

# Wir nehmen Ihre Software auf den Kieker

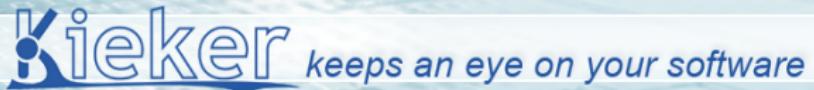
— Winterfest der Technischen Fakultät und Tag der Informatik 2012 —

André van Hoorn

Kiel University (CAU)  
Software Engineering Group

December 6, 2012 @ Kiel





## — Winterfest der Technischen Fakultät und Tag der Informatik 2012 —

André van Hoorn

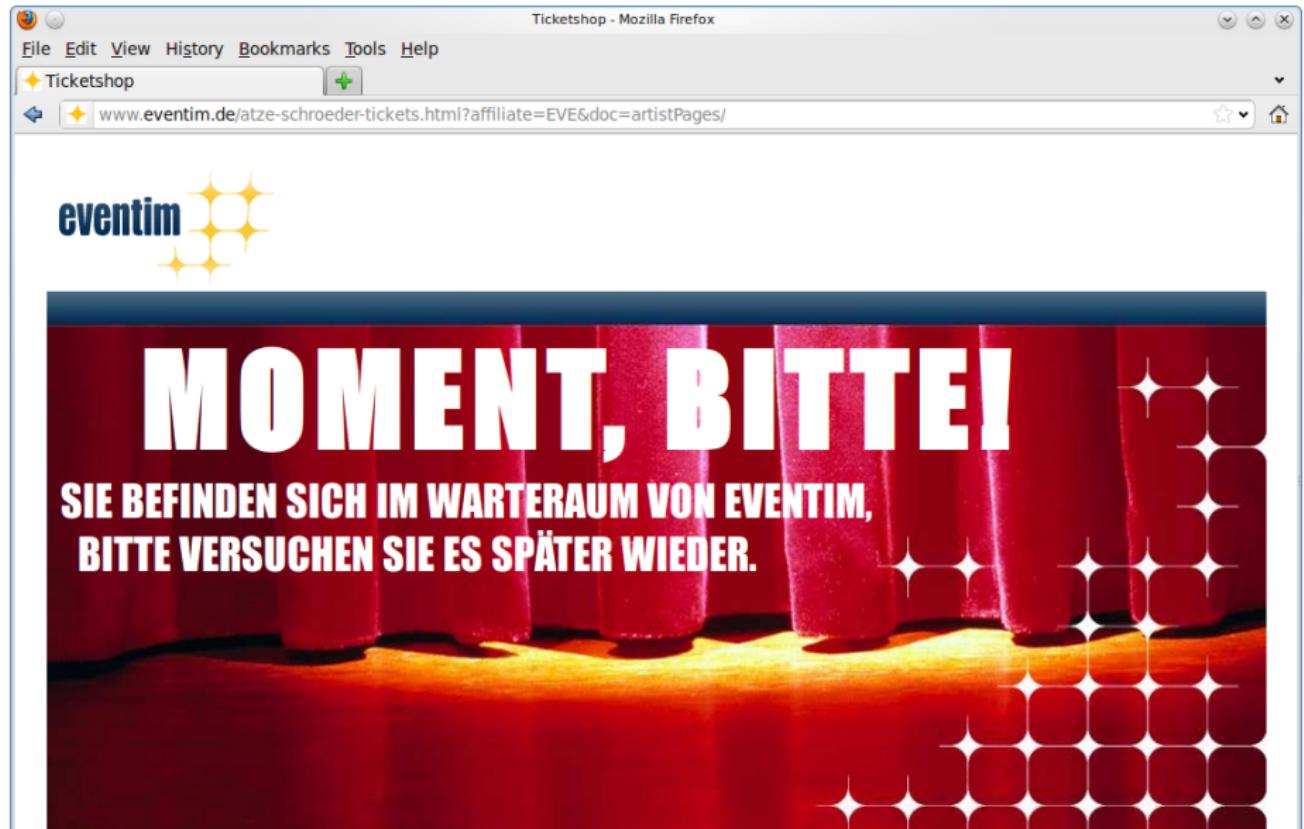
Kiel University (CAU)  
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Christian-Albrechts-Universität zu Kiel





simyo - der günstige Tarif für Mobiltelefonieren, SMS schreiben und im Internet surfen! - Mozilla Firefox

Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe

www.simyo.de

simyo - der günstige Tarif für Mobilt...

**simyo**  
Weil einfach einfach einfach ist.

## Wartungsarbeiten!

Lieber Besucher,  
wir sind stets bestrebt, unsere Internetseite für Sie zu optimieren.  
Und da wir gerade ein Update einspielen, fällt diese vorübergehend aus.  
Am 01.03.2012 um vorraussichtlich 10:00 Uhr ist die Seite wieder für Sie  
erreichbar.

Selbstverständlich lassen wir Sie auch in der Zwischenzeit nicht alleine.

**Unser Service-Team ist persönlich für Sie da:**  
an Werktagen (Mo–Fr) zwischen 08:00 und 21:00 Uhr und  
an allen anderen Tagen zwischen 10:00 und 18:00 Uhr.

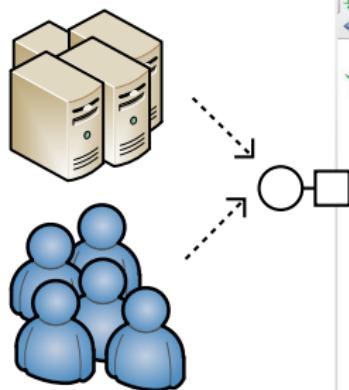
Bestellen: 0180 / 3 45 50 50<sup>1</sup>  
Informieren: 0180 / 5 45 44 55<sup>2</sup>  
Für Kunden: 1145<sup>3</sup> (Schnellwahl mit dem simyo Handy)

Oder wenden Sie sich schriftlich an uns:  
Per Fax: 0180 / 5 45 44 56<sup>2</sup>



# Monitoring/Dynamic Analysis

## Motivation



Screenshot of the Thalia.de website homepage. The page features a banner for "Schulbücher und Lernhilfen" (Schoolbooks and Learning Aids) with a photo of a young boy holding books. Below the banner, there are sections for "Top-Empfehlungen" (Top Recommendations) featuring five book covers, and a "Buchhändlertipp" (Bookstore Tip) featuring a photo of a woman and a book cover for "WEBER'S GRILLBIBEL". The navigation bar includes links for Bücher, eBooks, OYO, Hörbücher, Filme, Musik, Spielwaren, Games, and Software. The search bar has the URL "www.thalia.de/shop/tha\_hjemmestartsseide/show/".

Book Title	Author	Price
Der Knochenbrecher	Chris Carter	€ 9,99
Andreas FRANZ Todesmelodie	Daniel Holte	€ 9,99
House of Night 09... BESTIMMT	P.C. Cast	€ 16,99
Das Lied von Eis...	George R.R. Martin	€ 16,00
The Tribute of Panem	Suzanne Collins	€ 18,95

# Monitoring/Dynamic Analysis

## Motivation



Does the **searchBook** service respond  
in  $\leq 0.5$  seconds in 95% of all cases?

### Top-Empfehlungen

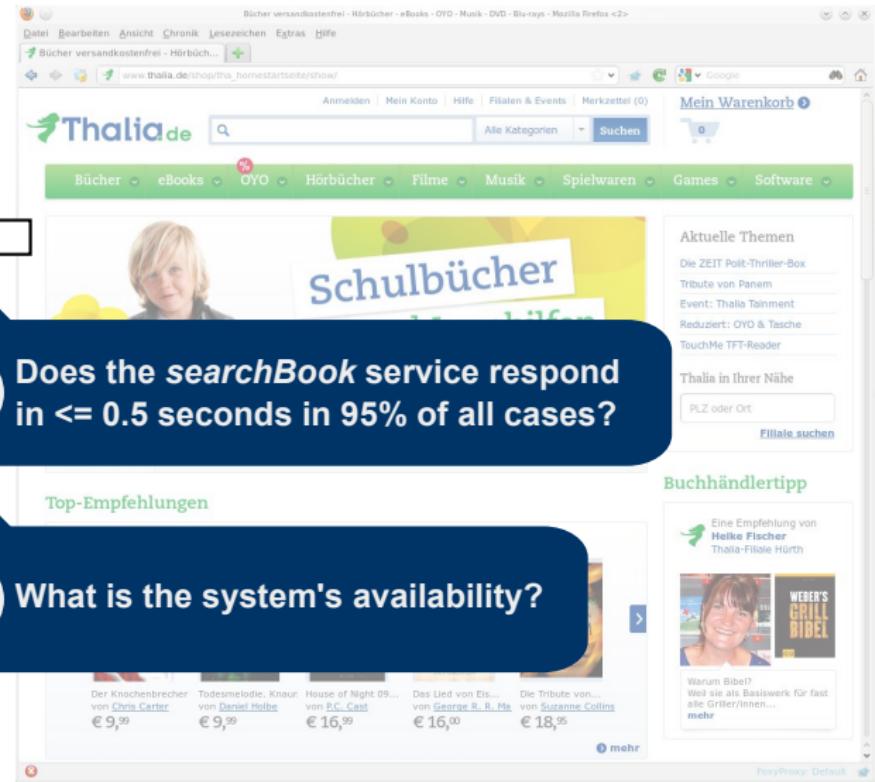


### Buchhändlertipp

A small image of a woman, Helike Fischer, is shown next to a book cover for "WEBER'S GRILLBIBEL". A text box below says: "Warum Bibel? Weil sie als Basiswerk für fast alle Grillier/Innen... mehr"

# Monitoring/Dynamic Analysis

## Motivation



Bücher versandkostenfrei - Hörbücher - eBooks - OYO - Musik - DVD - Blu-rays - Mozilla Firefox <2>

Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe

Bücher versandkostenfrei - Hörbücher...

www.thalia.de/shop/tha\_homesite/show/

Anmelden | Mein Konto | Hilfe | Filialen & Events | Merkzettel (0)

Alle Kategorien Suchen

Mein Warenkorb 0

Thalia.de

Bücher eBooks OYO Hörbücher Filme Musik Spiele Games Software

Schulbücher

Aktuelle Themen

- Die ZEIT Polit-Thriller-Box
- Tribute von Panem
- Event: Thalia Tainment
- Reduziert: OYO & Tasche
- TouchMe TFT-Reader

Thalia in Ihrer Nähe

PLZ oder Ort  Filiale suchen

Top-Empfehlungen

Der Knochenbrecher von Chris Carter € 9,99

Todesmelodie, Knaur von Daniel Holte € 9,99

House of Night von P.C. Cast € 16,99

Das Lied von Eis... von George R.R. Martin € 16,00

Die Tribute von... von Suzanne Collins € 18,95

mehr

FoxyProxy Default

Does the **searchBook** service respond in  $\leq 0.5$  seconds in 95% of all cases?

