




Sustainable Future for Mobility

Revolutionizing Traffic Flow
Optimisation using TraFO





In our rapidly evolving world, traffic congestion has become a pressing challenge that hampers productivity, wastes time, and negatively impacts the environment. As we confront the urgent climate crisis, optimizing traffic flow has taken on newfound significance in our collective **pursuit of a sustainable future**. Enter TraFO (Traffic Flow Optimizer), a game-changing solution designed by Fujitsu to revolutionize the way we navigate our roads and combat the environmental implications of transportation.

Efficient traffic optimization is crucial in addressing the **climate challenge**. As urban populations grow and vehicle numbers escalate, greenhouse gas emissions, air pollution, and energy consumption rise in tandem. The consequences are far-reaching, affecting not only our environment but also **public health and overall well-being**.

TraFO offers a multifaceted approach to tackling these challenges by **streamlining traffic flow and minimizing congestion**. Powered by advanced algorithms and cutting-edge technology, TraFO optimizes **traffic patterns, synchronizes traffic lights**, and provides **real-time insights** to infrastructure providers, creating a more efficient and sustainable transportation system.

One of the key aspects of TraFO's effectiveness lies in its ability to optimize traffic light programs in dependency to all intersections in a specific area. By strategically coordinating traffic signals, TraFO achieves significant improvement. This not only reduces overall travel time but also energy consumption and decreases carbon dioxide emissions.

Redefining Traffic Optimization with Innovative Solutions

1 Leveraging the power of digital twin

TraFO harnesses the transformative capabilities of Digital Twin technology to revolutionize traffic optimization. By creating a virtual replica of the traffic network, TraFO's Digital Twin provides real-time insights into patterns, congestion points, and potential bottlenecks.

This digital representation serves as a dynamic simulation platform, allowing TraFO to test and refine optimization strategies before implementation. Through the integration of real-time data and advanced analytics, TraFO's Digital Twin enables precise traffic signal coordination, lane assignment optimization, and proactive congestion management.

With TraFO's utilization of the Digital Twin, cities can embrace data-driven decision-making and unlock the full potential of traffic optimization for a better future.

2 Orchestrating traffic program alternatives for optimal efficiency

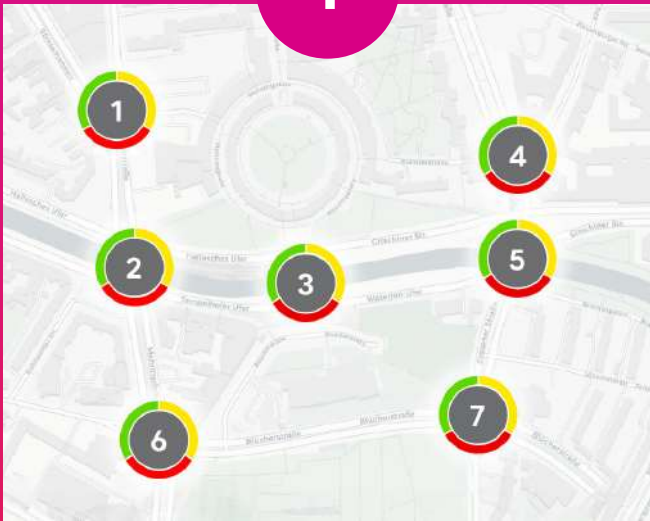
TraFO is changing the game in traffic optimization by utilizing cutting-edge algorithms. By generating alternative traffic light programs and clustering them using a distance algorithm, TraFO unlocks new possibilities for improving traffic flow. Taking it a step further, TraFO conducts prediction simulations to evaluate these alternatives based on various key performance indicators (KPIs), like sum of CO₂ emissions or travel time.

3 Unleashing the power of KPIs and the digital annealer

TraFO takes traffic optimization to the next level by harnessing the potential of KPIs and the Digital Annealer. By evaluating alternative traffic light programs of neighboring junctions against diverse KPIs, TraFO generates valuable data. This data is then fed into the advanced Digital Annealer, which tirelessly explores and identifies the best combination of alternatives for the entire traffic network.

