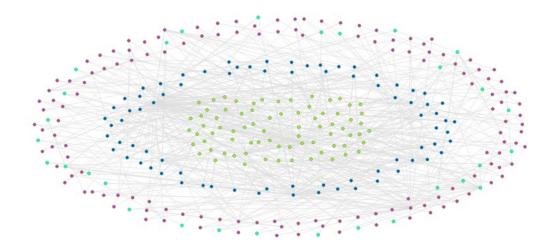




Real-time Visualization of Analyzed Industrial Communication Network Traffic

Xiaoru Li, Klevia Ulqinaku, Mario Alberto Gonzalez Ordiano, Philipp Mergenthaler Advisor: Ankush Meshram

PSE 2018/19





Background

- Industrial Network Security aims to understand the traffic in industrial production systems
- Analysis of the traffic to find anomalies
- Real-time visualization to help the user understand
 - Communication behavior
 - Changes in the communication
- Incidents can be detected visually





Back-end



Front-end



Demo



Evaluation





Requirements

- 24 Functional Requirements
 - User access control, security roles
 - Three different diagram types
 - Brushing
 - Data filter
- 12 Non-Functional Requirements
 - extensibility





Back-end



Front-end



Demo



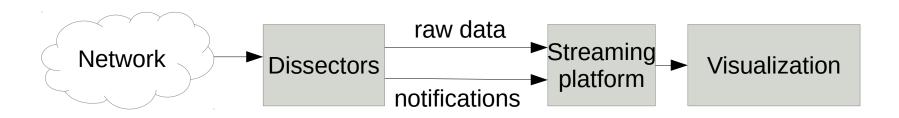
Evaluation





The Workflow

- Network traffic is recorded
- Traffic data is analyzed (dissected)
- Data is fed to a streaming platform (Kafka)
- A visualization tool displays data and analysis results





Architecture and Design

- Client-Server Architecture
- Front-End:
 - Model-View-Controller pattern
 - Observer pattern
- Back-End:
 - Mediator pattern
 - Strategy pattern