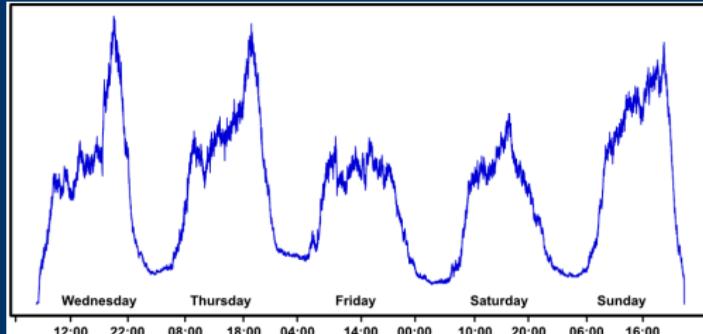
What is the system's availability?

# Monitoring/Dynamic Analysis

## Motivation

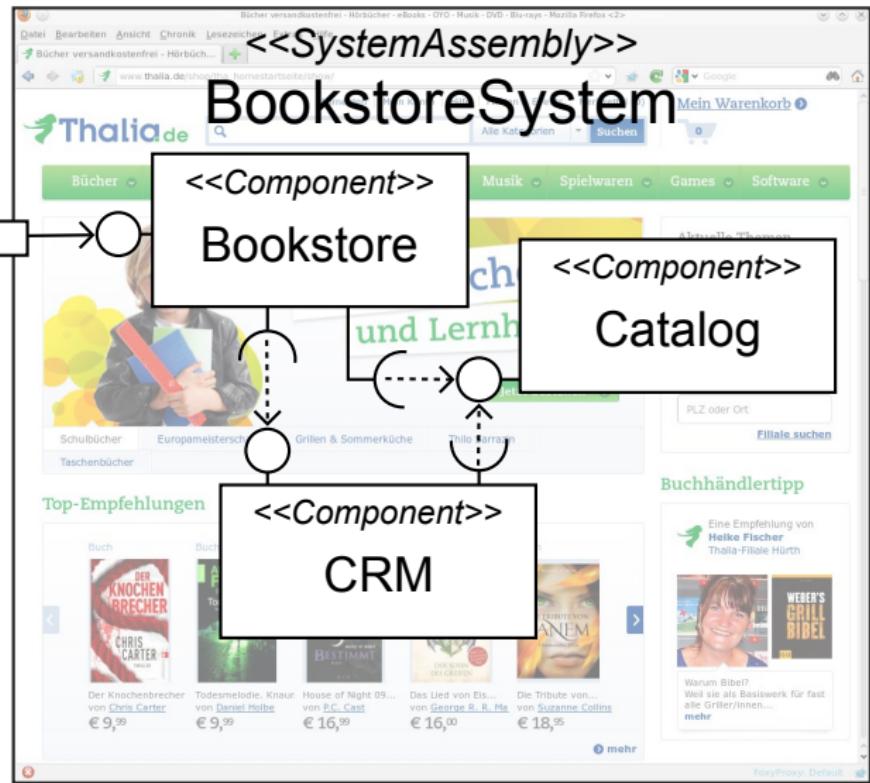
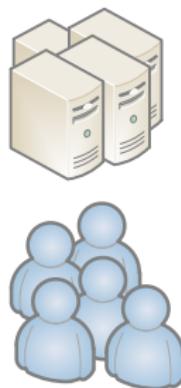


What is the expected workload profile?



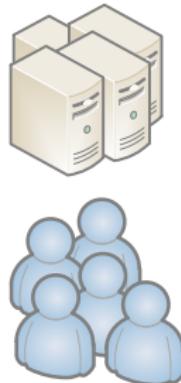
# Monitoring/Dynamic Analysis

## Motivation



# Monitoring/Dynamic Analysis

## Motivation



**<<SystemAssembly>>**

# BookstoreSystem

**<<Component>>** Bookstore

**<<Component>>** Catalog

**<<Component>>**

How do the components interact?

The diagram illustrates the BookstoreSystem architecture. It features three main components: Bookstore, Catalog, and another unlabeled component at the bottom. The Bookstore component contains a picture of a person holding books and links to categories like Schubbücher, Europameisterschaft, Grillen & Sommerküche, and Thilo Storz. The Catalog component also has a link to the Grillen & Sommerküche section. The bottom component is associated with Top-Empfehlungen. A dashed arrow points from the Bookstore component to the Catalog component. A solid arrow points from the Catalog component to the bottom component. A question mark icon is present in a blue box.

Der Knochenbrecher von Chris Carter € 9,99

Todesmelodie, Knaur von Daniel Holte € 9,99

House of Night 09... von P.C. Cast € 16,99

Das Lied von Eis... von George R. R. Martin € 16,00

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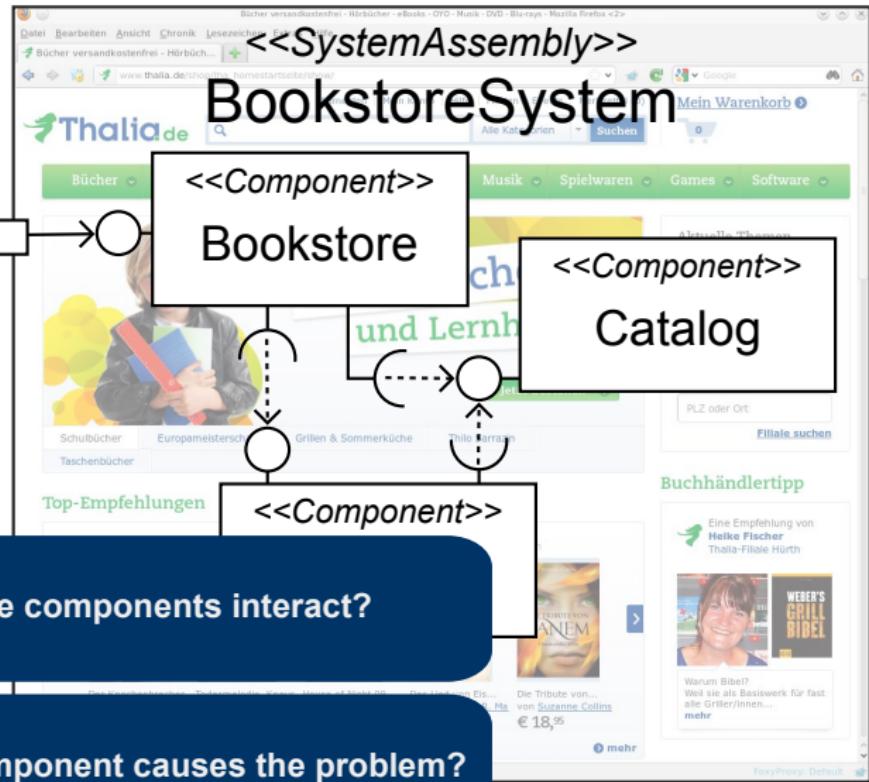
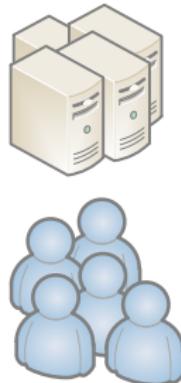
... mehr

Ein Empfehlung von Helike Fischer Thalia-Filiale Hürth

Warum Bibel? Weil sie als Basiswerk für fast alle Grillier/Innen... mehr

# Monitoring/Dynamic Analysis

## Motivation

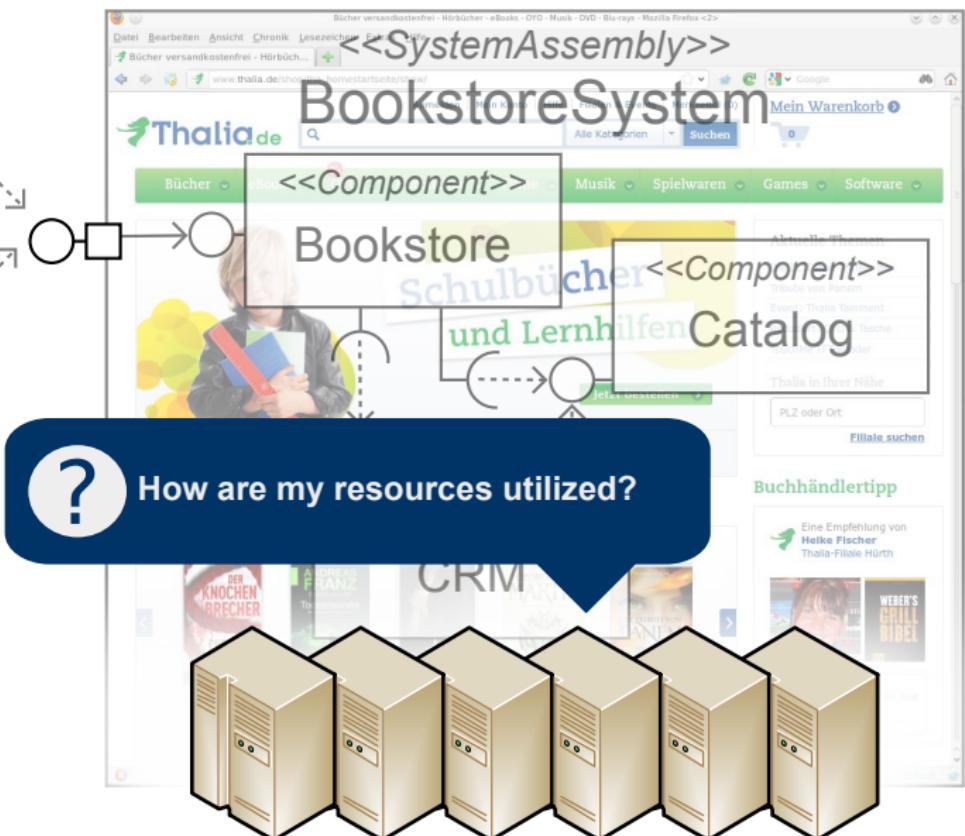
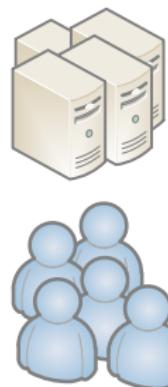


The screenshot shows a web browser displaying a bookstore website for "Thalia.de". The page includes navigation menus for Bücher, Musik, Spielwaren, Games, Software, and a search bar. A main banner features a person holding books. Below the banner, there are categories like Schubbücher, Europameisterschaft, Taschenbücher, Grillen & Sommerküche, and Thilo Storz. A sidebar on the right lists a "Buchhändlertipp" for Helike Fischer's book "Die Tribute von Panem". Overlaid on the website are three UML components:

- Bookstore**: A central component connected to the website's main content area.
- Catalog**: A component connected to the "Catalog" section of the website.
- ?** How do the components interact?: A question mark icon with a callout pointing to the interaction between the Bookstore and Catalog components.
- ?** Which component causes the problem?: A question mark icon with a callout pointing to the Bookstore component.