With this powerful synergy, TraFO achieves unmatched efficiency and minimizes congestion. Experience the future of traffic optimization with TraFO as it unlocks the full potential of data-driven decision-making for smoother, smarter transportation networks.

1



Create a digital twin

Foundation

- Create the digital twin, which contains:
 - The road network
 - The traffic regulations, like speed limits, directions, ...
 - The traffic light programs allowed
- Add situation specific data, like
 - The actual position and speed of vehicles on the streets
 - actual conditions, like weather
 - event information
- Use this Digital Twin to run simulation of traffic using standard algorithm.

2



Looking at each junction locally

Target

- Find good alternative traffic light programs for each crossing
- Programs has to be correct regarding legal regulations
- Program should improve traffic, so select the best ones out of thousands of possible alternatives

Challenge

- A program which is positive for a single junction can cause negative effects for other junctions and for the whole network

3



Combine all neighbouring junctions

Solution

- While predicting future traffic, combine neighbouring junctions with their alternatives
- Creating KPIs for each combination and using the power of the Digital Annealer to find the best overall combination
- This approach results in a view of the whole network
- Can be done in seconds instead of days, so we can do this live and continuously
- Using the butterfly effect to get the best out of every optimization cycle to create a big impact

Comparing TraFO: Unleashing the Power of Optimized Traffic Light Signal Programs for the Whole Network

When it comes to traffic optimization, various approaches to traffic light signal programs have been explored. By comparing these approaches to TraFO, we can highlight the unique advantages and capabilities of our solution. Let's examine each approach:

Fixed time: Traffic signals operate on a predetermined schedule, cycling through fixed timings regardless of real-time traffic conditions.

Demand based: Signal timings dynamically adapt to real-time traffic demands, adjusting signal phases and durations based on traffic volume and patterns directly using the sensors locally connected to the junction.

Green Wave: Coordinating signals along a stretch of road to synchronize green lights allows a continuous flow of traffic, minimizing stops and delays in one direction, but discriminates the opposite direction and crossing streets.

AI: Leveraging artificial intelligence, traffic light programs are optimized using pretrained networks that learn from vast historic traffic datasets, enabling predictions and adaptive signal control.

	Fixed Time	Demand Base	Green Wave	AI	TraFO
Improvement of Traffic Flow	✗	?	?	✓	✓
Real-Time Optimization	✗	✓	✗	✓	✓
Network-Wide / City-Wide Applicability	✓	✗	✗	✓	✓
Low Data Requirements	✓	✓	✓	✗	✓
Easy to Integrate Into New Area	?	✓	?	✗	✓
Easy Customize to New Goals	✗	✗	✗	✗	✓
Efficiency and Congestion Reduction	✗	?	?	✓	✓
Adaptability to Different Situations	✗	✗	✗	?	✓
Easy to Extend to Further Junctions	?	✓	✗	?	✓
Traceability of the Decision of Used Programs	✓	?	✓	✗	✓

✓ Fulfilled
 ? Partly fulfilled or depending on situation
 ✗ Not Fulfilled

When comparing TraFO to other approaches, it becomes evident that TraFO stands out as a comprehensive solution that surpasses traditional methodologies in several key aspects. Let's examine the distinctive advantages of TraFO:

