Parallel and Generic Pipe-and-Filter Architectures with TeeTime

ICSA 2017 – Research Tool Paper

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Wilhelm Hasselbring, and
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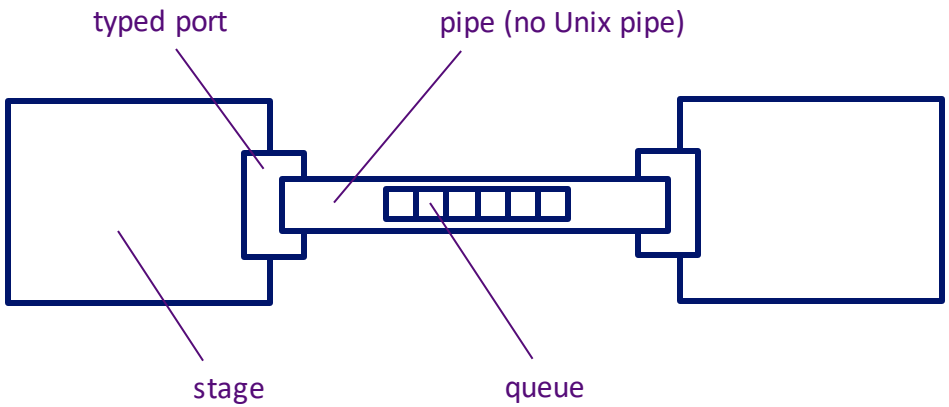
Motivation



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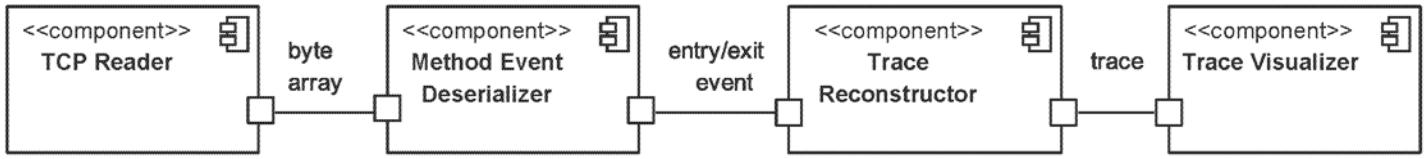
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TCP Reader
byte
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Method Event
Deserializer
entry/exit
event
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Trace
Reconstructor
trace
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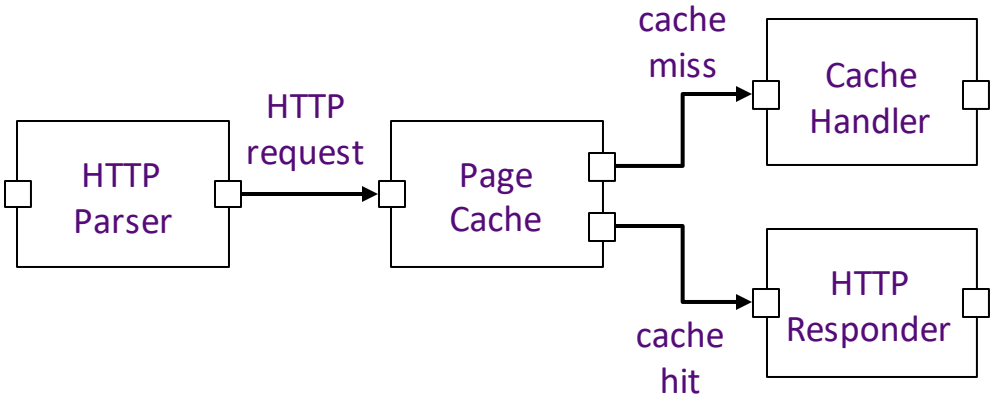
Trace Visualizer

Motivation


HTTP
Parser
HTTP
request
Page
Cache
cache
miss
Cache
Handler
cache
hit
HTTP
Responder

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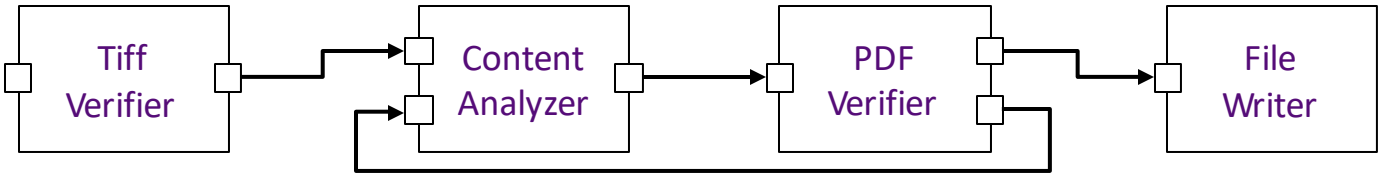

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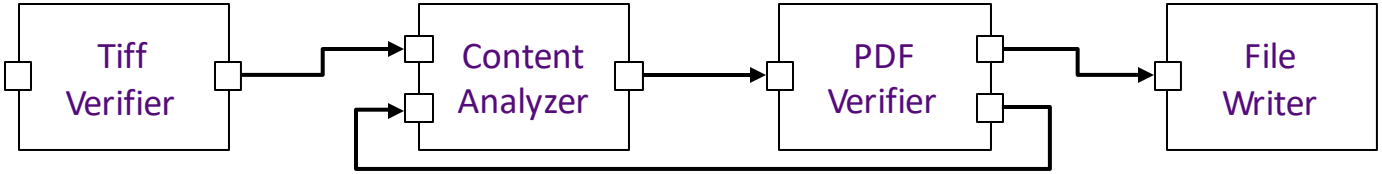