# Monitoring/Dynamic Analysis

## Motivation



## 1 Motivation

## 2 Kieker

- Framework Overview
- Selected Topics and Results
- Review of Kieker's History

## 3 Conclusion

# APM/Dynamic Analysis with Kieker



The screenshot shows the Eclipse IDE interface. On the left, the Java editor displays a file named Catalog.java with the following code:

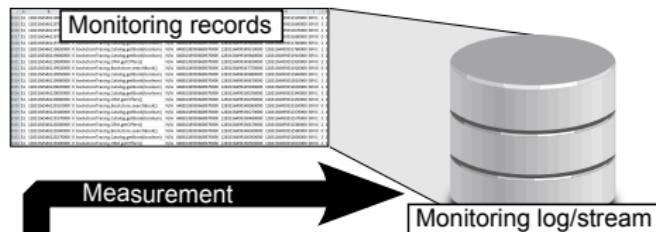
```
26:     @OperationExecutionMonitoring@probe
27:     public void catalog() {
28:         try {
29:             Thread.sleep(2000);
30:         } catch (InterruptedException ex) {
31:             ...
32:         }
33:     }
34: }
```

A red box highlights the annotation '@OperationExecutionMonitoring@probe' on line 26. On the right, the aspectJ editor shows a probe definition:

```
Node name kieker.monitoring.probe.aspectj.operation.
 ① concrete-aspe
 ② name kieker.monitoring.probe.aspectj.operation.
 ③ extends kieker.monitoring.probe.aspectj.operation.
 ④ pointcut
    ⑤ name monitoredOperation
    ⑥ express execution(int com.ibatis.jdbcstore.service.
```

Software system with monitoring instrumentation

# APM/Dynamic Analysis with Kieker



java - cd ch05-trace-monitoring-aspects/src/bookstoreTracing/Catalog.java - Eclipse

```
File Edit Source Refactor Navigate Project Run GT Window Help
Catalog.java
26
27 @OperationExecutionMonitoringProbe
28 public void getBooksFromBookstore() throws SQLException {
29     try {
30         Thread.sleep(2);
31     } catch (InterruptedException ex) {}
32 }
33 }
```

aquteclipse

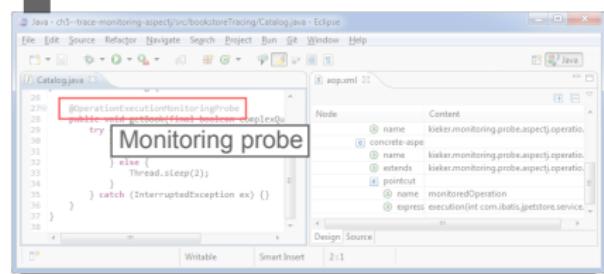
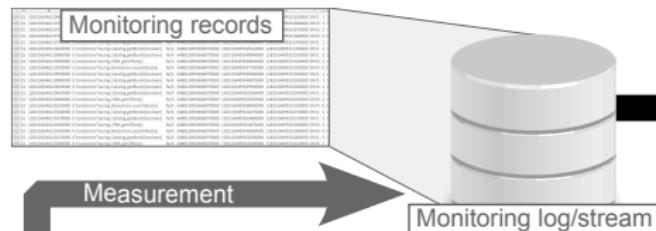
Node Content

- name kieker.monitoring.probe.aspectj.operation
- concrete-aspect
- extends kieker.monitoring.probe.aspectj.operation
- pointcut monitoredOperation
- express execution(int com.ibatis.jdbcstore.service...

Design | Source

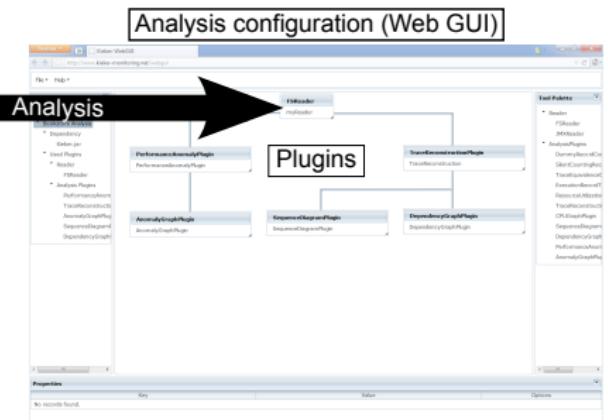
Software system with monitoring instrumentation

# APM/Dynamic Analysis with Kieker

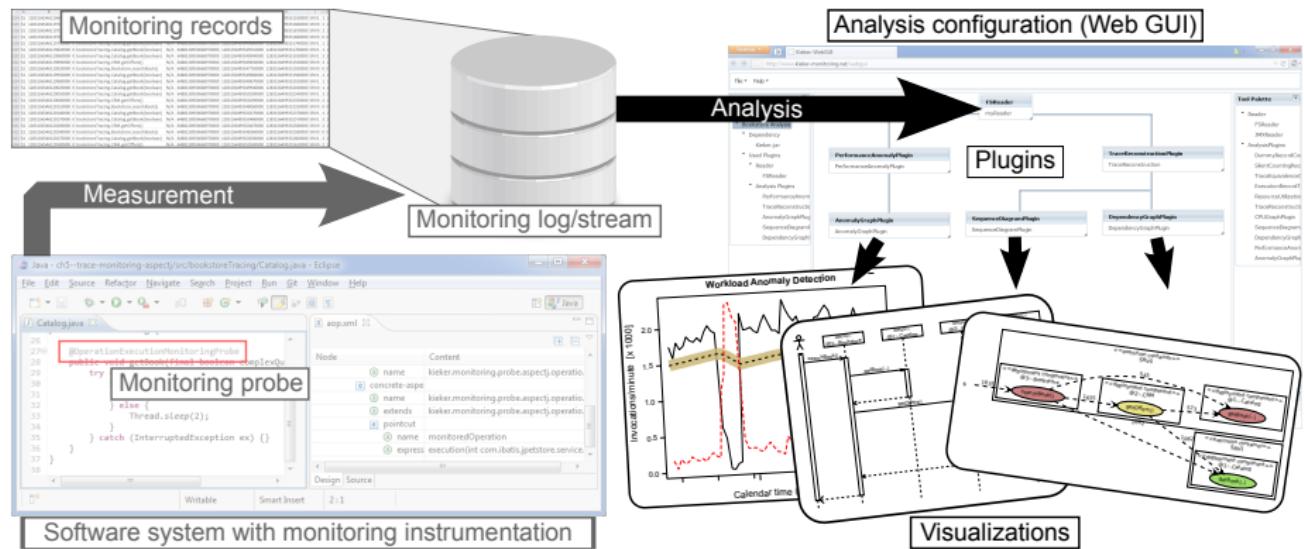


A screenshot of the Eclipse IDE interface. The title bar says "Java - ch0-trace-monitoring-aspect/uc/bookstoreTracing/Catalog.java - Eclipse". The code editor shows Java code with a red box highlighting a line: "276 @OperationExecutionMonitoringProbe". Below the code editor is a "Structure View" window titled "Catalog.java" which lists a "Monitoring probe" node.

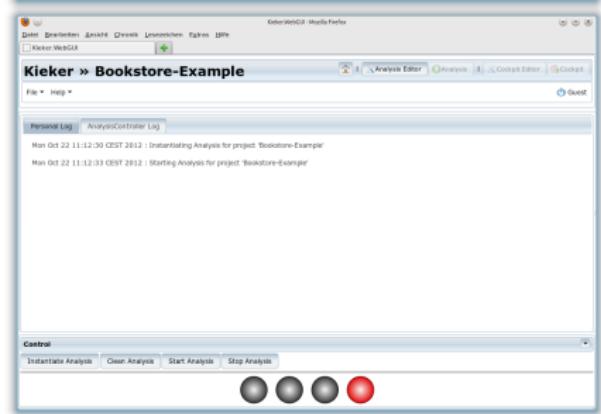
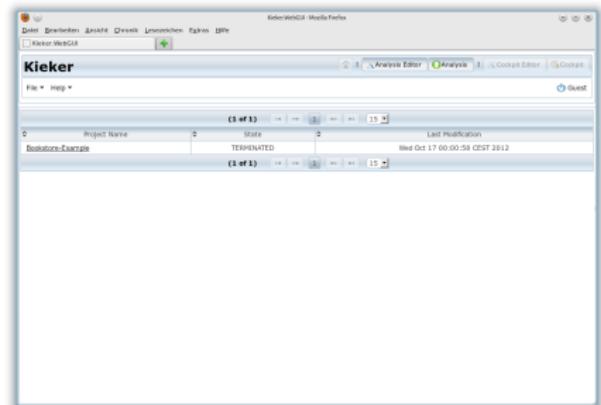
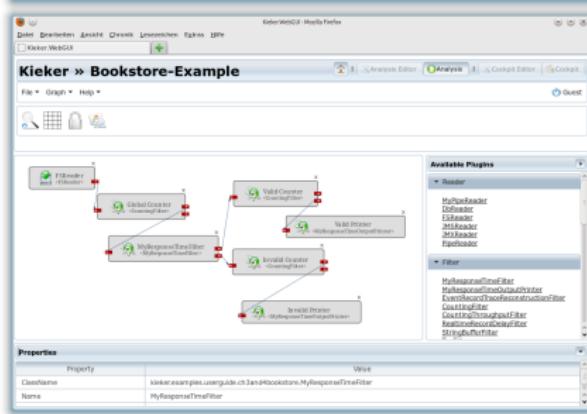
Software system with monitoring instrumentation



# APM/Dynamic Analysis with Kieker



# WebGUI (Beta) Included in Kieker 1.6



# WebGUI (Beta) Included in Kieker 1.6



Kieker > Framework Overview

Kieker WebGUI - Mozilla Firefox

Kieker » Bookstore-Example

File ▾ Graph ▾ Help ▾ Guest

Available Plugins

- Reader
  - MyPipeReader
  - DbReader
  - FSReader
  - JMSReader
  - JMXReader
  - PipeReader
- Filter
  - MyResponseTimeFilter
  - MyResponseTimeOutputPrinter
  - EventRecordTraceReconstructionFilter
  - CountingFilter
  - CountingThroughputFilter
  - RealtimeRecordDelayFilter
  - StringBufferFilter

