QUALITY OF FORECASTS FOR SIGNAL TIMINGS AT TRAFFIC LIGHTS

RESULTS PRESENTATION

Maik Halbach, DLR
Nils Gayer, LSBG
Heinrich Hener, HHVA

Car2Car Week #33
3rd March 2026

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AGENDA

1. Welcome and Introduction
   - Background and Motivation
   - Objective of the Project
2. Project Overview & Results
   - Approach to Developing the Evaluation Metric
   - Concept for Evaluation Metric of Forecast Quality
   - Practical Applicability and Next Steps
3. Q&A
   - Questions and Discussion
4. Summary
   - Summary
   - Outlook

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BACKGROUND AND MOTIVATION OF QUAPRODALI

Quality of Signal Timing Prediction Data at Traffic Lights
(**QUA**lität von Schaltzeit**PRO**gnose**DA**ten an **L**ichtsignalanlagen)

GLOSA services can...
- reduce braking and acceleration events
- reduce fuel/energy consumption
- lower emissions (CO2, particulate matter, etc.)

Poor forecast quality may lead to...
- lack of user acceptance
- additional braking and acceleration events
- dangerous traffic situations

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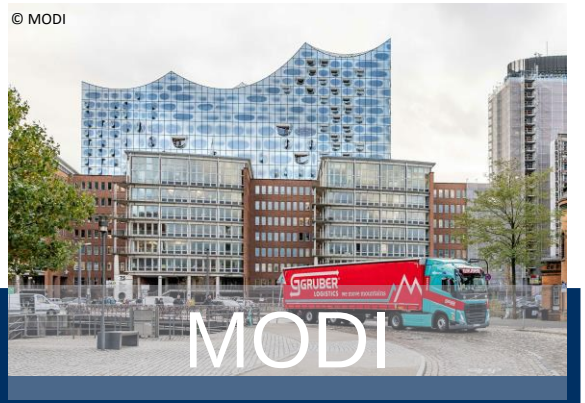
BACKGROUND AND MOTIVATION OF QUAPRODALI



"How good is your forecast and at which traffic lights is the forecast best?"

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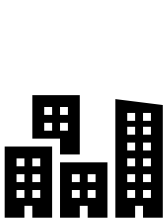
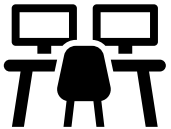
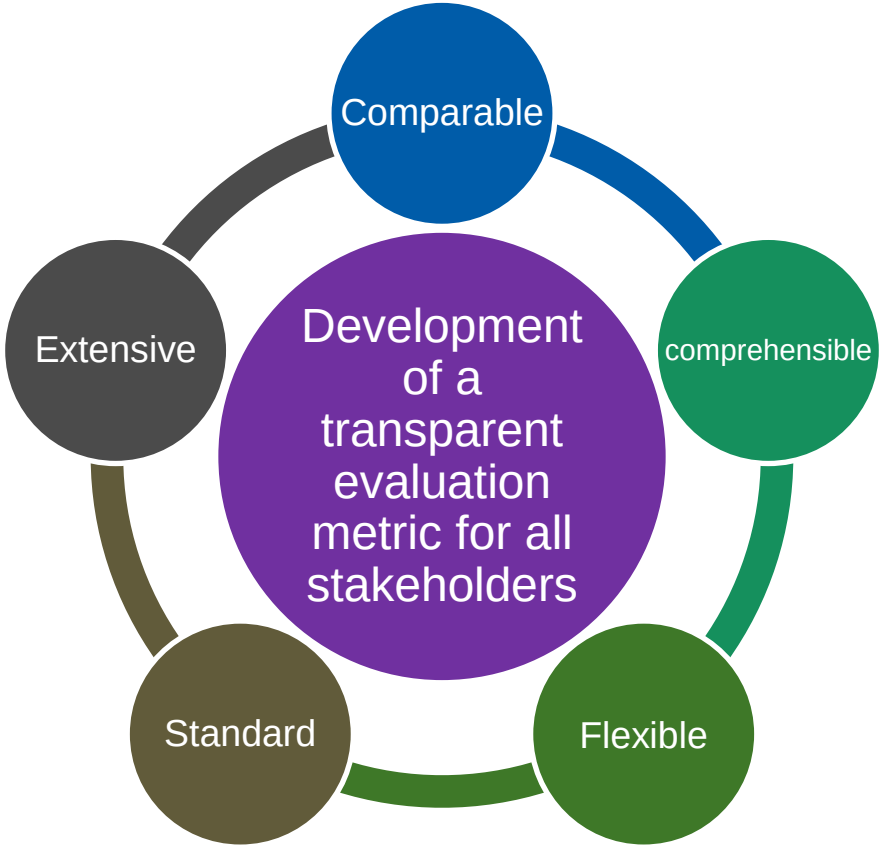
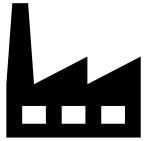
PROJECT OBJECTIVE









