

# WILLIAM SENTOSA

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## EDUCATION

<b>University of Illinois Urbana-Champaign, USA</b> Ph.D. in Computer Science Advisor: P. Brighten Godfrey	<i>Aug 2018 - (Expected: May 2026)</i>
<b>Bandung Institute of Technology, Indonesia</b> B.S. in Computer Science	<i>Aug 2013 - Oct 2017</i> GPA: 3.83/4.00

## RESEARCH STATEMENT

I am interested in a broad area of **systems and networking**, including (but not limited to) low-latency networking, transport layer, cellular networks, Sys for ML, and ML for Sys. My previous works center on three topics: (1) addressing fundamental low latency networking problems, including application latency using multipath (DChannel, NSDI'23; HVCs, HotNets'23), ISP latency (cISP, NSDI'22), and WiFi latency (WTSN, HotMobile'25); (2) developing an accurate cellular network emulator (CellReplay, NSDI'25); and (3) enabling cloud-based offloading for VR/AR components (RemoteVIO, MMSys'25; WarpLab, MMSys'25).

## PUBLICATIONS

### **CellReplay: Towards accurate record-and-replay for cellular networks**

William Sentosa, Balakrishnan Chandrasekaran, P. Brighten Godfrey, and Haitham Hassanieh  
*22nd USENIX Symposium on Networked Systems Design and Implementation (USENIX NSDI)*, 2025

- We develop CellReplay, an accurate trace-based emulator tool that captures real-world variability in cellular networks. Through measurement, we show that cellular networks exhibit latency dynamics that depend on workloads. CellReplay captures these dynamics using a novel interpolation and provides significantly better accuracy ( $\approx 2.5\times$ ) for networked apps (e.g., web browsing and video streaming) compared to the widely used state-of-the-art.
- This paper won **NSDI'25 Community Award** (best paper whose code and/or data set is made publicly available)

### **DChannel: Accelerating Mobile Applications With Parallel High-bandwidth and Low-latency Channels**

William Sentosa, Balakrishnan Chandrasekaran, P. Brighten Godfrey, Haitham Hassanieh, and Bruce Maggs  
*20th USENIX Symposium on Networked Systems Design and Implementation (USENIX NSDI)*, 2023

- 5G (and beyond) provide differentiated services: high throughput with increased latency (eMBB) and low latency with limited throughput (URLLC). DChannel provides a network-layer solution that dynamically steer packets across both channels, leveraging their combined high bandwidth and low latency benefits. Our experiments show that while URLLC provides only 1% of eMBB's bandwidth, utilizing both channels improves web page load times and mobile app responsiveness by 16–40% compared to using eMBB alone.

### **Accelerating Mobile Applications With Parallel High-bandwidth and Low-latency Channels**

William Sentosa, Balakrishnan Chandrasekaran, P. Brighten Godfrey, Haitham Hassanieh, Bruce Maggs, Ankit Singla  
*The Twenty-second International Workshop on Mobile Computing Systems and Applications (ACM HotMobile)*, 2021

- This position paper is an early version of our work on DChannel (NSDI'23).

### **Offloading Head Tracking for Low Power XR: An End-to-End System and Evaluation**

Qinjun Jiang, Yihan Pang, William Sentosa, Steven Gao, Muhammad Huzaifa, Jeffrey Zhang, Javier Perez-Ramirez, Dibakar Das, Dave Cavalcanti, P. Brighten Godfrey, and Sarita Adve.  
*16th ACM Multimedia Systems Conference (ACM MMSys)*, 2025

- We develop RemoteVIO, the first end-to-end extended reality (XR) system that offloads head tracking to a remote server. Our studies with 30 users show that RemoteVIO provides a satisfactory user experience under typical network conditions. Energy tests on real hardware show that RemoteVIO reduces end-to-end system power consumption by up to 20%.

### **WarpLab: Evaluating Edge-Assisted Rendering Offload for Low Power Extended Reality Devices**

Steven Gao, Jeffrey Liu, Qinjun Jiang, Finn Sinclair, William Sentosa, P. Brighten Godfrey, and Sarita Adve.

*16th ACM Multimedia Systems Conference (ACM MMSys)*, 2025

- In a cloud-based VR, reprojection is needed to compensate for an additional latency coming from the network. This paper presents OpenWarp, a mesh-based reprojection technique that generates new frames by warping older frames according to six degrees-of-freedom (DoF) motion. Through user studies, we show that 45% and 75% of users find OpenWarp's quality of experience indistinguishable from on-device rendering under 5G and WiFi networks, respectively.