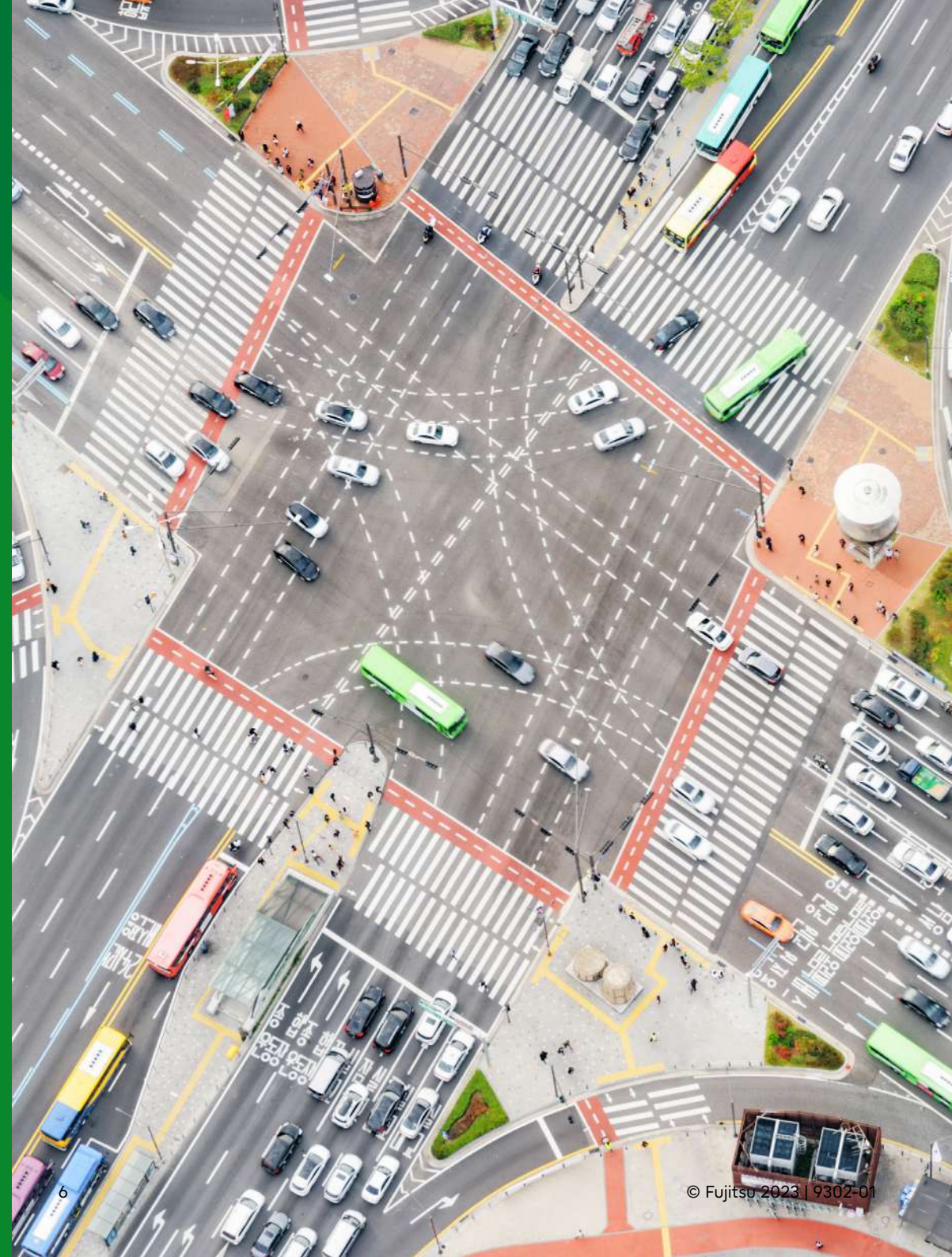
Real-time optimization: While fixed-time programs and Green Wave operate on predetermined schedules, TraFO optimizes traffic in real-time, dynamically adjusting signal timings and routes as conditions change.

Global network approach: Unlike approaches limited to specific locations like Demand Based solutions, TraFO embraces an overall perspective, offering seamless optimization across diverse locations, ensuring consistent efficiency for a whole region.

Minimal historical data: Unlike AI-based approaches that rely on extensive historical data, TraFO's agile nature allows it to deliver exceptional results without the need for huge amounts of historical training data.

Easy integration and adaptability: TraFO exceed in integrating with new infrastructure, and seamlessly adapts to changing situations and goals. Its flexibility and adaptability ensure continuous optimization as traffic conditions evolve.