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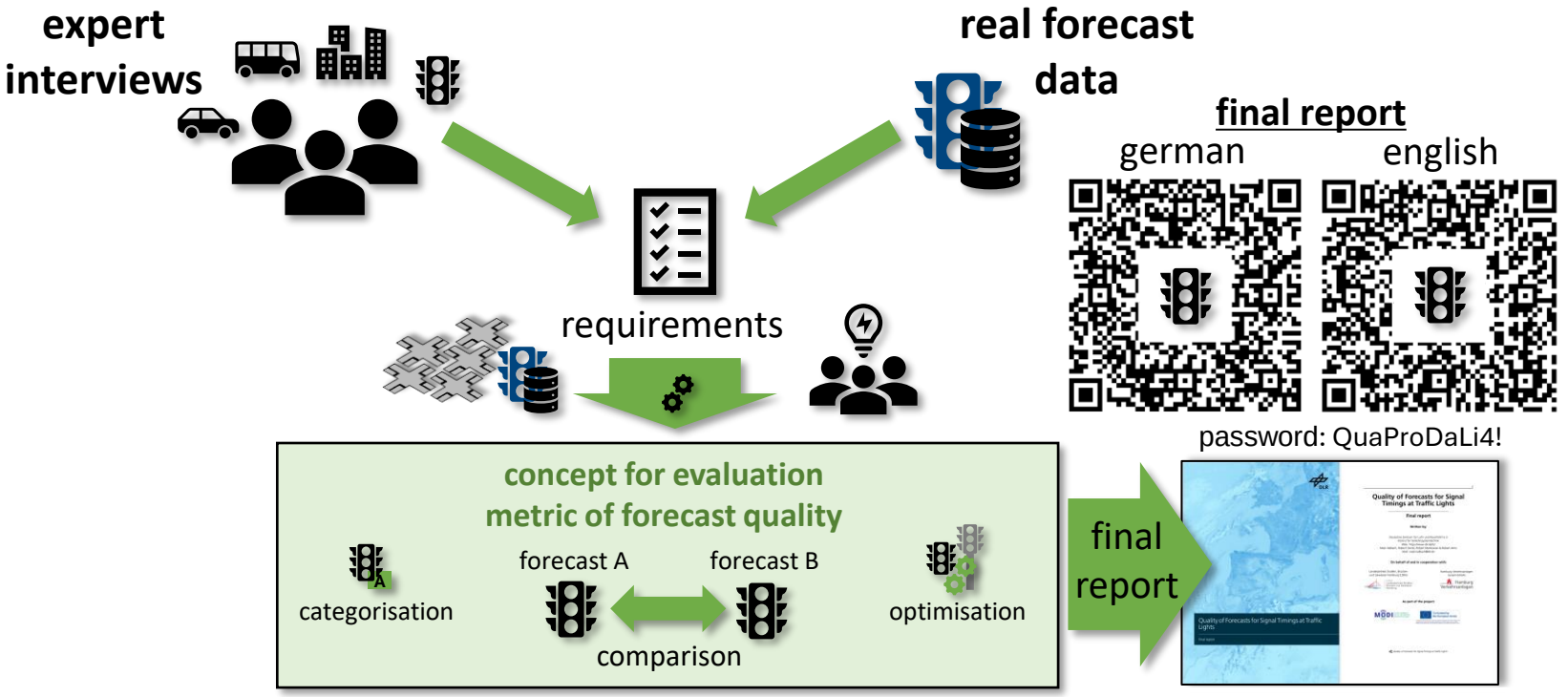
PROJECT OVERVIEW



