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Methods and Strategies to Rate and Optimize Transactional Memory Applications

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Chair for Computer Architecture and Parallel Processing

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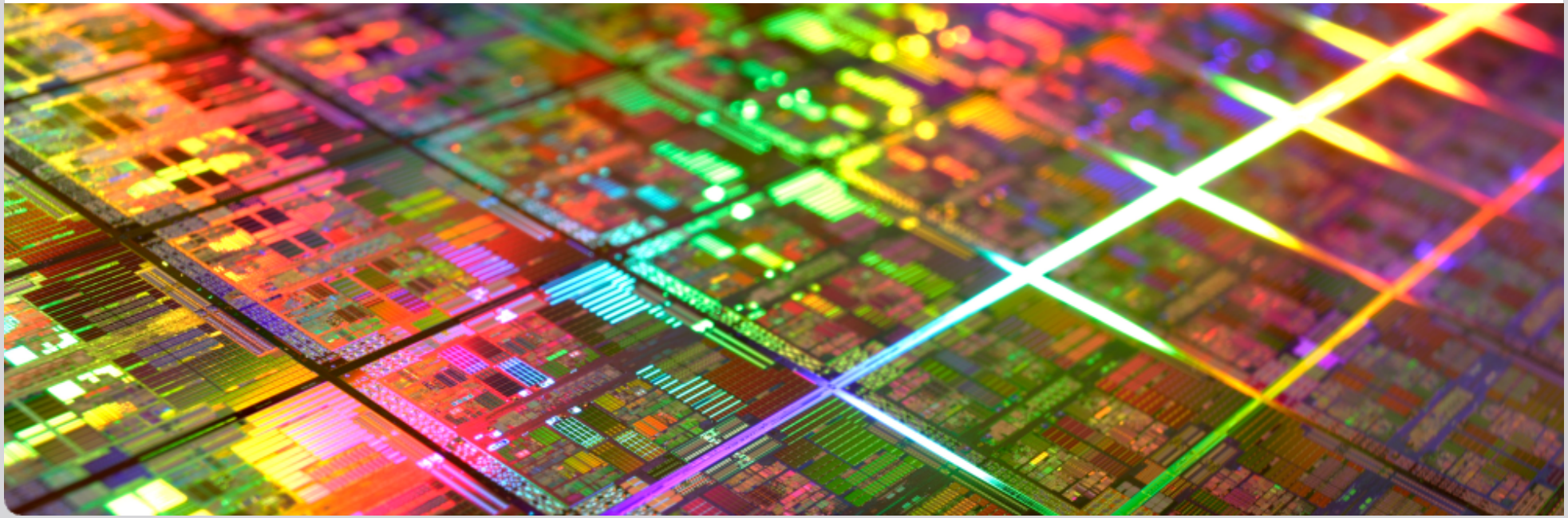
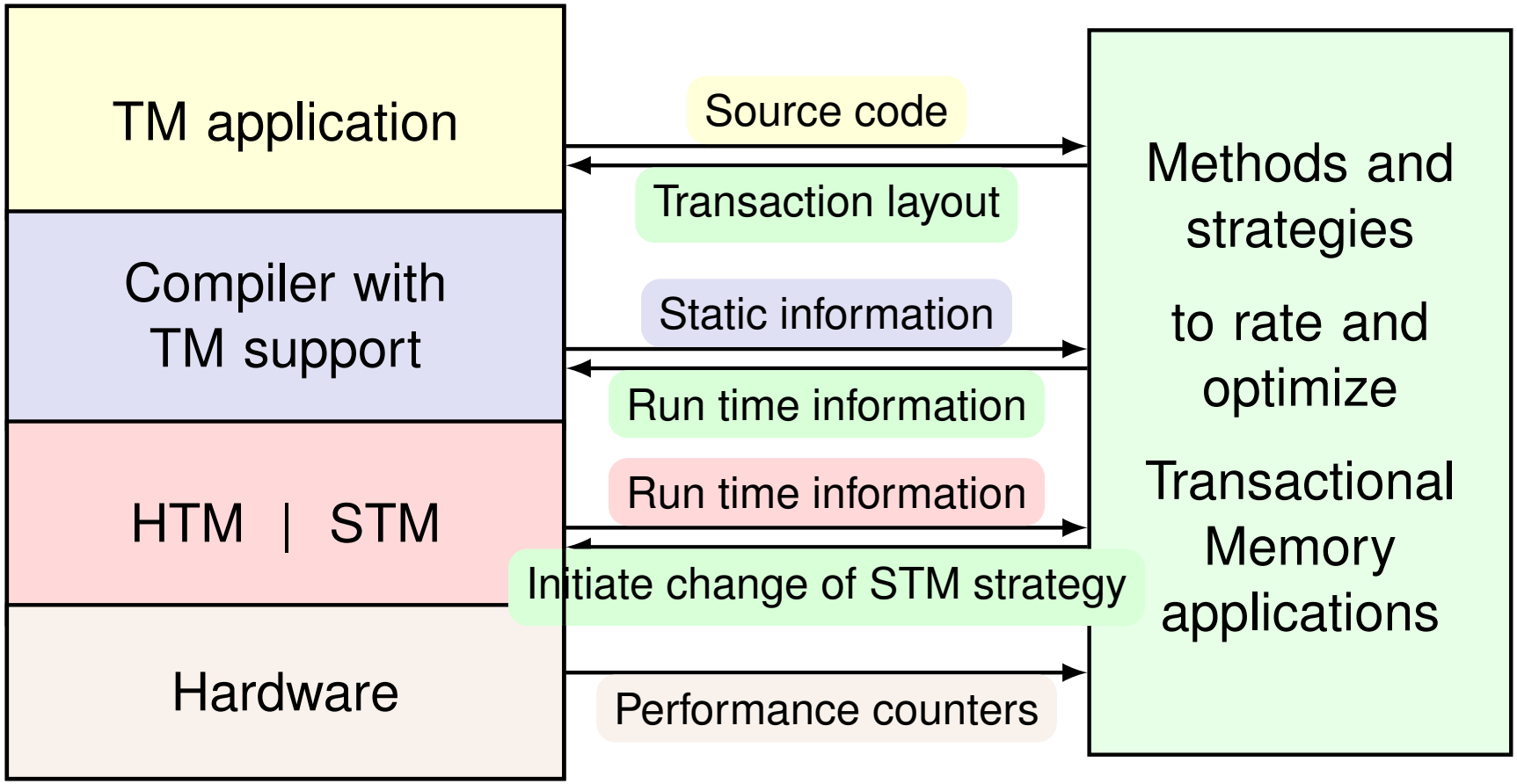


