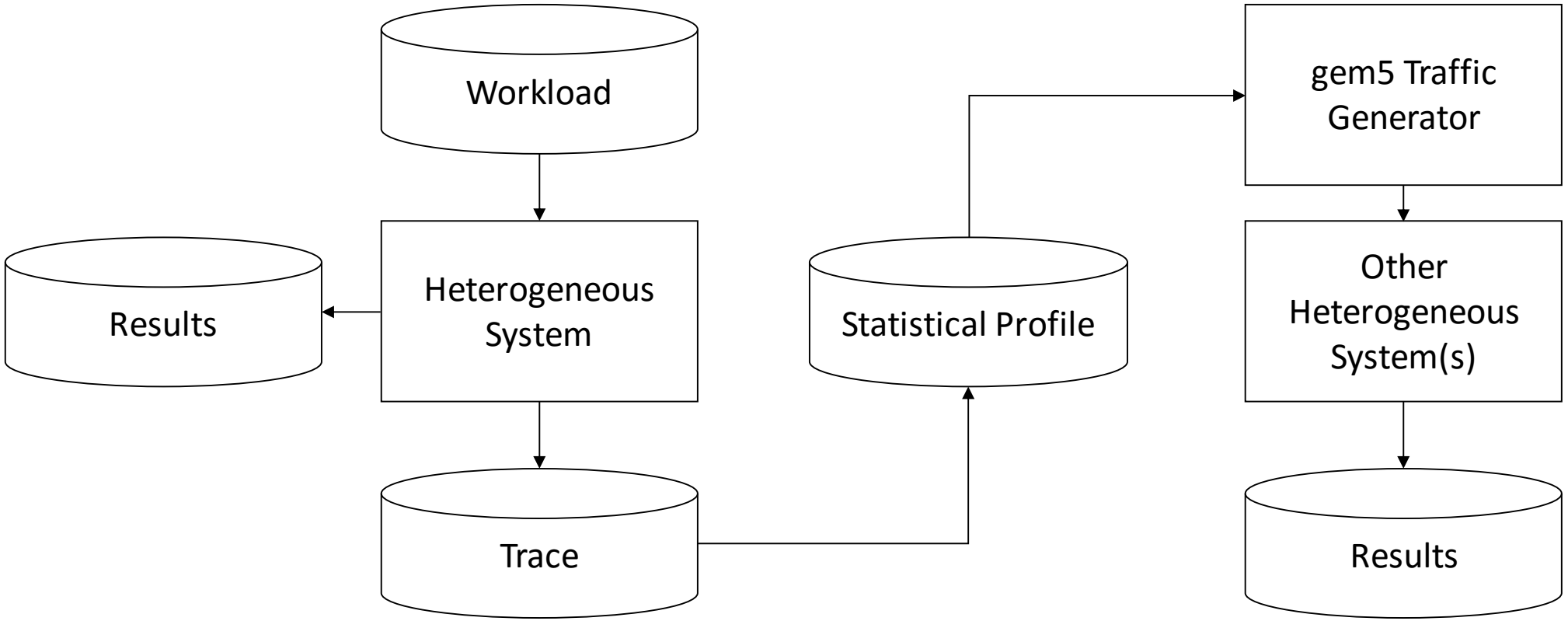
Generating Synthetic Traffic for Heterogeneous Architectures

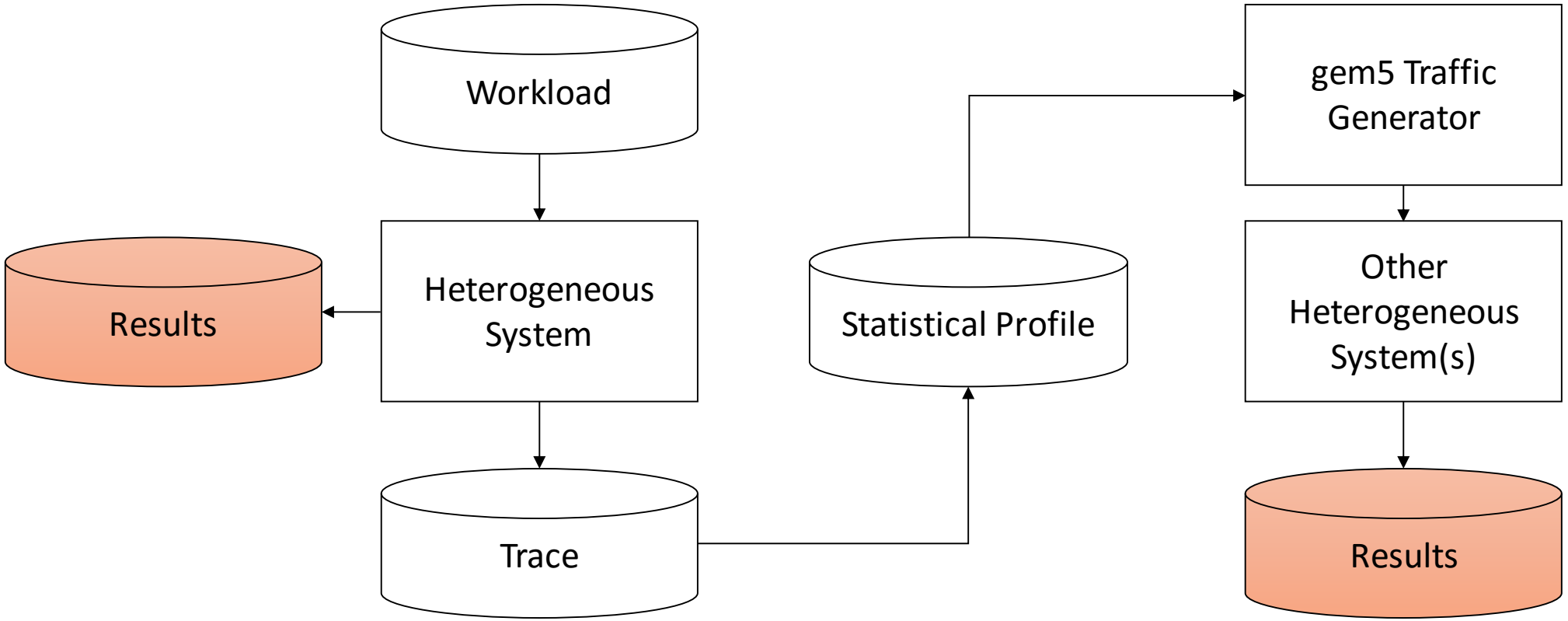
Mario Badr | Natalie Enright Jerger | Riken Gohil | Radhika Jagtap | Matteo Andreozzi

What is Synthetic Traffic?