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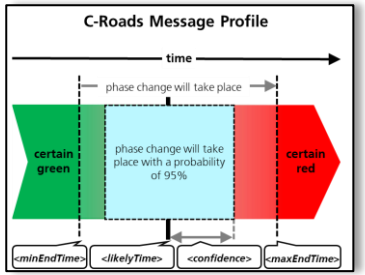
DATA SOURCES

V2X-message SPATEM



24h forecast data
of 5 junctions in Hamburg

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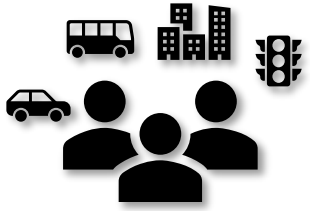
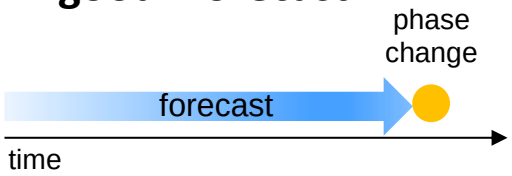
KEY FINDINGS FROM EXPERT INTERVIEWS



expert interviews

“good” forecast:



- constant availability
- should become more accurate and reliable
- no sudden changes (no time jumps)

key requirements of metric

- comparability
- availability and consistency of content
- evaluation of the forecast quality
- comprehensibility and flexibility at the same time

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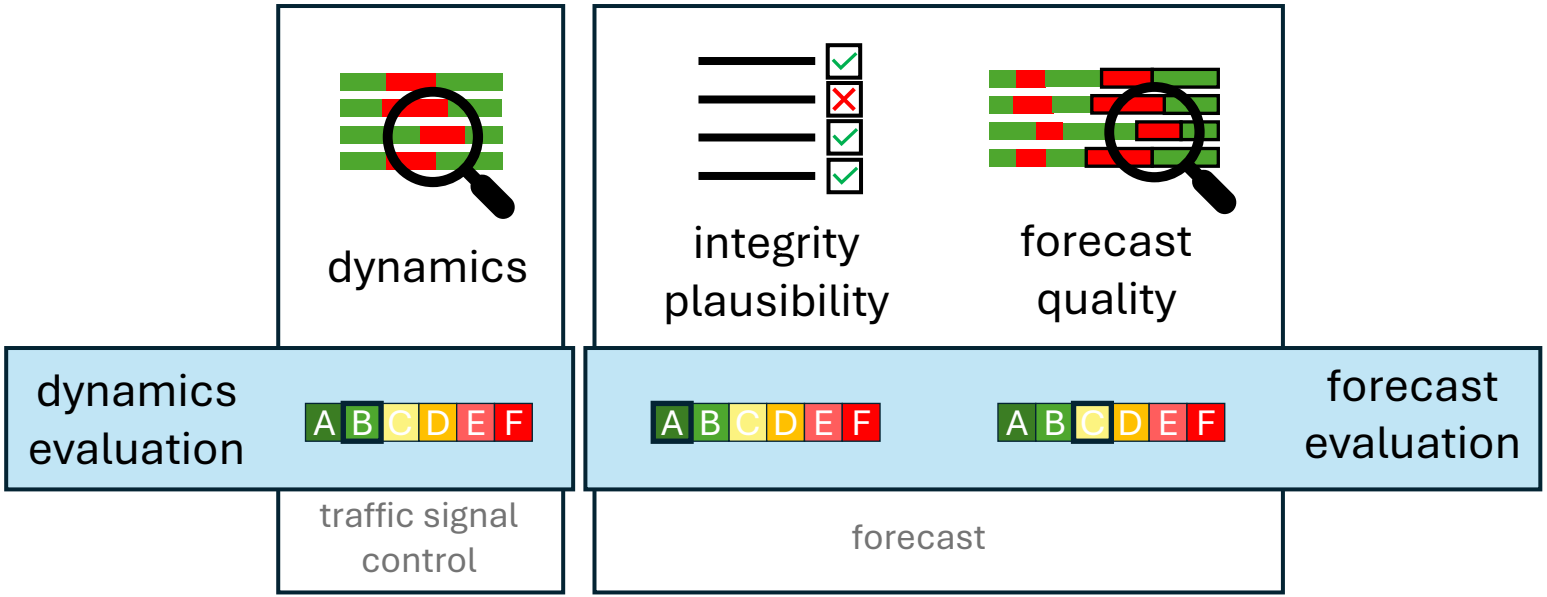
CONCEPT FOR EVALUATION METRIC OF FORECAST QUALITY



