

Raptor Codes for Reliable Transport

Source: www.youtube.com



Amin Shokrollahi
Laboratoire d'algorithmique
EPFL

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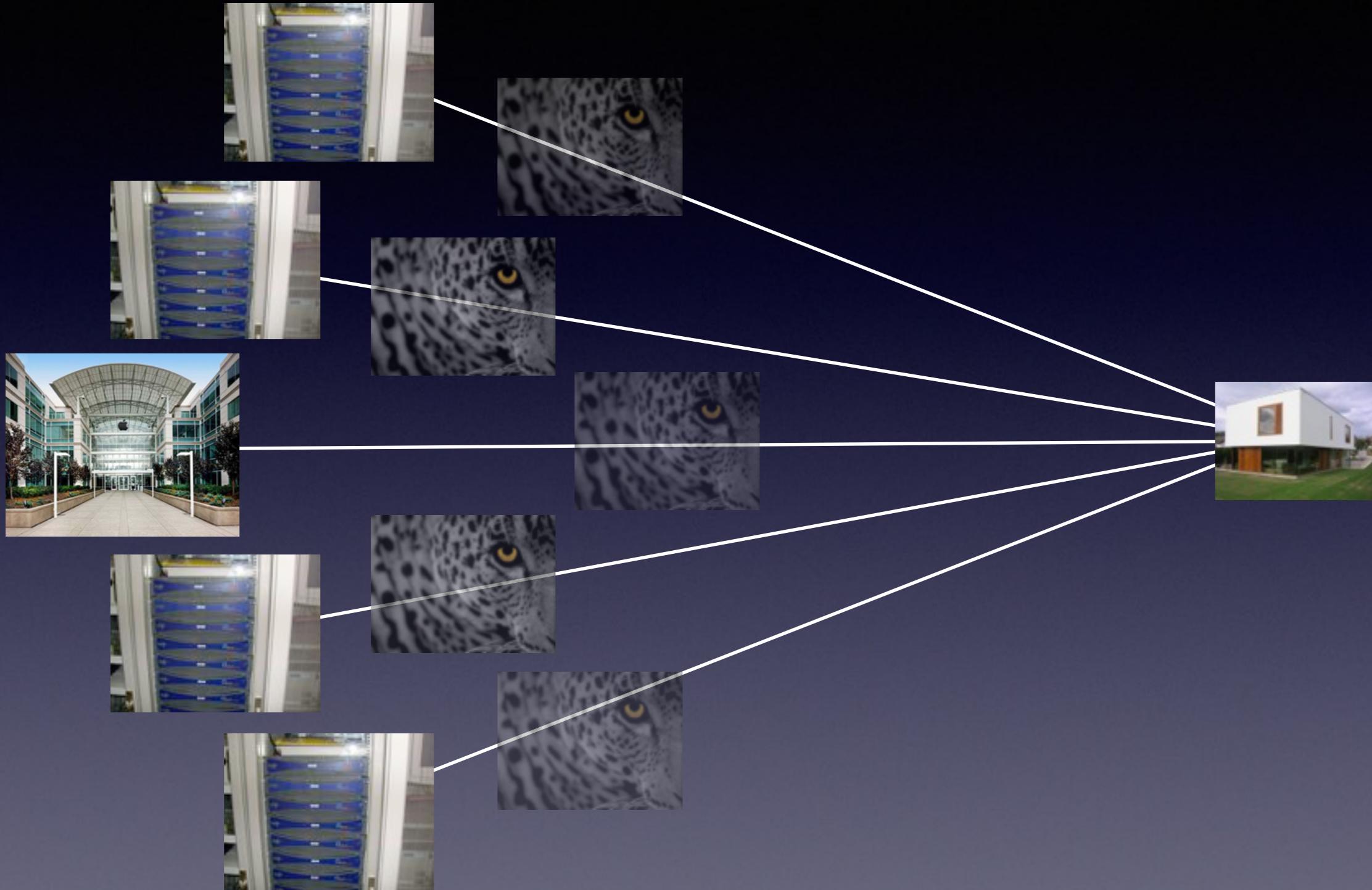
reliably

