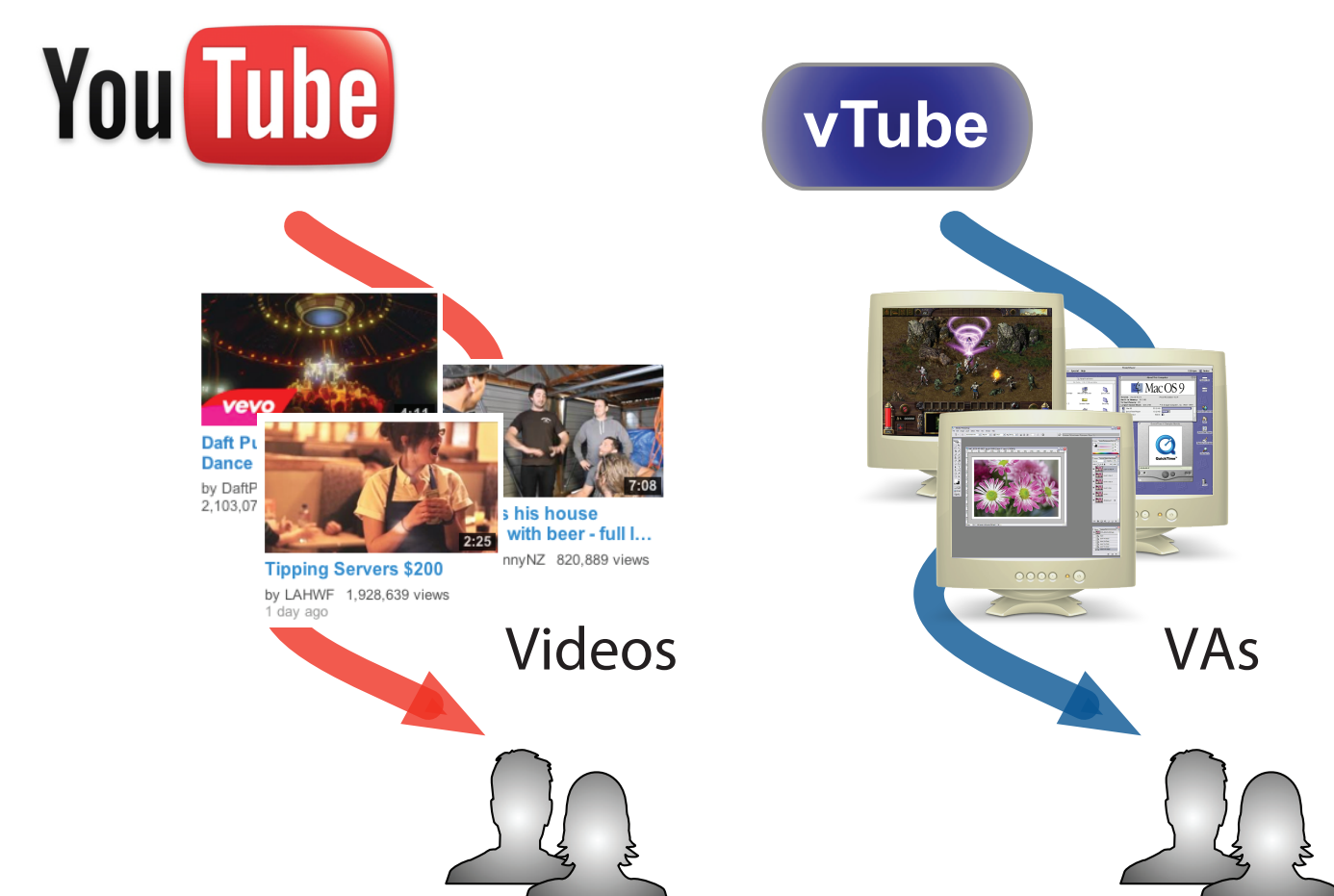


vTube: Efficient Streaming of Virtual Appliances Over Last-Mile Networks

Yoshihisa Abe†, Roxana Geambasu‡, Kaustubh Joshi•, H. Andrés Lagar-Cavilla*, Mahadev Satyanarayanan†

