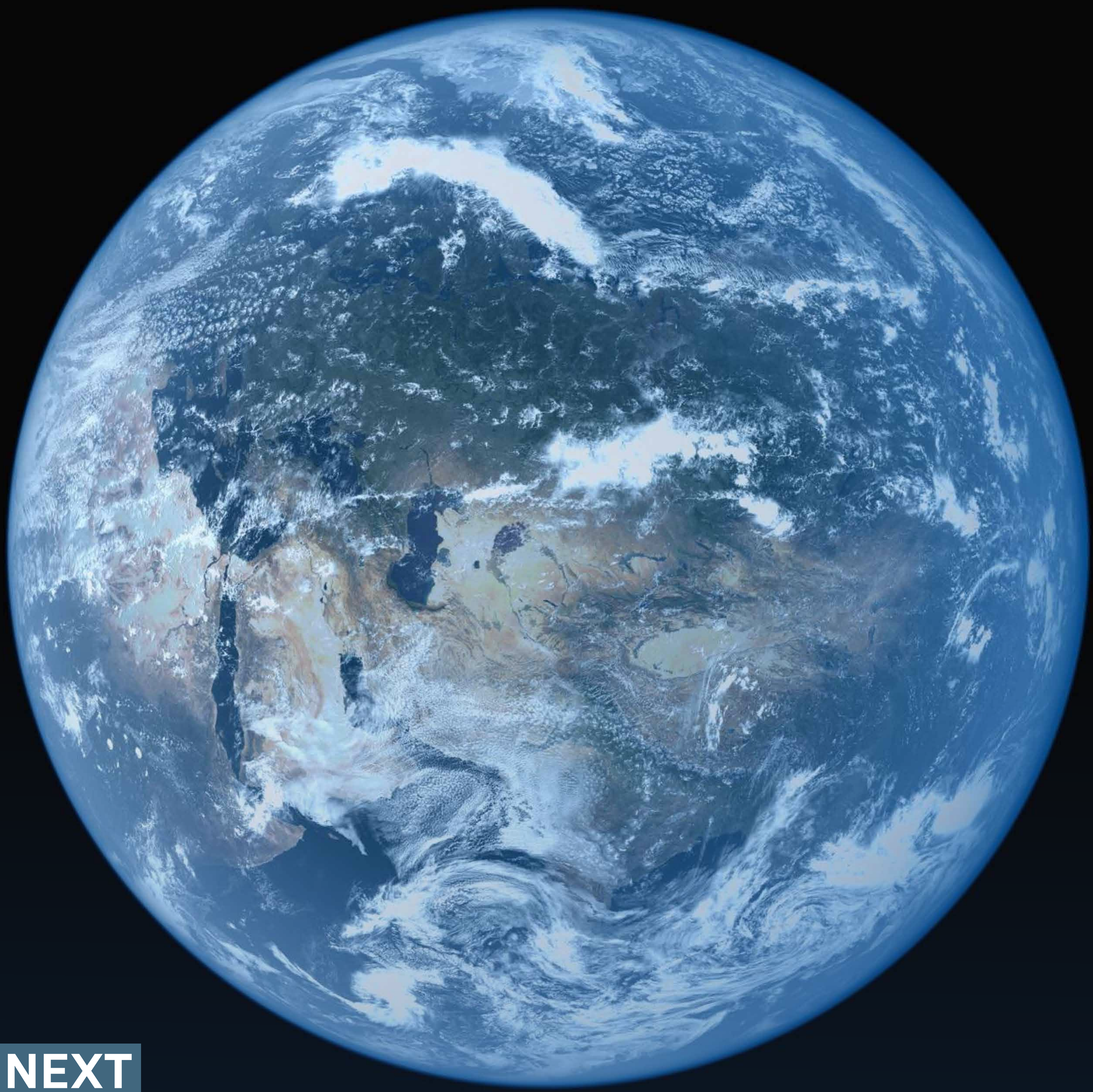
TECHNISCHE HOCHSCHULE DEGGENDORF



NEXT

DESIGN AND PROTOTYPE IMPLEMENTATION OF THE NEXT GENERATION VECTOR MAP RENDERING STACK WITH A SPECIAL FOCUS ON WEB MAPS

Weitere Infos:

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Abstract

Working Title:

Design and prototype implementation of the next generation vector map rendering stack with a special focus on web maps

Short Title:

Design of the next generation map rendering stack

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INSTITUTE: Digitech Doctoral Centre

SUPERVISOR: Professor Dr. Roland Zink

Deggendorf Institute of Technology

Project title:

Design and prototype implementation of the next generation vector map rendering stack with a special focus on web maps

Short title:

Design of the next generation map rendering stack

Introduction:

Digital maps are strongly integrated into various aspects of modern life. They have a wide range of use cases, such as navigation, location-based services, and logistics. Many of the widely used digital map applications and services are based on the free available planet-scale OpenStreetMap (OSM) dataset. For the management, processing and visualization of geospatial data such as OSM, the technology stack from a company called Mapbox and its open-source forks from the MapLibre organization are widely considered state-of-the-art in the mapping industry. The excellence of these technologies is highlighted by their widespread adoption among major technology companies such as Meta, Amazon, and Microsoft. However, some of these components were designed nearly a decade ago and consequently do not fully align with the capabilities of contemporary hardware and modern APIs, as well as the demand for the strongly increasing geospatial data volumes.

Aim:

To address these limitations, this project will take the newly available technological capabilities into account and design as well as prototype implement a novel map rendering stack end-to-end. Innovations and optimizations across the entire technology stack, from the provisioning of maps in the cloud to rendering on the client, are expected to result in a significantly better user experience and a more cost-effective deployment of large vector basemaps.

Method:

This thesis will focus on the following key components and methods. Firstly, it introduces a new cloud optimized file format (COMTiles), specifically designed to reduce cloud access charges and simplify the deployment workflow of large map tilesets in a cloud-native environment. Secondly, it proposes a novel vector tiles format (MLT), which is based on a column-oriented layout and lightweight compression schemes, aiming to combine good compression ratios with fast decoding and processing performance. Thirdly, it presents a web-based proof-of-concept map renderer that offloads the entire processing of vector tiles to the GPU, utilizing WebGPU shaders for optimized performance.

Result:

Preliminary work on the cloud-optimized format has shown that a planet-scale OSM dataset can be deployed on cloud object storage with a significant reduction in the costs compared to a Software as a Service (SaaS) provider like Google Maps, achieving cost savings of approximately three orders of magnitude. Furthermore, the new vector tiles format MLT shows an up to 6x reduction in size compared to the state-of-the-art Vector Tile (MVT) format while still offering a faster decoding performance. Based on these benchmarks, Microsoft is financially supporting the integration of the current research prototype into the MapLibre mapping stack.

Project participants:

- Markus Tremmel
- Prof. Dr. Roland Zink (TH Deggendorf)