TM-Opt: Overview



TM-Opt

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Goal

- Support and aid the development and optimization of TM applications
- Aggregate and analyse information from all layers of the TM system
- Guide application developer when optimizing

TM-Opt

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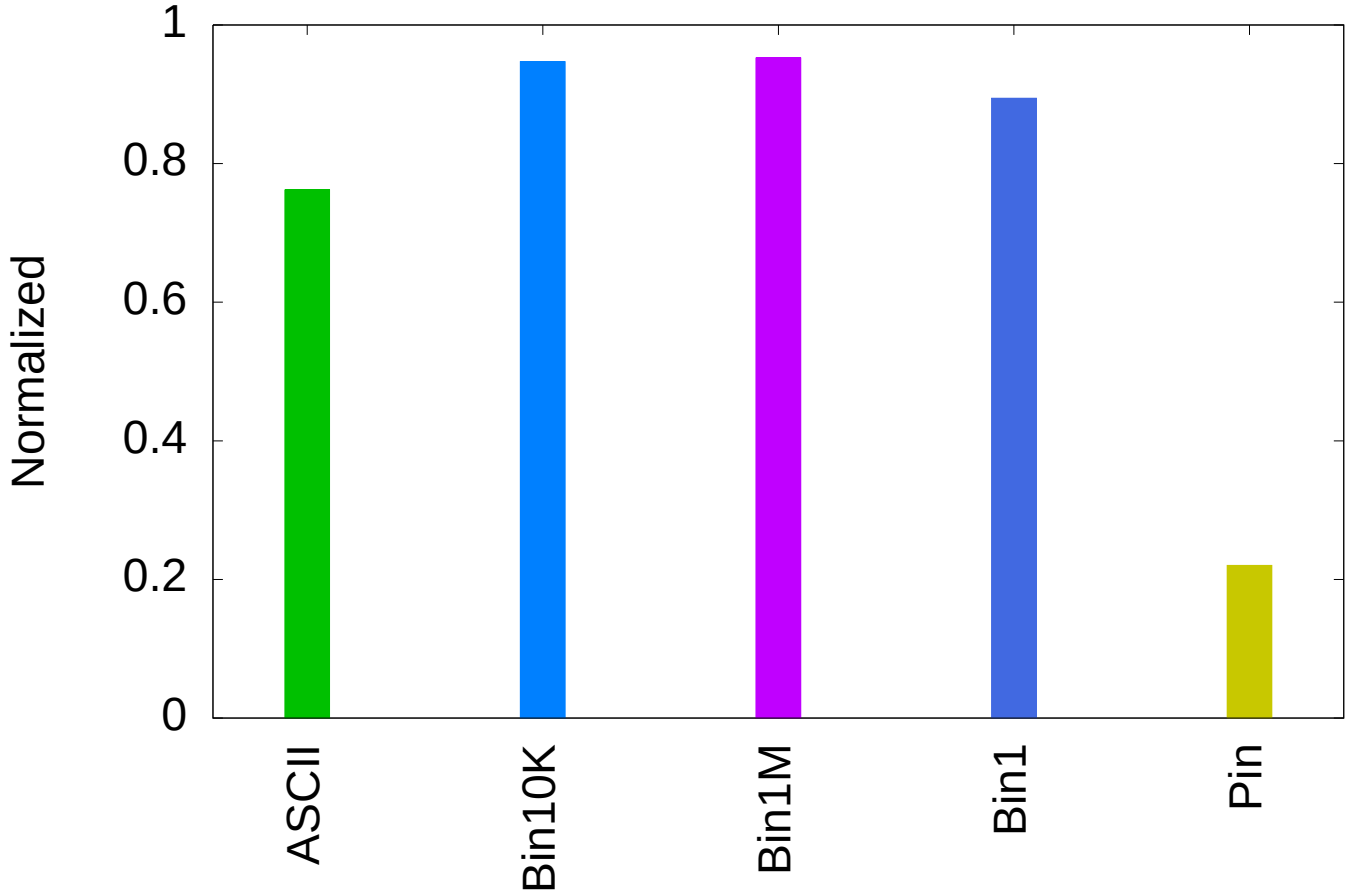
Information retrieval in STM systems

- TracingTinySTM logs STM events (start, commit, abort, load, store) in trace files
- Compresses buffers with zlib or lzo (multi-threaded trace compression!)
- Comparison with Pin:
  - Smaller influence on application behavior
  - Higher throughput (Txn/s)
- Evaluation with STAMP benchmarks
  - Run times of different tracing variants
  - Size of log files

TracingTinySTM – Bank TM application



- Normalized to execution w/o tracing
- Former throughput [Txn/s]

TM-Opt: ARCS 2011 – MAPT

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Exploiting and analyzing static information (LLVM)

