Network Coding in Wireless Communication

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***Abstract* — This paper proposes a new architecture for wireless networks. In addition to forwarding packets, routers mix packets from different sources to increase the information content of each transmission. We show that intelligently mixing packets increases network throughput. Our design is rooted in the theory of network coding. XOR method is implemented to mix incoming packets on the butterfly topology. The project is written in Python language and compiled in application PyCharm.**

***Keywords* — Algorithms, design, network coding, performance, theory, XOR, wireless networks.**

I. INTRODUCTION

WIRELESS networks suffer from low throughput and do not scale to dense deployments [1]. To address this problem, it is present a new forwarding architecture that substantially improves the throughput of stationary wireless networks. This method identifies coding opportunities and benefits from them by forwarding multiple packets in a single transmission. Design is inspired by the theory of network coding. Consider the scenario in Fig. 2, where Alice and Bob want to exchange a pair of packets via a router. In current approaches, Alice sends her packet to the router, which forwards it to Bob, and Bob sends his packet to the router, which forwards it to Alice. This process requires 4 transmissions. Now consider a network coding approach. Alice and Bob send their respective packets to the router, which XORs the two packets and broadcasts the XORed version. Alice and Bob can obtain each other's packet by XORing again with their own packet. This process takes 3 transmissions instead of 4. It is shown in Fig. 1 [2].

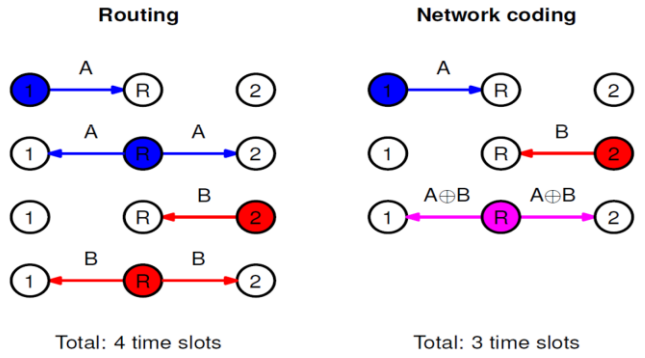

Fig. 1. Differences between number of time slots

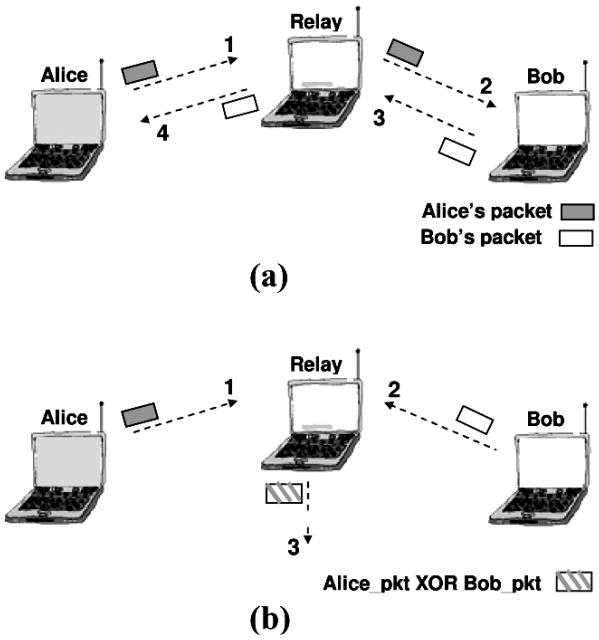

Fig. 2. (a) Traditional networking. (b) Network Coding.

II. BUTTERFLY TOPOLOGY

In this project, network coding operation is implemented on butterfly topology. If this topology is examined, the difference between traditional routing algorithm and network coding could be shown as:

- Traditional Routing Algorithm (Fig. 3a)
  - Two packets b1 and b2 should be conveyed to two destinations
  - Each link can handle one packet per time slot
  - Bottleneck is in the middle
  - Either packet b1 or b2 will be transmitted
- Network Coding (Fig. 3b)
  - Both b1 and b2 will be transmitted in a time slot by coding
  - Destination nodes process XOR operation between received packets again [5]

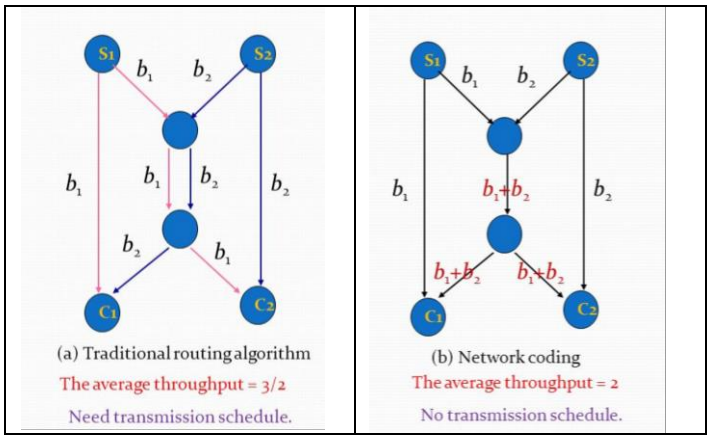

Fig. 3. Butterfly topology

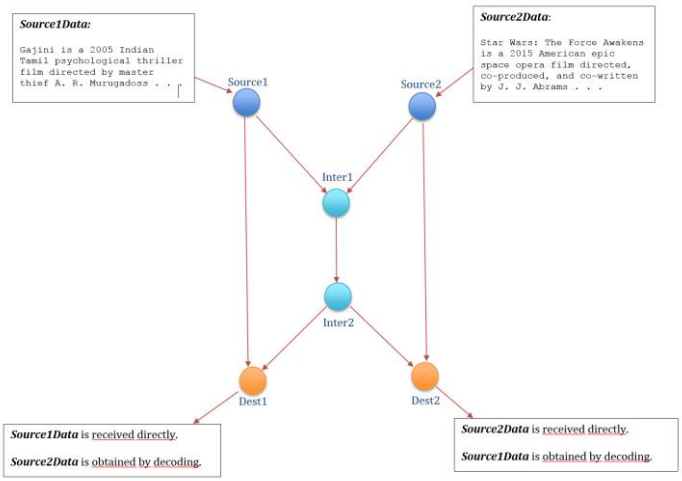

Fig. 4. Steps of the flow in butterfly topology

III. PROJECT DESIGN AND APPLICATION

The project is design to transfer 2 source files to 2 destinations. Source files formats is chosen as text and they are include same length of data. Steps of the project are as follows:

- Source Node 1 sends its data to Intermediate Node 1 and Destination Node 1 (first time slot *t*)
- Source Node 2 sends its data to Intermediate Node 1 and Destination Node 2 (first time slot *t*)
- Intermediate Node 1 takes the Source1data and Source2data packets
- Then it encodes these 2 packets by XOR method
- After encoding it forwards the XORed packet to Intermediate Node 2 (second time slot *t)*
- Intermediate Node 2 takes the XORed packet and broadcasts it to Destination Node 1 and Destination Node 2 (third time slot *t)*
- Destination Node 1 takes the XORed data and decode it by using Source1data that is taken directly in first time slot hence it obtained the Source2data
- Destination Node 2 takes the XORed data and decode it by using Source2data that is taken directly in first time slot hence it obtained the Source1data

These steps are figured out in Fig. 4.

IV. CONCLUSION

Finally, it is commented on the scope of the project that the present design targets wireless networks, where the nodes are located as butterfly topology. Throughput increament on the wireless communication by coding is implemented from theory to practice. We have seen, through application written on Python, network coding is a promising way to achieve significant performance improvements for wireless networks.

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