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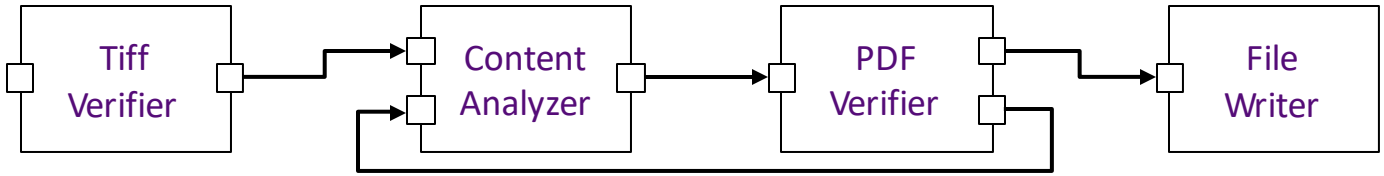

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- Efficient parallel execution for P&F is still WIP

[Gordon2006, Sugerman2009, Suleman2010]

Some Fields of Application

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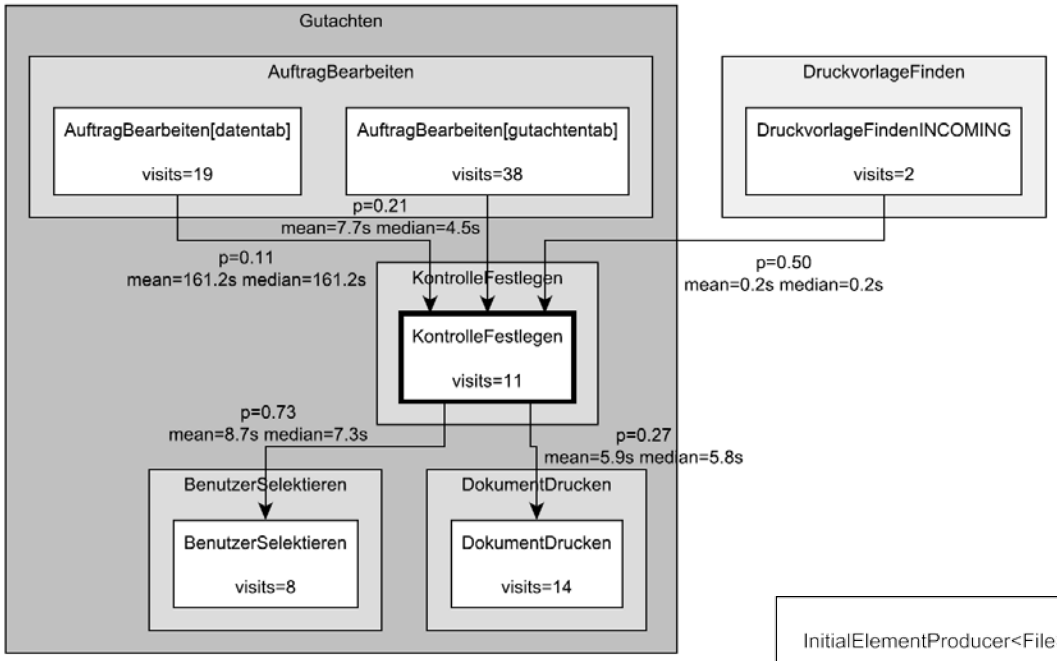