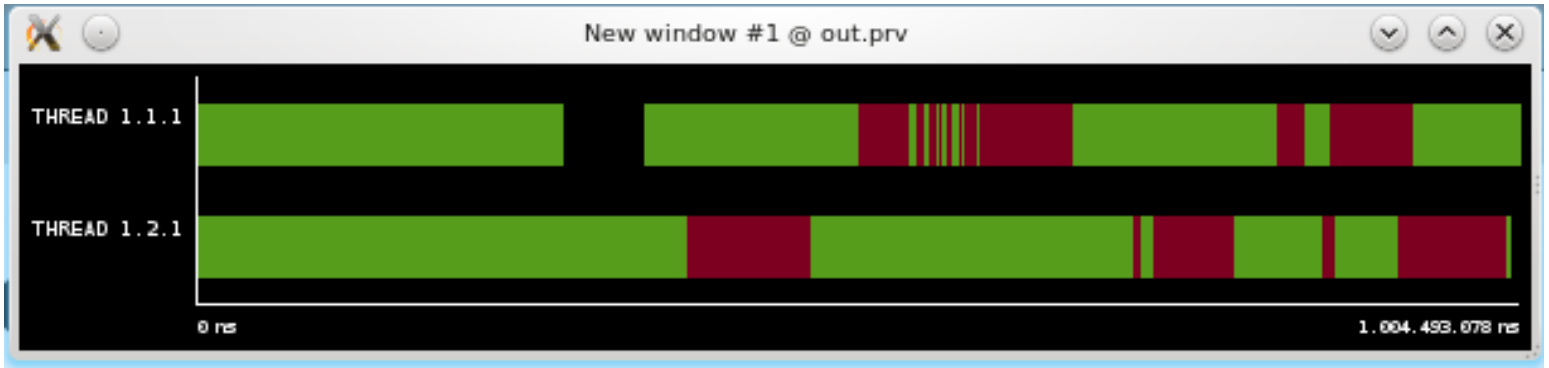
- Analysis of Memory Access Patterns in Transactions: MAPT
- Granularity of conflict detection influences run time
- Conflicts are detected falsely (False Positives)
- Problem is analog to the false sharing in caches

→ Exploit compiler information

- Extract and analyze the memory accesses

→ Compiler proposes the superior conflict detection granularity: between cache line and word-based conflict detection

Visualization of TM applications



Paraver (UPC/BSC)

- Abort/Commit coded as states
- Loads/Stores as events
- Time transformation

Visualization of kmeans (from STAMP)

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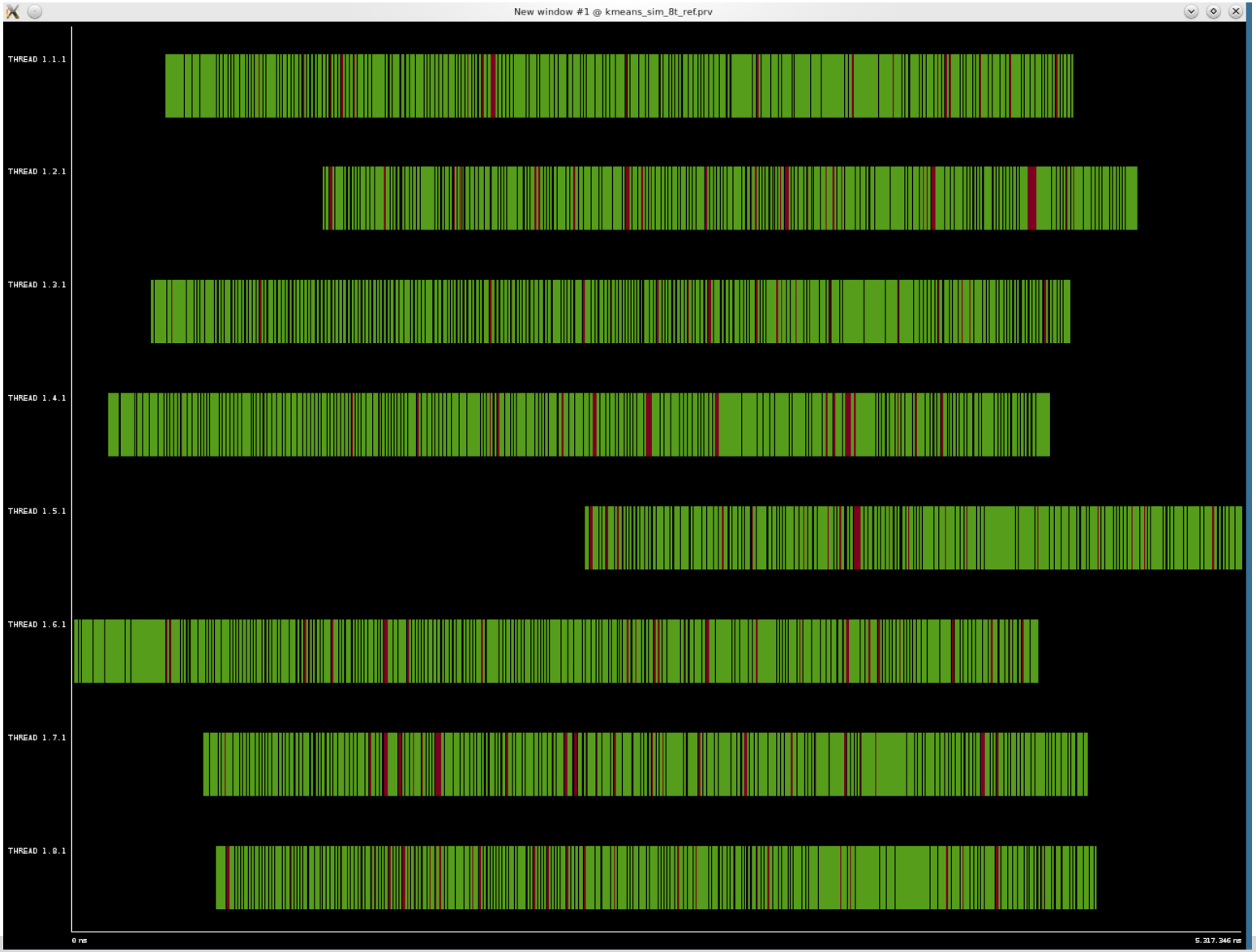