Properties

Property	Value
ClassName	kieker.examples.userguide.ch3and4bookstore.MyResponseTimeFilter
Name	MyResponseTimeFilter

```
graph LR; FSReader[FSReader] --> GlobalCounter[Global Counter]; GlobalCounter --> MyResponseTimeFilter[MyResponseTimeFilter]; MyResponseTimeFilter --> InvalidCounter[Invalid Counter]; InvalidCounter --> InvalidPrinter[Invalid Printer]; ValidCounter[Valid Counter] --> ValidPrinter[Valid Printer]
```

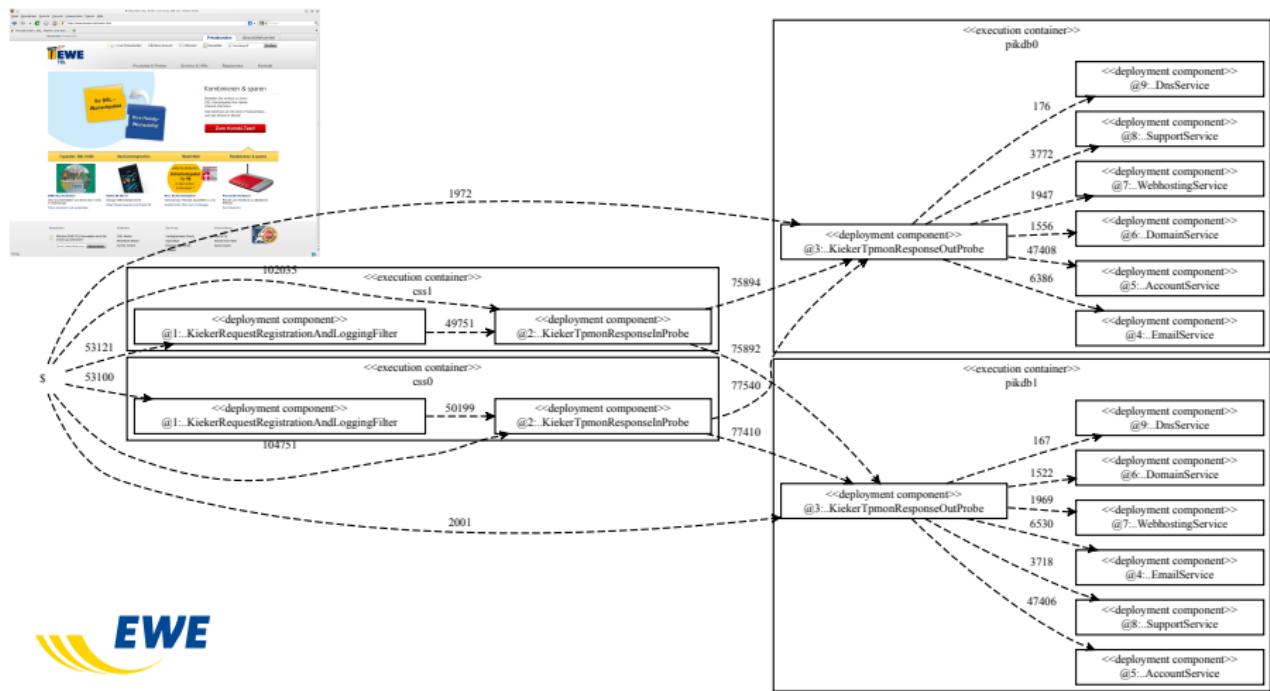
## 1 Motivation

## 2 Kieker

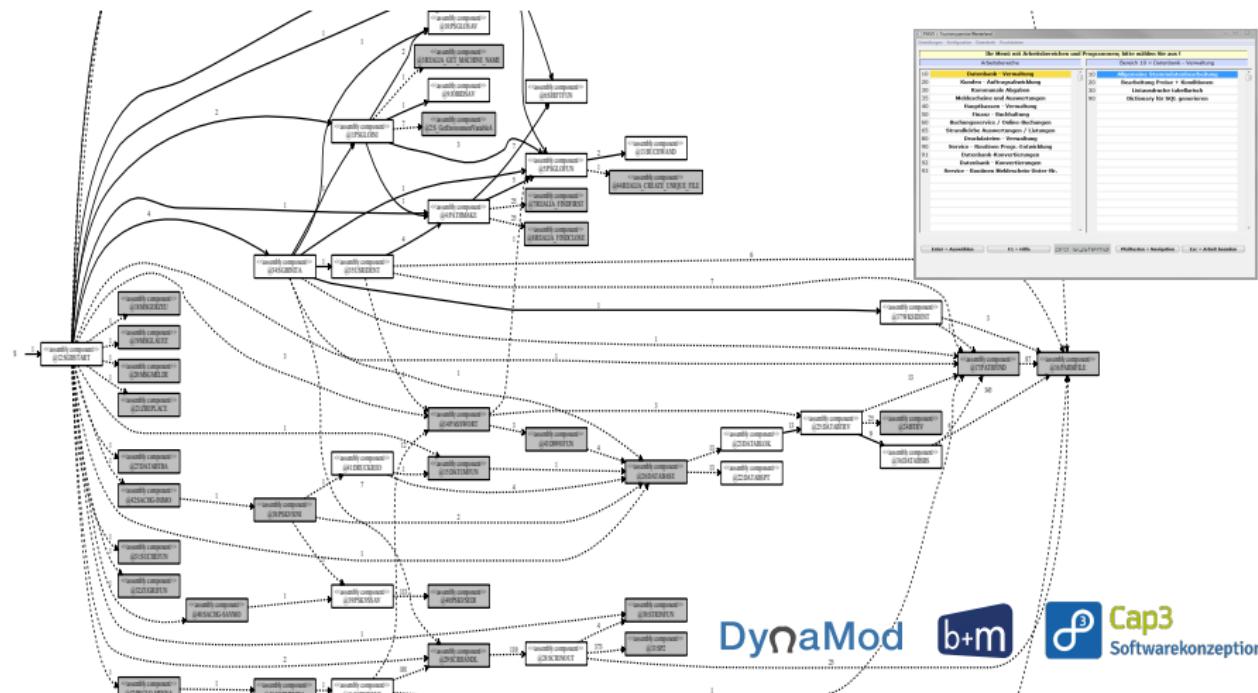
- Framework Overview
- **Selected Topics and Results**
- Review of Kieker's History

## 3 Conclusion

## Architecture Discovery: Model Extraction + Visualization



## Architecture Discovery: Model Extraction + Visualization (cont'd)



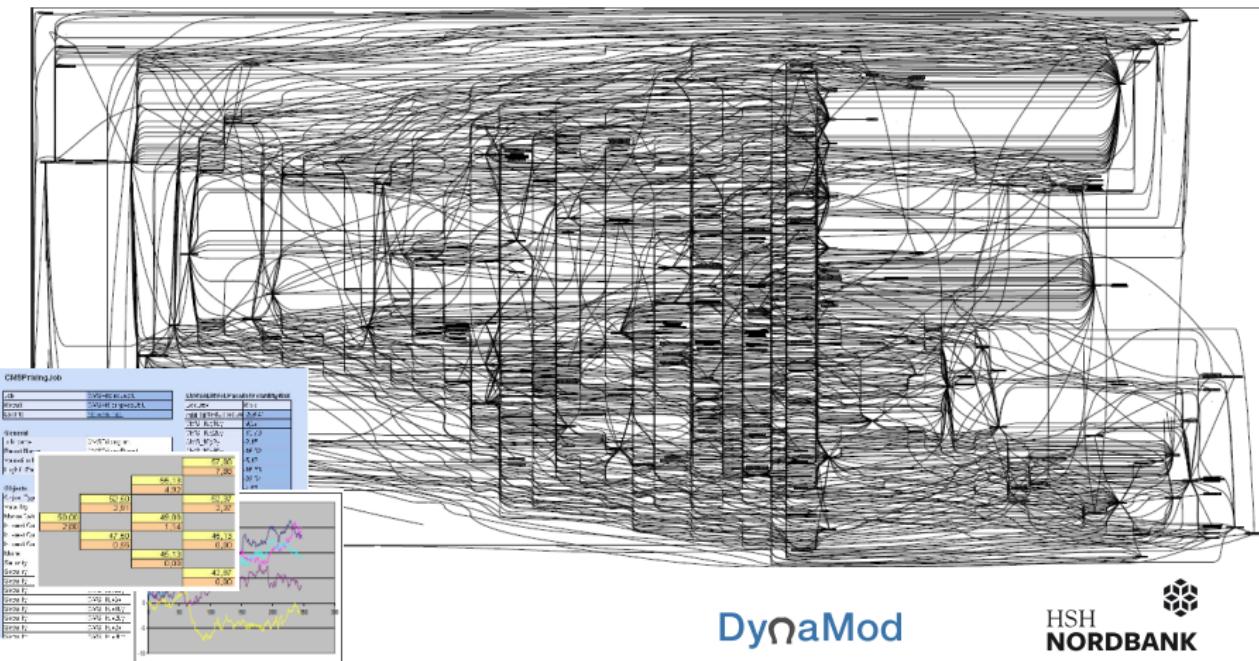
[Richter 2012]

DynaMod

b+m

Cap3  
Softwarekonzeption

## Architecture Discovery: Model Extraction + Visualization (cont'd)

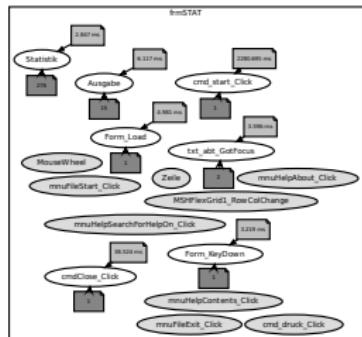
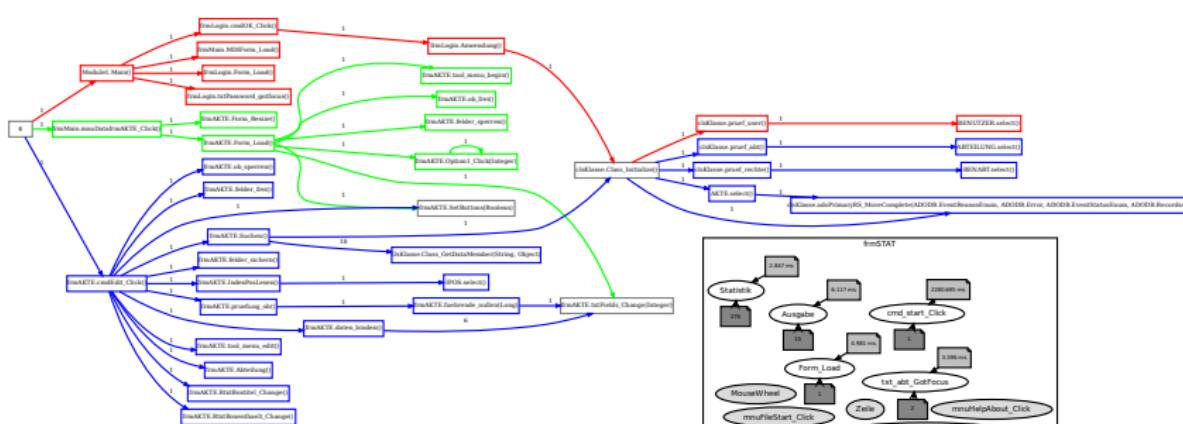