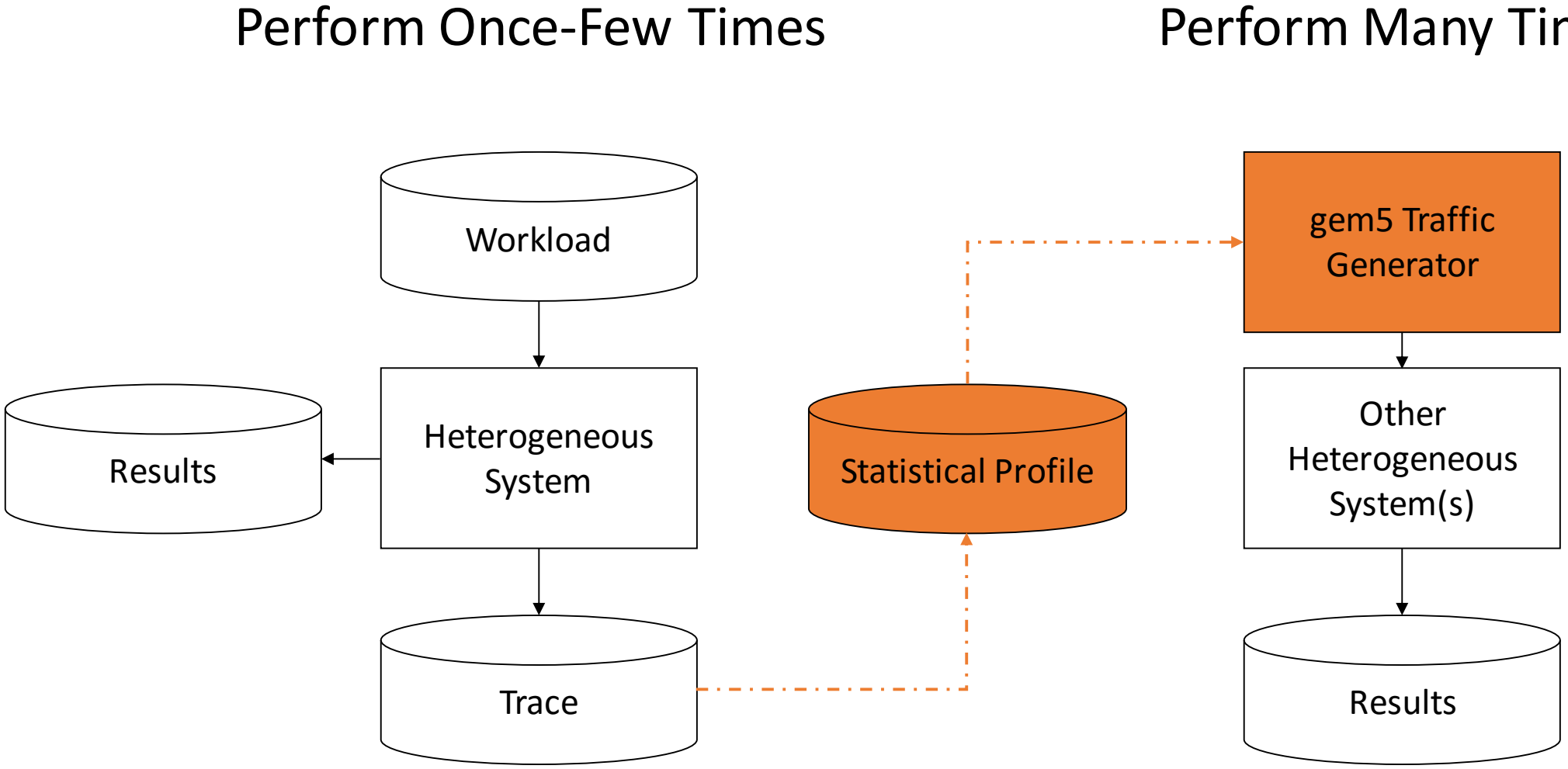


Perform Once-Few Times

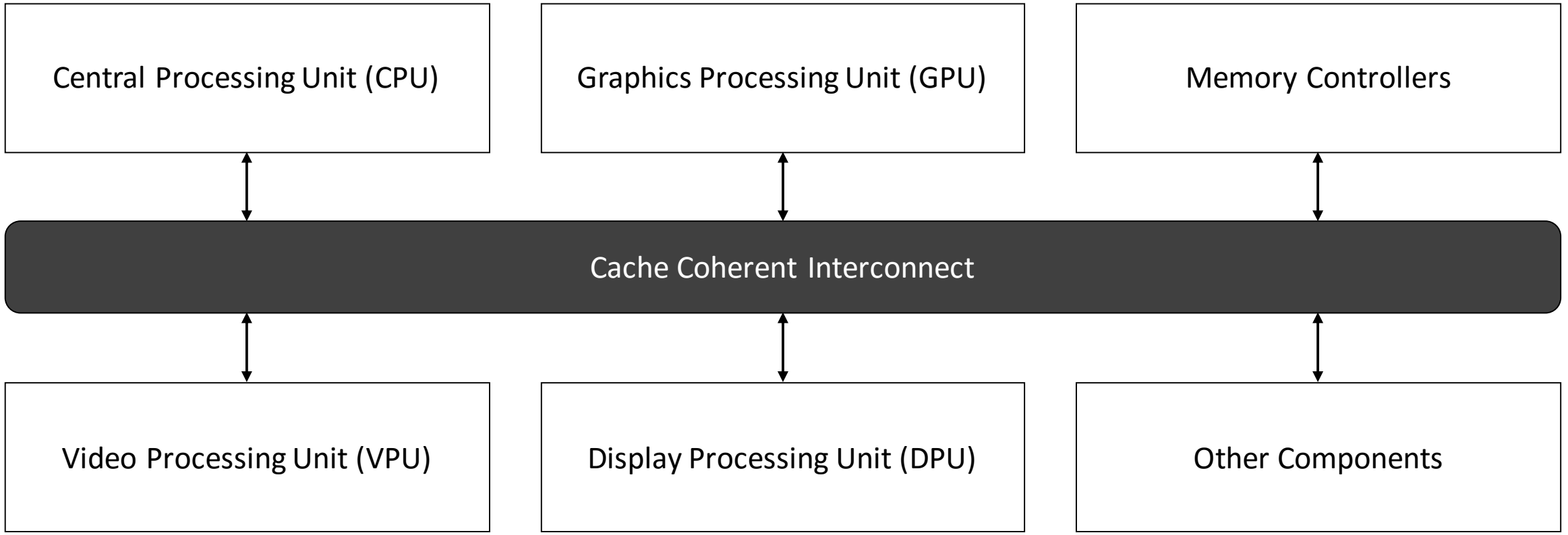
Perform Many Times



Goal: Synthetic Traffic Results ~= Original Workload Results



gem5 Contributions (WIP)