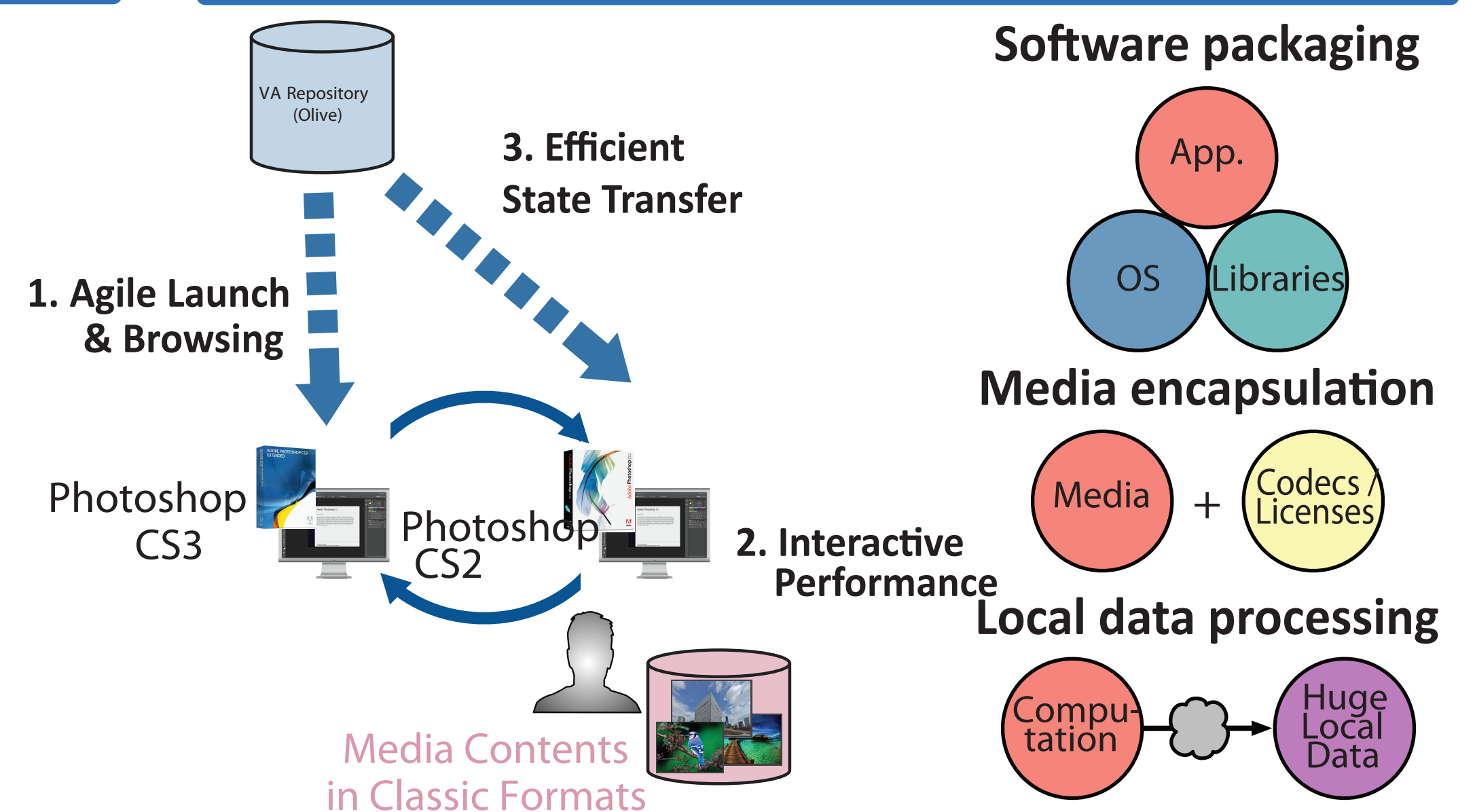
†Carnegie Mellon University, ‡Columbia University, •AT&T Research, *GridCentric

