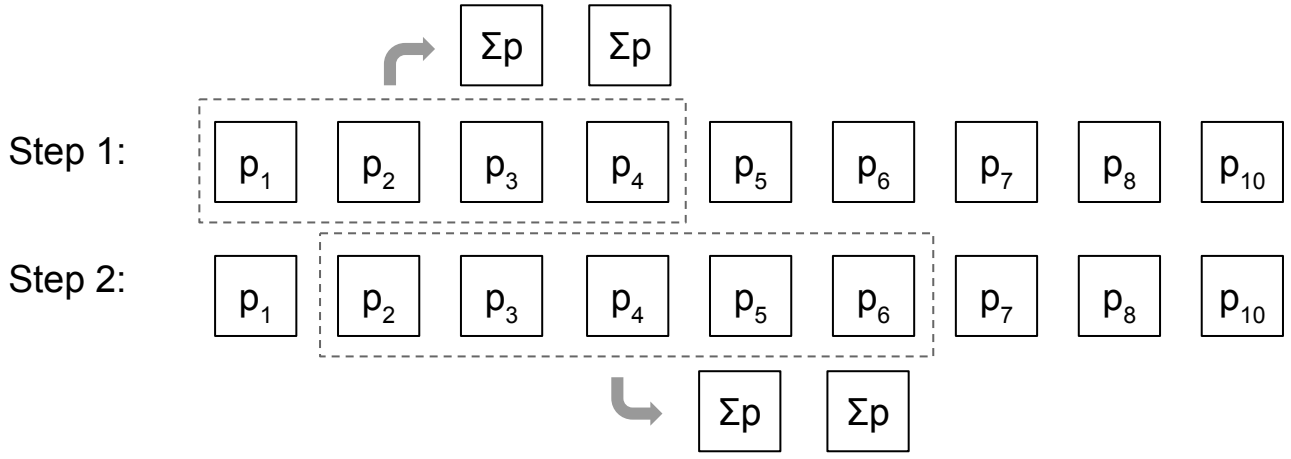
Traditional block codes

- Operate non-overlapping fixed sets of packets



Sliding window codes

- Can manage coding window in time
- Useful for building reliable low-latency network protocols:
  - Video
  - Control
  - Etc.