SPATEM messages
specified according to C-Roads

configurability

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ASPECT - SIGNAL CONTROL DYNAMICS

objective:
establishing the comparability of forecasts in relation to signal controls with different dynamics

evaluation indices:

- start timings
- end timings
- time intervals

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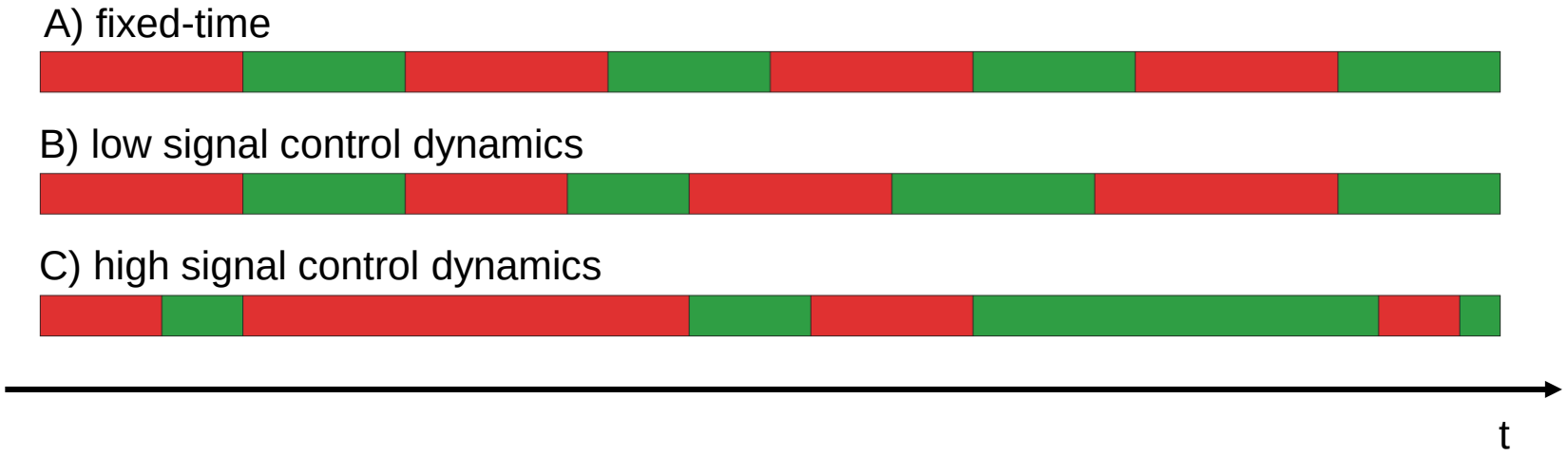
ASPECT - SIGNAL CONTROL DYNAMICS
EXAMPLE OF DIFFERENT DYNAMICS