VA STREAMING



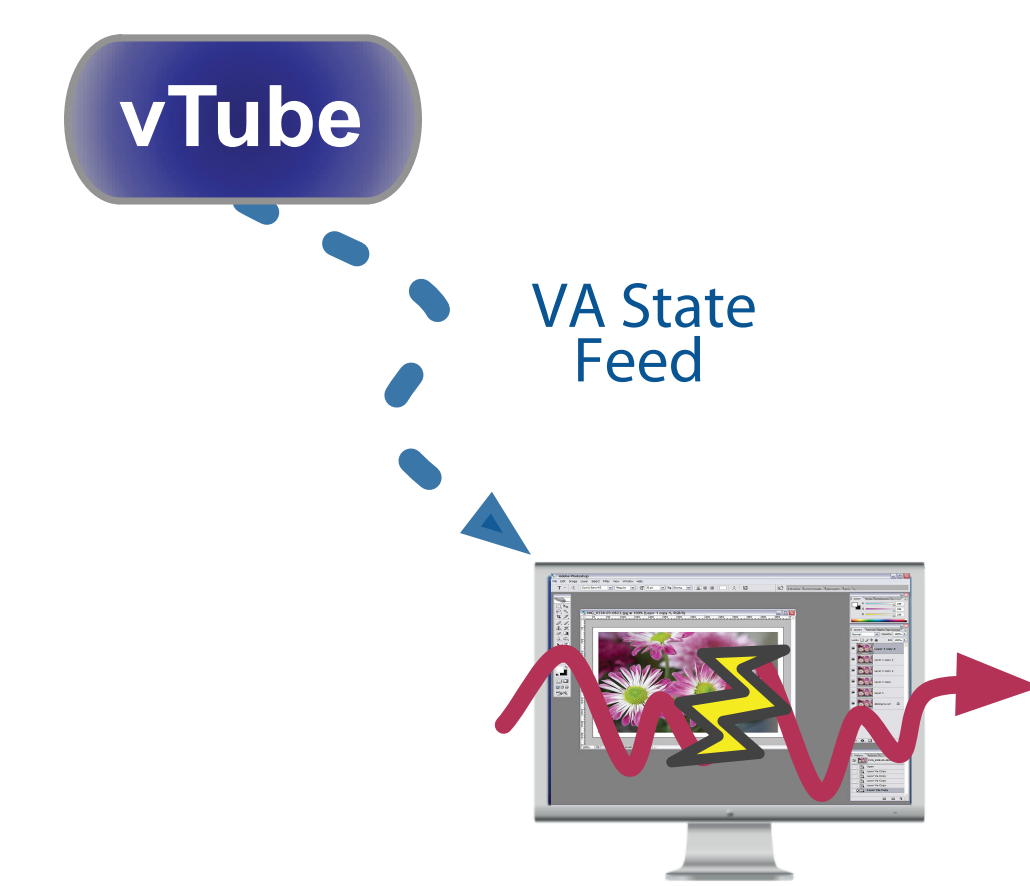
- Stream VAs just like videos
 - Easy and instant access
 - Over Wi-Fi, 4G/3G etc.
- VAs are richer than videos
 - Computation and data
 - Enable new use cases

DRIVING USE CASES



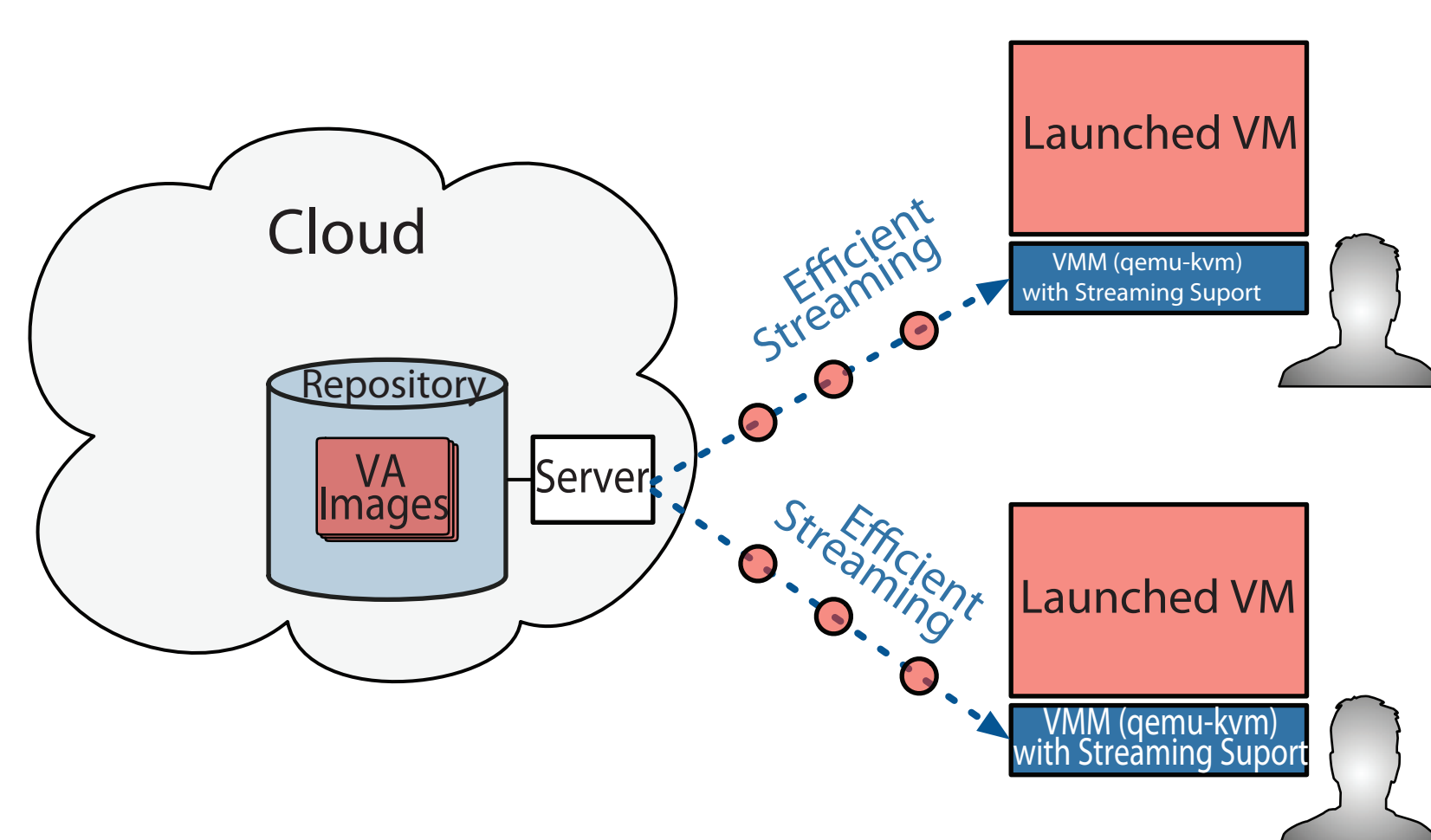
- VA Repository (E.g., olivearchive.org)
 - User with huge local media contents
 - Looking for good editing software
 - Needs *agility, interactivity, efficiency*