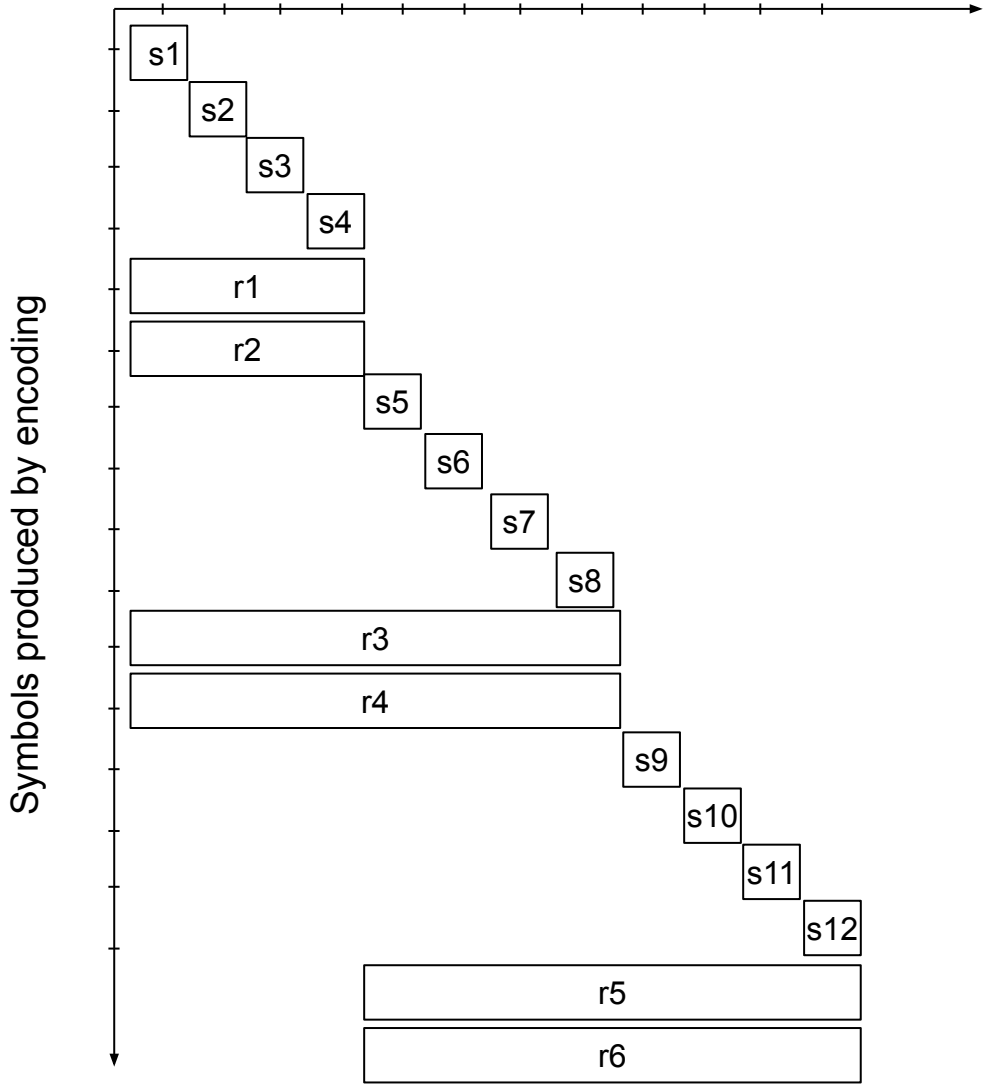


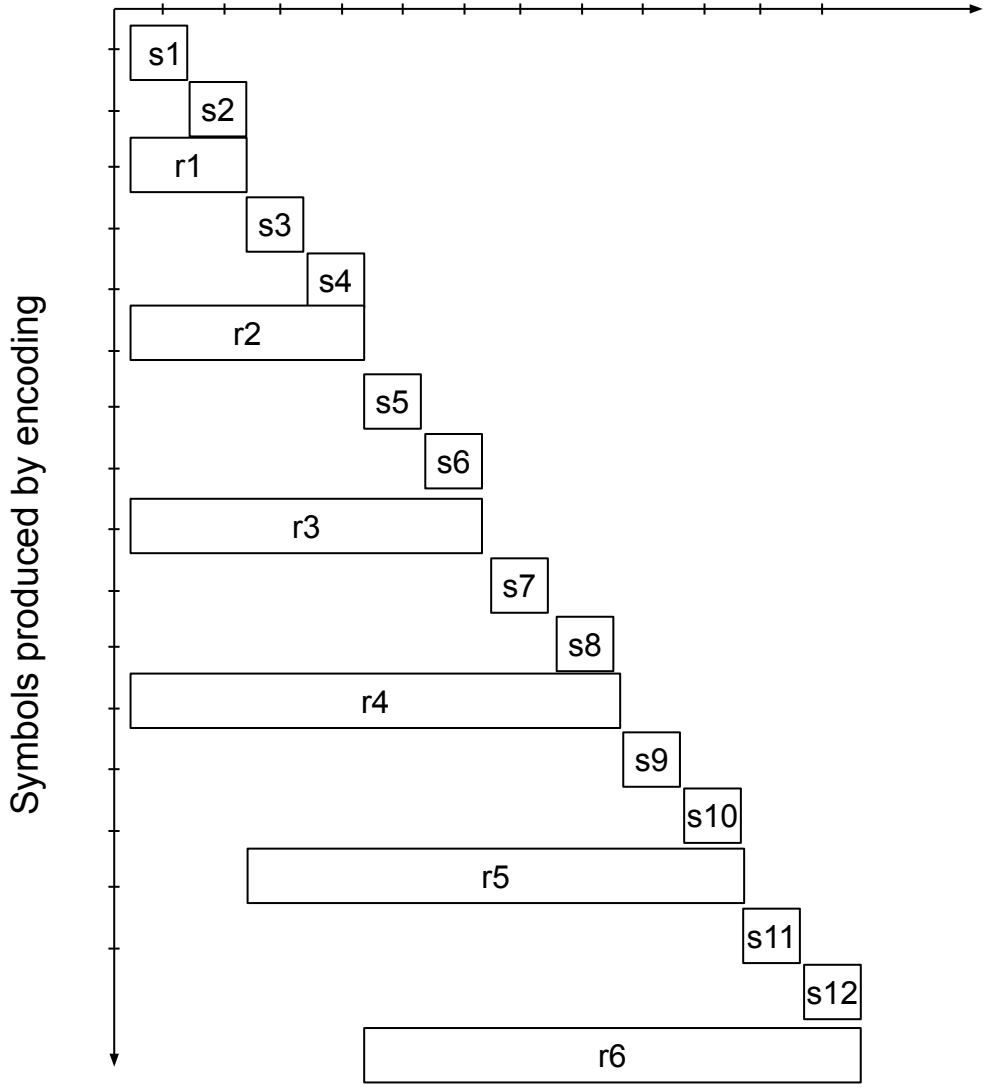
Current coding window.