A Heterogeneous System

1

Distribute models, not traces

2

Modify the model for custom behaviour

3

Converge quickly to final result

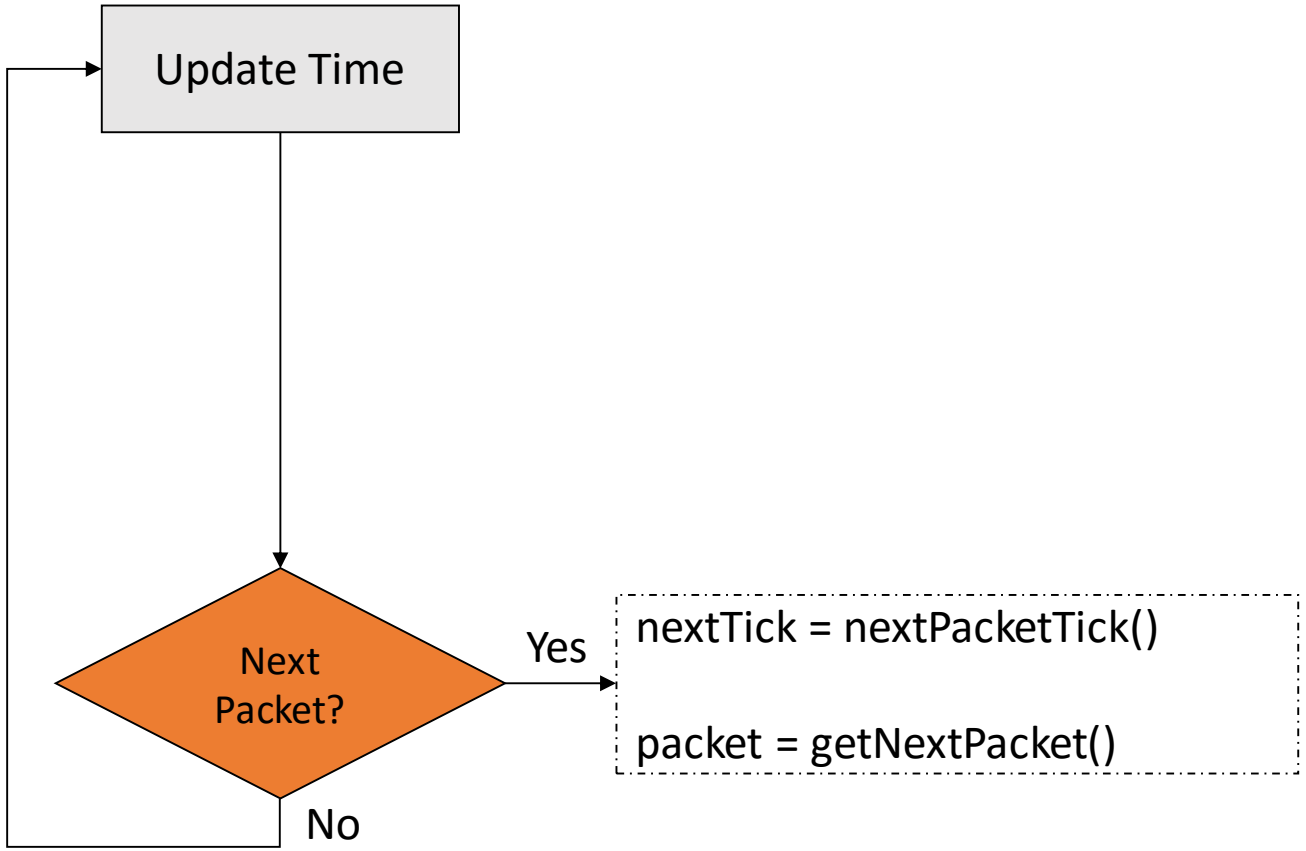
Why Synthetic Traffic?

1. What kind of message should be sent?
2. When should a message be sent?
3. How big is the message?
4. Where is the message going?
5. How does it change over time?

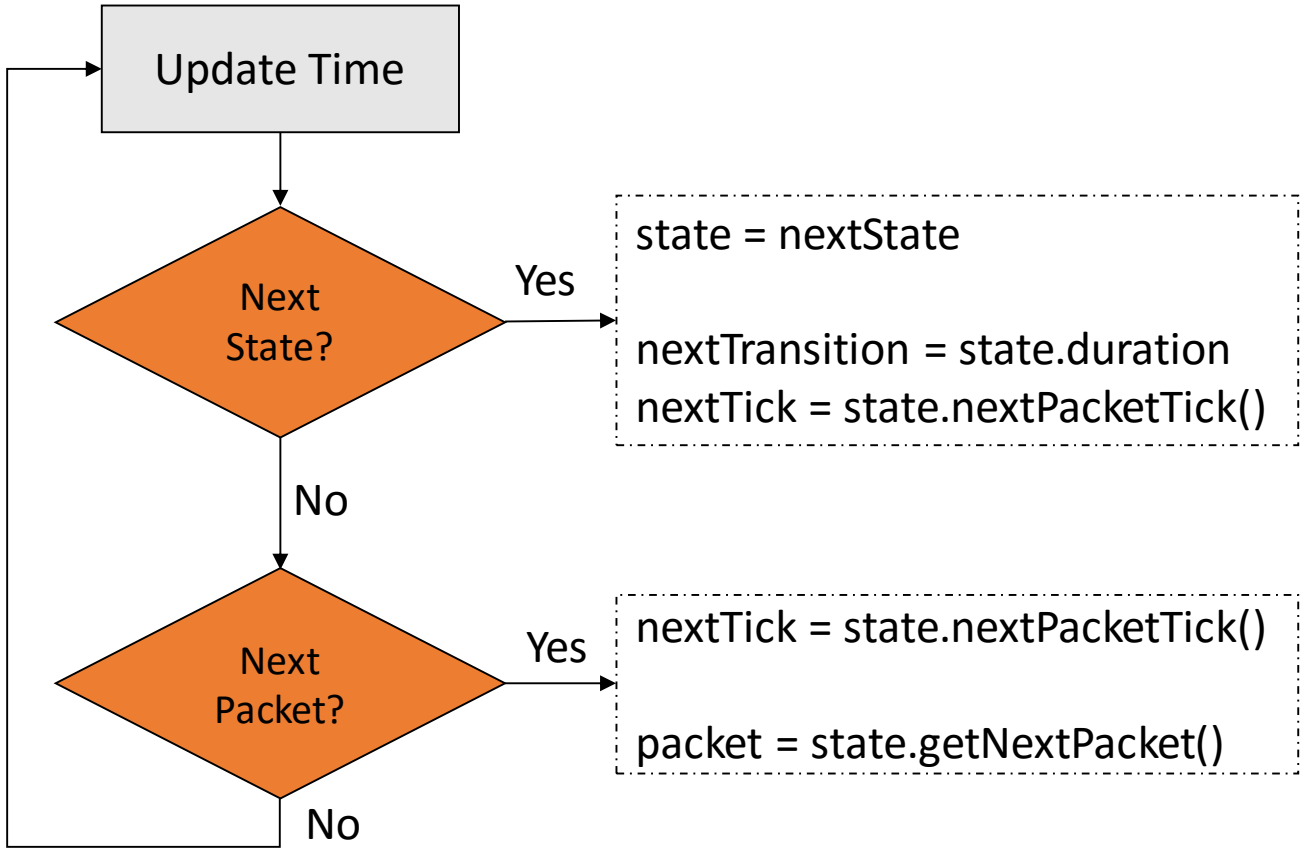
The Statistical Profile

1. What kind of message should be sent?	Read Percentage
2. When should a message be sent?	Average Delta Time
3. How big is the message?	Average Data Size
4. Where is the message going?	Address Synthesis
5. How does it change over time?	State Transitions