CHALLENGES



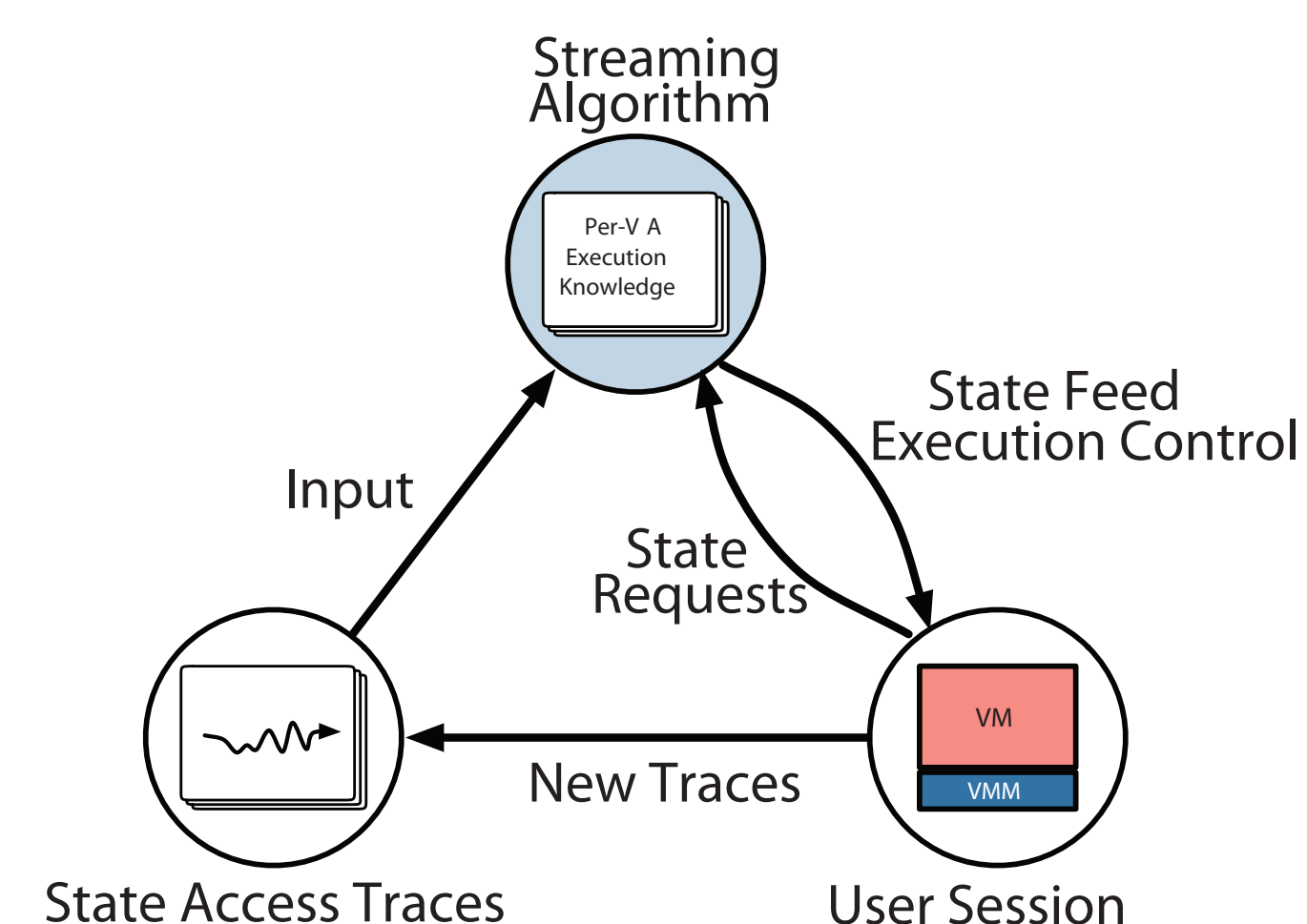
- VM is non-deterministic
 - Depends on workload
- State accesses are bursty
 - Hard to predict timings
- Misses impact usability
 - Need accurate streaming

