Queue-Sharing Multiple Access Protocol

Tech ID: 34410 / UC Case 2020-268-0

BACKGROUND

Medium Access Control (MAC) protocols determine how multiple devices share a single communication channel. This started with Additive Links On-Line Hawaii Area (ALOHA) channel protocol and advanced to Carrier Sense Multiple Access (CSMA) protocols, variants of which are used today as WiFi standards. Such random access protocols are generally divided into contention-based methods like ALOHA and CSMA which are simple yet can have collisions at high traffic loads, and contention-free methods like Time Division Multiple Access (TDMA) which offer high efficiency but require complex clock synchronization and inflexible time slotting. While distributed queuing concepts have been pitched to help bridge this gap (e.g., DQDB or DQRAP) they have traditionally relied on physical time slots, dual buses, and/or complex signaling that makes them less suitable for the modern demands of wireless networks.

TECHNOLOGY DESCRIPTION

To help address these challenges in modernizing communications protocols, researchers at UC Santa Cruz (UCSC) have developed Queue-Sharing Multiple Access (QSMA; including KALOHA with Queue Sharing a.k.a. KALOHA-QS or QSMA with No Carrier Sensing a.k.a. QSMA-NCS) which introduces a virtual, collision-free transmission schedule that's similar to TDMA but without requiring physical time slots, clock synchronization, or a central coordinator. UCSC's QSMA enables high-efficiency and collision-free communications by maintaining a global distributed queue state entirely through small data fields (e.g., queue size, position, ack, next) piggybacked on standard data packets, allowing nodes to self-organize into a dynamic firing order. The QSMA protocol that can seamlessly operate with or without carrier sensing, effectively solving the "hidden node" and "long propagation delay" problems that plague current standards. KALOHA-QS is a specific embodiment of the QSMA protocol designed to operate without carrier sensing, effectively upgrading the traditional ALOHA protocol by adding the "distributed queue" mechanism.

APPLICATIONS

- IoT / wireless sensor applications
- underwater and acoustic communication applications
- satellite and long-range telemetry applications

FEATURES/BENEFITS

- Eliminates the need for network-wide clock synchronization and fixed time slots, reducing hardware cost and complexity for IoT devices.
- Carrier-sense independent operation means high-efficiency and collision-free communication even in deaf environments like underwater and long-range.
- Unlike TDMA there are no empty slots waiting for idle nodes, ensuring near 100% channel utilization.
- Removes overhead of separate control channels or request-to-send (RTS) handshakes, which increases effective data throughput for small-packet traffic.

INTELLECTUAL PROPERTY INFORMATION

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,876,725	01/16/2024	2020-268

RELATED MATERIALS

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OTHER INFORMATION

KEYWORDS

Medium Access Control, Carrier Sense Multiple Access, Time Division Multiple Access, TDMA, QSMA, Queue-Sharing Multiple Access, protocol, Queue Sharing Multiple Access, KALOHA, queue, channel, packet, node, sensing, delay, transmission, Distributed Queue Dual Bus, Distributed Queuing Random Access Protocol, DQDB, DQRAP

CATEGORIZED AS

- **Communications**
  - Internet
  - Networking
  - Wireless

RELATED CASES

2020-268-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Loop-Free and Multi-Path Network Methods
- Differentiating Congestion Vs. Random Loss: A Method For Improving TCP Performance Over Wireless Links
- Scalable Integrated Services Architecture for Computer Networks
- Carrier Sense Multiple Access With Collision Avoidance And Pilots (CSMA/CAP)
- Interference Management for Concurrent Transmission in Downlink Wireless Communications
- Tree-Based Ordered Multicasting in Computer Networks

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