A Potential Statistical Profile



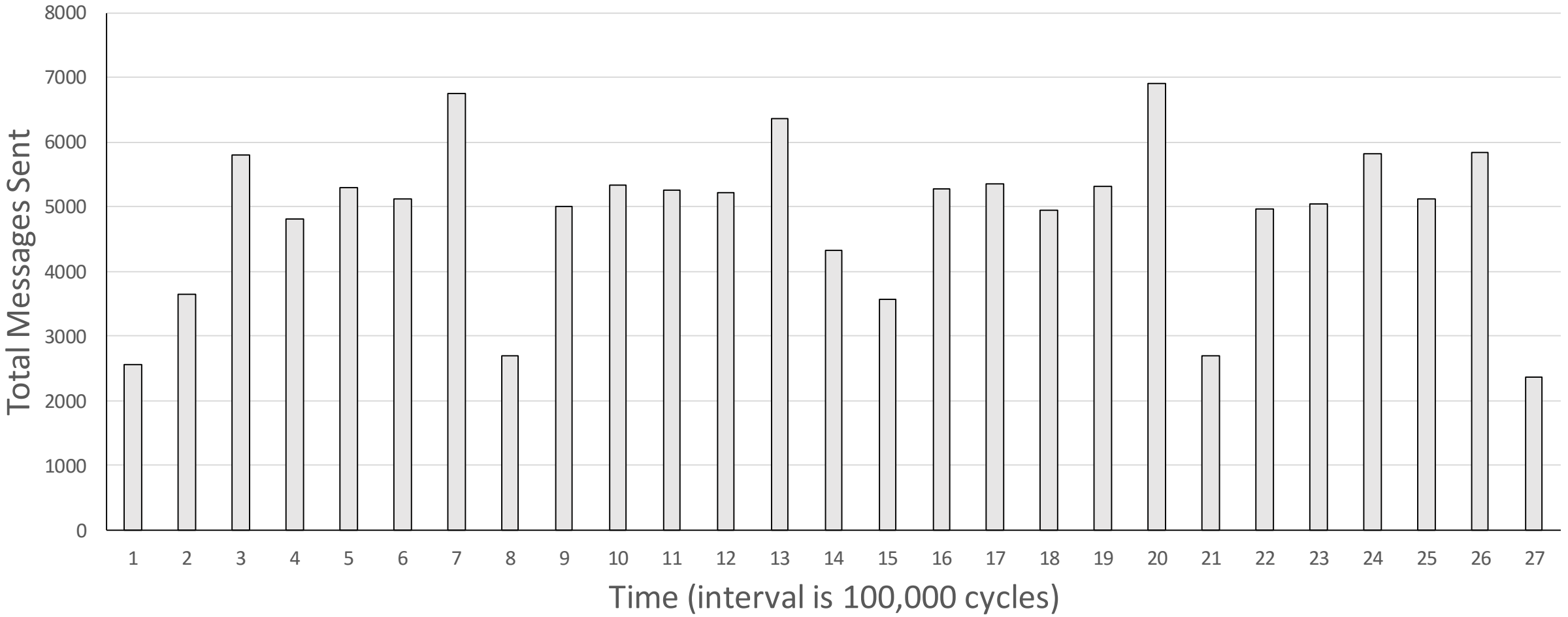
Generating Traffic



Generating Time-Varying Traffic

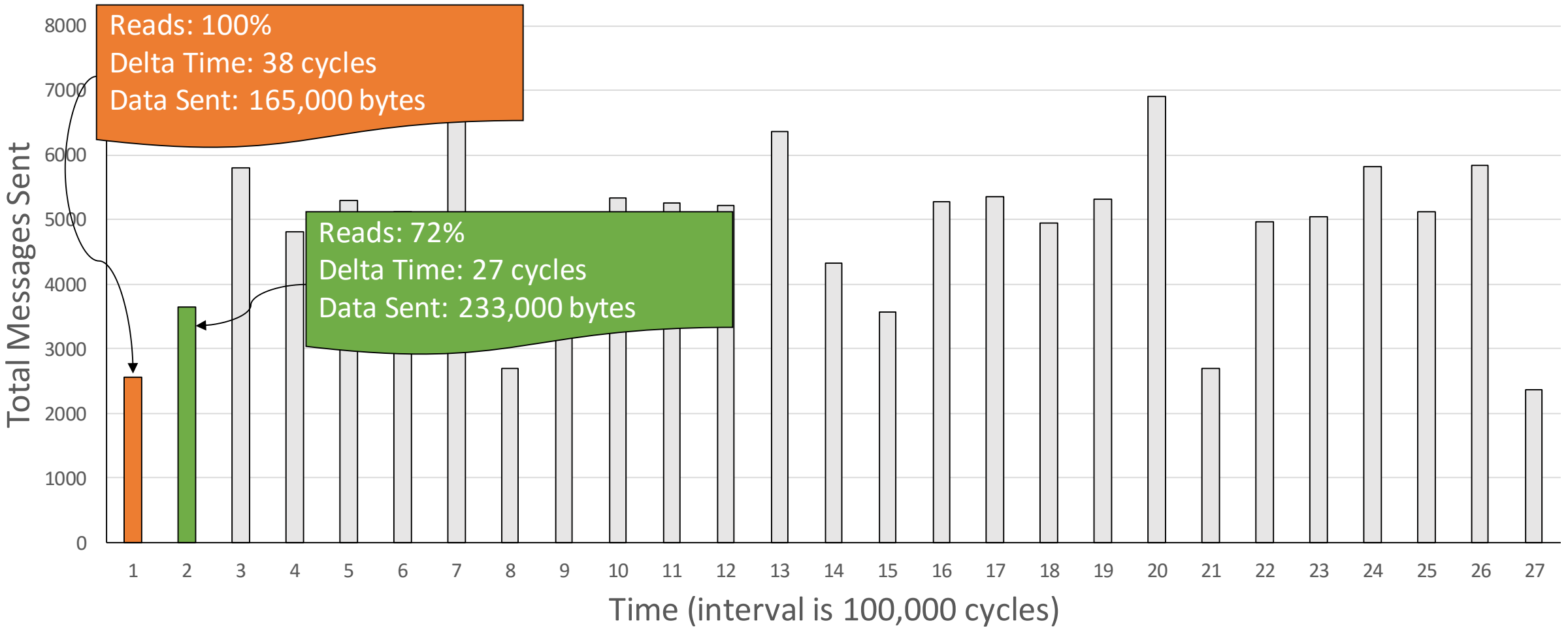
Divide	Group	Model	Transition
Discretize trace into intervals	Group similar intervals into a state	Model each state	Model transitions between states

