EDGE COMPUTING: VISION AND CHALLENGES - ONE PAGE SUMMARY REPORT

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NEED FOR EDGE COMPUTING

- **Cloud Limitations**: Despite powerful cloud processing, network bandwidth stagnation hinders real-time data transfer (e.g., 5 GB/s from a Boeing 787 or 1 GB/s from autonomous vehicles).
- **IoT Growth**: By 2020, 50 billion devices will connect to the internet, producing vast data best processed locally to save bandwidth, reduce latency, and enhance privacy.
- **Role Shift**: Edge devices now produce and consume data (e.g., social media uploads), necessitating local processing capabilities.

INTRODUCTION

- Edge Computing enables computation on downstream (cloud-to-edge) and upstream (IoT-to-cloud) data flows, distinguishing it from Fog Computing by focusing on the "things" side.
- Benefits include reduced latency (e.g., face recognition response time dropped from 900 ms to 169 ms), energy savings (30-40% via cloudlet offloading), and enhanced privacy by processing sensitive data locally.

CASE STUDIES

1. **Cloud Offloading**: Offloading tasks like shopping cart updates to edge nodes cuts latency, improving user experience.
2. **Video Analytics**: Local processing of camera data (e.g., finding a lost child) speeds up results while preserving privacy.
3. **Smart Home**: EdgeOS on gateways manages home IoT devices, reducing bandwidth use and enhancing privacy.
4. **Smart City**: Edge processing handles large data volumes (180 PB/day in a 1-million-person city by 2019) with low latency and location awareness.
5. **Collaborative Edge**: Connects distributed edges for data sharing (e.g., healthcare collaboration during a flu outbreak), balancing privacy and utility.

CHALLENGES AND OPPORTUNITIES

- **Programmability**: Heterogeneous edge platforms require flexible "Computing Streams" to define where and how data is processed.
- **Naming**: Scalable, dynamic naming schemes (e.g., beyond DNS) are needed for vast, mobile IoT devices.
- **Data Abstraction**: Balancing data filtering with usability amid unreliable sources and diverse formats is complex.
- **Service Management**: Requires differentiation, extensibility, isolation, and reliability (DEIR) for robust edge services.
- **Privacy and Security**: Local processing aids privacy, but awareness, data ownership, and lightweight security tools remain gaps.
- **Optimization Metrics**: Latency, bandwidth, energy, and cost must guide workload allocation across edge layers.

CONCLUSION

- Edge Computing emerges as a critical evolution beyond Cloud Computing, promising efficiency, speed, and privacy for IoT-driven applications. While offering substantial benefits, its implementation faces significant technical hurdles. The authors call for community attention to refine this paradigm, envisioning its societal impact akin to that of Cloud Computing.

APPENDICES

1. ☐ **Technical Specifications of Edge Devices**
2. ☐ **Case Study Data and Metrics**
3. ☐ **Edge Computing vs Related Paradigms**
4. ☐ **Proposed EdgeOS Framework Prototype**