

PRESENTATION

# Hybrid LiFi–WiFi Systems for Low–Latency Communication

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NHSJS Published Research

IEEE Houston Section Student Spotlight

*“Today I want to talk about how future wireless systems may combine both light and radio communication to create faster, smarter, and more secure networks.”*

# Why Latency Matters

Why do delays in communication matter? In many systems, speed isn't the only thing that matters because **response time** matters too.



## Video Conferencing

Ensuring seamless, real-time human connection without the lag.



## Cloud Gaming

Milliseconds determine the outcome in high-speed digital environments.



## Autonomous Systems

Critical decision-making for vehicles and delivery drones.



## Hospitals & Robotics

Precision control for remote surgeries and medical automation.

# Understanding WiFi vs LiFi



## WiFi

Uses radio waves and works almost everywhere, but can become easily crowded and congested.



## LiFi

Uses light for extremely fast potential. It is more secure and immune to radio interference.

**Analogy:** "If WiFi is like a radio station broadcasting everywhere, LiFi is like a flashlight sending information directly where it's needed."

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# Why Hybrid Systems Matter

“Instead of replacing WiFi, LiFi could become another tool that networks use intelligently.”

## Smart Selection

Use LiFi when conditions are ideal for maximum throughput and security.

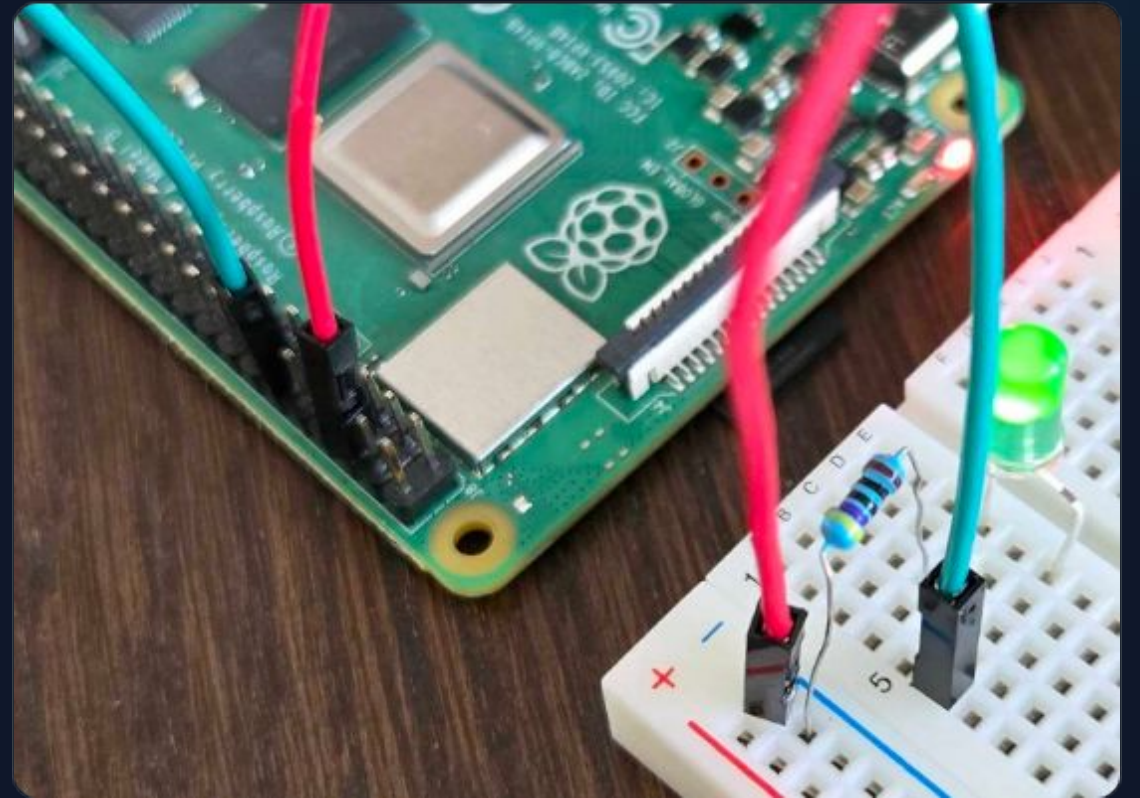
## Reliable Fallback

Seamlessly switch back to WiFi when the user moves or signals are blocked.

# Exploring Hybrid Communication Systems

How do we move from theory to reality? My research involved building a hands-on foundation for these adaptive networks.

-  **Prototype:** Built a Raspberry Pi-based hardware validation system.
-  **Validation:** Tested real-world LiFi and WiFi behavior in the lab.
-  **Simulation:** Modeled low-density environments (1-5 users) where latency is critical.
-  **Logic:** Explored how switching systems could work dynamically in real time.



# Where Could Hybrid Systems Be Used?



## Smart Hospitals

Reduced interference and secure patient communication in critical care units.



## Industrial Automation

Machine coordination and low-delay sensor systems for precision manufacturing.



## Secure Facilities

Confined data signals for government and defense offices inside specific rooms.



## Rural Connectivity

Creating flexible hybrid infrastructure in areas where traditional fiber is limited.

# Why LiFi Could Improve Security

## ❗ WiFi Limitation

Radio signals travel through walls, allowing potential interception from outside the building.

## LiFi Advantage

Signals stay contained inside illuminated spaces. Unauthorized users outside the room cannot even access the signal.

*"It's much harder to intercept a flashlight than a radio tower."*

# | Networks That Think and Adapt

100%

Adaptive Optimization

Future systems will automatically monitor congestion and detect lighting conditions to switch methods instantly.

| "The future of networking may be adaptive rather than fixed."

# AI-Driven Communication

Artificial Intelligence will be the brain of future hybrid systems, enabling predictive performance.

-  **Predict:** Anticipate congestion before it happens.
-  **Optimize:** Switch protocols in microseconds.
-  **Prioritize:** Critical traffic (like surgery) over browsing.
-  **Efficiency:** Maximize energy savings through LED control.

ABOUT FAQ 

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# Why This Research Matters

-  **Exponential Demand:** Growing need for faster, reliable communication every day.
-  **Scale:** Moving toward 50 billion connected devices globally.
-  **Security:** The absolute requirement for secure, private data transmission.
-  **Infrastructure:** Expanding smart city and building capabilities.

## The Takeaway

"Future communication systems will likely require multiple technologies working together rather than relying on a single solution."

# Conclusion



LiFi Potential



WiFi Essential



Hybrid Strength



Adaptive Future

**"The future of wireless communication may not be invisible radio waves alone, but it may also be powered by the light around us."**

QUESTIONS?