From Trace to Profile



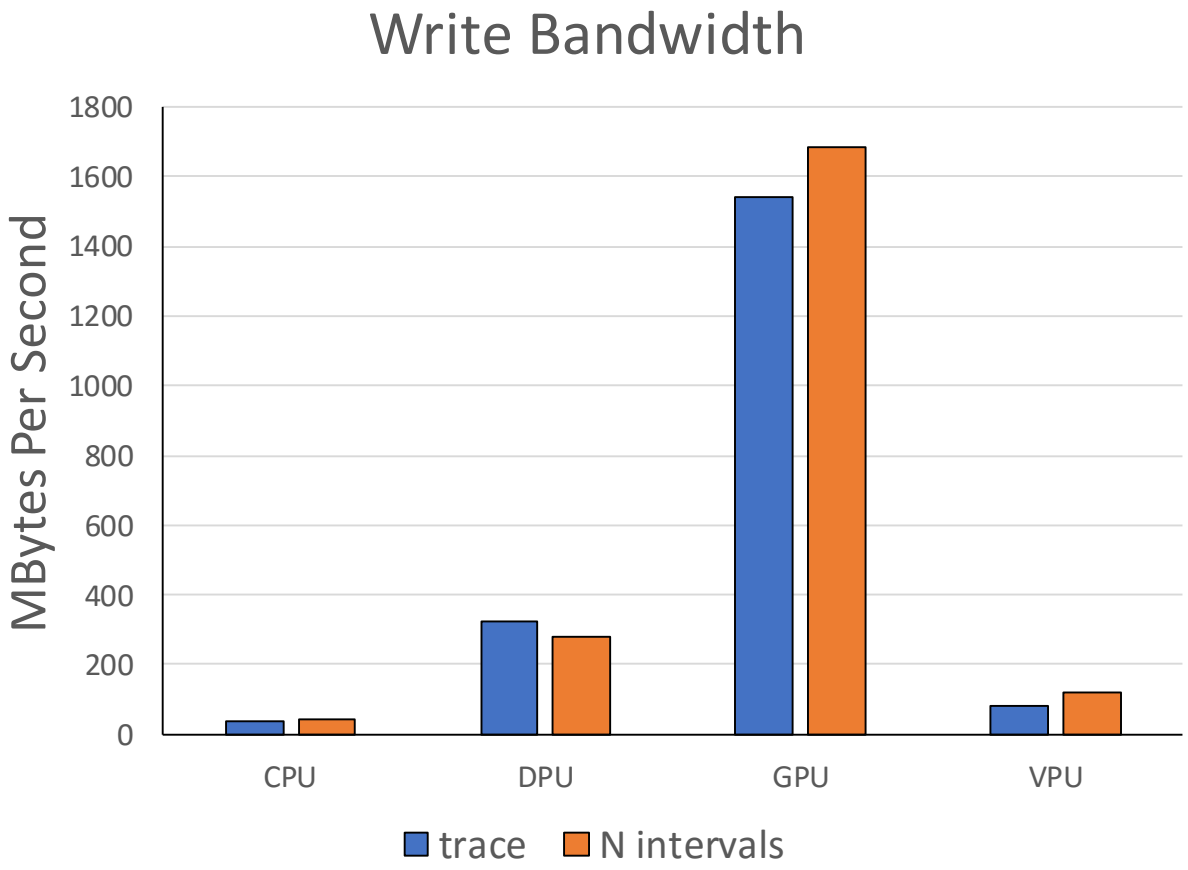
Dividing a Trace into Intervals

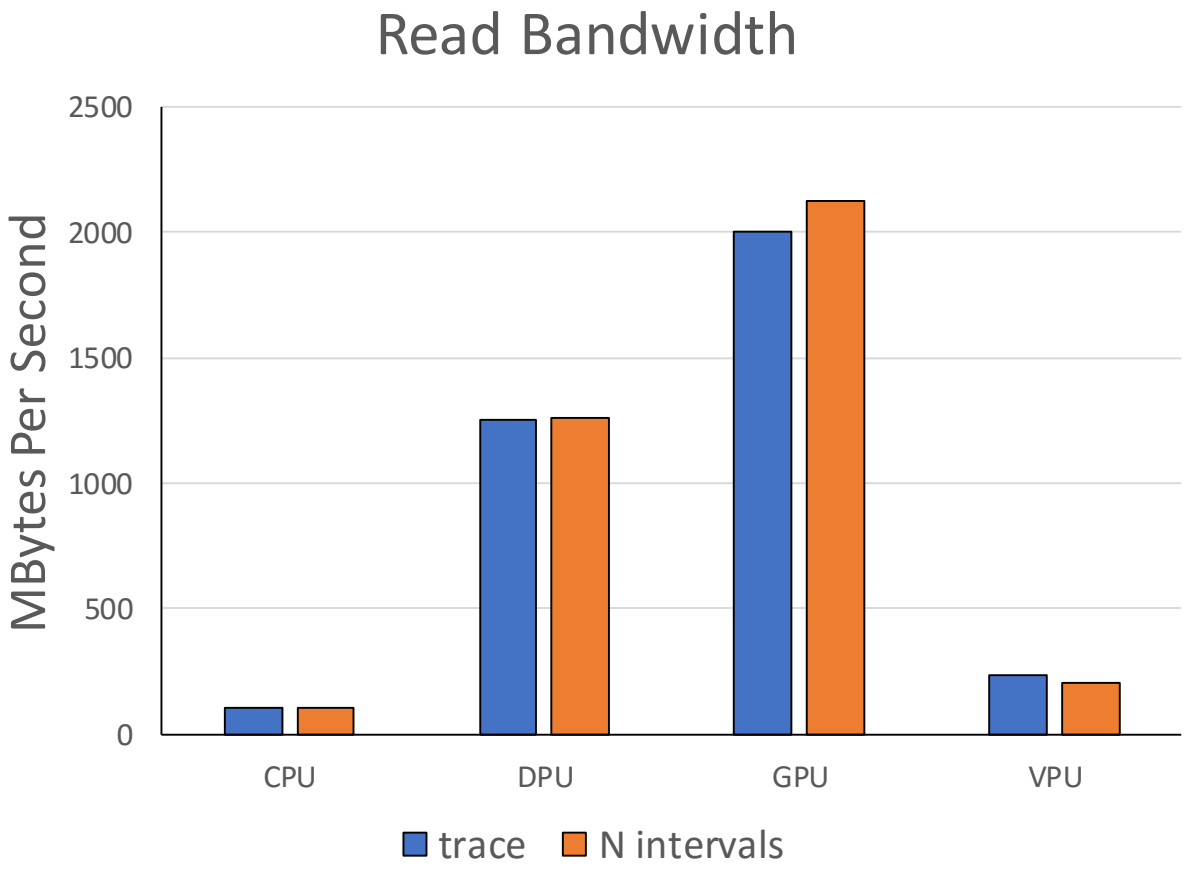
GPU



Dividing a Trace into Intervals

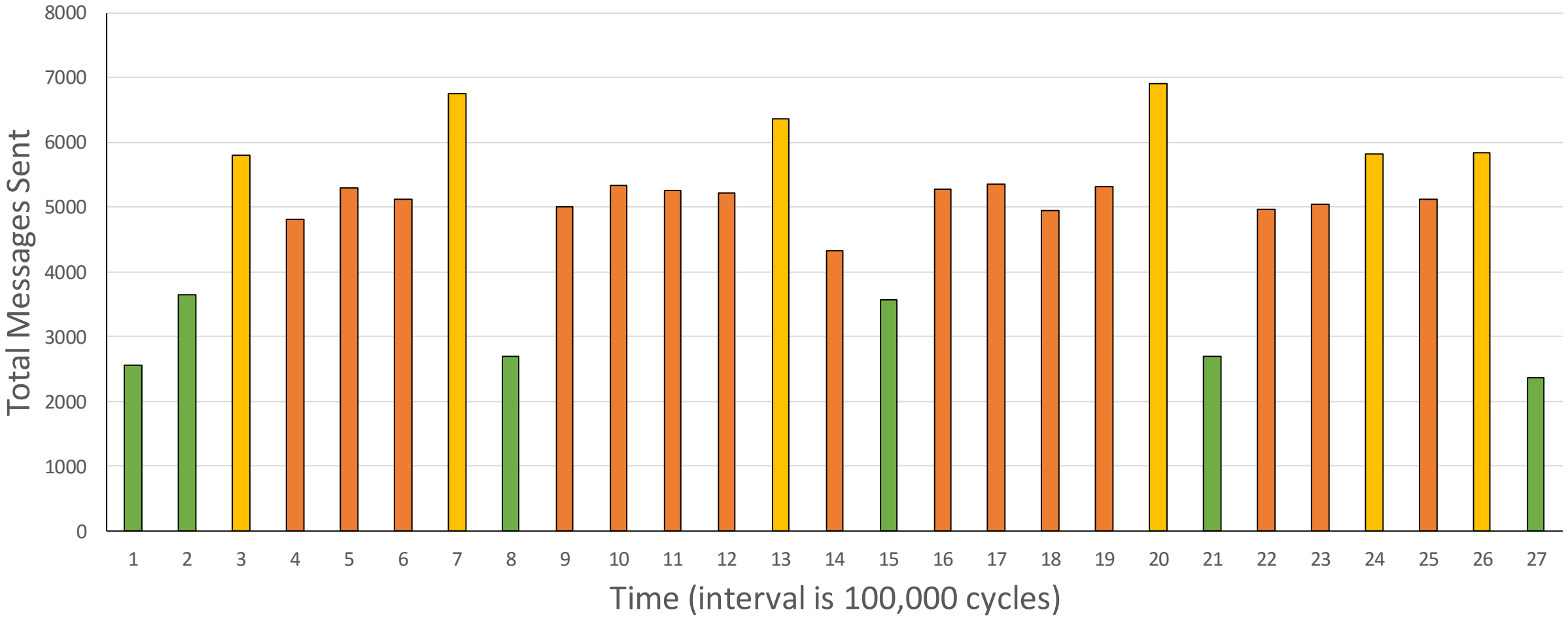
GPU





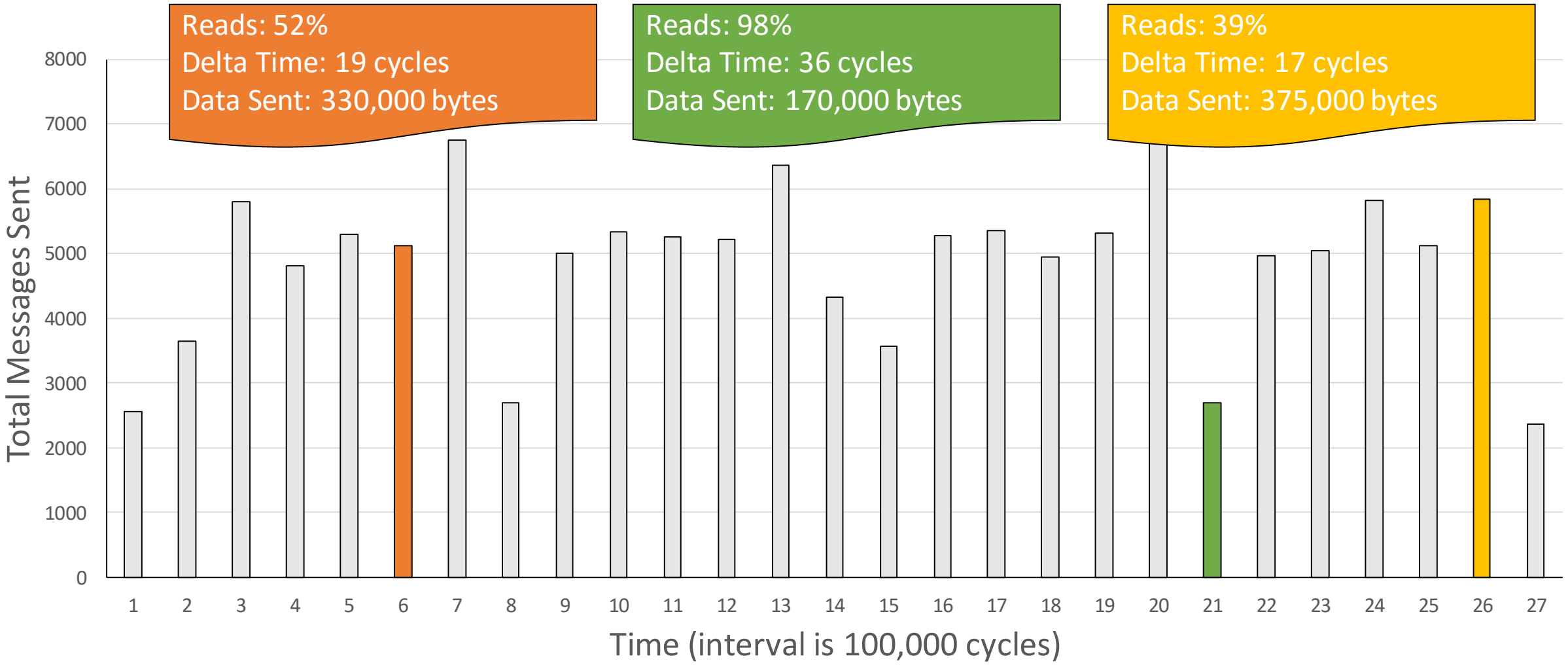