DynaMod

HSH  
NORDBANK

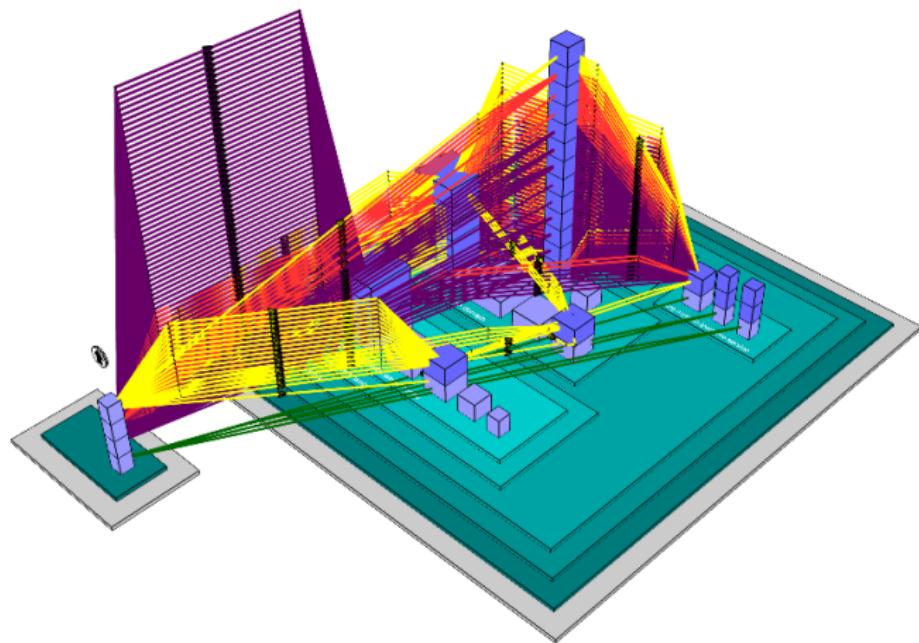
[Magedanz 2011]

## Architecture Discovery: Model Extraction + Visualization (cont'd)



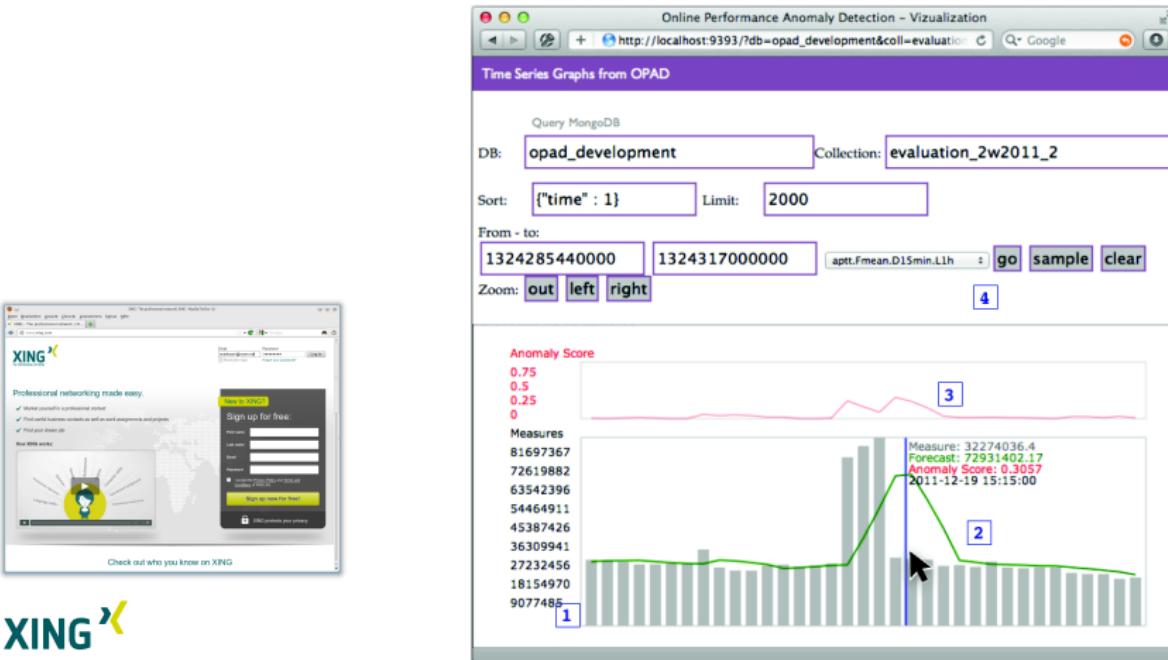
DynaMod b+m dataport

## Architecture Discovery: Model Extraction + Visualization (cont'd)



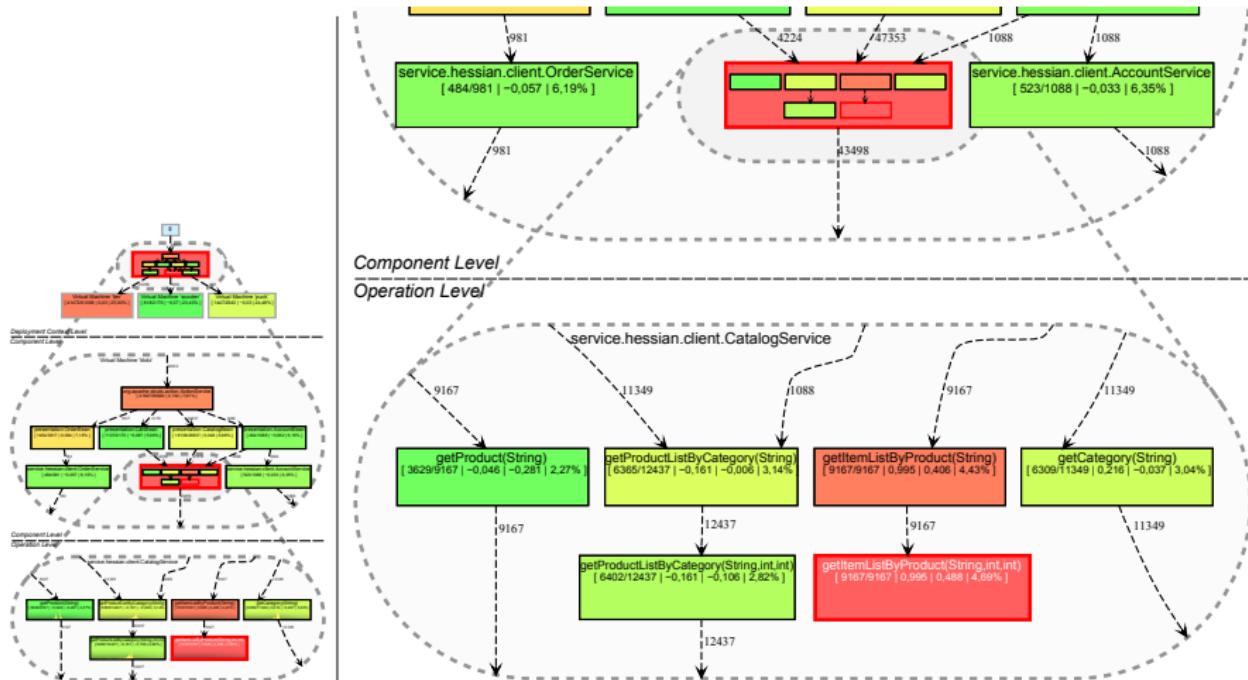
[Döhring 2012] (based on [Wulf 2010])

## APM: Anomaly Detection + Diagnosis



[Bielefeld 2012]

## APM: Anomaly Detection + Diagnosis (cont'd)



[Marwede et al. 2009]