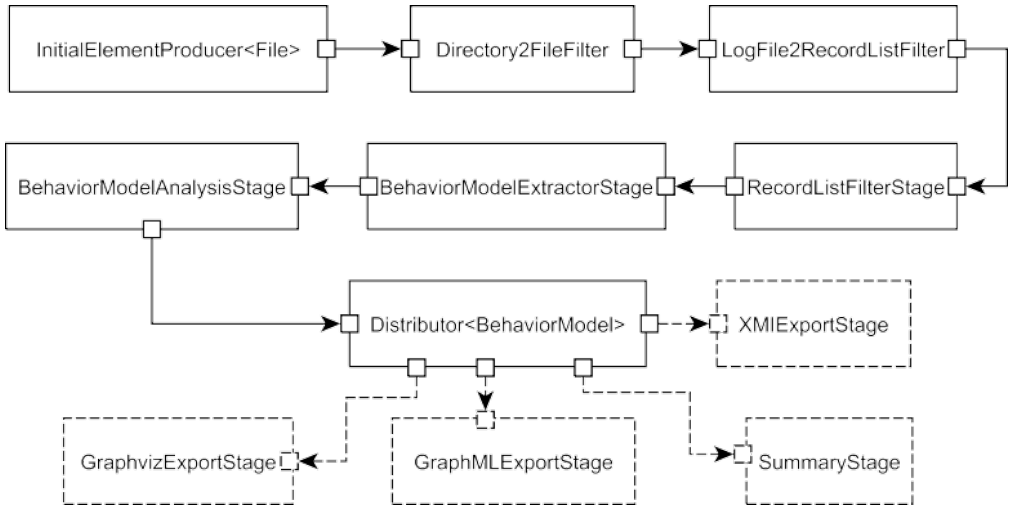

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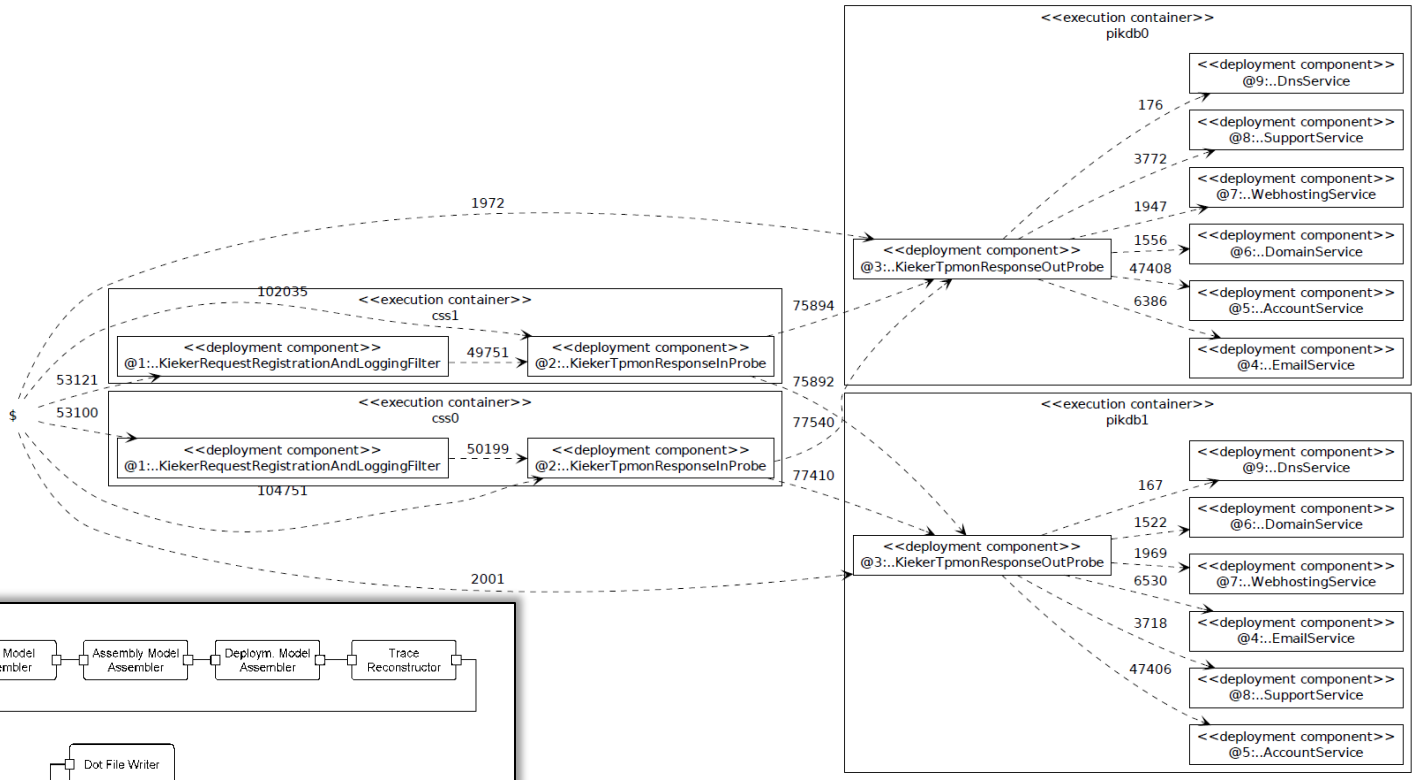
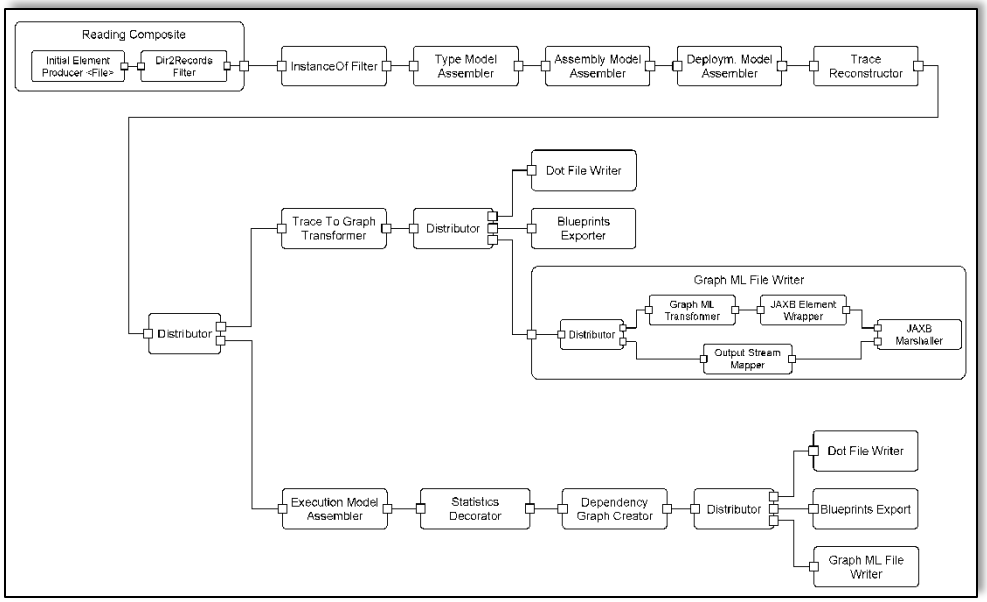




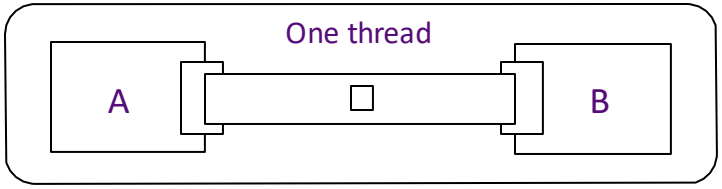
Selected Features

TeeTime

http://teetime-framework.github.io

- More than one input/output port per stage
  => for all P&F manifestations
- High-performance, parallel execution
  => for multi-core systems
- Passive stages
  => for modularization
- Custom pipes and schedulers
  => for experimentations with the P&F style