Point-to-Point Communication



Point-to-Multipoint Communication

Multipoint-to-Point Communication



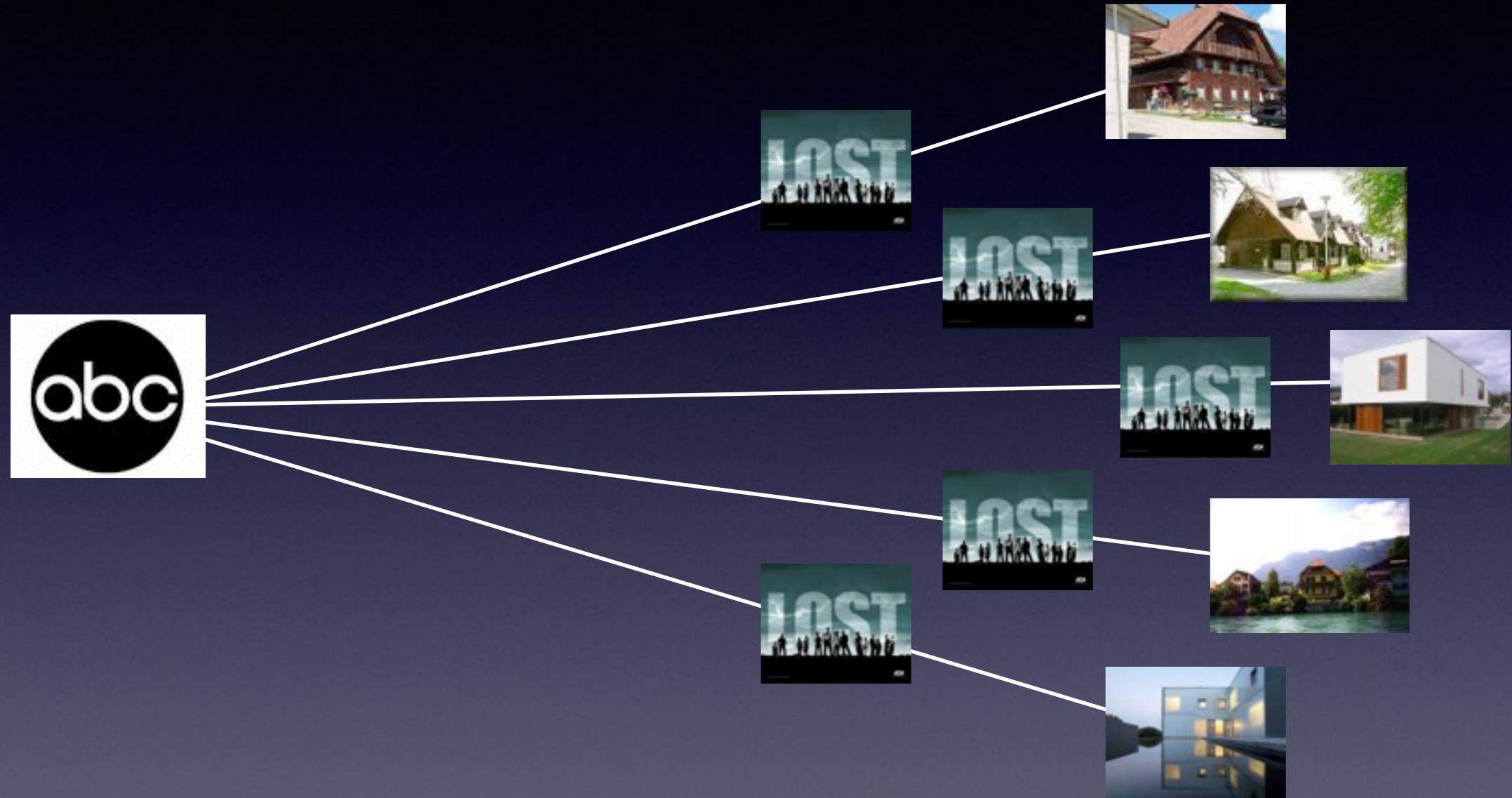
TCP

Point-to-Point Communication:TCP



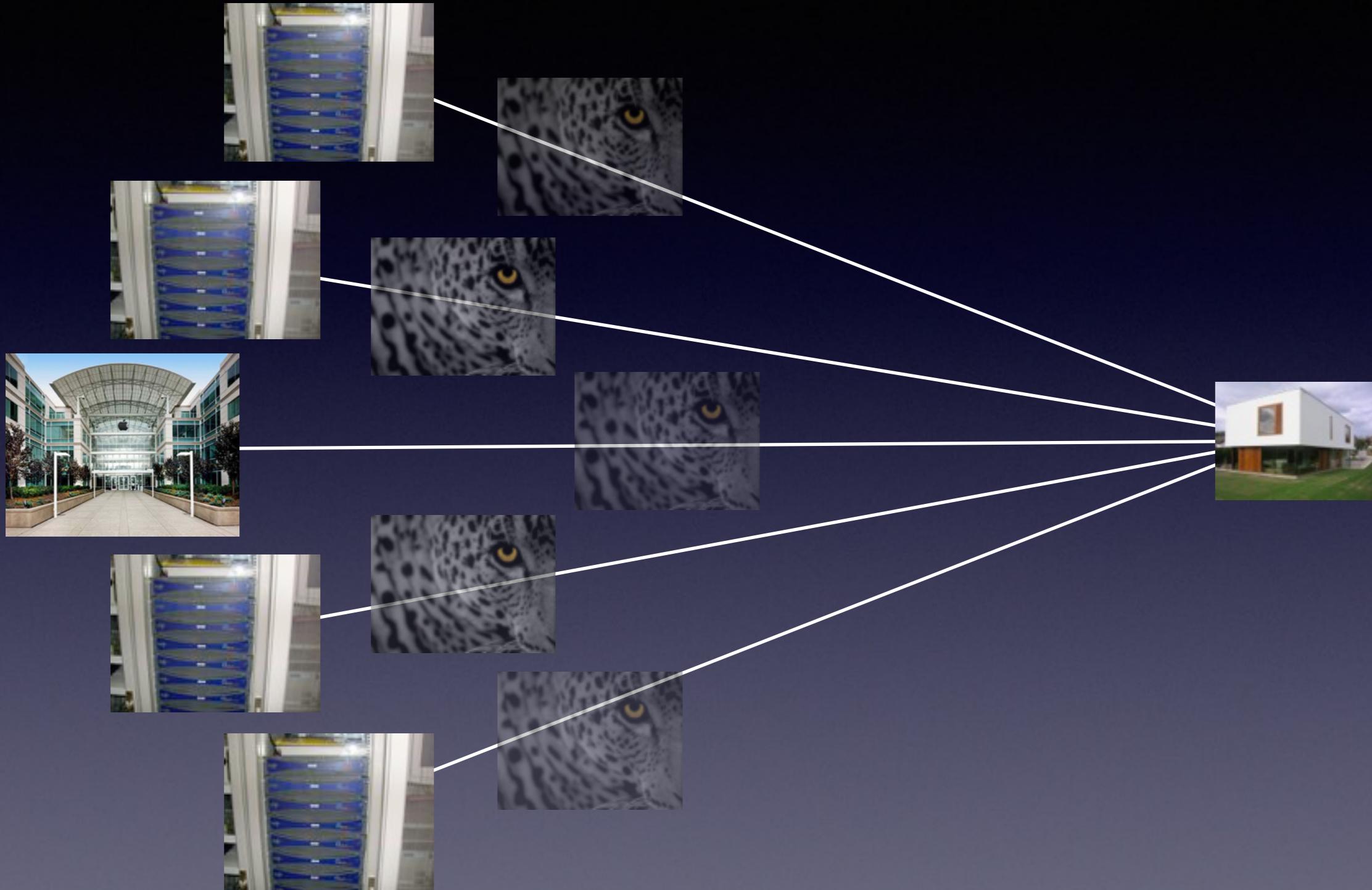
Inefficient if distance is large

Point-to-Multipoint Communication: TCP