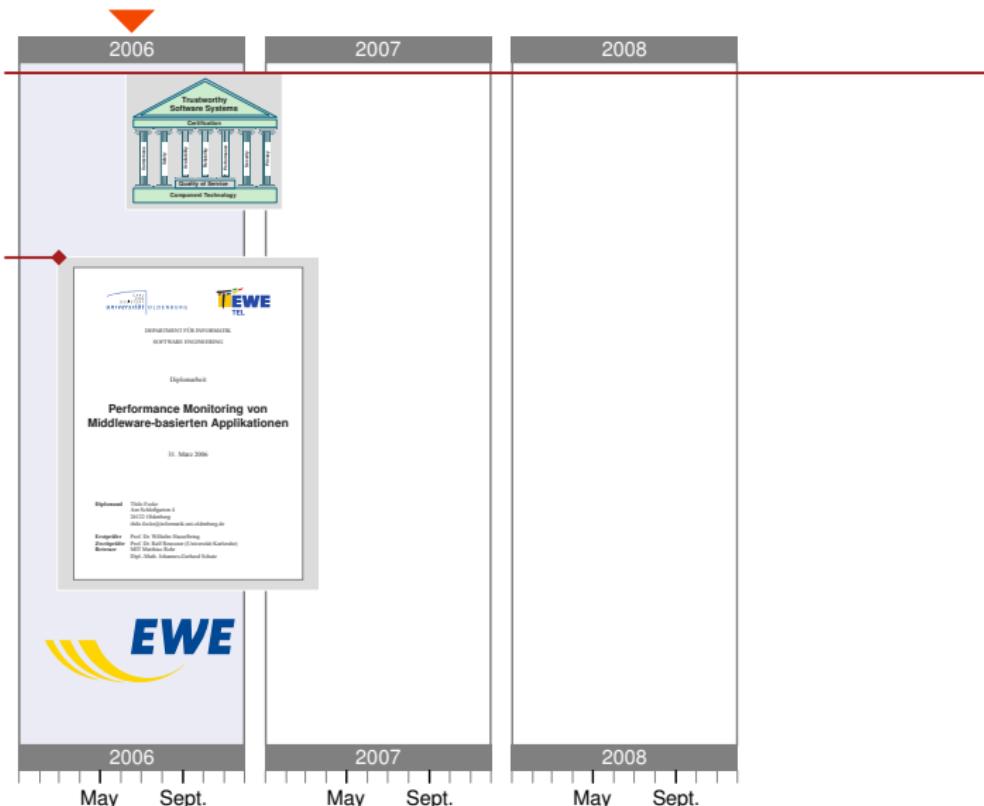
## 1 Motivation

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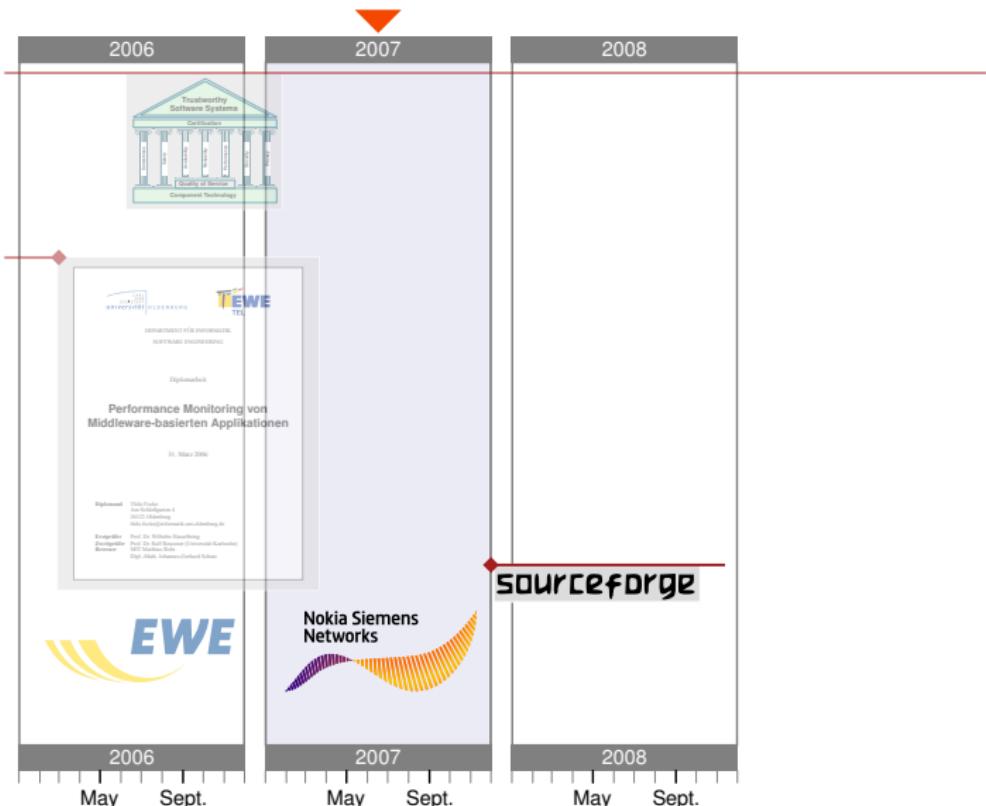
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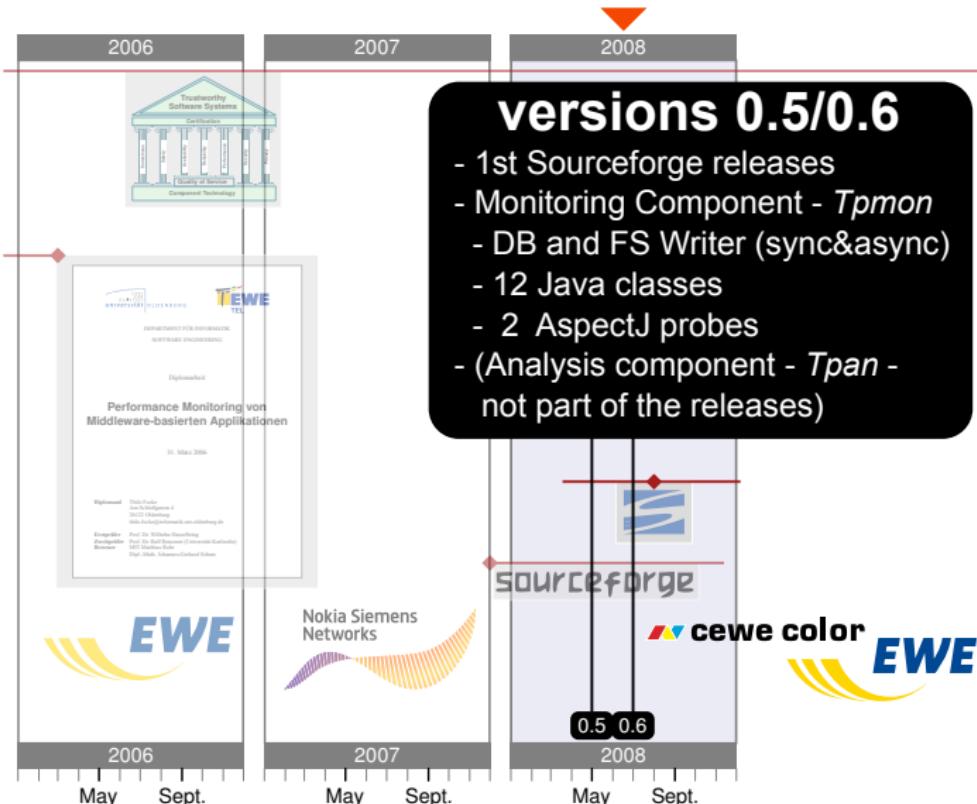
## 3 Conclusion