Framework Architecture



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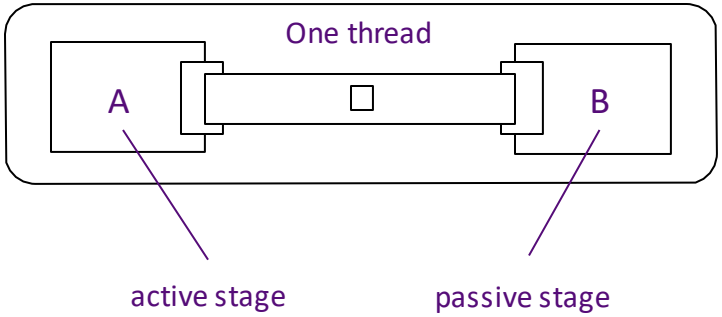

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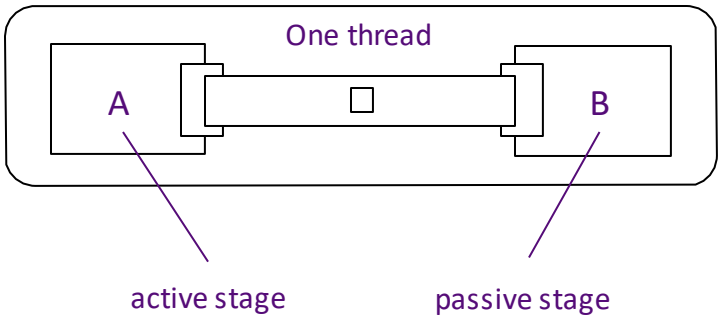

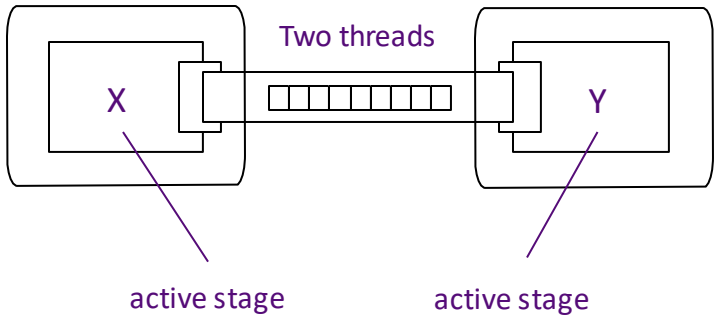

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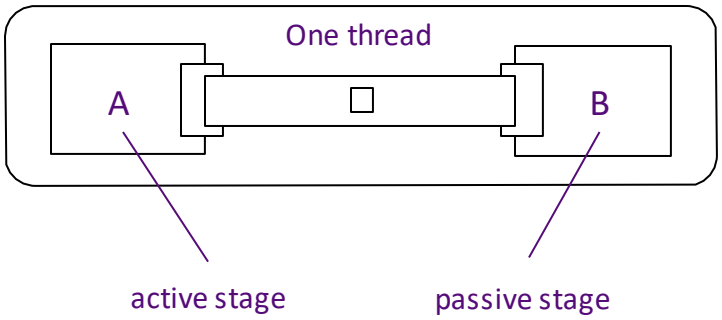

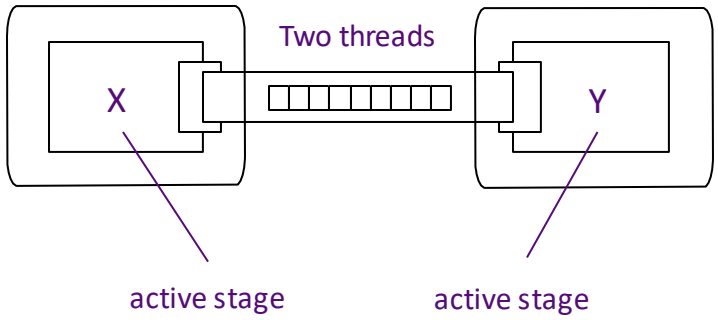

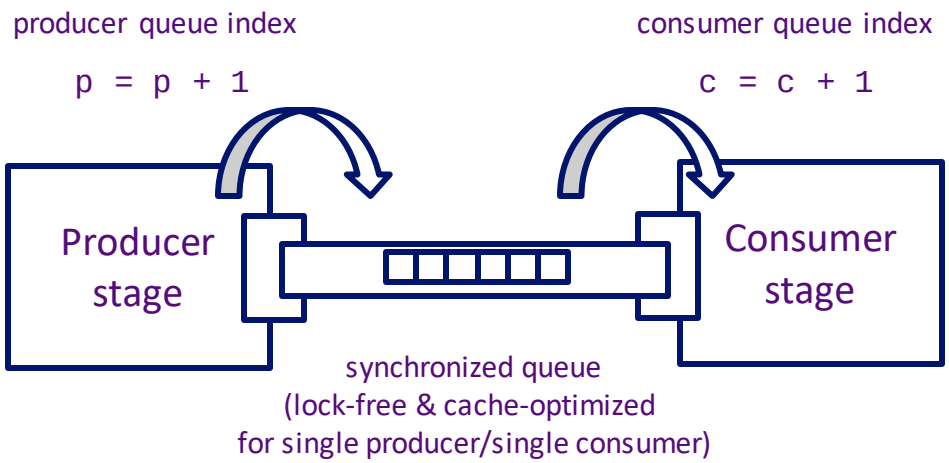

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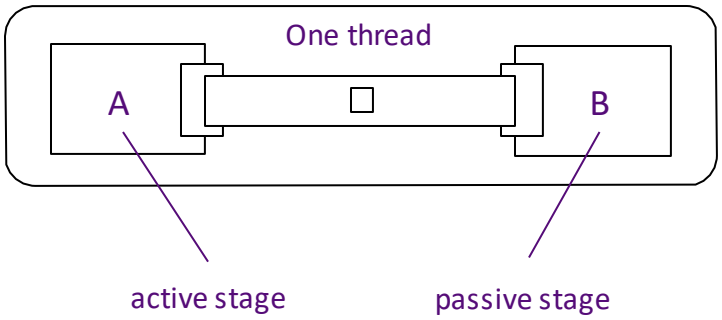