By outperforming traditional approaches with real-time optimization, a global network approach, minimal historical training data requirements, and easy integration and adaptability, TraFO sets a new standard for traffic management. Embrace TraFO's transformative capabilities and unlock the full potential of efficient, adaptable, and goal-oriented traffic optimization.






Case Study: Hamburg Port Authority

The Hamburg Port Authority (HPA) plays a pivotal role in managing the bustling traffic within the Port of Hamburg. However, they face significant challenges, particularly in addressing emissions and stop-and-go traffic caused by about 20,000 heavy goods vehicles (HGVs) and thousands of commuters per day. With limited scope for infrastructure expansion, the HPA is turning to digital solutions to revolutionize traffic management.

By leveraging innovative technologies, such as real-time data analytics and intelligent routing systems, the HPA aims to optimize traffic flow, reduce congestion, and minimize environmental impact. With a forward-thinking approach, the HPA is committed to improving the efficiency and sustainability of one of Europe's busiest ports, setting the stage for a greener and more seamless future.



The Hamburg Port Authority has embarked on an ambitious journey to transform traffic management within the Port of Hamburg, and the results speak for themselves.

Through Fujitsu's innovative digital solutions, the HPA can achieve remarkable outcomes. Commuters and HGVs experience a 20% increase in travel speed, significantly reducing transit times and enhancing overall efficiency.

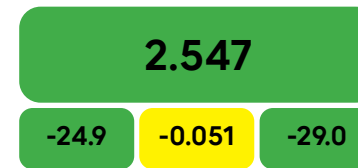
Moreover, the implementation of the intelligent traffic signal management systems can result in a remarkable 10% reduction in CO₂ emissions, contributing to a greener and more sustainable environment.

The HPA's commitment to leveraging technology and data-driven solutions will not only improve traffic flow but also set a new standard for ports worldwide, demonstrating that smart and innovative strategies can lead to substantial positive impacts.

Tailored Optimization for Individual Goals

Fujitsu offers a flexible approach to traffic optimization, adapting its strategies based on specific goals. With TraFO, you can achieve different objectives, each with its own defined set of key performance indicators (KPIs) to guide the optimization process. Here are some examples of the goals TraFO can help you accomplish:

- **Faster traffic:** TraFO can prioritize enhancing traffic flow and reducing congestion, leading to faster travel times for commuters and vehicles.
- **Less CO₂ emissions:** By optimizing traffic patterns and minimizing stop-and-go situations, TraFO aims to reduce vehicle idling and improve fuel efficiency, resulting in smoother traffic and lower CO₂ emissions.
- **On-time public transport:** TraFO can focus on optimizing traffic signal timings to ensure the on-schedule passage of public transport vehicles, enabling timely arrivals and departures, enhancing the reliability of public transportation systems.
- **Emergency vehicle transport:** TraFO can facilitate the efficient movement of emergency vehicles by prioritizing their routes. This results in minimized delays and decreases possible dangerous situations, and providing them with clear pathways, enabling faster response times during emergencies.

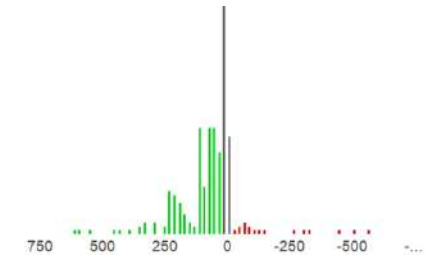


KPIs of the optimization

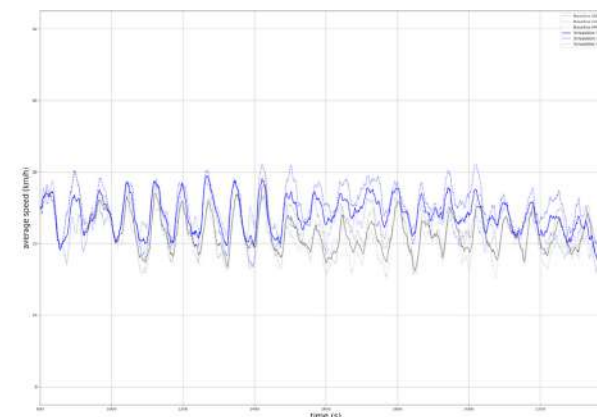
Top line: Improvement of average speed over the whole optimization run