p_x Packet number x

Σp Coded packet from the current coding window

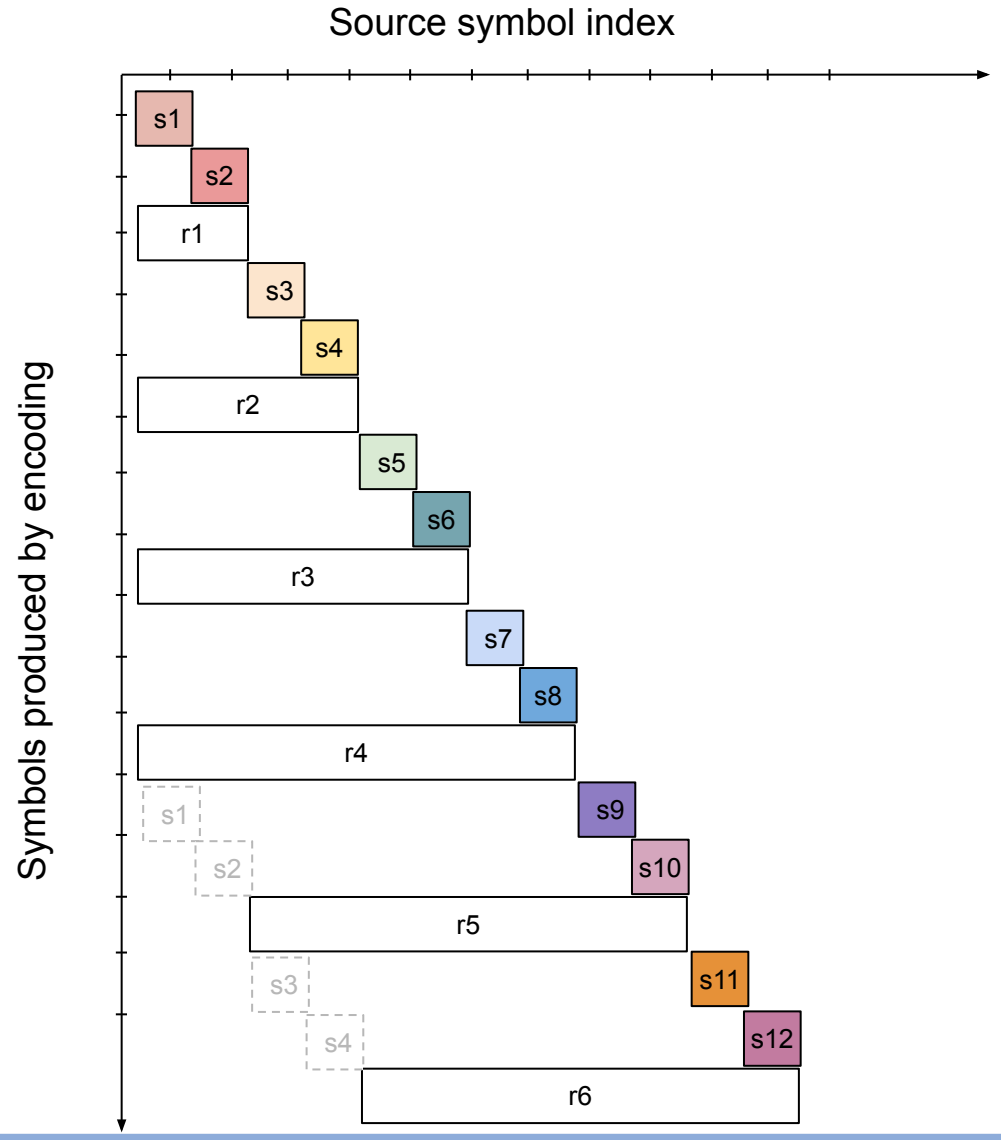
Repair pattern (4,2) vs (2,1)





Uniform traffic (2,1)

- Repair rate 33%
- New symbol arrive every 10ms and expire after 80 ms.
- Distance to repair is minimized i.e. latency at the decoder is minimized.
- All symbols are covered by 4 parity symbols.
- Latency penalty of losing s1 is 10 ms since r1 is generated directly after s2.