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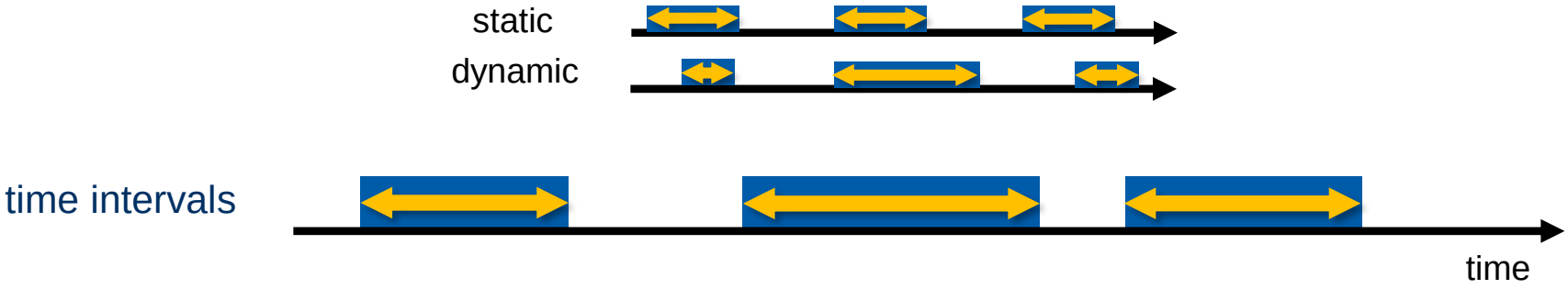
ASPECT - SIGNAL CONTROL DYNAMICS EXAMPLE INDEX



active eventState/signal state

state duration in [s]

result

information entropy

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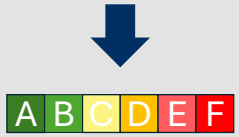

dynamics level

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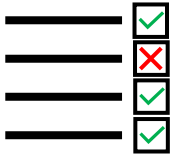
ASPECT - INTEGRITY AND PLAUSIBILITY



objective:
checking the forecast for consistency of content

evaluation indices:

- availability
- minEndTime
- maxEndTime
- minEndTime-likelyTime-maxEndTime
- check for static eventStates

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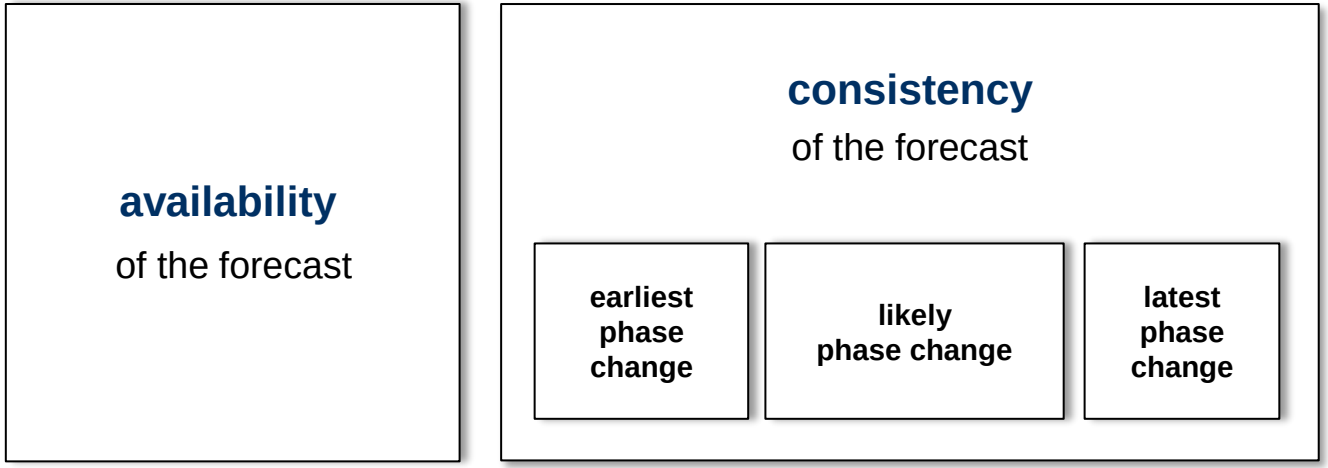