Bottom line: Number of vehicles-in network, average deceleration over time, average number of vehicles in traffic jam situation

Number of vehicles by distance



Comparison of improvement for vehicles on street. Green means, that using TraFO the vehicles are more ahead in their way, while red are vehicles, which are behind because of the optimization.

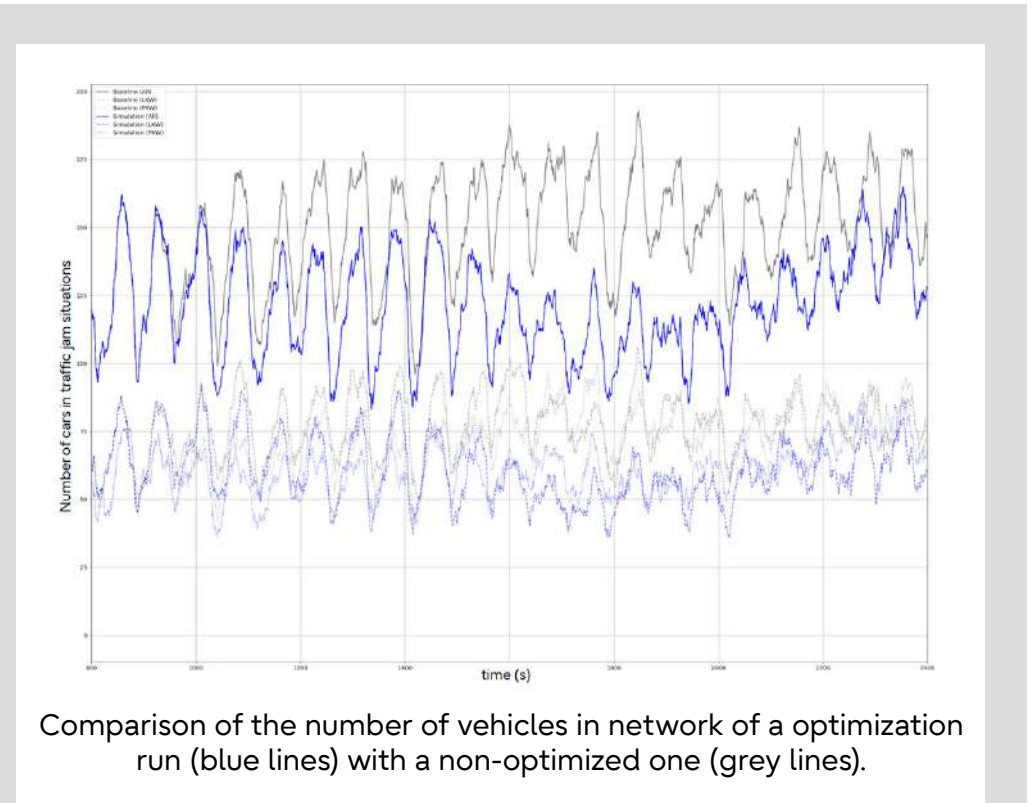