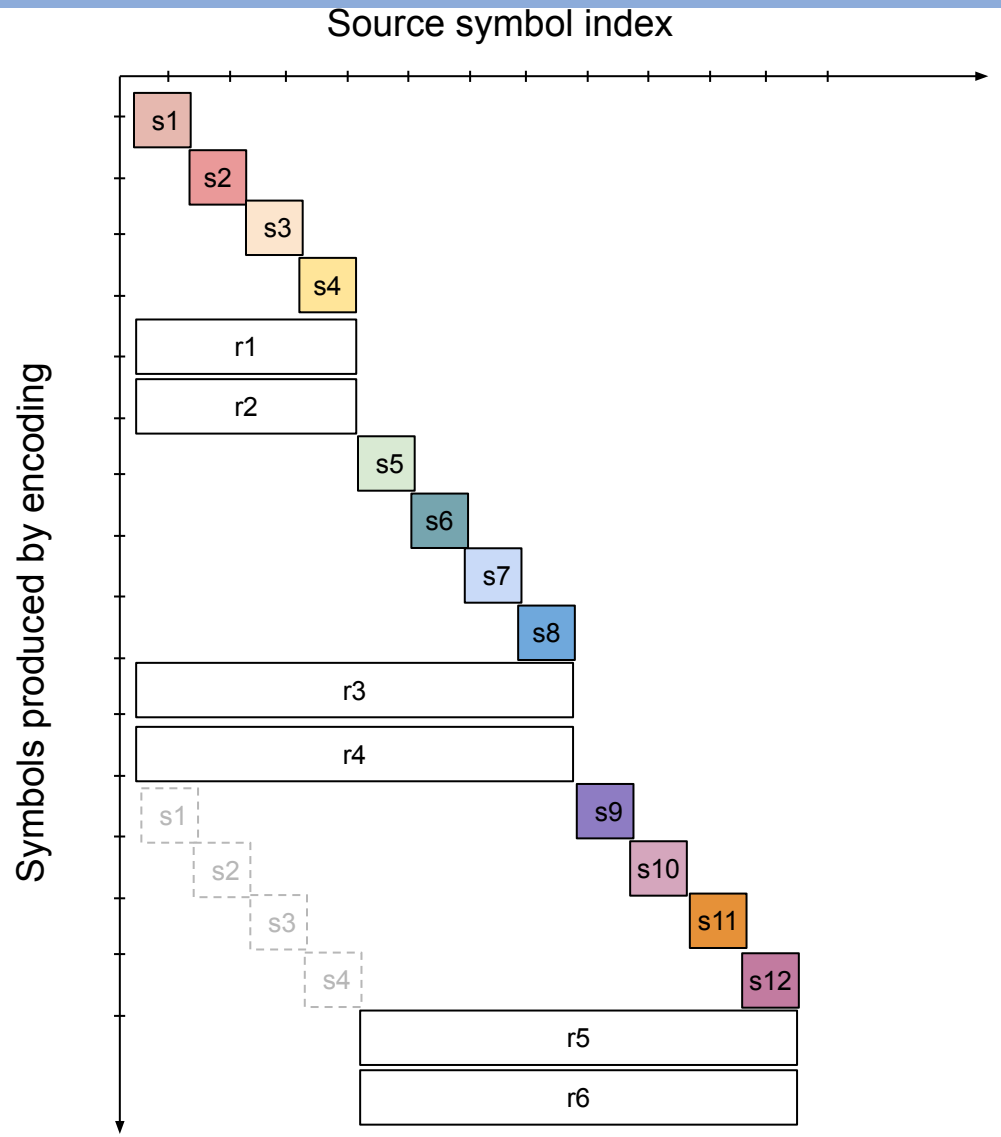


Grey box shows when symbols expire

Symbols with the same color arrive simultaneously

Uniform traffic (4,2)

- Repair rate 33%
- New symbol arrive every 10ms and expire after 80 ms.
- Distance to repair is not minimized i.e. latency at the decoder is not minimized.
- All symbols are covered by 4 parity symbols.
- Latency penalty of losing s1 is 30 ms since r1 is generated directly after s4.