vTUBE DESIGN



- Server with VA repository
- Client VMM with streaming support
- VA streaming algorithm
 - Applies video streaming paradigm
 - Buffers while VM is paused
 - Streams while VM is executed

STREAMING ALGORITHM

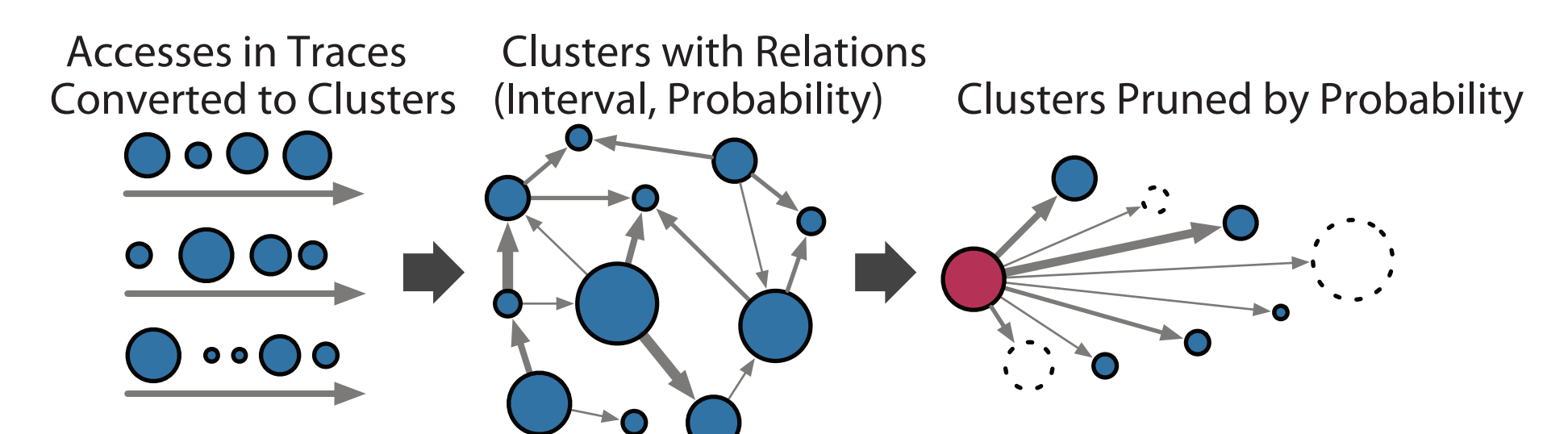


INSIGHTS

- Extract access patterns from traces
 - Capture bursty nature
- Act on current VM behavior
 - Deal with non-determinism
- Combination leads to:
 - Accuracy by scoped predictions
 - Efficiency by bounded transfer