Back-end



Front-end



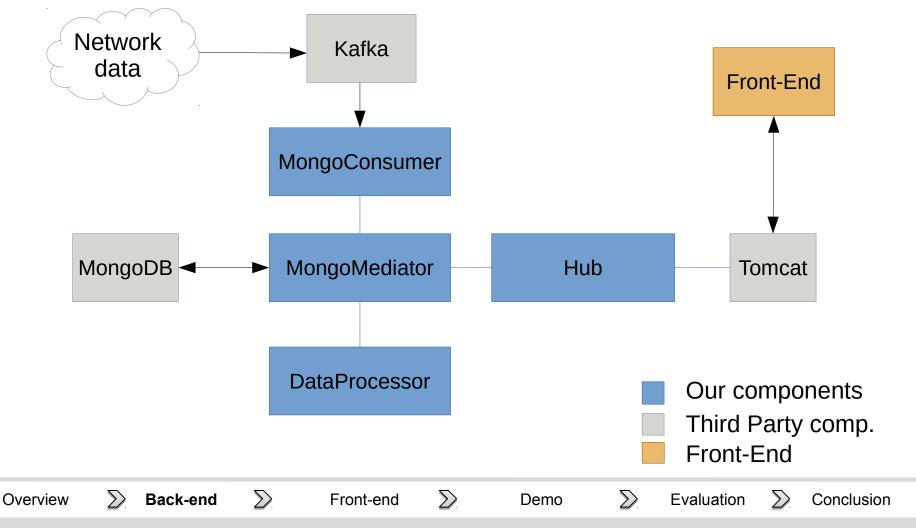
Demo

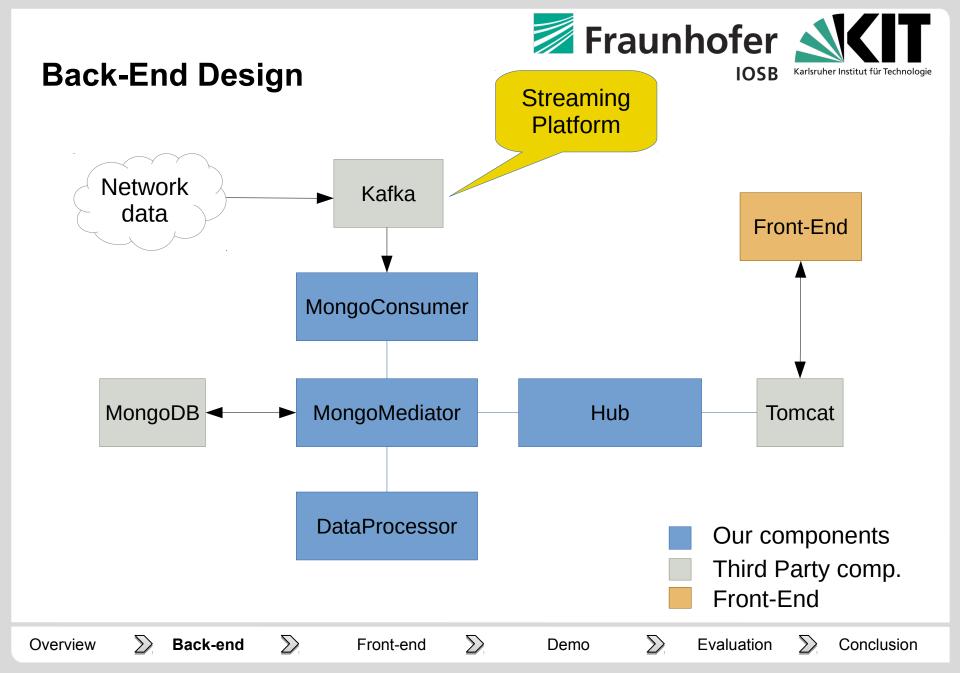


Evaluation

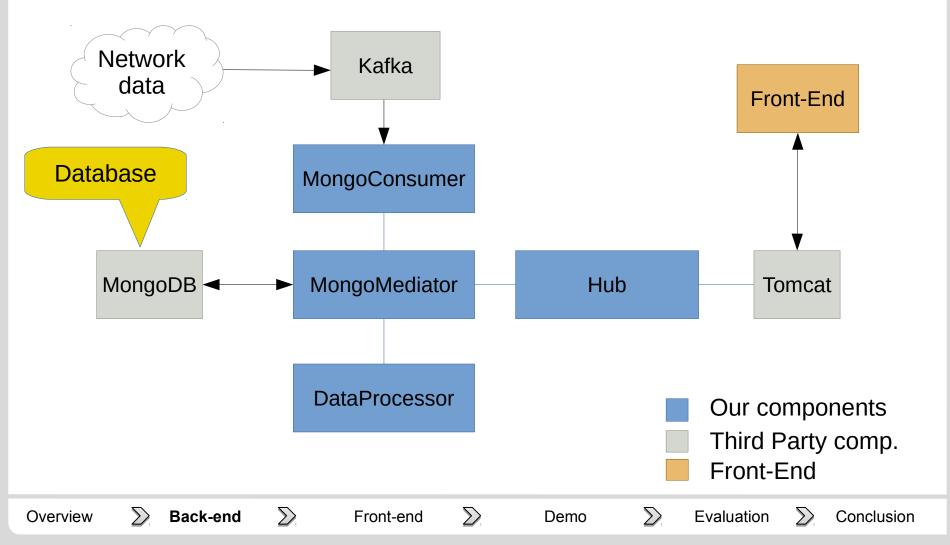




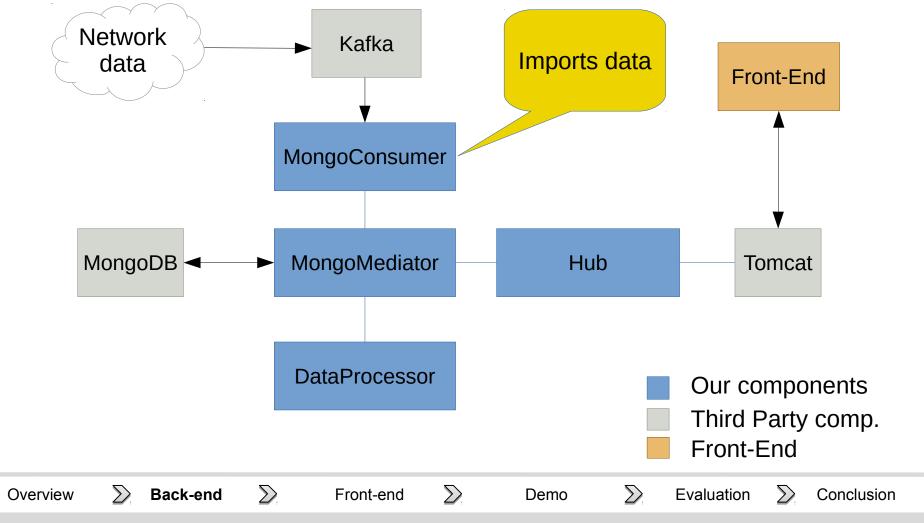




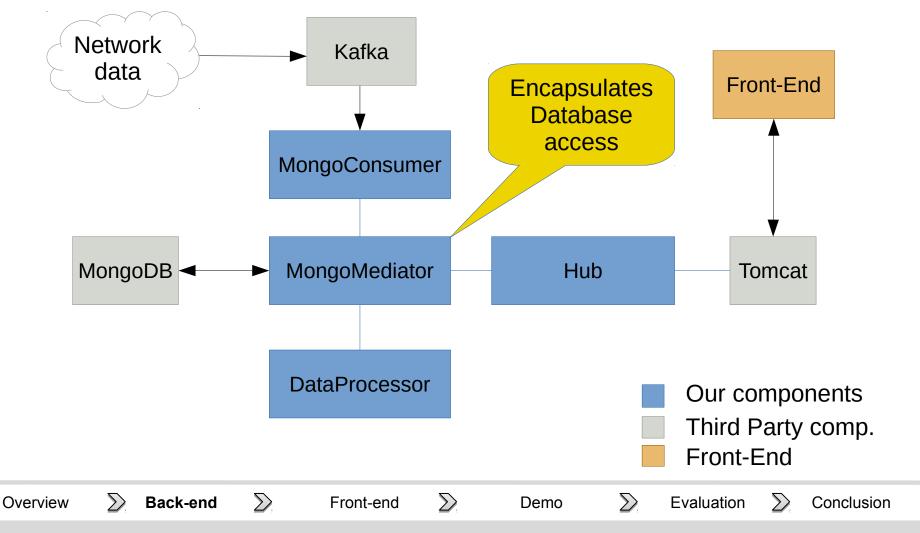




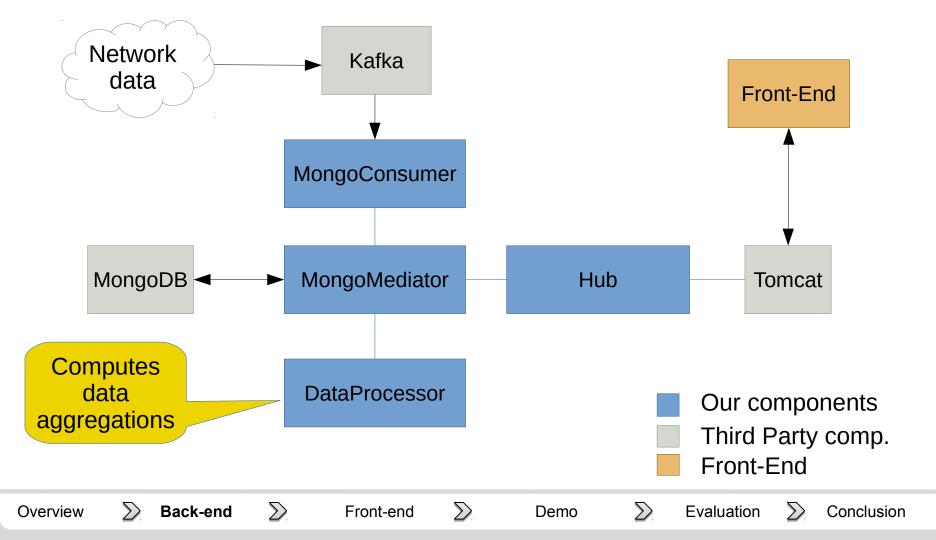




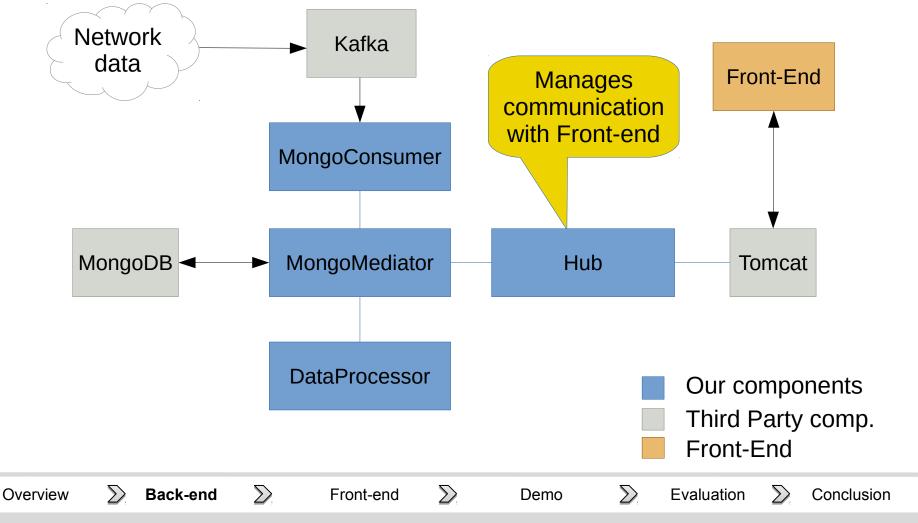




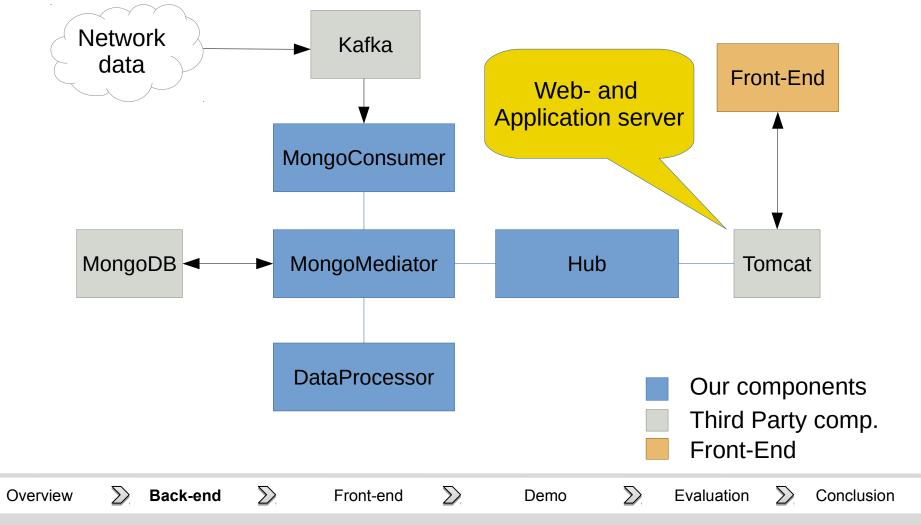






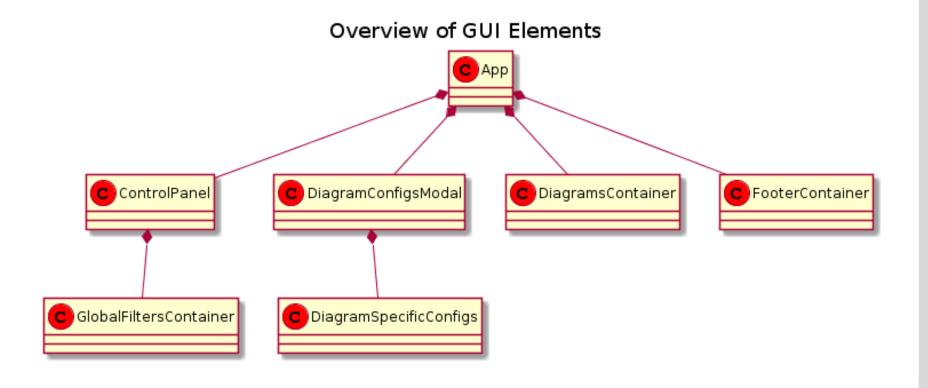








Front-End Design



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Demo

Front-end

Overview

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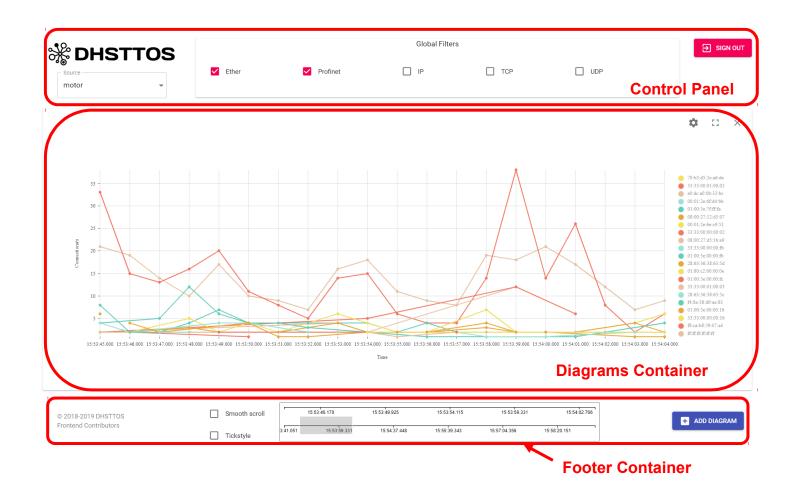
Back-end

Conclusion

Evaluation



Front-End Design



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Demo

Front-end

15.04.2019