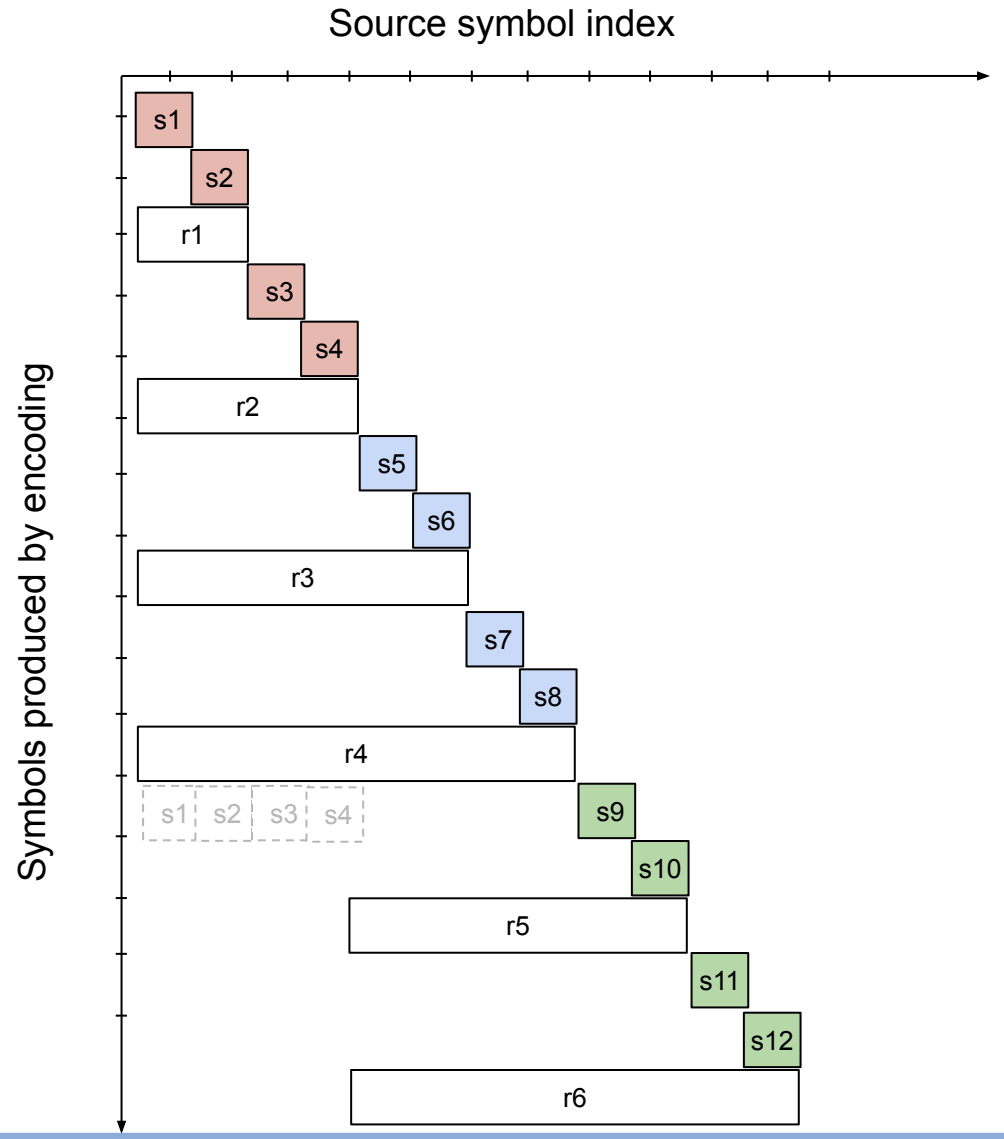


Grey box shows when symbols expire

Symbols with the same color arrive simultaneously

Bursty traffic (2,1)

- Repair rate 33%
- New symbols arrive in bursts of 4 arrive every 40ms and expire after 80 ms.
- Notice that since the scheme does not follow the burst s3 and s4 are only protected by 3 parity symbols since s1, s2, s3 and s4 will have expired when r5 is generated.
- Latency penalty of losing s1 is ~0 ms since r1 and r2 is generated together with s1, s2, s3, s4