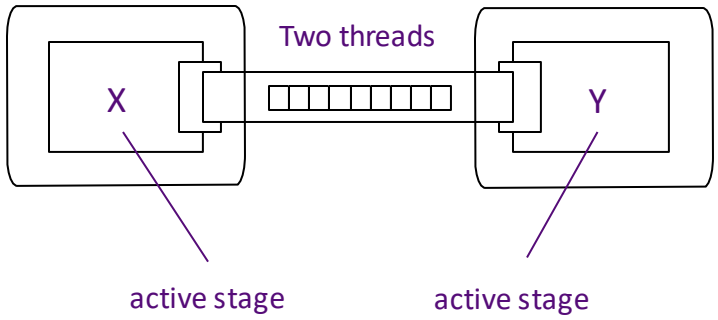

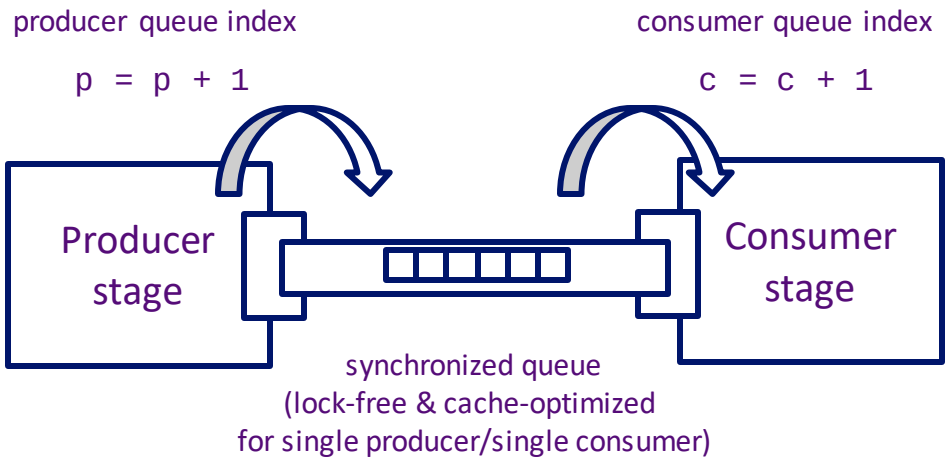

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Sp/Sc queue	6.4 billion b/s

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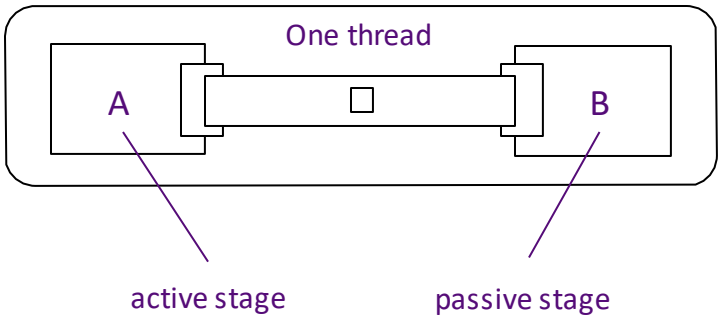