Back-end

Overview

Conclusion

Evaluation

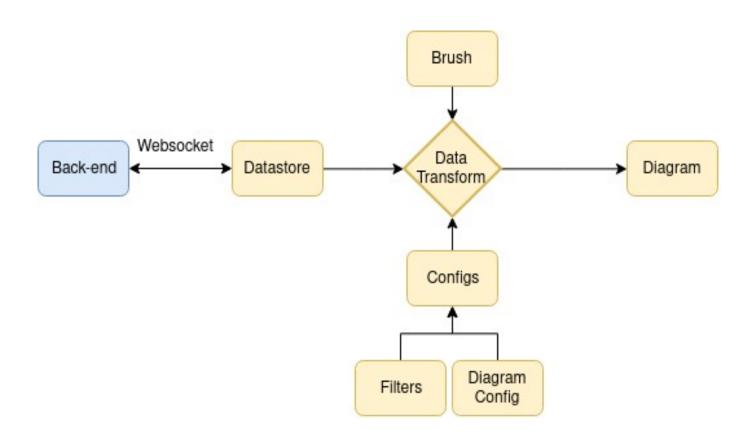


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Evaluation

Demo

Front-End Data Flow



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Front-end

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Back-end

Overview





Front-End Components

- Written in Javascript
- Additional third party components (open source):
 - React library
 - 33 D3 graphics library
- nivo diagram components
 - MobX state management





Back-end



Front-end



Demo

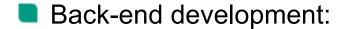


Evaluation



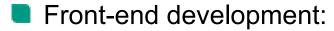


Development Tools Used





Maven





Parcel.js

Netlify (CD)

Common tools:





GitHub



Slack

LATEX Latex

Overview