### **Is WTSN the missing piece for low latency in general-purpose Wi-Fi?**

Milind Kumar Vaddiraju, William Sentosa, Qinjun Jiang, Sarita Adve, Dave Cavalcanti, Dibakar Das, P. Brighten Godfrey, Javier Perez-Ramirez, and Deepak Vasishth.

*Twenty-second International Workshop on Mobile Computing Systems and Applications (ACM HotMobile)*, 2025

- Wireless Time-Sensitive Networking (WTSN) offers low-latency, reliable, and time-synchronized data transmission over WiFi. However, it traditionally relies on precise prior knowledge of packet arrival times, which is impractical for many applications. This paper demonstrates that WTSN can achieve low latency without such knowledge by leveraging a multipath design.

### **Boosting Application Performance using Heterogeneous Virtual Channels: Challenges and Opportunities**

Talal Touseef, William Sentosa, Milind Kumar Vaddiraju, Debopam Bhattacherjee, Balakrishnan Chandrasekaran, P. Brighten Godfrey, and Shubham Tiwari.

*Twenty-second ACM Workshop on Hot Topics in Networks (ACM HotNets)*, 2023

- This position paper discusses the emergence of the Heterogeneous Virtual Channels (HVCs) across various context (5G, WiFi, WAN), and how to use HVCs in different networking layers (network, transport, and application). HVCs comprise multiple channels or paths, each optimized for specific performance aspects such as throughput, latency, or reliability. We also implement a cross-layer scheme that leverages HVCs to reduce tail latency in real-time video streaming.

### **cISP: A Speed-of-Light Internet Service Provider**

Debopam Bhattacherjee, Waqar Aqeel, Sangeetha Abdu Jyothi, Ilker Nadi Bozkurt, William Sentosa, Muhammad Tirmazi, Anthony Aguirre, Balakrishnan Chandrasekaran, P. Brighten Godfrey, Gregory Laughlin, Bruce Maggs, and Ankit Singla.

*19th USENIX Symposium on Networked Systems Design and Implementation (USENIX NSDI)*, 2022

- We explore the design of wide-area networks (cISP) that move data at near light speed in a vacuum. Our cISP design aims to augment the Internet's fiber with free-space microwave wireless connectivity over paths very close to great-circle paths. To achieve ultra low latency, we address various practical challenges ranging from transmission tower availability to packet queuing. Finally, we explore the application-level benefits and present estimates demonstrating that cISP's utility far outweighs its cost.

### **Understanding and Auto-Adjusting Performance-Sensitive Configurations**

Shu Wang, Chi Li, Henry Hoffman, Shan Lu, William Sentosa, Achmad Imam Kistijantoro

*ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ACM ASPLOS)*, 2018

- We present SmartConf, a systematic and general control-theoretic framework that automatically tunes and dynamically adjusts performance-sensitive configurations to meet operational constraints while optimizing other performance metrics. We then apply SmartConf to six configuration related performance issues in various software systems (i.e., Cassandra, HBase, HDFS, and MapReduce), and show that it provides better performance than even the best static configuration developers can choose.

#### **WORK AND TEACHING EXPERIENCE**

<b>Teaching assistant</b> at University of Illinois Urbana-Champaign, USA CS241 (now CS341) - Systems Programming	Jan 2019 - Dec 2019
<ul style="list-style-type: none"><li>• I led lab sessions to teach system programming foundations such as processes, synchronization, scheduling, networking, and memory management.</li><li>• I assisted students to do the system programming assignments in C</li></ul>	

## INVITED TALKS

Accelerating Mobile Applications With Parallel 5G High-bandwidth and Low-latency Channels

- Microsoft Research, Sept 2022, Inviter: Sharad Agarwal
  - Embrace.io, May 2022, Inviter: Anuj Jaiswal

## TECHNICAL STRENGTHS

<b>Programming</b>	C/C++, Python, Java, SQL, JavaScript
<b>Databases</b>	MySQL, PostgreSQL, Cassandra
<b>Distributed Systems</b>	Hadoop, HBase, Presto
<b>Other Skills</b>	HTTP, QUIC, P4, NVIDIA CUDA