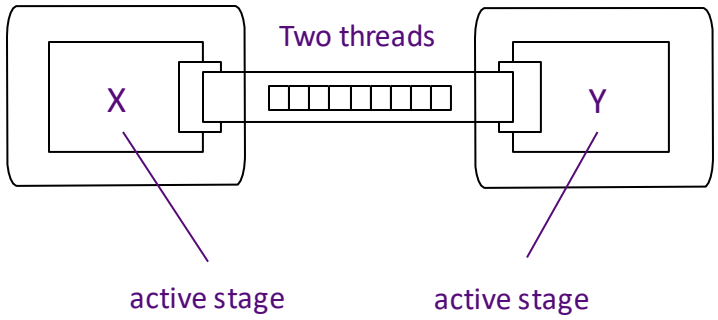

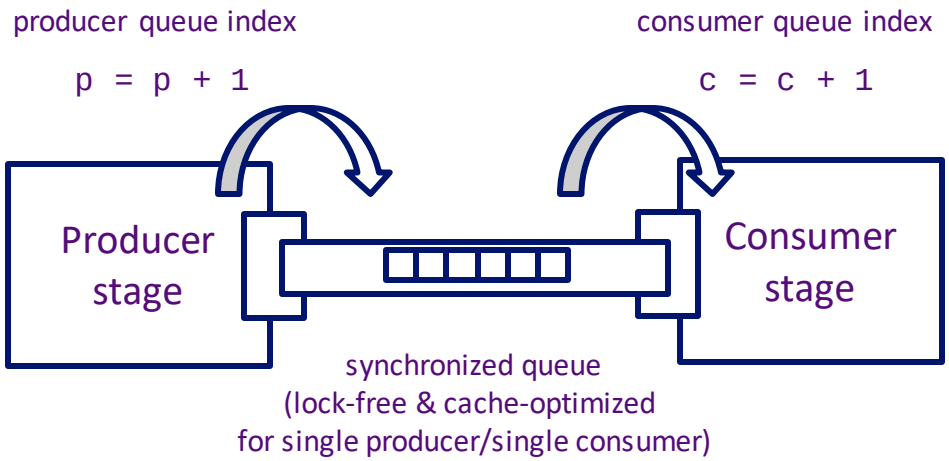

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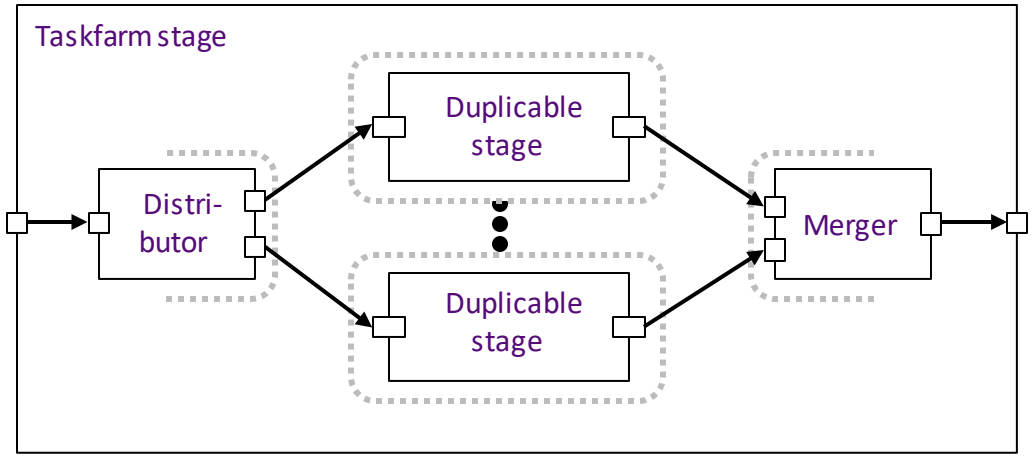
=> much potential for optimization on a single node

Parallel, Composite Stage



Taskfarm Stage [Wulf2016]

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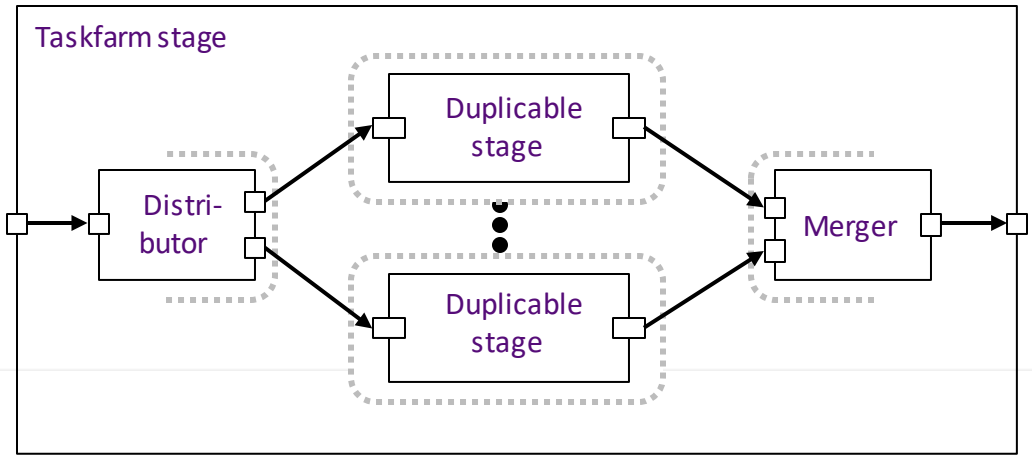

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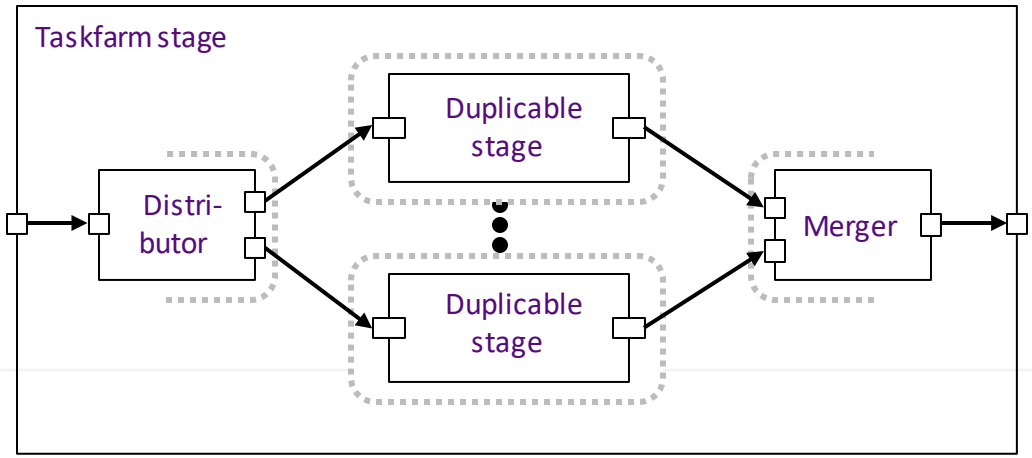