Interval Replay Results

Bandwidth



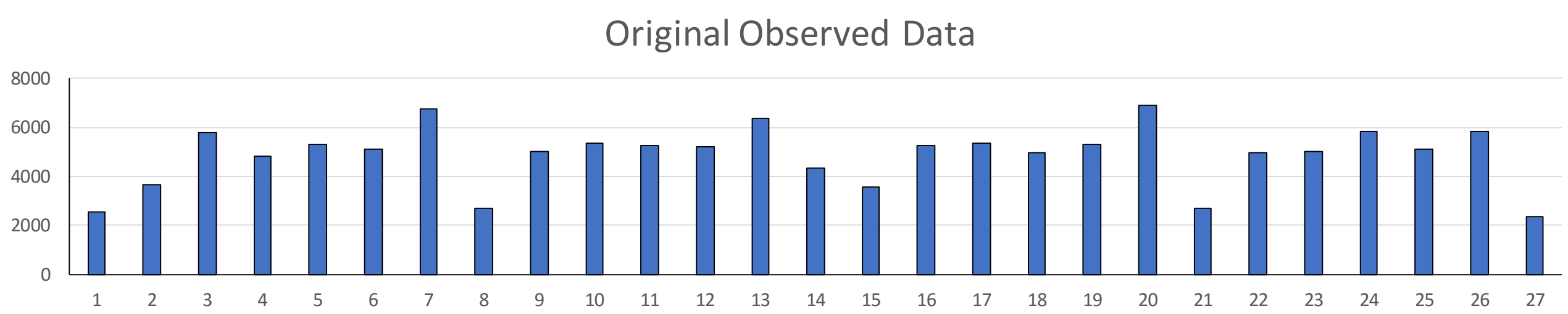
Grouping Similar Intervals

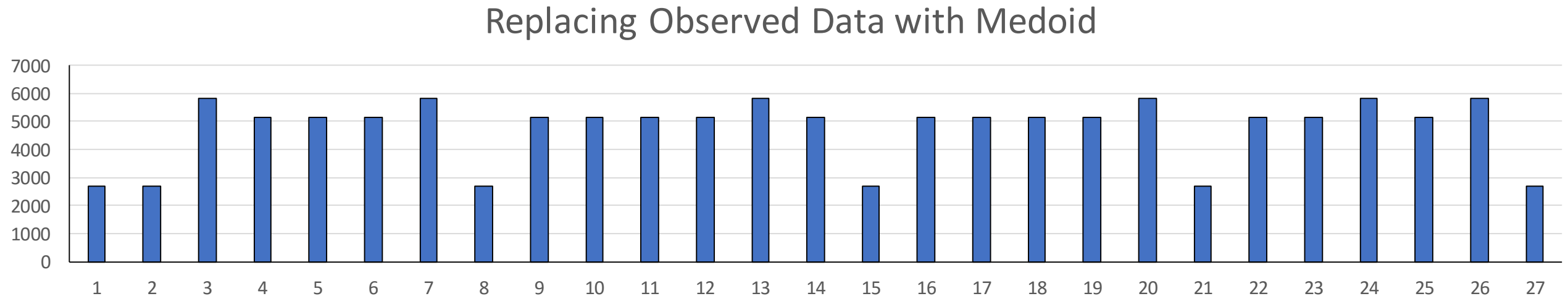
3 Groups



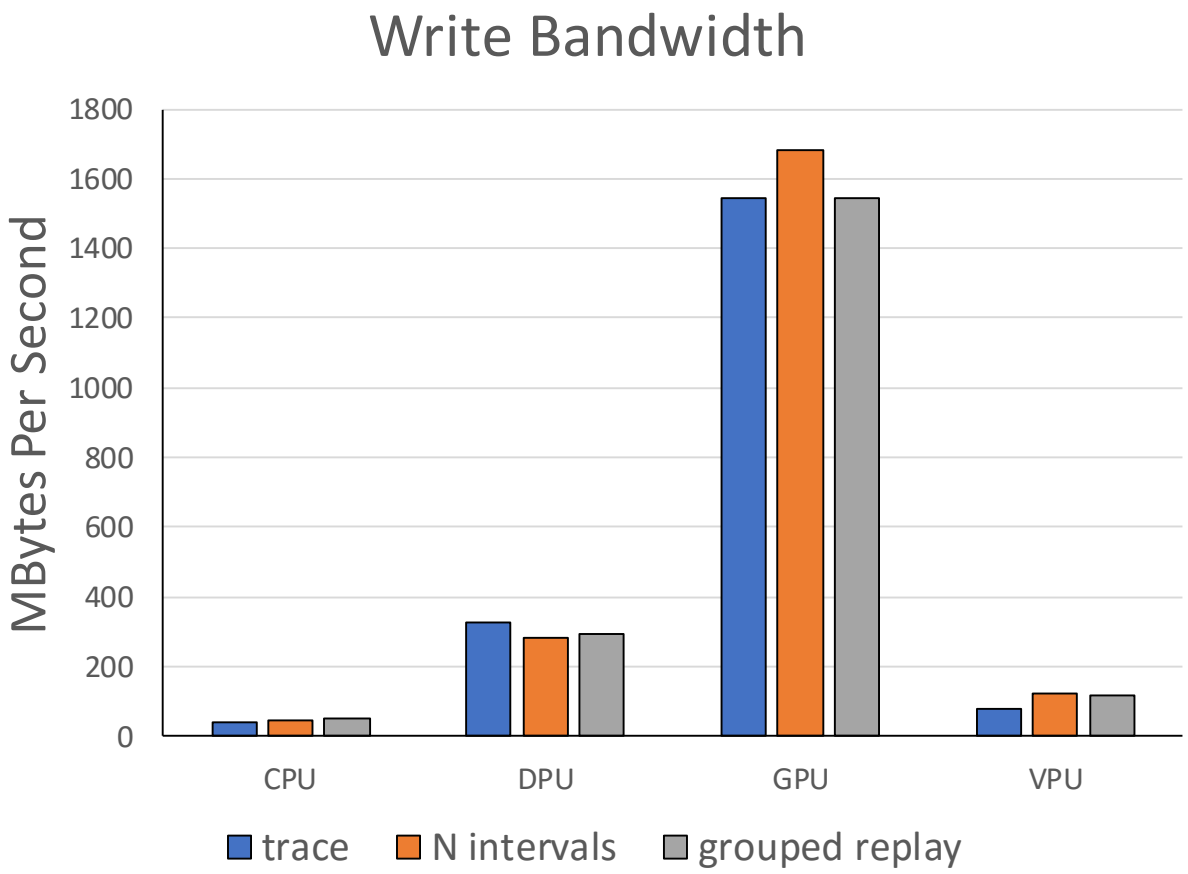
The Representative Intervals

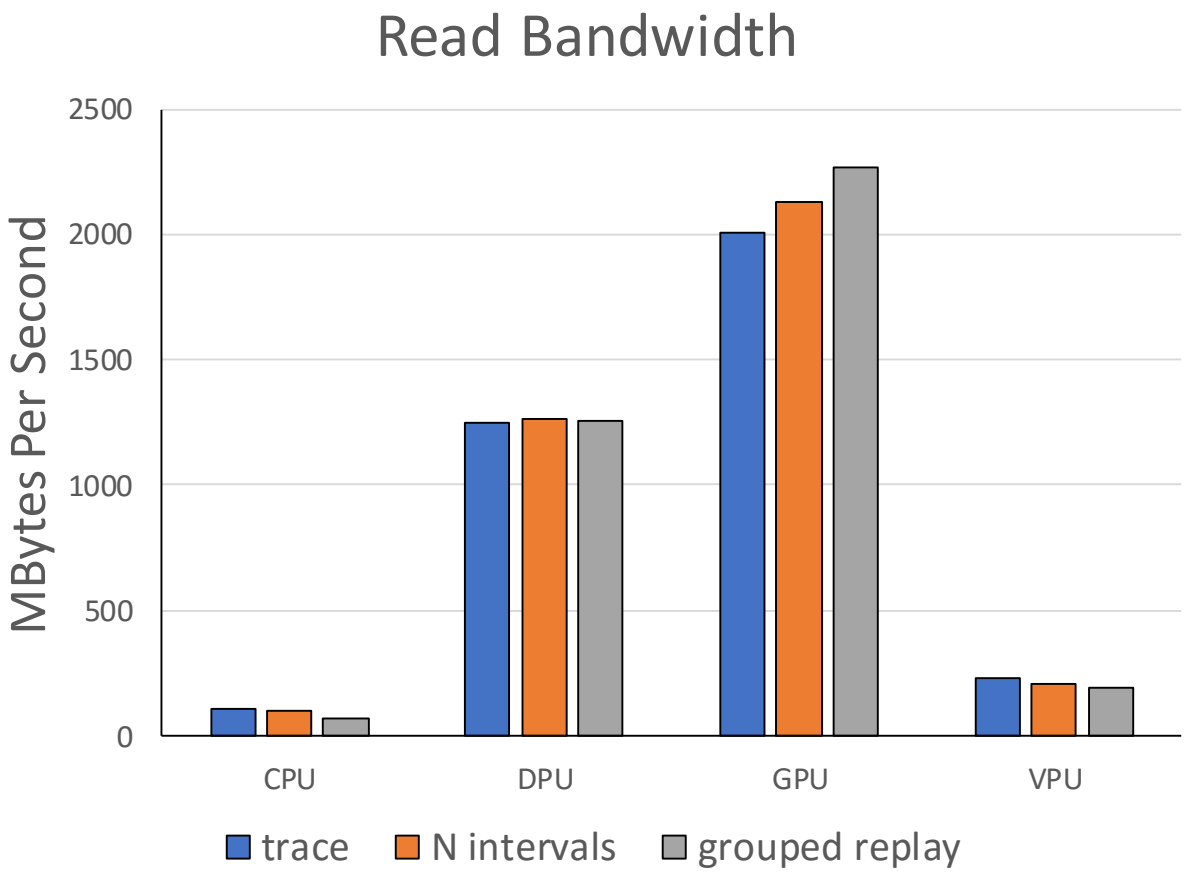
Medoids