result

proportion of consistent messages

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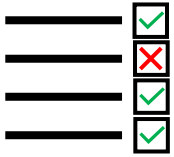

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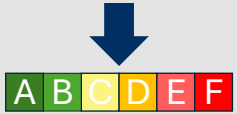

evaluation level

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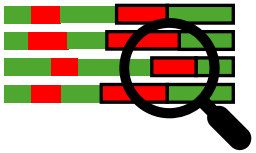
ASPECT – FORECAST QUALITY



objective:
evaluation of the forecast quality

evaluation indices:

- C-Roads-compliant horizon
- confidence
- weighting confidence-likelyTime
- minEndTime
- maxEndTime

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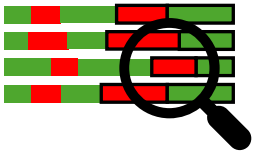
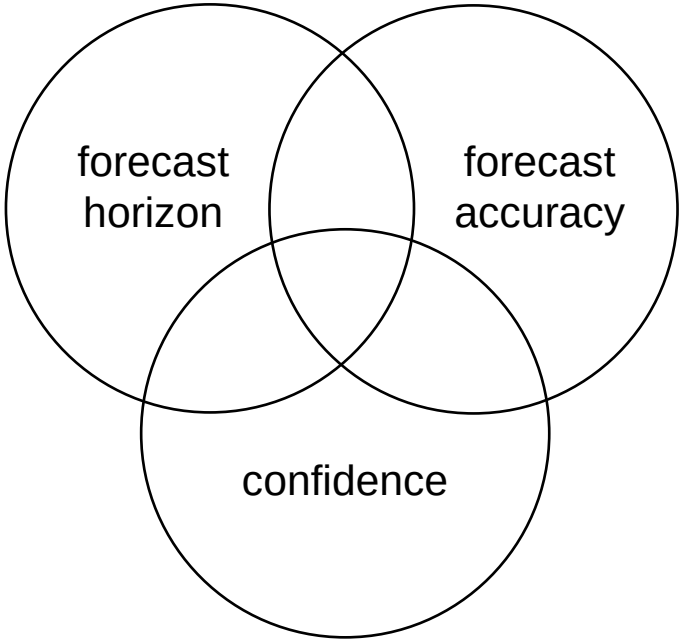
ASPECT – FORECAST QUALITY





The **forecast quality** is a sum of confidence evaluations weighted according to forecast horizons.

