Buffer-aware scheduling of modal radio graphs

Buffer-Aware Scheduling for Modal Radio Graphs

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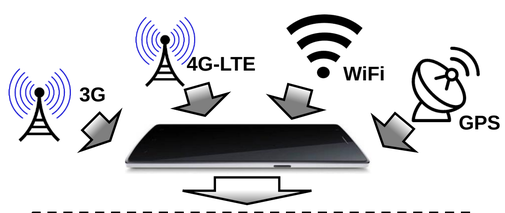
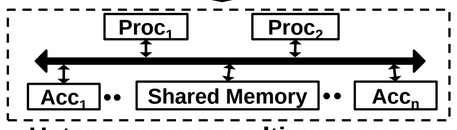
1. Introduction

- **Real-time streaming applications**
  - **Require timing correctness**
  - **Run continuously**
  - **Process infinite input stream**

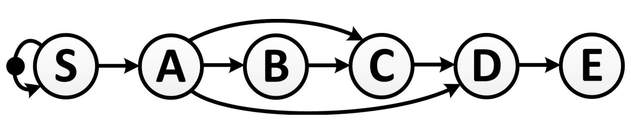




Heterogeneous multi-processor hardware platform

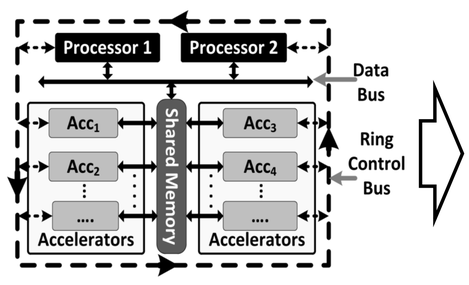
- **Dataflow**
  - **Suitable to model real-time streaming applications**

Dataflow	Analytical properties	Expressiveness
Static dataflow	Strong	Limited
Mode-controlled dataflow	Strong	Medium
Dynamic dataflow	Limited	Strong

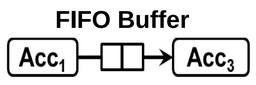


Static dataflow: Single-Rate Dataflow (SRDF) graph

- **Multi-processor without back-pressure**

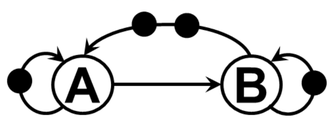


Hardware platform



Communication

No overflow

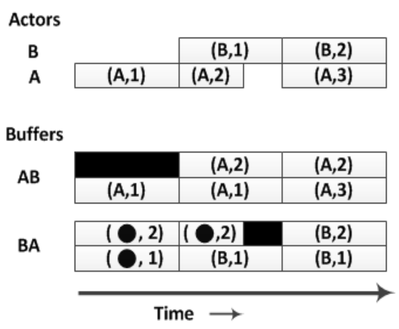


Back-pressured communication

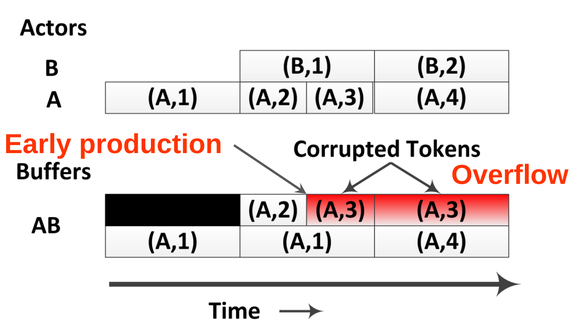
May overflow

Non-back-pressured communication

2. Motivation



Back-pressured execution



Non-back-pressured execution

Self-timed execution: varying execution time

3. Buffer allocation

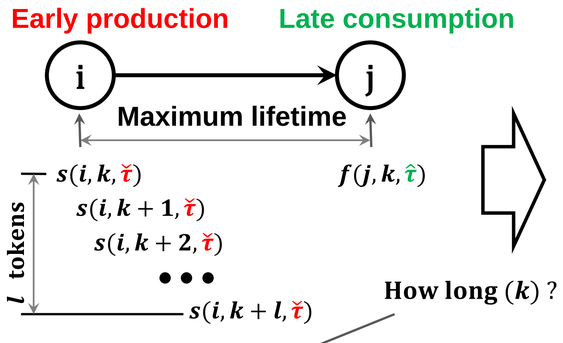
s: Start time

k: Iteration number

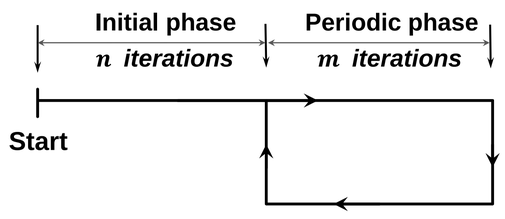
$\check{\tau}$: Best-case execution time