Representative Replay

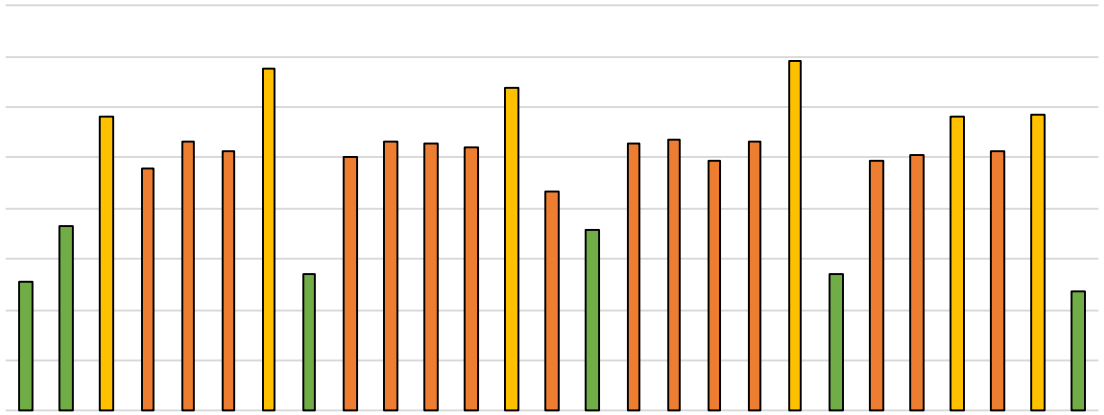




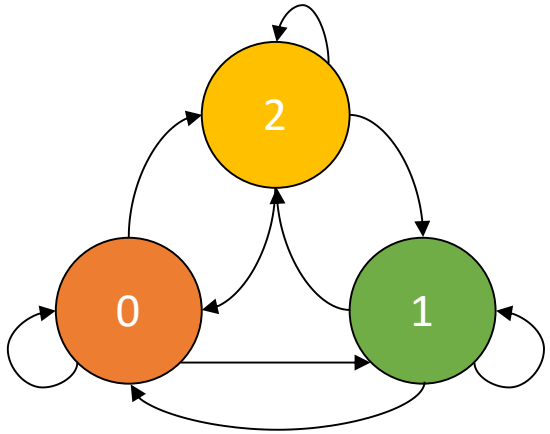
Grouped Replay Results

Bandwidth

Observed Sequence of Medoids



Markov Chain



$$\begin{bmatrix} 0.6 & .07 & .33 \\ 0.6 & 0.2 & 0.2 \\ 0.5 & 0.5 & 0.0 \end{bmatrix}$$