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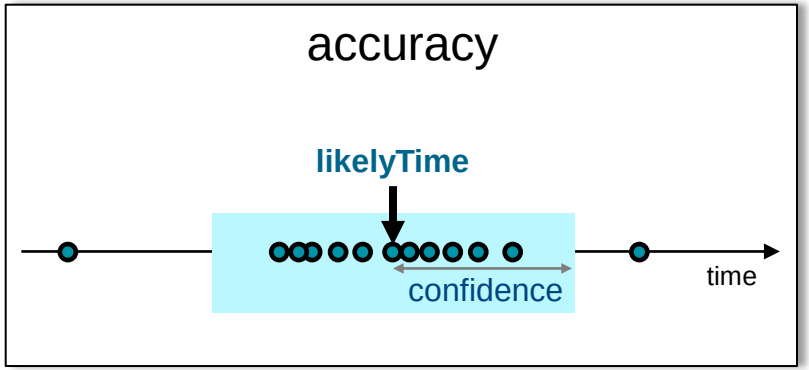
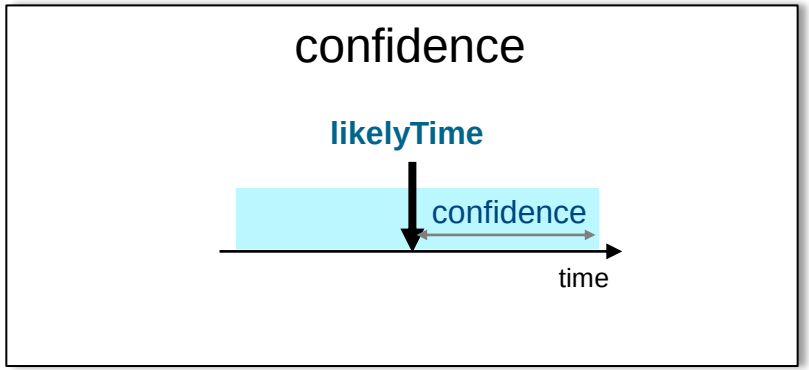
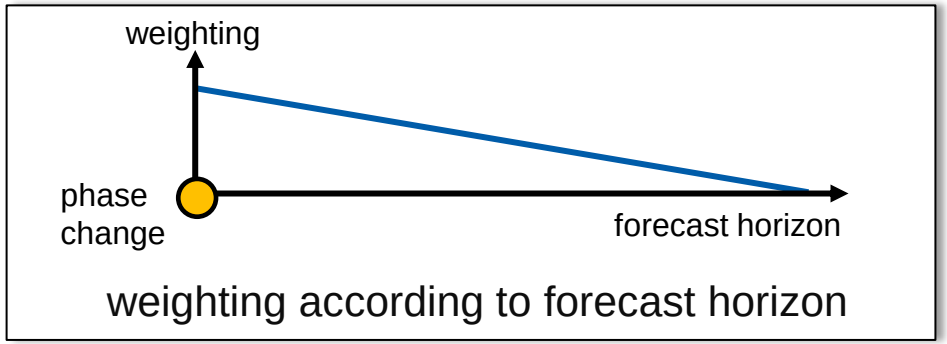
ASPECT – FORECAST QUALITY







actual phase change

likelyTime

confidence

result

forecast quality

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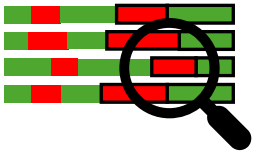

objective :
evaluation of the forecast quality

evaluation indices:

- C-Roads-compliant horizon
- confidence
- weighting confidence-likelyTime
- minEndTime
- maxEndTime

evaluation:

forecast quality

A B C D E F

evaluation level

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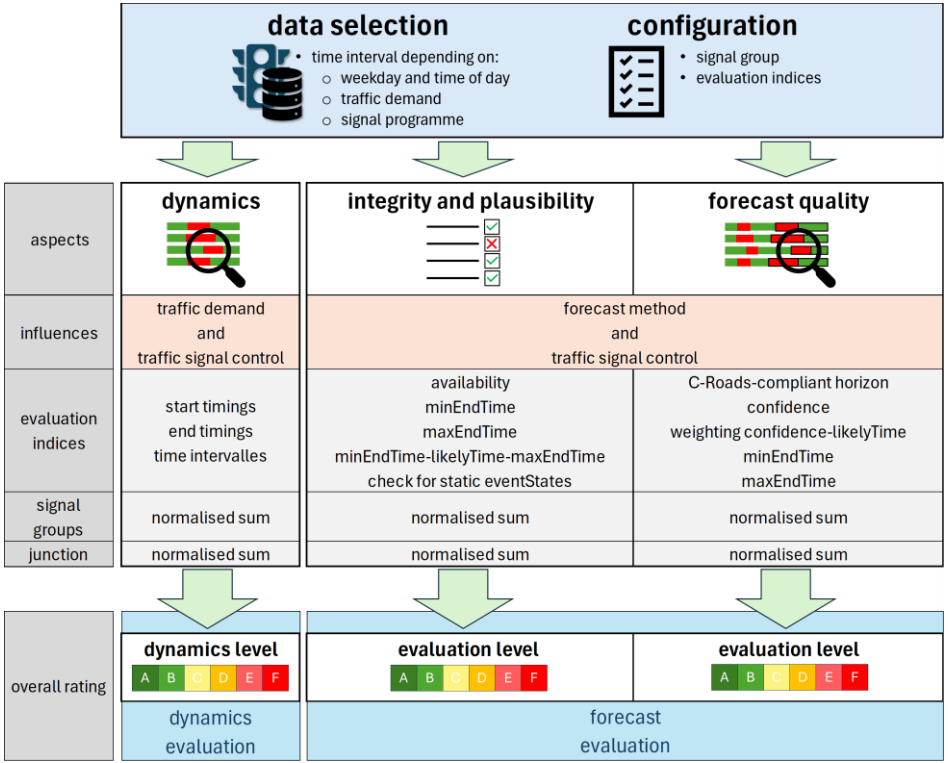