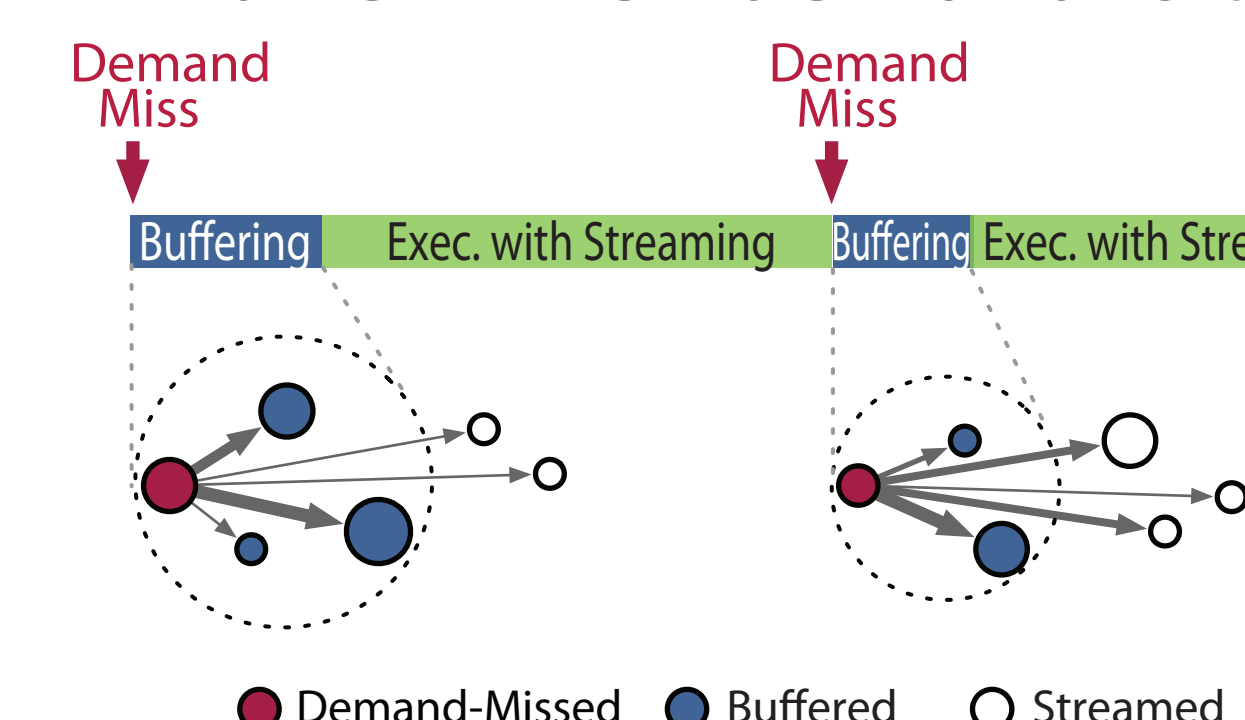
1. Process traces to extract access patterns

- Derive "clusters," components of



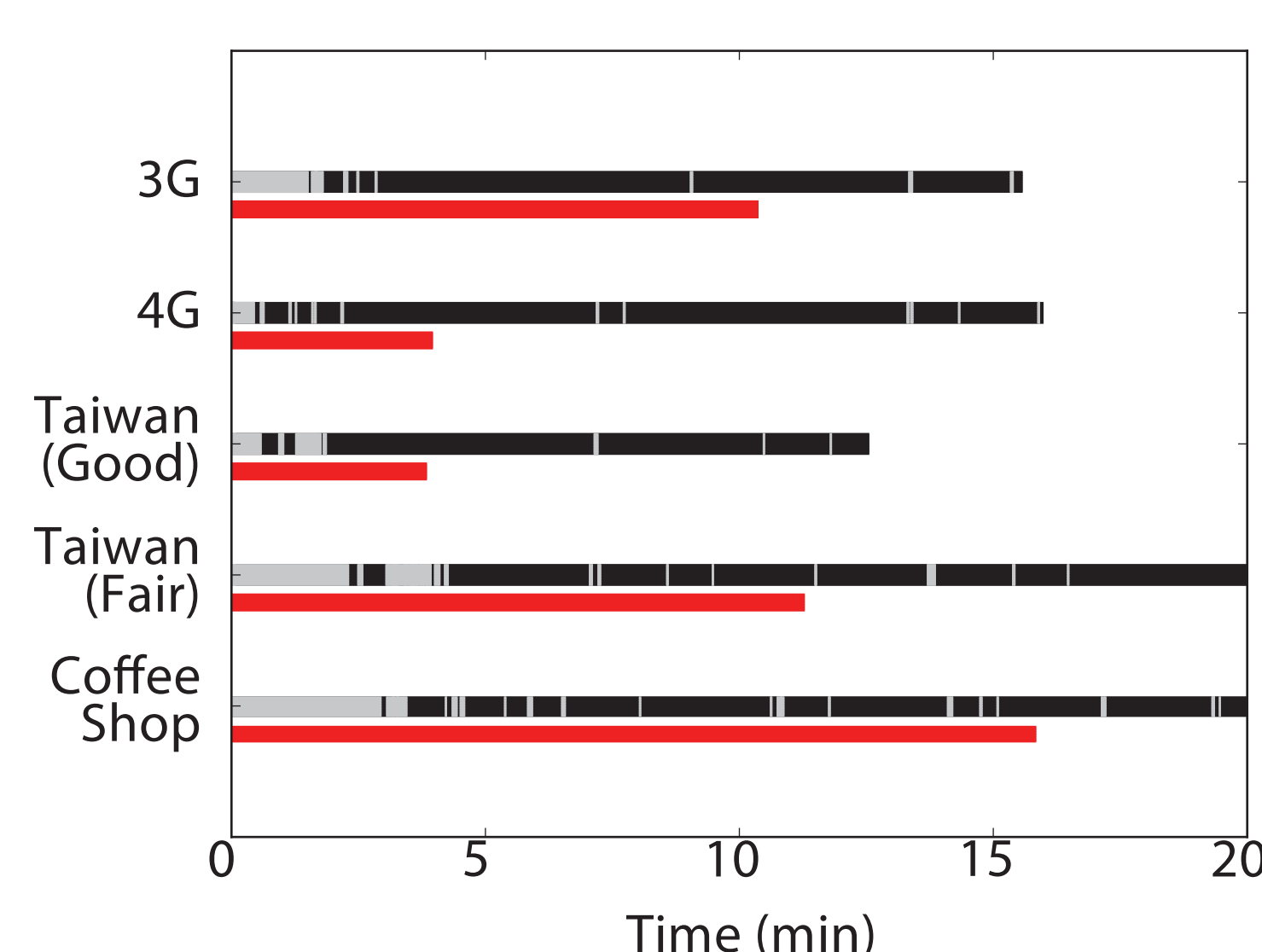
2. Control VM state transfer and execution