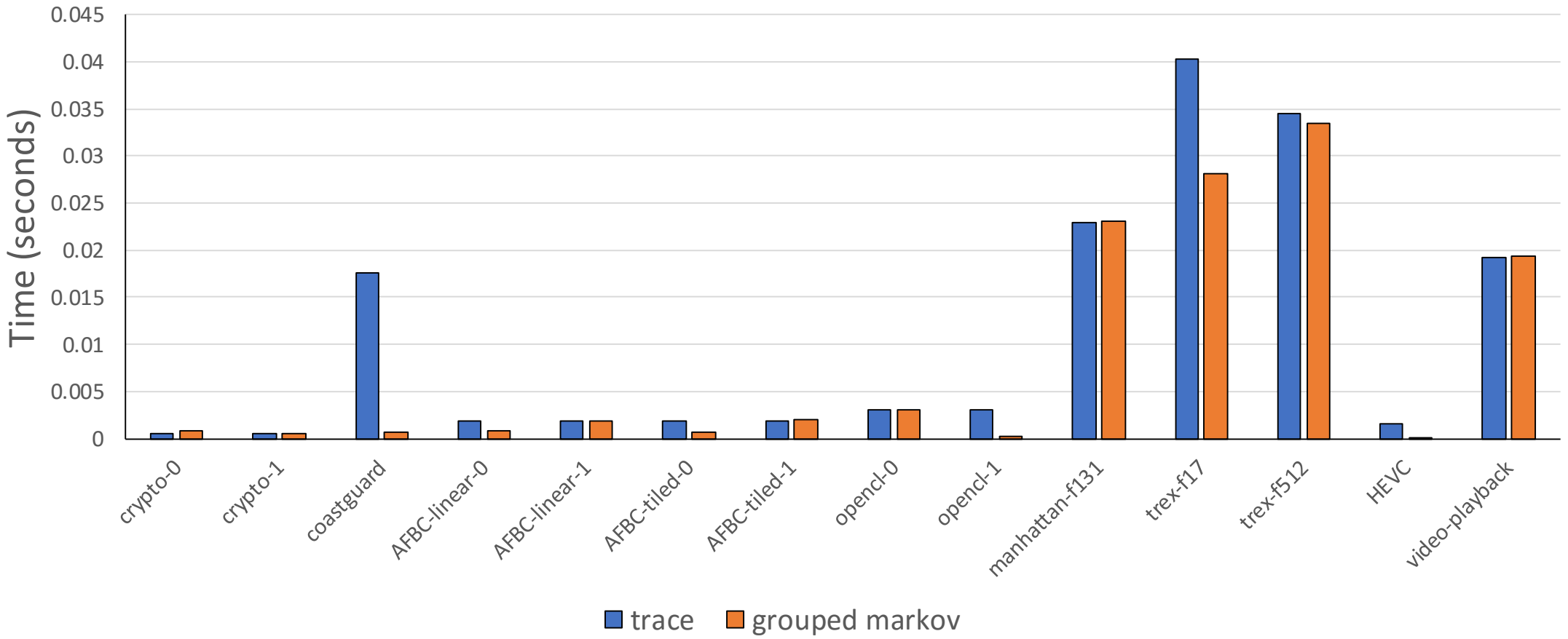
Compare Simulated Distribution to Steady State

$$\begin{bmatrix} 0.60 \\ 0.16 \\ 0.24 \end{bmatrix} \approx \begin{bmatrix} 0.58 \\ 0.19 \\ 0.23 \end{bmatrix}$$

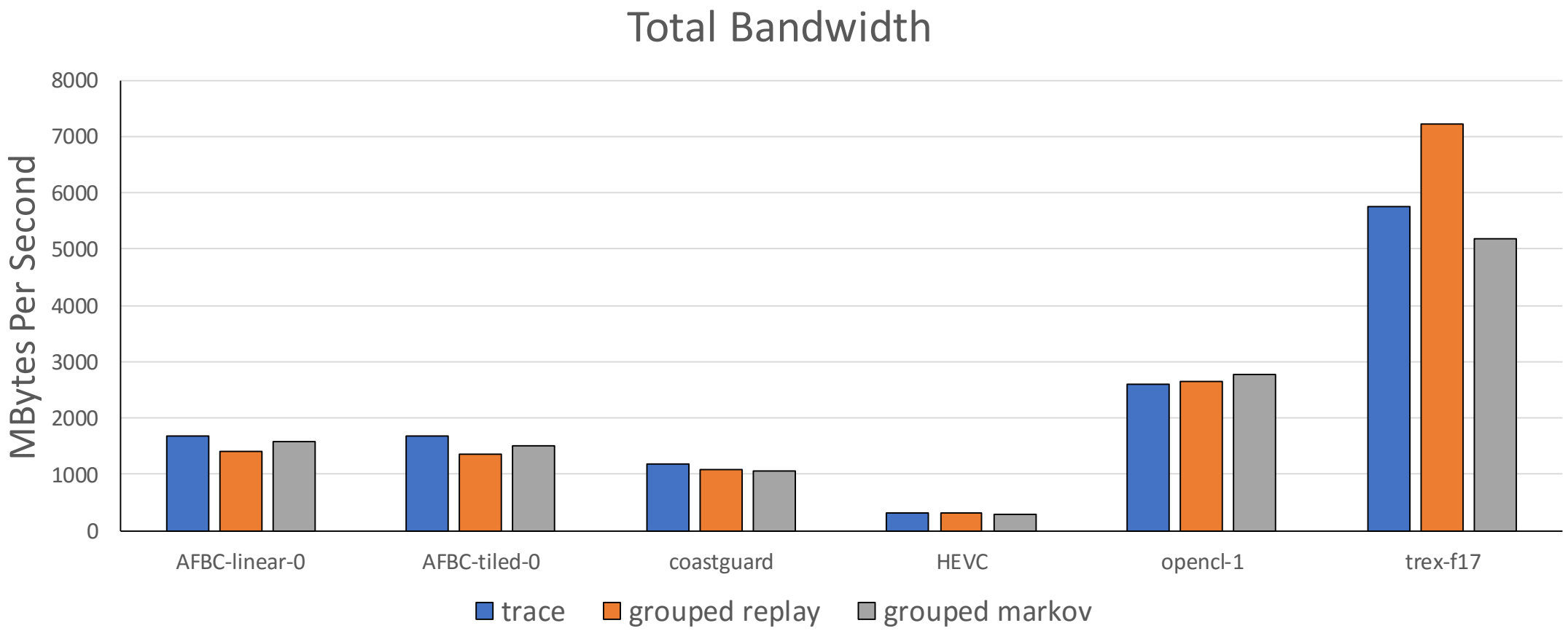
Steady State Markov Chain

$$\begin{bmatrix} 0.6 & .07 & .33 \\ 0.6 & 0.2 & 0.2 \\ 0.5 & 0.5 & 0.0 \end{bmatrix}^{512} = \begin{bmatrix} 0.58 & 0.19 & 0.23 \\ 0.58 & 0.19 & 0.23 \\ 0.58 & 0.19 & 0.23 \end{bmatrix}$$

Converging Early



Time to Converge



Converging Results

Bandwidth

- What should the interval size be?
- How many groups should their be?
- How should addresses be synthesized?

Future Work