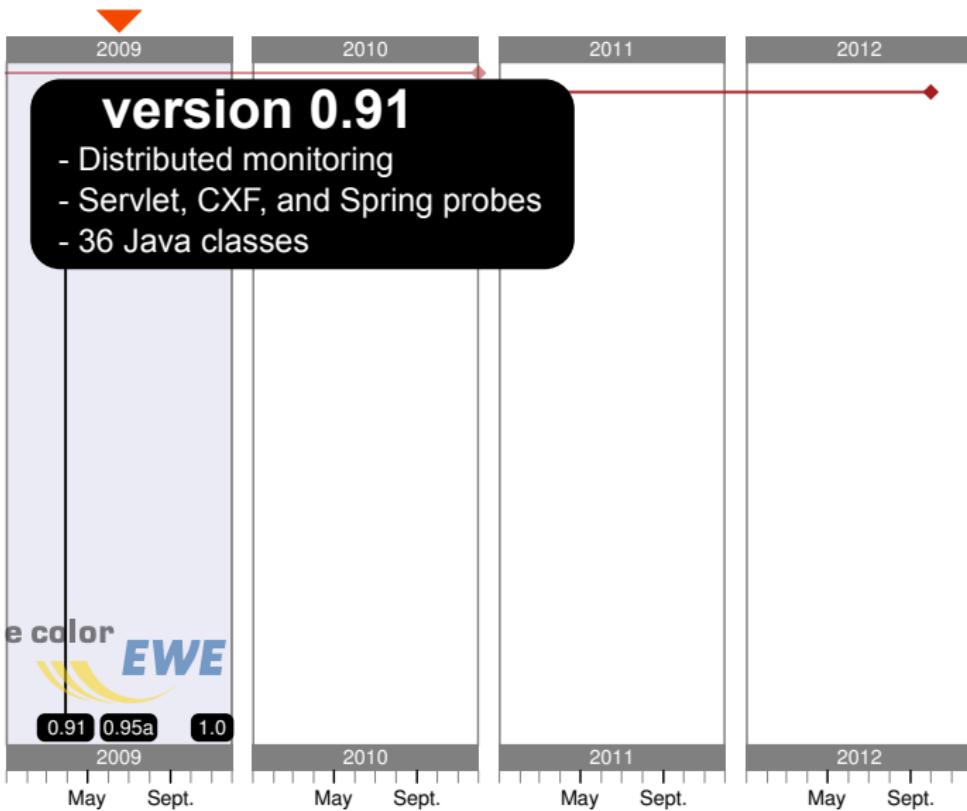
# Looking back ... 2006–2008

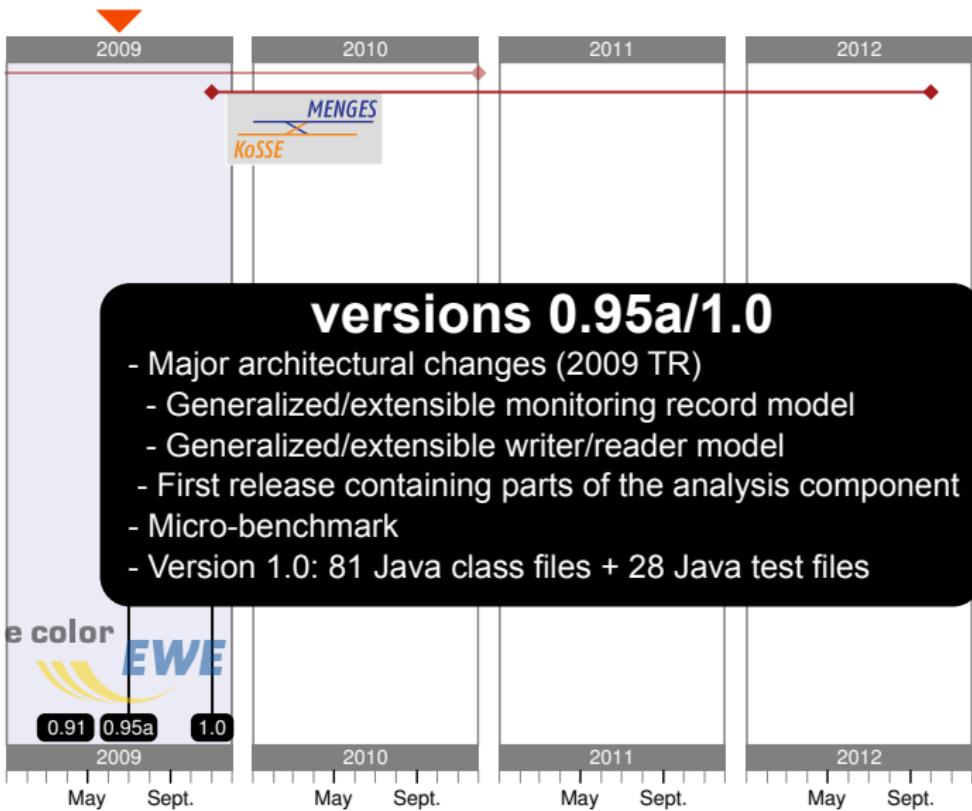


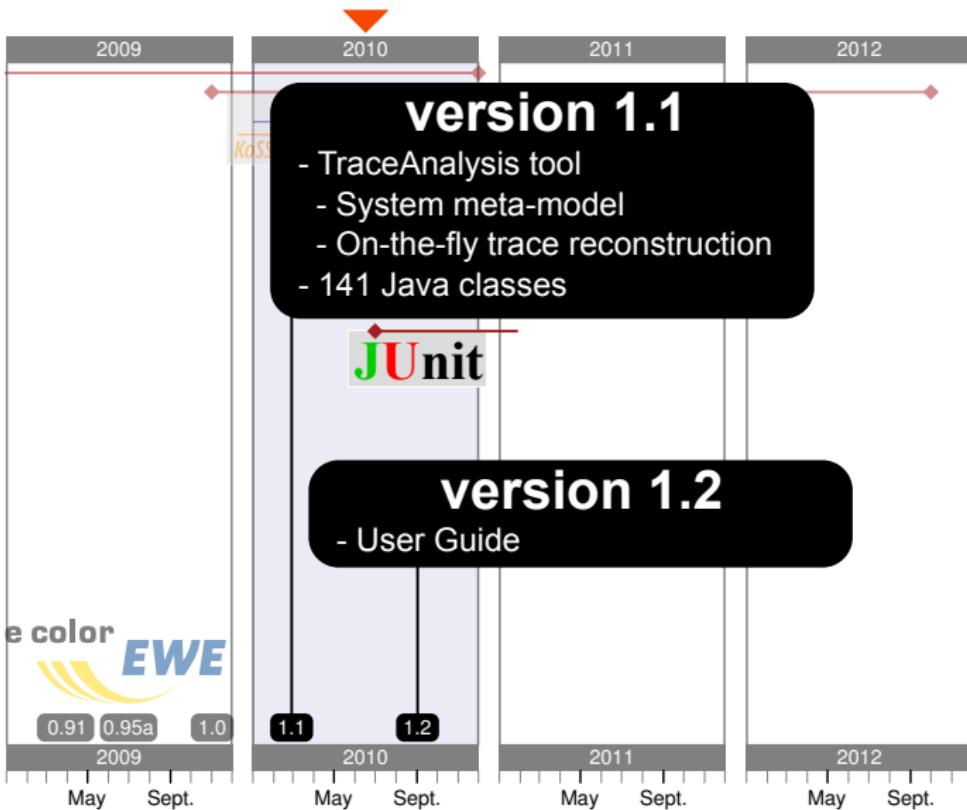
# Looking back ... 2006–2008









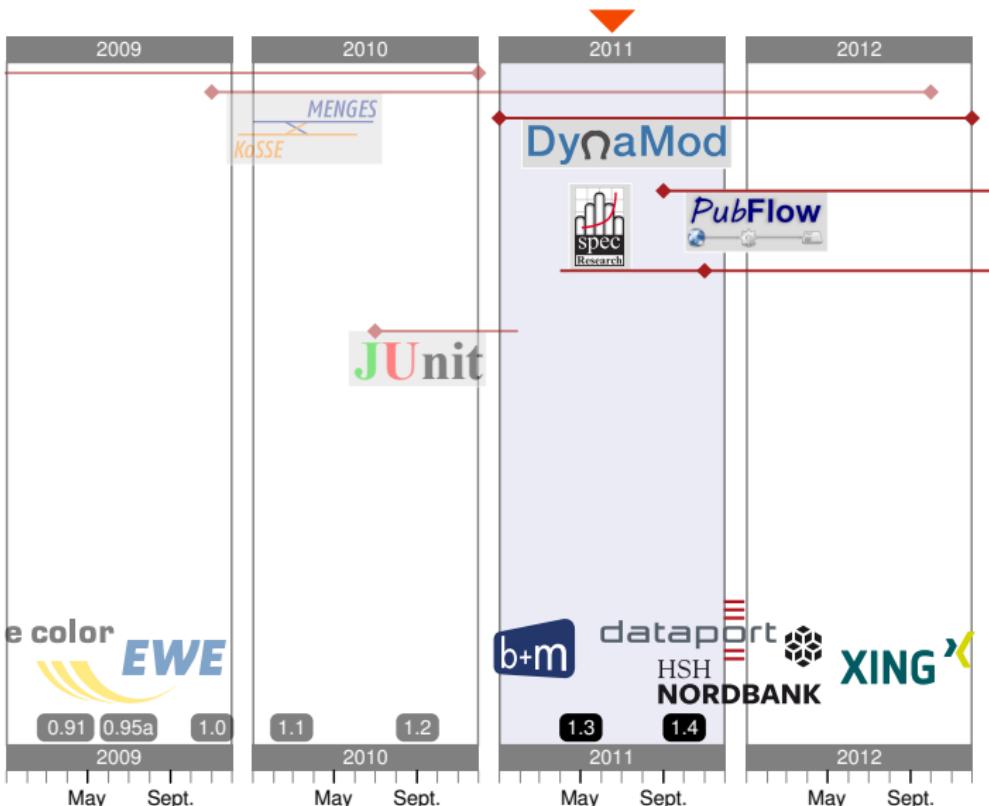


# Looking back ... 2009–2012

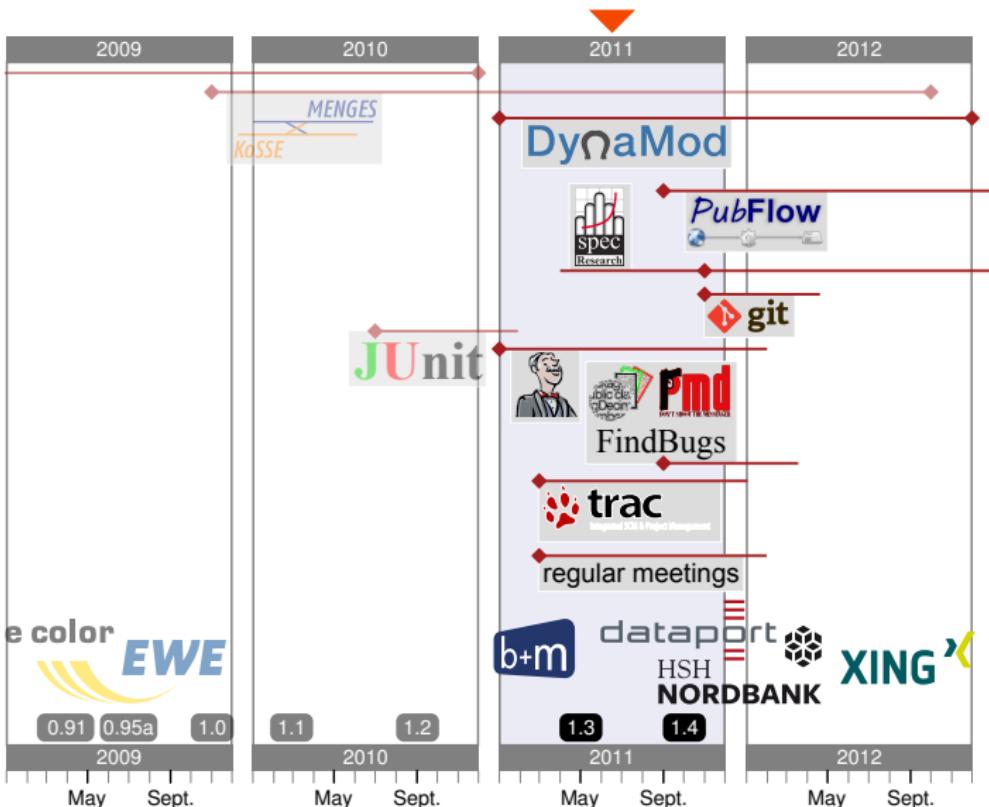
Kieker > Review of Kieker's History



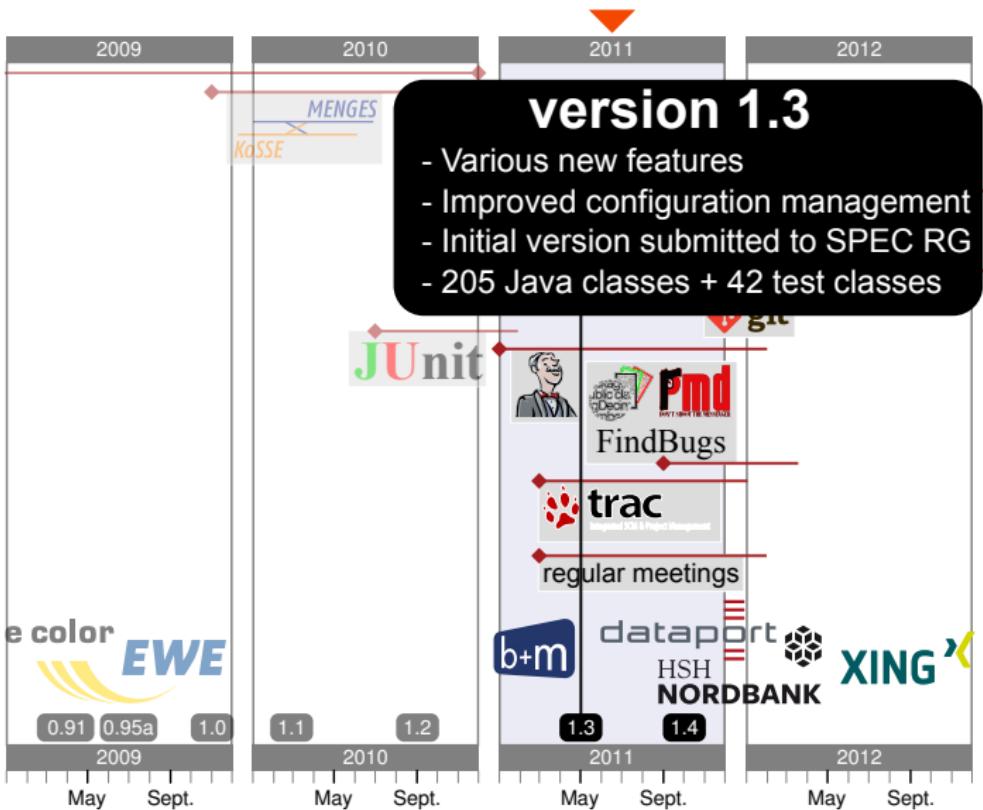
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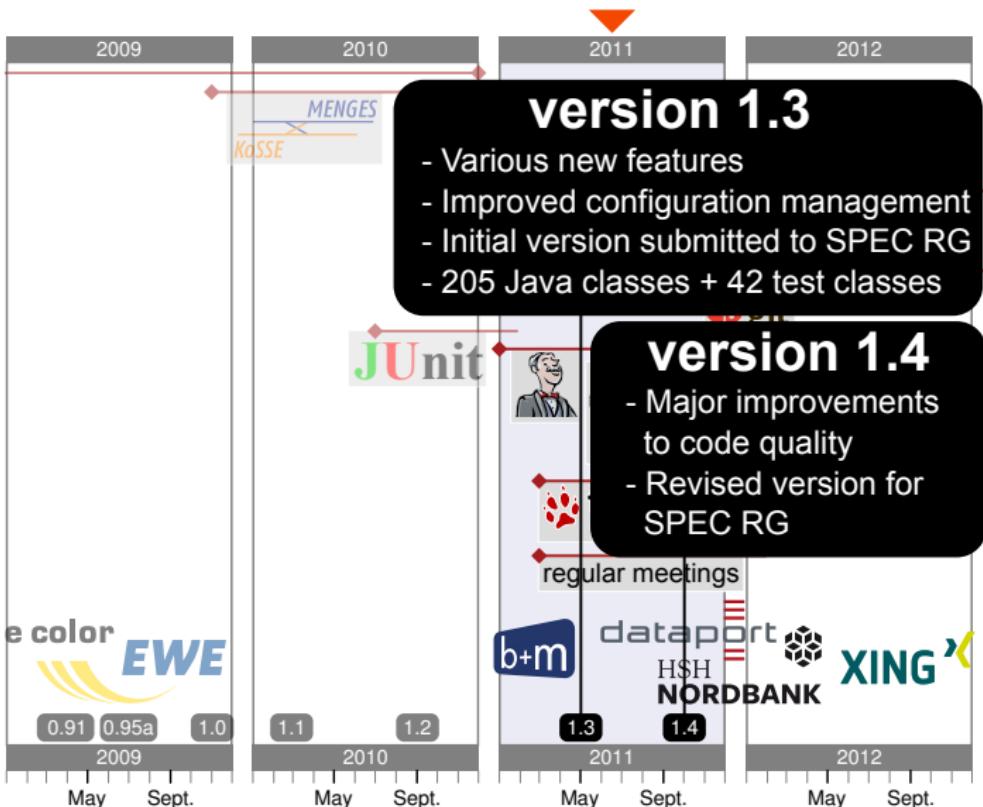
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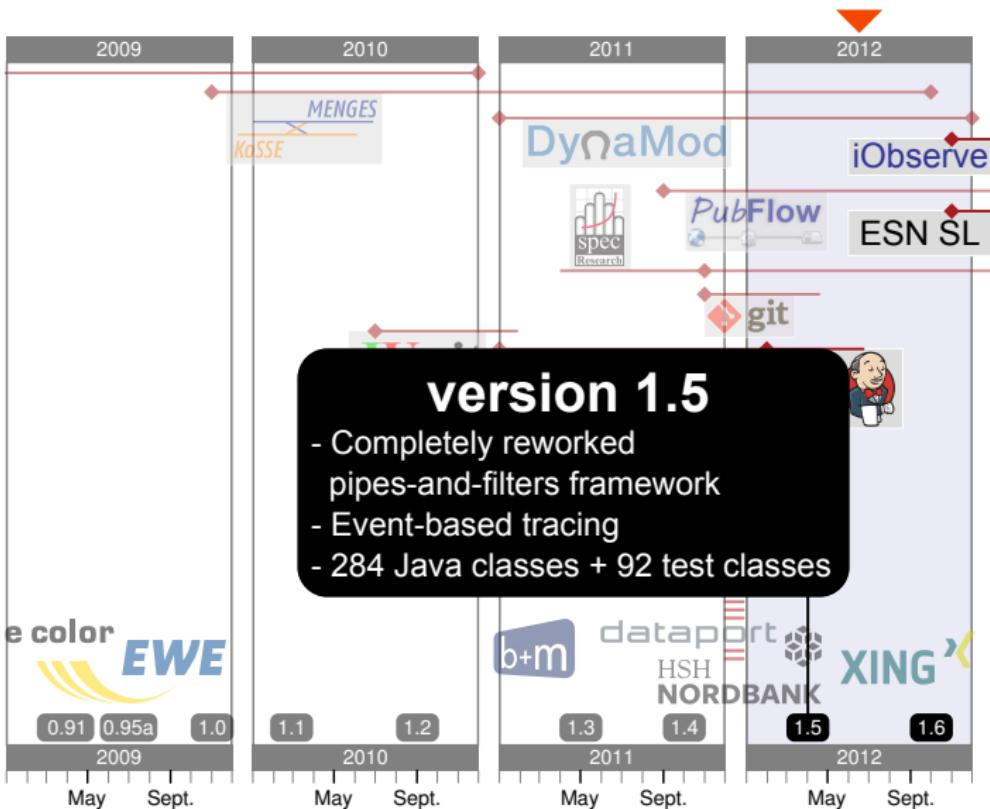
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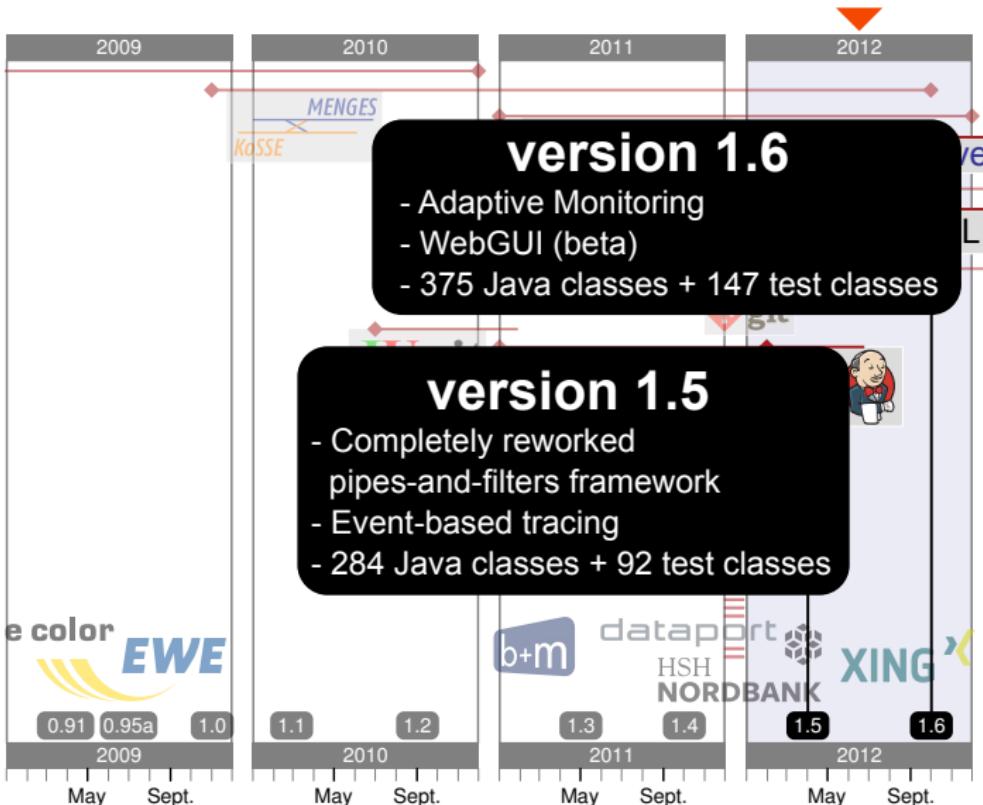


# Looking back ... 2009–2012



# Looking back ... 2009–2012





- Modular, flexible, and extensible architecture (Probes, records, readers, writers, filters etc.)
- Pipes-and-filters framework for analysis configuration
- Distributed tracing (logging, reconstruction, visualization)
- Low overhead (designed for continuous operation)
- Evaluated in lab and industrial case studies



cewe color

dataport



HSH  
NORDBANK

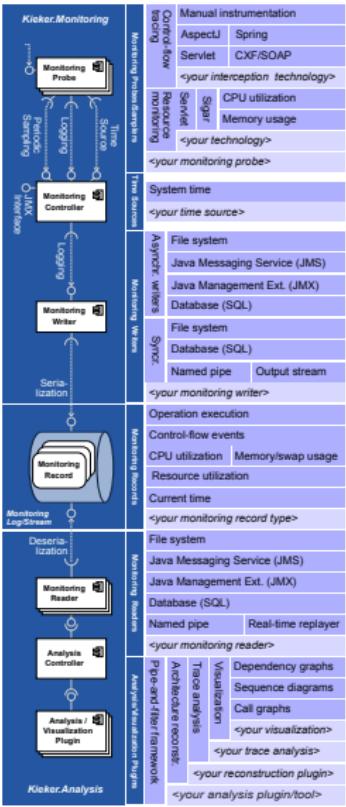


Kieker is open-source software (Apache License, V. 2.0)

<http://kieker-monitoring.net>

Kieker is distributed as part of SPEC® RG's repository of peer-reviewed tools for quantitative system evaluation and analysis