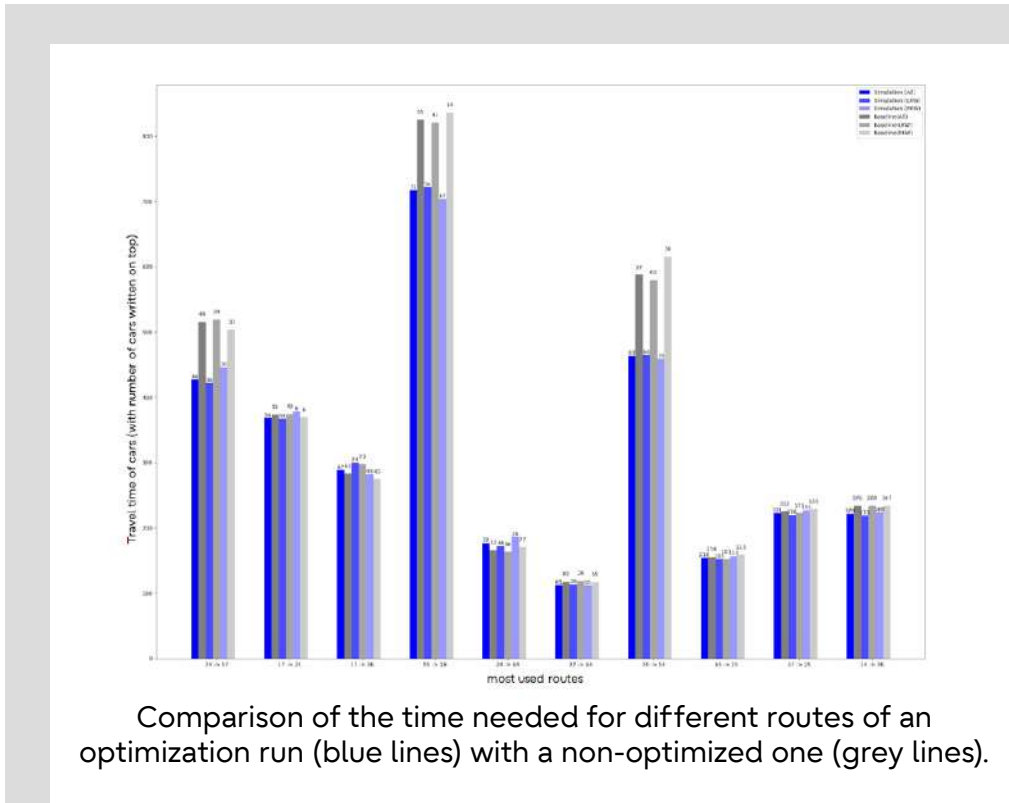
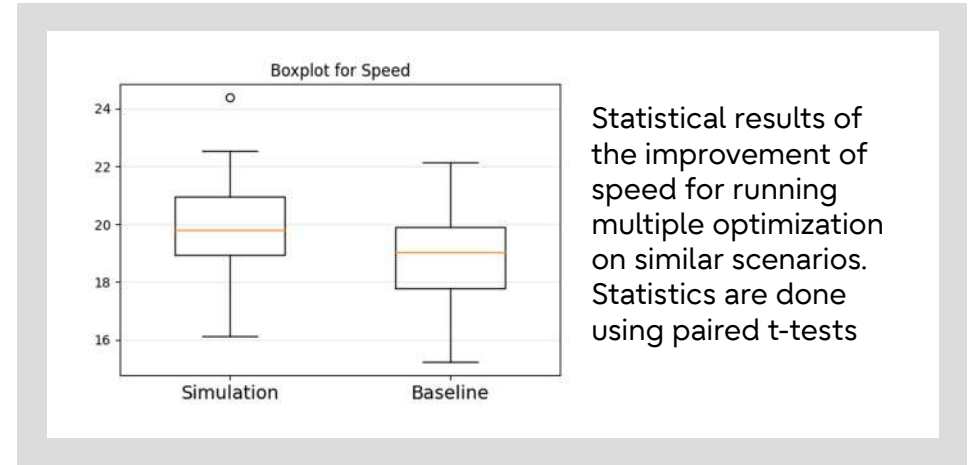


Comparison of the average speed of a optimization run (blue lines) with a non-optimized one (grey lines).

- **Flexible event management:** Adjust traffic management strategies to handle special events, considering factors such as increased traffic volume, temporary road closures, and alternative routing options to ensure smooth event operations.