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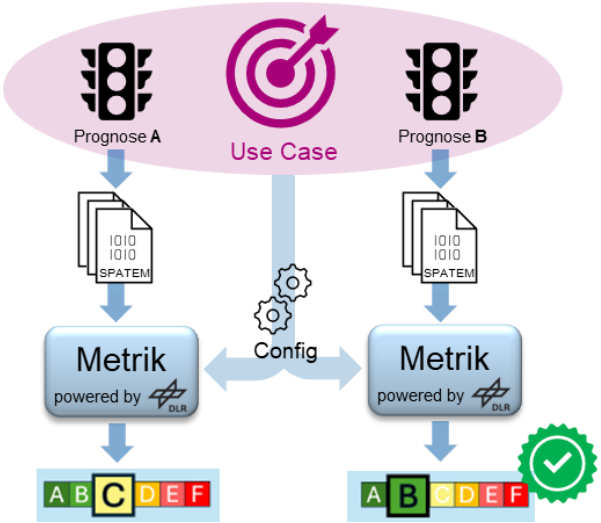
PRACTICAL APPLICABILITY

As the implementation body of the City of Hamburg, Hamburg Verkehrsanlagen faces the following questions:

- Which system provides the "better" forecast for a defined use case?
- Is a use case involving a forecast suitable for a specific location?

Hamburg Verkehrsanlagen



Application scenarios for the evaluation metric:

- Comparison of manufacturers / forecast providers (e.g., tenders)
- Comparison of junction-specific influences (e.g., site selection)
- Comparison of signal control-specific parameters

Prerequisites for practical applicability:

- Configuration of the metric must reflect the requirements of the use case
- Automated evaluation of generated forecast data
- Ensuring comparability factors

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NEXT STEPS

Current Status:

- Approach & concept developed
- Influencing factors identified
- Stakeholders and expectations explored
- Evaluation metric developed
- Mathematical description
- Algorithm design
- Implementation of program code
- Testing on real-world forecast data
- Results interpreted and documented

What is still open?

- Categorisation of use cases
- Definition of threshold values for quality levels
- User-friendly, software-based implementation
- Practical validation
- Coordination with stakeholders for further development of the evaluation metric

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SUMMARY

- Background and motivation of QuaProDaLi
- Explanation of the approach to developing the evaluation metric concept
- Presentation of the evaluation metric and its various aspects
- Q&A and joint discussion on evaluation metric

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WHAT‘S NEXT?

Wrap-Up	Discussion & standardisation	Follow-up activities
• Evaluation of the discussion and Q&A session • Possible revision or detailing of evaluation metric of forecast quality	• CAR 2 CAR Week #33 • Intertraffic Amsterdam 10-13. March 2026	• Development of a follow-up project for application and verification of the evaluation metric of forecast quality

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