Back-end



Front-end



Demo



Evaluation





Implementation

- User access control
- Data source selection
- Multiple diagram types
- Brushing
- Modular structure
- 19 of 24 functional requirements

- Node-link diagram (partial)
- Filtering (partial)
- Data selection
- Display notifications



Back-end



Front-end



Demo



Evaluation



Fraunhofer Unexpected Difficulties and Challenges IOSB Karlsruher Institut für Technologi

- Only four team members
- Larger Scope than expected
- Many different technologies
 - Javascript and the libraries make use of multiple programming paradigms
 - Complexity of D3
 - Nivo components have inconsistent features
 - MongoDB idiosyncracies





Back-end



Front-end



Demo



Evaluation





Lessons Learned

- Design more thoroughly
 - Especially data structures and protocolls
- Plan and schedule more strictly
- Evaluate third party components more thoroughly
- Waterfall model didn't work.







Front-end



Demo



Evaluation





Best Practices

- Overall design was viable
- Good commit practices
- Frequent team communication
- Flexibility
- Learning from each other





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Front-end



Demo

 \sum

Evaluation





Conclusion

- We produced a working system
- Usable as a good and extensible base for future work
- Underestimated the amount of work required
- Gained experience with teamwork
- Gained understanding of technologies



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Back-end



Front-end



Demo



Evaluation