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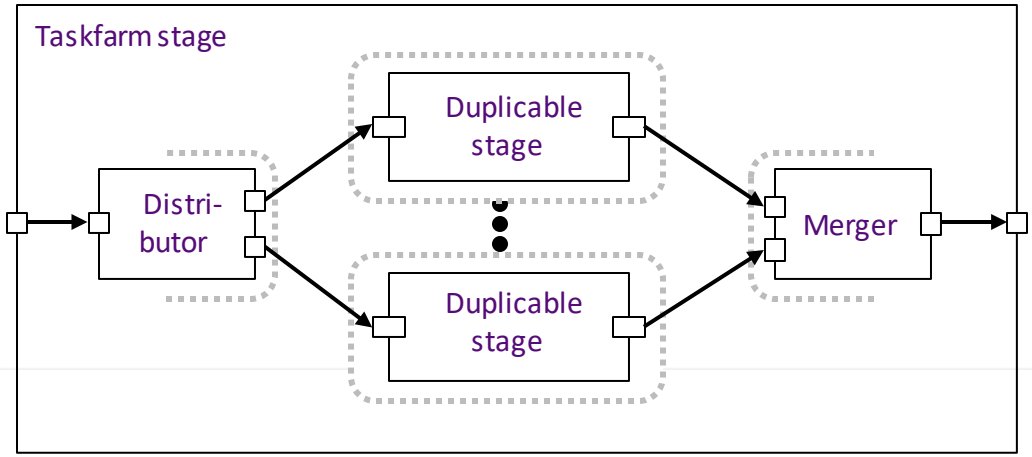

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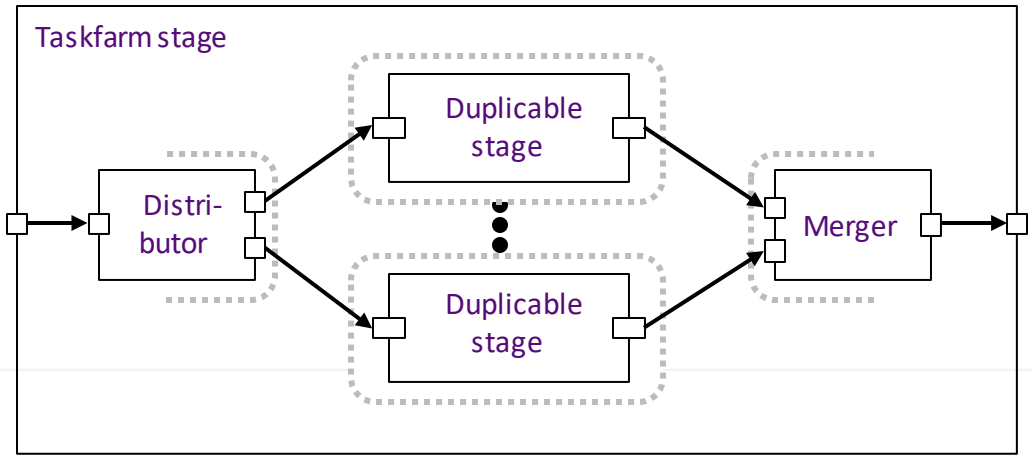

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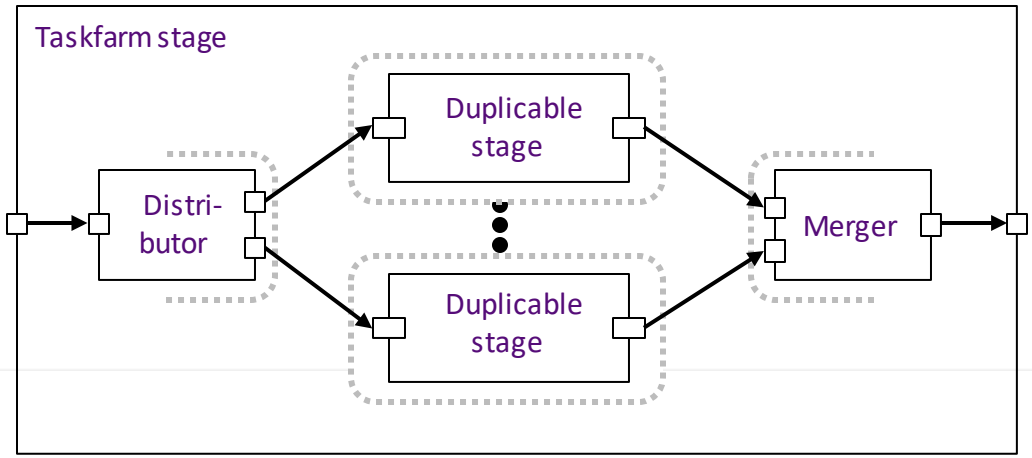

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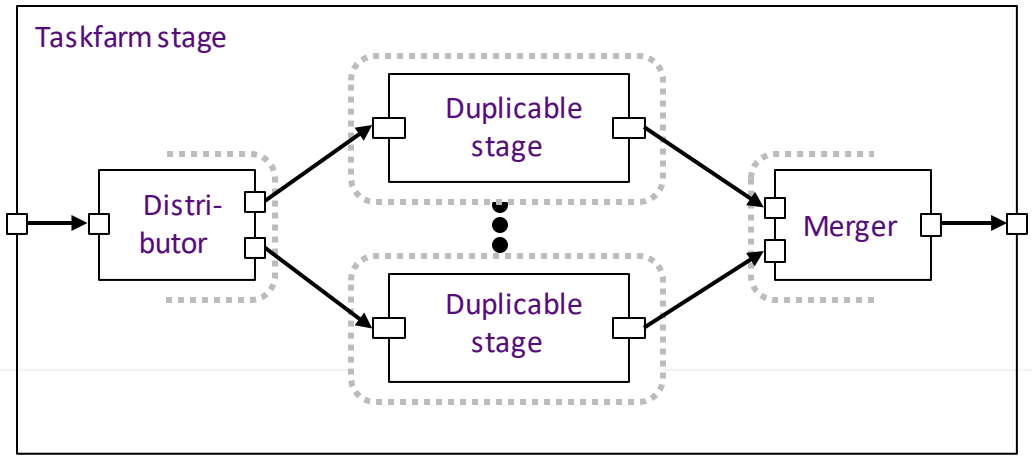