Visualization of TM applications III

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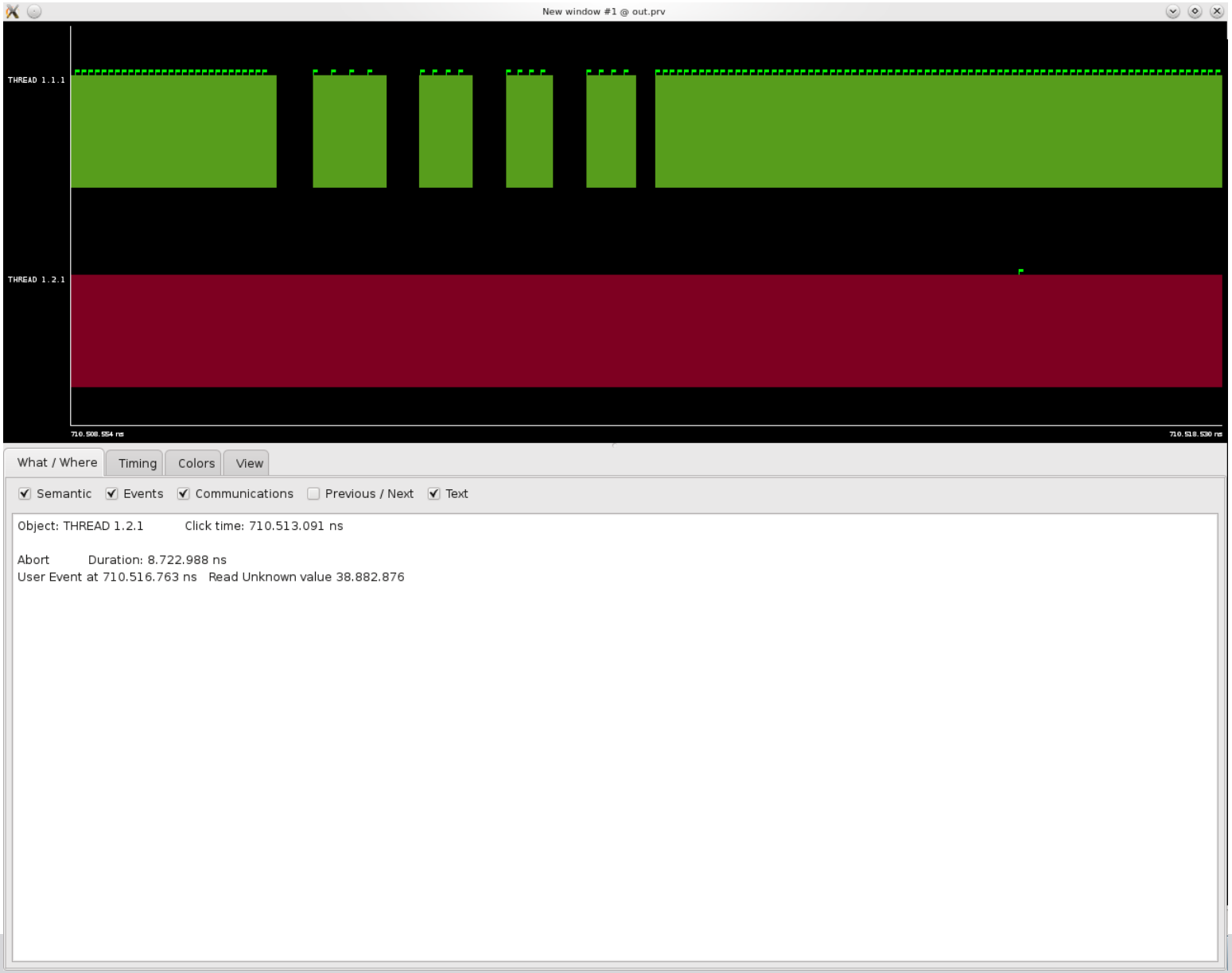