With TraFO, you have the flexibility to define your specific goal and utilize tailored optimization strategies matching with your desired outcomes. Whether it's improving traffic flow, reducing emissions, ensuring punctual public transport, or expediting emergency vehicle transport, TraFO provides the tools to achieve your objectives effectively.

Which goal do you want to achieve?





Technical Background: Powering TraFO's Flexibility and Customization

TraFO is built on a robust microservices architecture, enabling a flexible and scalable solution that can be tailored to meet your unique challenges. This architecture allows for easy integration with existing infrastructure and provides the agility to adapt TraFO to varying traffic management systems worldwide.

To solve complex optimization problems, TraFO leverages the cutting-edge power of Fujitsu's Digital Annealer. This advanced technology rapidly searches through vast solution spaces, finding the best strategies to solve the problem.

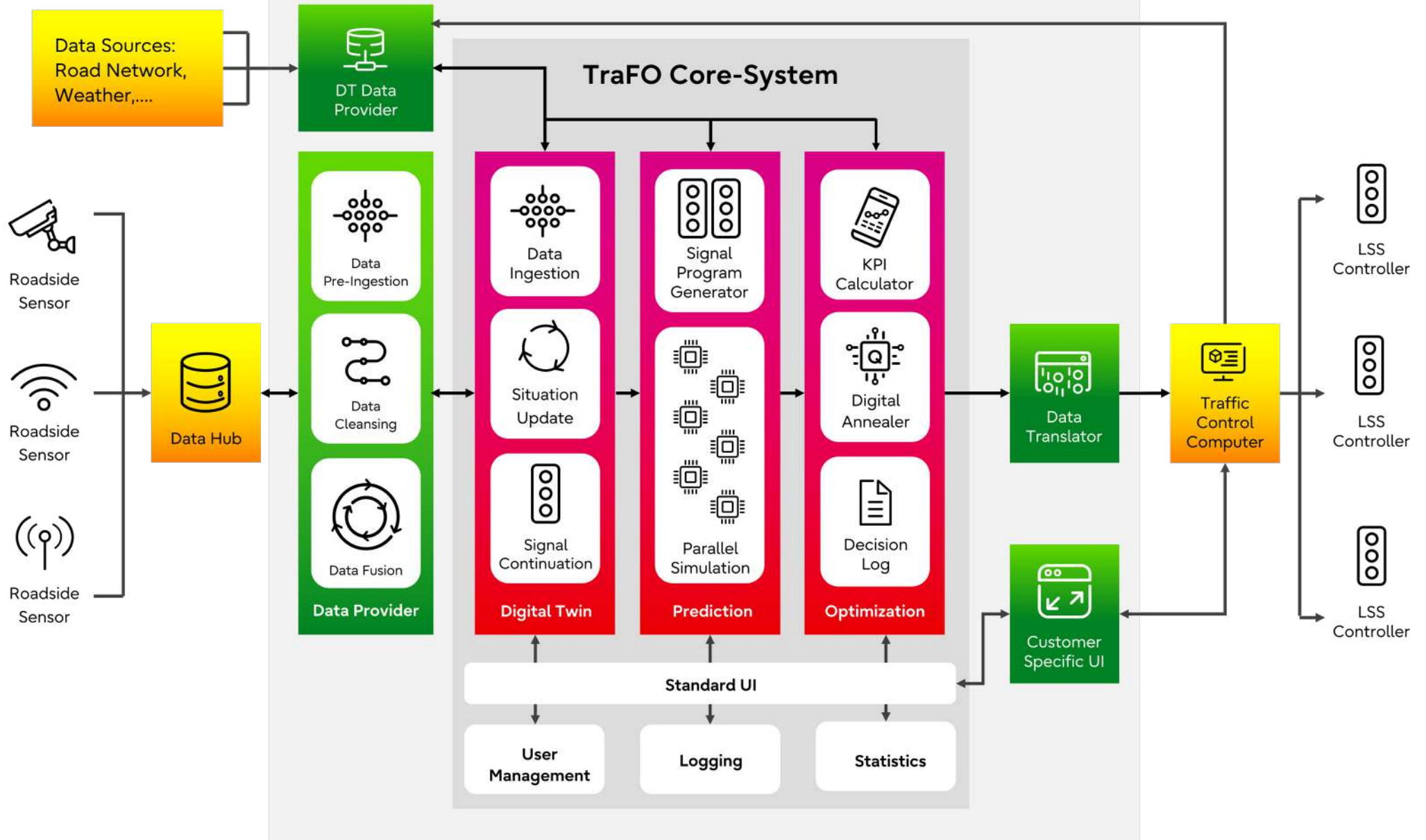
TraFO offers the versatility of running on-site or in the cloud, providing options that align with different operational requirements. Whether it's the need for local control or the benefits of cloud-based