- Buffer/stream based on access demands
- Buffer when demand is too high



EXPERIMENTS

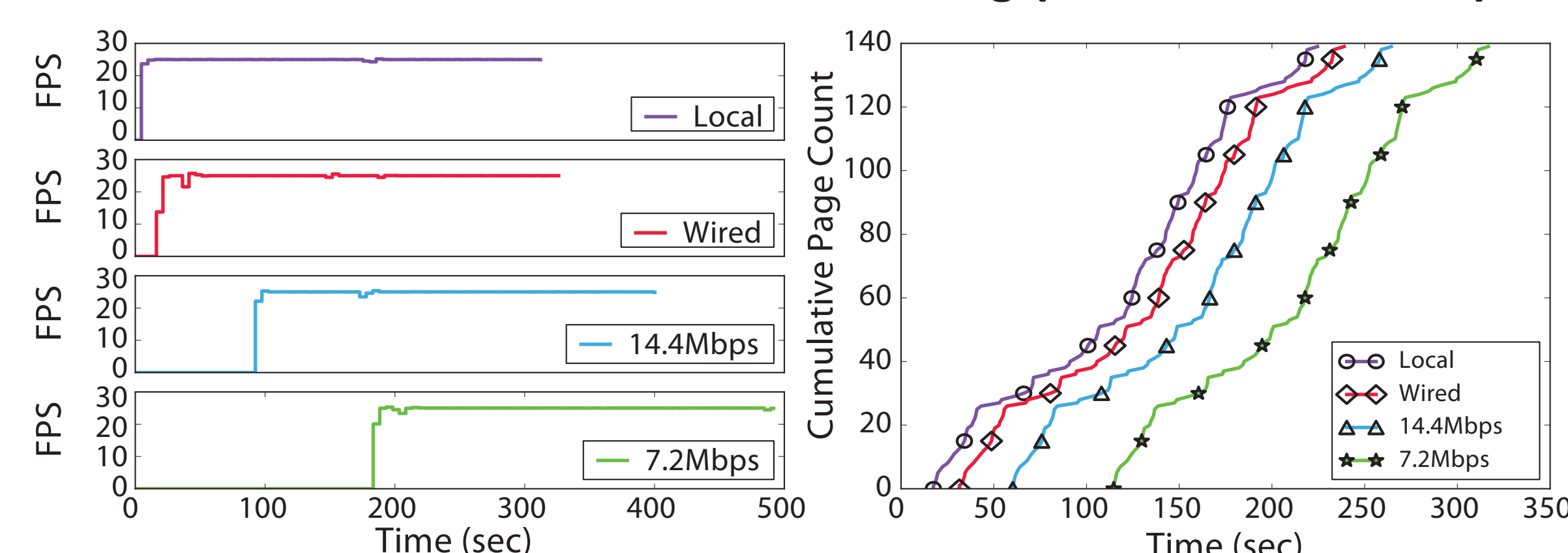
- Streaming over real networks
 - Game "Riven" on Windows 7



