

# n-hop technologies

## Inventor of Network Coding



### Network coding and BATched Sparse code

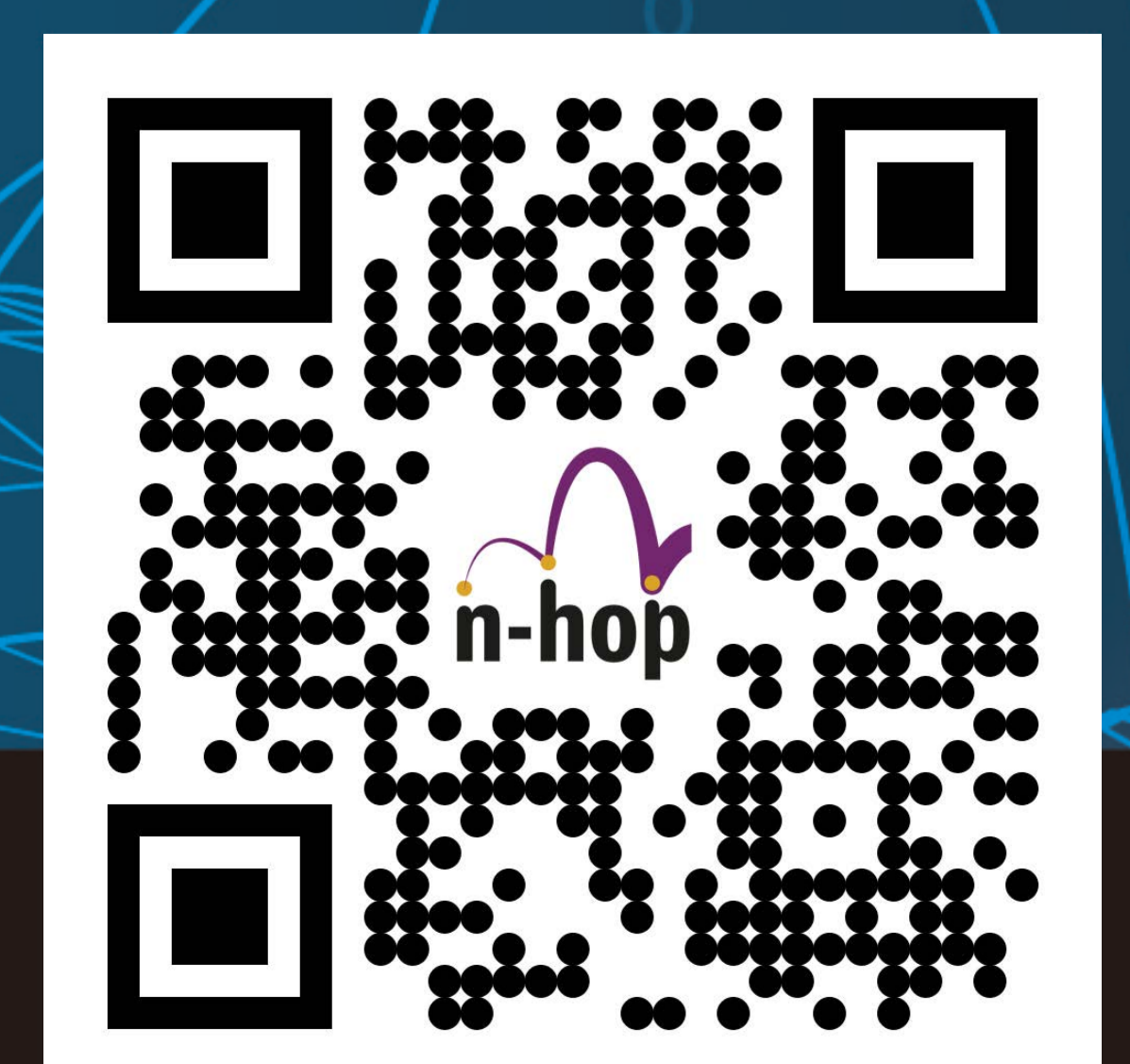
To realize the performance requirements of modern networks, we can no longer rely on traditional network technologies. Network coding gives us a new paradigm to maximize network information flow and achieve the requirements of modern networks.

BATS Sparse (BATS) code is a unique and ingenious technology that delivers the promise of Network Coding. BATS reaps the benefits of Network Coding without requiring excessive overhead and processing.

### The multi-hop curse

Multi-hop wireless networks are very useful for rapid and low cost deployment of communication systems. They also help extending the reach to places where fiber/wired connectivity is prohibitive.

The difficulty with multi-hop networks is the accumulation of packet loss over successive hops. Traditional methods such as packet retransmission and end-to-end forward error correction add latency and inefficiency whilst trying to overcome packet loss. This has led to engineers avoiding long multi-hop chains and is known as "the multi-hop curse".



