Learning video digital twins at the network edge

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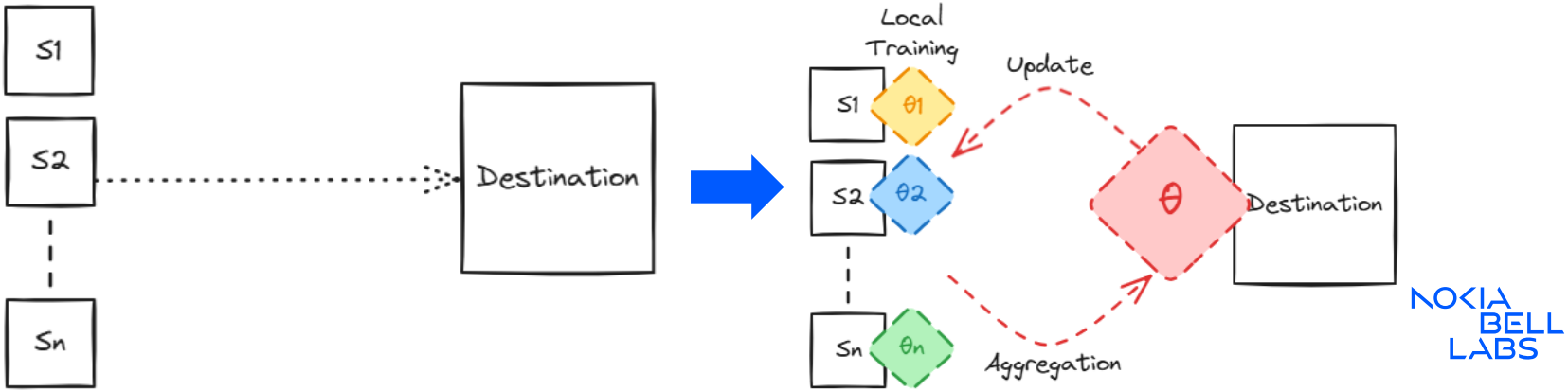
Edge computing research at Bell Labs

Where we are coming from…

Leveraging the availability of computing resources close to the users for AI/ML-based applications

- Inference Delivery Networks (INFIDA, 2021 – joint work with INRIA)
- Head Network Distillation with dynamic edge offload (ReBEL, 2022 – joint work with INRIA)
- Understanding Federated Learning in heterogeneous settings (A. Nasser's thesis, with INRIA)
- Federated Learning as a form of "Semantic Group Communication" (very preliminary ideas)



Synthesis of 3D models from captured images and streams

An emerging practical network- and compute-intensive SGC problem!

Mip-NeRF 360 (Barron et al., 2022)

Distributed-Oriented Gaussian Splatting (Chen et al., 2024)

Block-NeRF (Tancik et al., 2022)

Problem statement: Digital Video Twin Synthesis over 6G

Joint work with Y. Alexandre Lalle and Francesca Bassi (IRT-SystemX)

- Goal: Build dynamic, large-scale continuous 3D scene reconstructions for 6G metaverse applications.
- Research Gap: Most studies in the related work focus on algorithmic optimization (training speed, compression) or rendering performance in both centralized and edge-assisted scenarios
- Our Focus: The practical challenges of timely data acquisition and processing at the edge, with an attempt to collaboratively building and updating a digital twin from heterogeneous video sources
- Target Use Case: Vehicular networking scenario with mobile cameras (cars) and fixed infrastructure
- Core Difficulties: This acquisition-first approach highlights key challenges in handling non-IID data, managing pose / synchronization errors, and maintaining model consistency in dynamic 6G networks