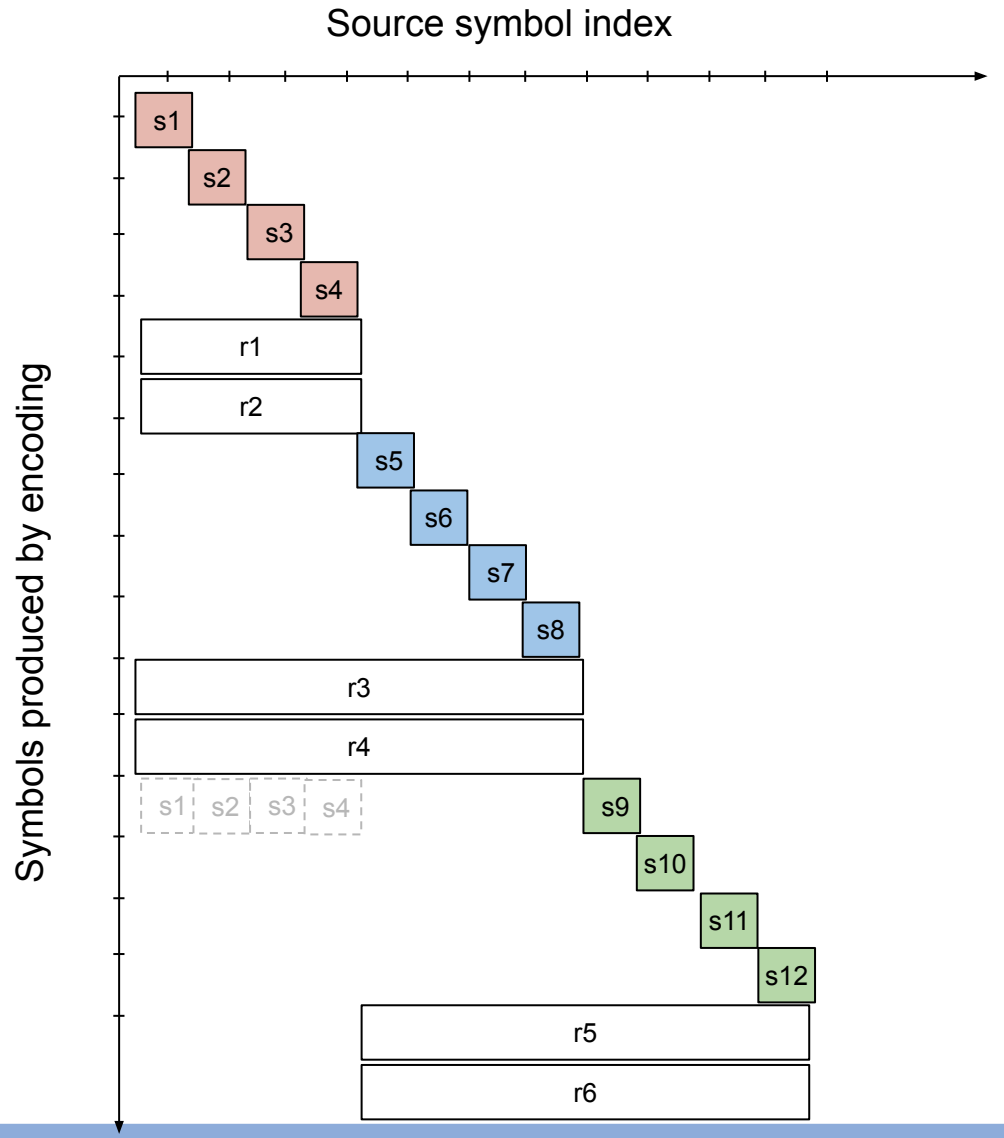


Grey box shows when symbols expire

Symbols with the same color arrive simultaneously

Bursty traffic (4,2)

- Repair rate 33%
- New symbols arrive in bursts of 4 arrive every 40ms and expire after 80 ms.
- This scheme follow the bursts and therefore all symbols are again protected by 4 parity symbols. Latency penalty of losing s1 is ~0 ms since r1 and r2 is generated together with s1, s2, s3, s4.



Grey box shows when symbols expire

Symbols with the same color arrive simultaneously

Conclusion

- The repair pattern should follow the traffic
  - For uniform/random traffic minimize the distance to repair to minimize latency.
  - For bursty traffic follow the bursts to maximize protection.

- More about content aware coding:
  - https://rely.steinwurf.com/docs/latest/design/content_aware_coding.html
  - https://www.steinwurf.com/blog/2020-10-30-content-aware-ecc-fec.html

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