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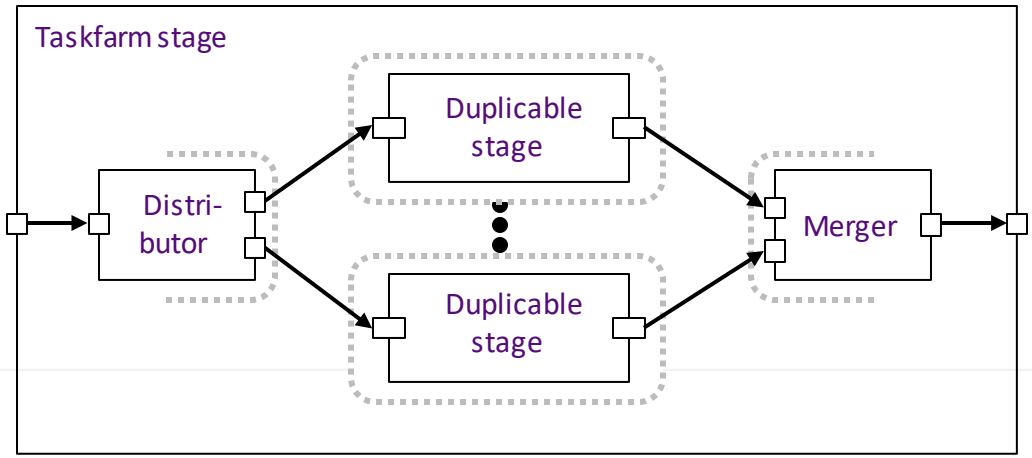

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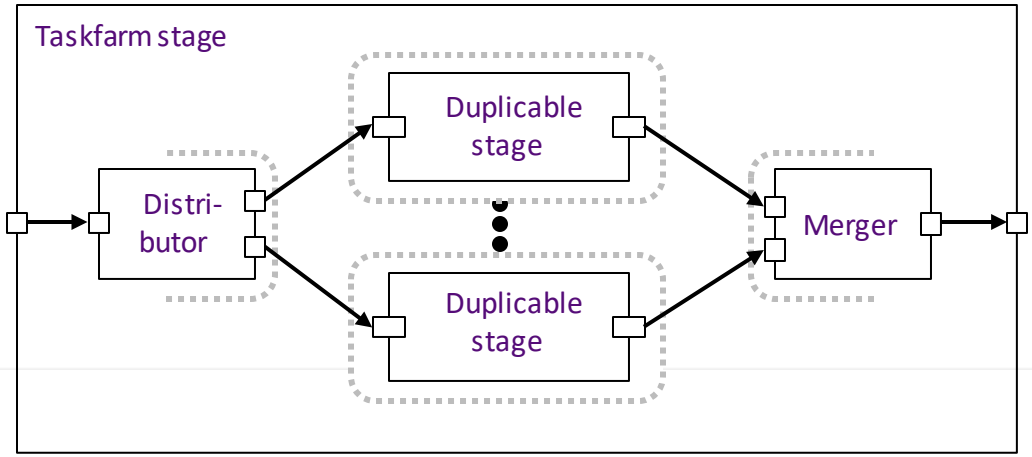

Taskfarm Stage [Wulf2016]

Conclusion

- Supports all P&F manifestations
- Tuned for a parallel execution on multi-core systems
- Type safe connection at compile time
- Open for modifications & experimentations

Java [TeeTimeJava]

TeeTime ≡

C++ [TeeTimeC++]

http://teetime-framework.github.io

- Fault-tolerant distributed execution with Akka
- Live visualization for performance diagnoses
- Comparison with other frameworks

Selected References

[AkkaWebsite]

[Aldinucci2014]

[Gordon2006]

[Sugerman2009]

[Suleman2010]

[TeeTimeC++]

[TeeTimeJava]

[Wulf2016]

Example P&F Configuration


```
14 public class LogReaderConfig extends Configuration {
15
16     final CollectorSink<Record> sink;
17
18     public LogReaderConfig(final List<Path> dirs) {
19         InitialElementProducer<Path> producer = new InitialElementProducer<>(dirs);
20         KiekerLogDirSwitch kiekerLogDirSwitch = new KiekerLogDirSwitch();
21         AsciiLogDirReader asciiDirReader = new AsciiLogDirReader();
22         BinaryLogDirReader binaryDirReader = new BinaryLogDirReader();
23         Merger<Record> merger = new Merger<>();
24         this.sink = new CollectorSink<>();
25
26         connectPorts(producer.getOutputPort(), kiekerLogDirSwitch.getInputPort());
27         connectPorts(kiekerLogDirSwitch.getAsciiPort(), asciiDirReader.getInputPort());
28         connectPorts(kiekerLogDirSwitch.getBinaryPort(), binaryDirReader.getInputPort());
29         connectPorts(asciiDirReader.getOutputPort(), merger.getNewInputPort());
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14 public class LogReaderConfig extends Configuration {
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45         Execution<LogReaderConfig> execution = new Execution<>(config);
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Example P&F Stage


```
53 class KiekerLogDirSwitch extends AbstractStage {
54     InputPort<Path> inputPort = super.createInputPort();
55     OutputPort<Path> asciiPort = super.createOutputPort();
56     OutputPort<Path> binPort = super.createOutputPort();
57     OutputPort<Path> elsePort = super.createOutputPort();
58
59     @Override
60     protected void execute() {
61         Path path = inputPort.receive();
62         if (path == null) {
63             return;
64         }
65         if (path.endsWith("ascii")) {
66             asciiPort.send(path);
67         } else if (path.endsWith("binary")) {
68             binPort.send(path);
69         } else {
70             elsePort.send(path);
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72     }
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74     public InputPort<Path> getInputPort() {
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