Visualization of TM applications IV

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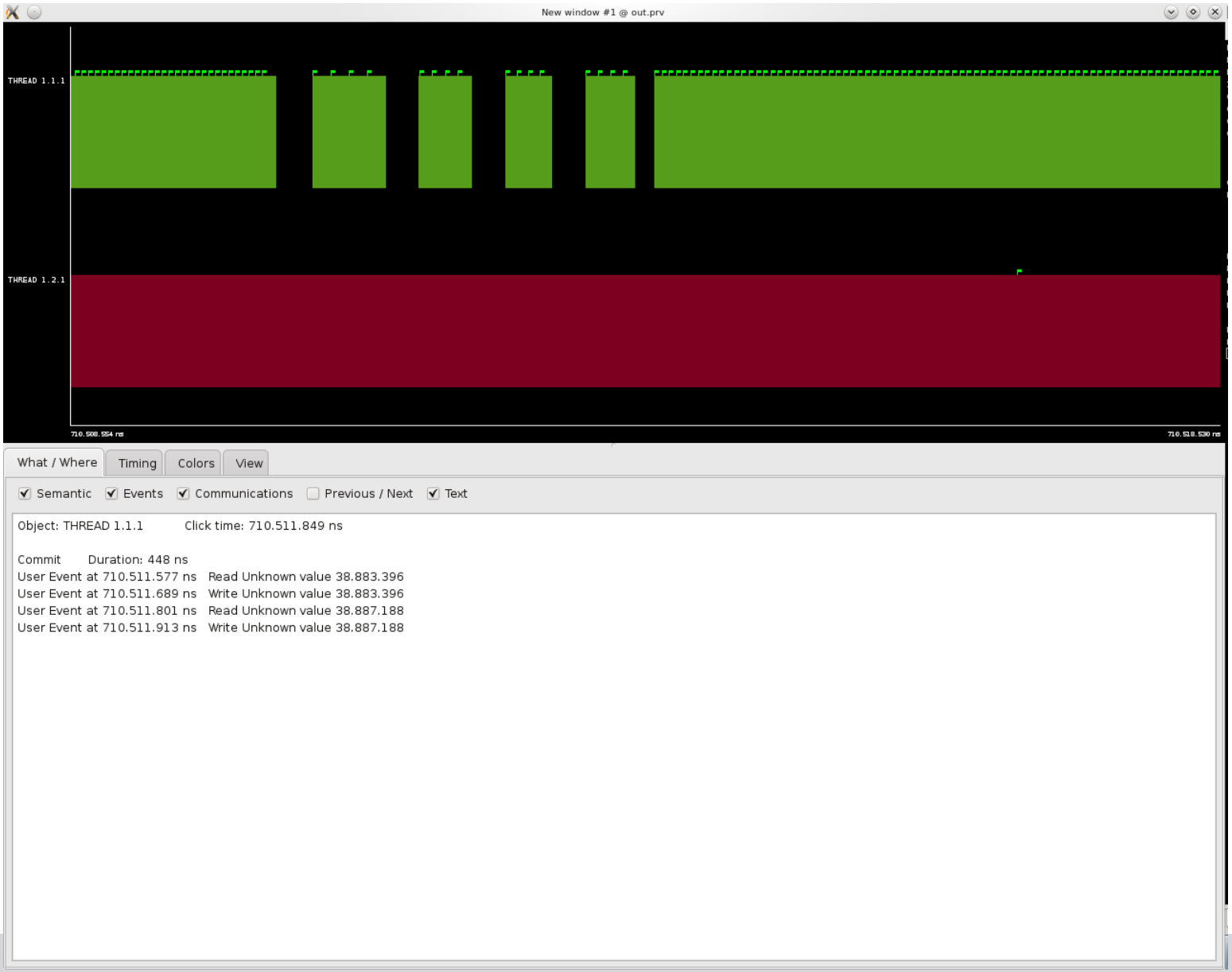
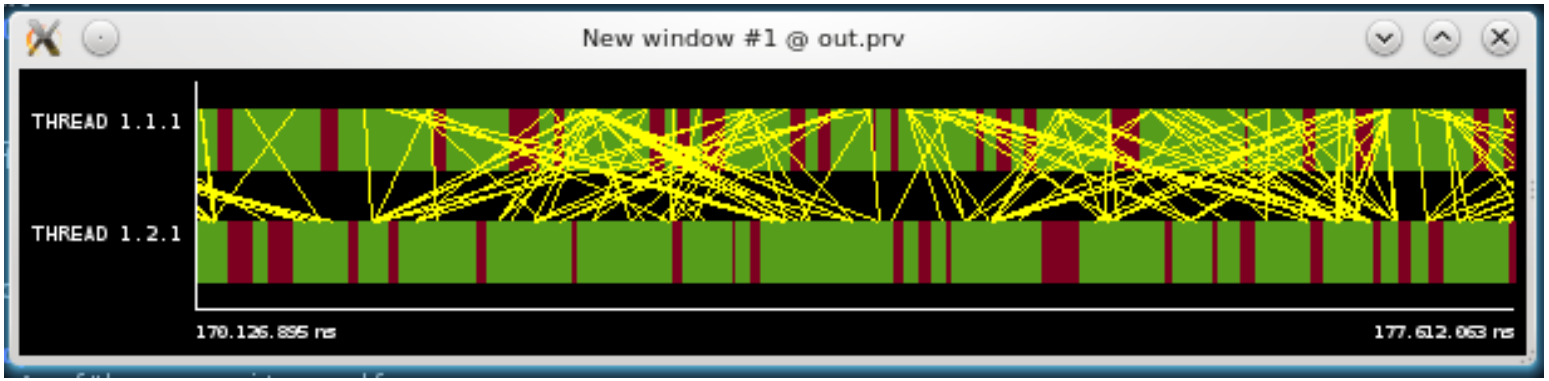


Visualization of TM applications V



Visualize dependencies between Txns

- Analysis identifies dependencies
- Code as separate event (cf. MPI communication)
- Visualize in Paraver (zoomable)

→ Find source of conflicts

Optimization of TM applications

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Optimizing the layout/size of transactions

- Transaction size is critical:
  - Overhead for setup/destroy of transaction must amortize through parallelism (longer runs are better)
  - Long Txns waste a lot of work when rolled back
- Identify transactions with low/high conflict potential
  - Compare complete Read/Write Sets

  → Avoid chasing conflicts one after the other
  - Optimize Txns:
    Fuse Txns with low conflict potential
    Split Txns with high conflict potential
- Determine beneficial size of Txn experimentally
  Goal: Automatically detect cases where optimization is promising