$\hat{\tau}$: Worst-case execution time

Early production — Late consumption



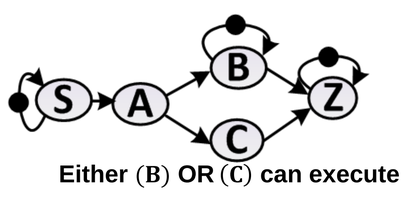
An execution of an SRDF graph,
- becomes periodic
- after finite number of iterations
- assuming constant τ for actors across iterations



Need to analyze $(max(\check{n}, \hat{n}) + m)$ iterations

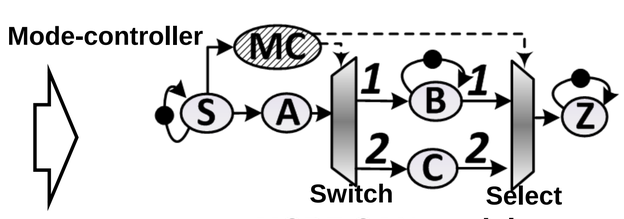
4. Data-dependent (dynamic) behavior

- **Mode-Controlled Dataflow (MCDF)**

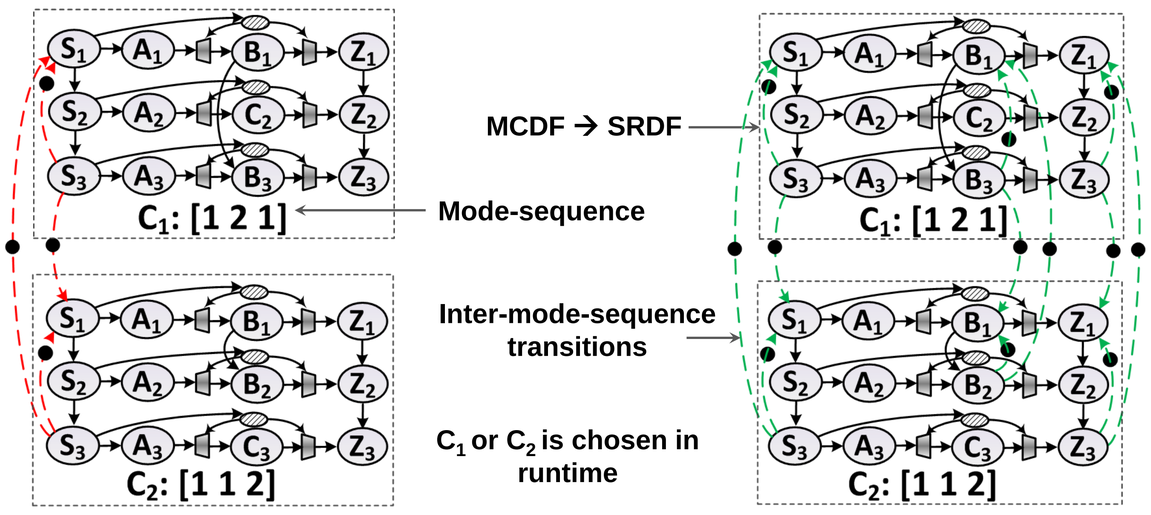


Either (B) OR (C) can execute

SRDF CANNOT model (data-dependent) behavior



MCDF CAN model (data-dependent) behavior



Best-case behavior — Worst-case behavior

5. Results

- **Buffer sizes for systems without back-pressure**

LTE receiver	Buffer sizes (Kbytes)	Saving (%)
Manual	575	-
Single-rate Dataflow	489	15
Mode-controlled Dataflow	433	25

6. Conclusion

- **Early production and latest consumption → buffer overflow.** ?
- **MCDF model of an LTE receiver saves 11% versus SRDF model and 25% versus manual buffer sizes.**

Contact

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Acknowledgements

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