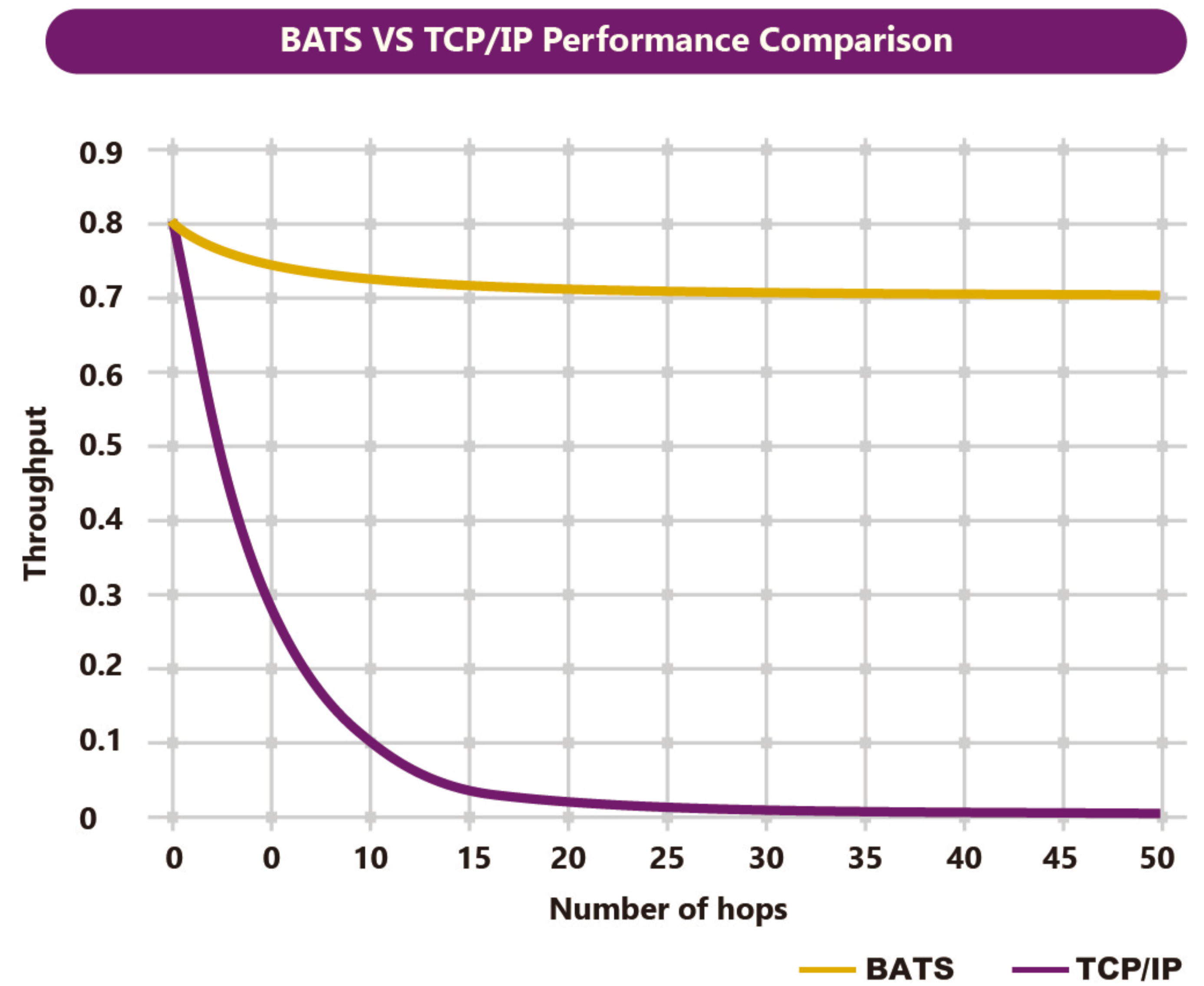


# Overcoming the curse with BATS



One of the enablers of Network Coding, Random Linear Network Coding (RLNC) can overcome the multi-hop curse, but this comes at a cost. Traditional RLNC requires excessive processing and memory at the intermediate network nodes and can be suboptimal in terms of latency and efficiency. BATS is a sophisticated form of RLNC that mitigates the processing and memory requirements, whilst increasing efficiency and bounding the latency.

With BATS, we overcome the multi-hop curse elegantly and efficiently. The figure on the right shows a comparison between the multi-hop performance of TCP versus BATS coding as a function of number of hops when each link has 20% loss.



\*Conditions applied, details found in: [https://n-hop.com/wp-content/uploads/2022/01/n-hop\\_white\\_paper.pdf](https://n-hop.com/wp-content/uploads/2022/01/n-hop_white_paper.pdf)

## Applications of BATS

BATS improves the overall performance of various types of networks

**Cellular Network 5G**  
BATS improves information flow in multi-hop cellular network

**SD-WAN Architecture**  
BATS enables SD-WAN network with high efficiency and reliability

**V2X Communication Network**  
BATS realizes Network Coding to enable high data rate and low latency

**Satellite**  
With long latency of satellite link, BATS transcends traditional network protocol to enable efficient transmission