

Friday, October 17, 2025

11:15am, ITE 336

What If Networks Could Understand What They Are Sending? Semantic Communication for Smarter 6G

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Building next-generation AI-native wireless networks (e.g., 6G) requires overcoming key limitations of current AI systems—opaque decision-making, massive data needs, high energy use, and poor adaptability. We envision a paradigm shift where networks evolve from “dumb bit pipes” into a Telecom Brain: an intelligent cognitive backbone capable of reasoning, planning, and decision-making, serving as the nervous system for autonomous machines. This vision is realized through semantic communications, which transmit meaning rather than raw data, enabling devices to exchange concepts efficiently using AI and game-theoretic principles. Such semantic exchanges dramatically reduce bandwidth and reduce latency while supporting contextual reasoning at both transmitter and receiver ends. Applications span but not limited to collaborative robotics where drones and human operators coordinate disaster response, and machine-to-machine networks, where AI agents autonomously develop compact, task-specific languages. Experimental results show 10–100x compression gains, reduced latency, and improved resilience, highlighting a fundamental shift from bit-centric transmission to meaning-centric intelligent networking.

Christo K Thomas received his BS in Electronics and Communication Engineering from National Institute of Technology, Calicut, India in year 2010, his MS in Telecommunication Engineering from Indian Institute of Science, Bangalore, India in year 2012, and his PhD from EURECOM, France in year 2020. He is currently an assistant professor at the Electrical and Computer Engineering Department at WPI. Previously, he was a postdoctoral associate at the Electrical and Computer Engineering Department at Virginia Tech. His research interests include semantic communications, statistical signal processing, and artificial general intelligence (AGI)-native wireless systems. From 2012 to 2014, he was a staff design engineer on 4G LTE with Broadcom communications, Bangalore, and from 2014 to 2017, he was a design engineer with Intel corporation, Bangalore. During November 2020 till June 2022, he was a staff engineer on 5G modems with wireless research and development division of Qualcomm Inc., Espoo, Finland. He was a recipient of the best student paper award at IEEE SPAWC 2018, Kalamata, Greece, and received third prize for his team titled “Learned Chester” ML5G-PHY channel estimation challenge, as part of the ITU AI/ML in 5G challenge, conducted at NCSU, US, 2020. He had presented multiple tutorials on approximate Bayesian inference techniques at several IEEE conferences such as ICASSP and EUSIPCO, and a tutorial on AGI-native networks at IEEE GLOBECOM. He has also edited a Wiley-IEEE Press book on semantic communications and is co-author of a visionary paper on AGI-native networks in Proceedings of IEEE.

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