Lumissil's Approach to Simplify Lighting Communication

In modern life, comfort plays a significant role, especially in spaces where people spend the most time. While bedrooms are a primary focus for comfort at home, automobiles are the next most significant environment. With the rise of autonomous vehicles, the interior experience is evolving, but even in traditional and self-driving vehicles, the lighting experience remains essential.

One of the most impactful ways to enhance in-vehicle comfort is through the integration of lighting solutions, including ambient and animated lighting systems. These technologies are designed to create a visually appealing and relaxing atmosphere, making the driving and riding experience more enjoyable. Ambient lighting, for instance, provides customizable color schemes and intensities, which can adapt to different moods or driving conditions. Animated lighting can be used to communicate information subtly, such as guiding passengers to buckle their seat belts or indicating climate control settings. Another critical benefit of these lighting systems is their ability to mitigate motion sickness. By carefully optimizing the design and placement of interior lights, manufacturers can reduce sensory conflict between the visual and vestibular systems, a primary cause of motion sickness. Uniform, non-intrusive lighting schemes minimize distractions and create a stable visual reference point within the cabin, significantly enhancing passenger well-being. This dual focus on aesthetics and functionality demonstrates how advanced lighting technologies are reshaping the in-car experience for both drivers and passengers.

While advanced lighting solutions revolutionize in-car comfort and aesthetics, their integration presents significant challenges for automotive manufacturers, particularly in managing high-speed communication protocols like Controller Area Network (CAN). These systems require a rapid data exchange to ensure seamless and colorful lighting effects, which can be difficult to achieve in environments with high data traffic and complex system demands.

To address these challenges, **Lumissil** has developed **LUMIBUS™**, a proprietary protocol designed to meet the demands of high-speed automotive lighting systems. Built on a **UART-based communication framework**, **LUMIBUS** is compatible with most microcontroller units (MCUs). It operates using a **command-and-response structure**, where the host MCU acts as the master, controlling all communication with the connected devices. This design allows the host MCU to read and write to the registers of each device, ensuring precise control over lighting operations. In order to maintain a streamlined and predictable communication flow, slave devices connected to the **LUMIBUS** network never initiate traffic. This offers several advantages:

1. It minimizes the risk of communication collisions
2. Simplifies protocol implementation
3. Ensures that all devices respond promptly and consistently to the host's commands

Let's do a quick overview of CAN communications: CAN (Controller Area Network) is a high-speed serial bus using message-based communication protocol for automotive systems. It is capable of transferring data at 1 Mbps in standard form and up to 8 Mbps with CAN-FD (Flexible Data). The higher speeds of CAN make it well-suited for applications requiring rapid data exchange, such as ambient lighting systems, enabling more dynamic, adaptive, and responsive lighting solutions that enhance the user experience.

LUMISSIL'S SOLUTION

LUMIBUS is a UART protocol over CAN bus, it works with both CAN PHY and CAN-FD PHY, making it highly suitable for applications involving a large number of LED drivers. The bus transmission speed varies depending on the system topology, offering flexibility and efficiency for automotive lighting needs. **LUMIBUS** comprises two main components: A **simplified 5V Physical layer** that converts CAN PHY transmission signals into UART Rx/Tx signals for internal processing, and the **UART protocol layer**, which handles communication at the register level. For topologies with multiple devices (see figure 1), unique addresses are essential for communication. To achieve this, the LAA (Location Address Assignment) method is employed, enabling automatic address assignment. This method ensures that identical devices within a topology are each assigned to a unique NAD (Node Address), which is then stored in the device's OTP (One-Time Programmable) memory. Some drivers also integrate a simplified 5V physical layer into the device, enabling direct signal connections to the CANH and CANL pins (see figure 2). This design operates within CAN PHY standards, managing differential signaling in a regulated 5V system and eliminating the need for external CAN PHY components. Thanks to the pseudo differential signaling of the CAN bus, **LUMIBUS** provides robust EMI/EMC performance, making it highly resistant to external RF interference and ground bounce.

A limitation to **LUMIBUS** and including protocols from other manufactures such as Melibu from Melexis is that devices from alternative manufacturers cannot fit in one protocol as each manufacturer has defined their own protocol. In order to address this issue CAN-FD Light, a standard currently being developed and promoted by Bosch, is designed to streamline communication in automotive networks. Lumissil is actively working to integrate this standard into its LED drivers, enabling compatibility with various CAN-FD Light devices from different suppliers on the same network.

In conclusion, **LUMIBUS** is a high-speed UART protocol over CAN PHY designed to meet the data transfer demands of automotive lighting systems. It is a license-free protocol, making it cost-effective and easy to implement. Lumissil offers a diverse portfolio of components that support the **LUMIBUS** protocol, including the following:

Part No	Part Description
IS32FL3202	Smart RGB dot LED driver
IS32FL3105 (Sampling)	2x18 Matrix LED Driver with Integrated CAN Phy Transceiver
IS32FL3257 (Sampling)	2x18 Matrix LED Driver
IS32CS9201/2	32-bit RISC-V MCU 64KB/8KB
IS32LT3131B	Integrated CAN Phy Transceiver, 12 Ch Linear LED Driver with UART
IS32LT3132	12 Ch Linear LED Driver with UART
IS32LT3137	12 Ch Linear LED Driver with UART
IS32LT3138A	18 Ch Linear LED Driver with UART
IS32LT3365B	Integrated CAN Phy Transceiver, Matrix Controller
IS32IO1163	CAN Transceiver
IS32IO1044	CAN Transceiver

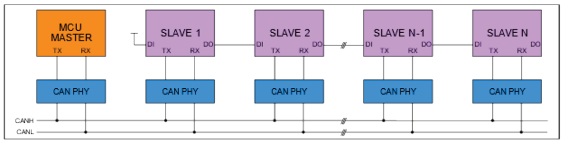

Figure 1: Multi-Device Topology for LUMIBUS

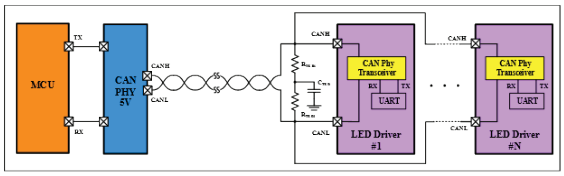

Figure 2: CANLITE Interface for Long Distance Intramodular Communication