<http://research.spec.org/projects/tools.html>



## Conclusion

- T. C. Bielefeld. Online performance anomaly detection for large-scale software systems. <http://eprints.uni-kiel.de/15488/>, Mar. 2012. Diploma Thesis, Kiel University.
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- A. van Hoorn, M. Rohr, W. Hasselbring, J. Waller, J. Ehlers, S. Frey, and D. Kieselhorst. Continuous monitoring of software services: Design and application of the Kieker framework. Technical Report TR-0921, Department of Computer Science, University of Kiel, Germany, Nov. 2009. URL [http://www.informatik.uni-kiel.de/uploads/tx\\_publication/vanhoorn\\_tr0921.pdf](http://www.informatik.uni-kiel.de/uploads/tx_publication/vanhoorn_tr0921.pdf).
- A. van Hoorn, J. Waller, and W. Hasselbring. Kieker: A framework for application performance monitoring and dynamic software analysis. In *Proceedings of the 3rd ACM/SPEC International Conference on Performance Engineering (ICPE 2012)*, pages 247–248. ACM, Apr. 2012. ISBN 978-1-4503-1202-8. doi: 10.1145/2188286.2188326.
- C. Wulf. Runtime visualization of static and dynamic architectural views of a software system to identify performance problems. B.Sc. Thesis, University of Kiel, Germany, 2010.