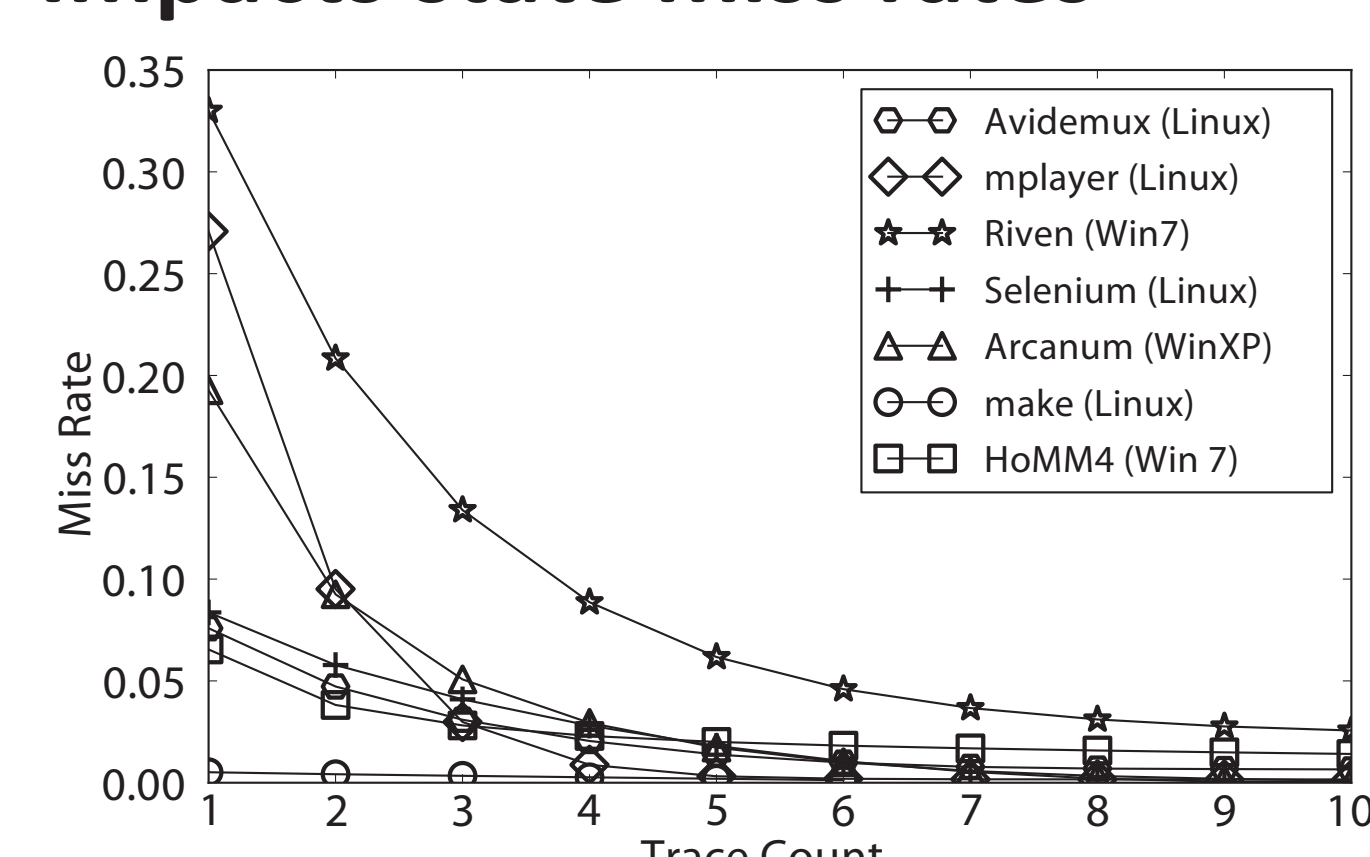
Black: execution Gray: buffering
Red: download time for partial

- VM launched within minutes
- Minimal disruption afterwards

- Application-level performance
 - Video playback (MPlayer)
 - HTML document browsing (Firefox+Selenium)



- Trace coverage
 - Impacts state miss rates



- Numbers at a glance
 - 7 VAs for media editing, games etc.
 - Span Ubuntu and Windows XP/7
 - Accessed state: 76 - 379 MB
 - State transfer overhead: $\leq 51\%$

SUMMARY

- vTube achieves VA streaming with:
 - Agility, interactivity, efficiency
- Efficient streaming algorithm
 - Applies video streaming paradigm
 - Uses fine-grained analysis of traces
- Demonstrated good usability
 - Swift VM launch
 - Execution with minimal disruption
 - Over Wi-Fi and 4G/3G connections