infrastructure, TraFO ensures seamless integration and optimal performance.

Customizability is a key feature of TraFO, allowing users to tailor the solution to their specific requirements. From defining goals and selecting KPIs to adapting algorithms and optimization strategies, TraFO provides the flexibility to create a solution that meets unique traffic management objectives.

With TraFO's microservices architecture, utilization of the Digital Annealer, flexible deployment options, and customizable features, this advanced solution empowers traffic management authorities to tackle complex optimization challenges and create a traffic management system perfectly suited to their needs.

TraFO Customized Solution



TraFO and Fujitsu Uvance: Building a sustainable and resilient future together

TraFO: Revolutionizing traffic optimization for a sustainable future

TraFO's innovative approach to traffic optimization aligns seamlessly with Fujitsu Uvance's vision of creating a Trusted Society that prioritizes sustainability and the global environment. By focusing on reduced congestions and improved traffic flow, TraFO contributes to the development of a livable society that takes into account various road users. With its flexibility and ability to adapt to emergencies through countermeasures, TraFO helps cities prepare for unforeseen events. Together we are building a sustainable and resilient future that prioritizes the well-being of people and the planet.

Fujitsu Uvance: Trusted technologies for social problem solving

Fujitsu's Uvance initiative advances the creation of a Trusted Society by harnessing trustworthy technologies to solve social problems. With a focus on abundance, safety, security, and sustainability, Fujitsu collaborates with countries, governments, citizens, and business partners to address societal challenges. By integrating TraFO into this ecosystem, we leverage its innovative traffic optimization capabilities to contribute to the development of a harmonious and prosperous society. Together, we strive to create an environment-first, resilient future where people can live in peace and prosperity.





A collaborative path to a sustainable and resilient society

Through the collaboration between Fujitsu TraFO technology and Fujitsu Uvance, we forge a path towards a sustainable and resilient society. By combining TraFO's commitment to sustainable traffic management with Fujitsu Uvance's holistic societal approach, we pave the way for a future that embraces safety, security, and sustainability. Together, we address social challenges, prioritize the environment, and prioritize the well-being of individuals and communities. By leveraging trustworthy technologies and innovative solutions, we build a Trusted Society where people can thrive in peace and prosperity, fostering a harmonious coexistence between humans and the planet.

Get in touch with us today to discover how Fujitsu TraFO can revolutionize your traffic management strategies, create a sustainable and resilient future, and contribute to the development of a Trusted Society.

Contact us now to explore the possibilities and embark on a journey towards optimized traffic flow, reduced emissions, and enhanced livability in your city or region.



Fujitsu

smart.city@fujitsu.com

Fujitsu 2023 © | 9302-01. All rights reserved. Fujitsu and Fujitsu logo are trademarks of Fujitsu Limited registered in many jurisdictions worldwide. Other product, service and company names mentioned herein may be trademarks of Fujitsu or other companies. This document is current as of the initial date of publication and subject to be changed by Fujitsu without notice. This material is provided for information purposes only and Fujitsu assumes no liability related to its use. We reserve the right to change delivery options or make technical modifications