Is not scalable

Multipoint-to-Point Communication: TCP



Not scalable, and needs management

Fountain

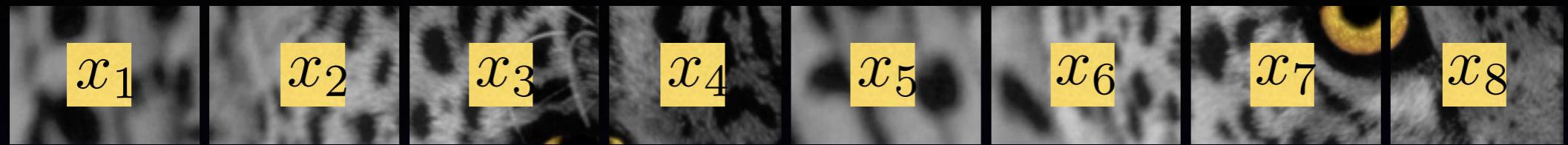
Generates for a given piece of data a **potentially limitless** stream of packets such that:

1. Each packet is generated **independently** of any other packet.
2. It is sufficient to collect any set of packets that is in aggregate of **the same size** as the original piece of data for recovery.
3. Generation and recovery are very **efficient**.



Source: <http://lisa.innereyes.com/wp-photos>

Nokia CTC visit, July 30-31, 2007

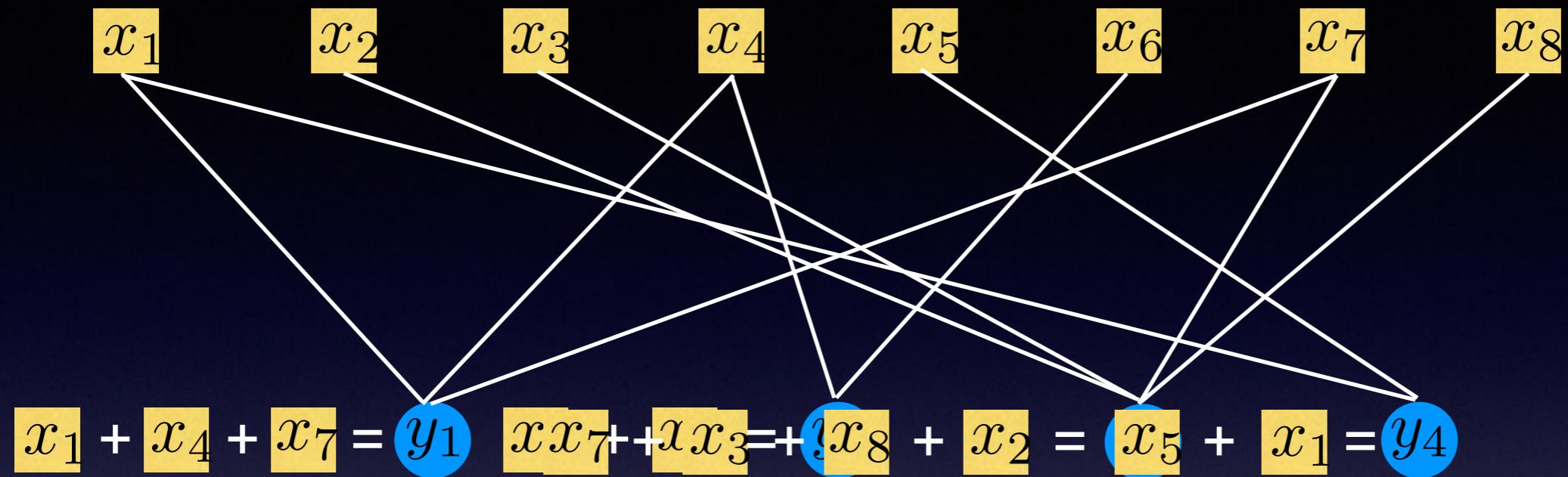


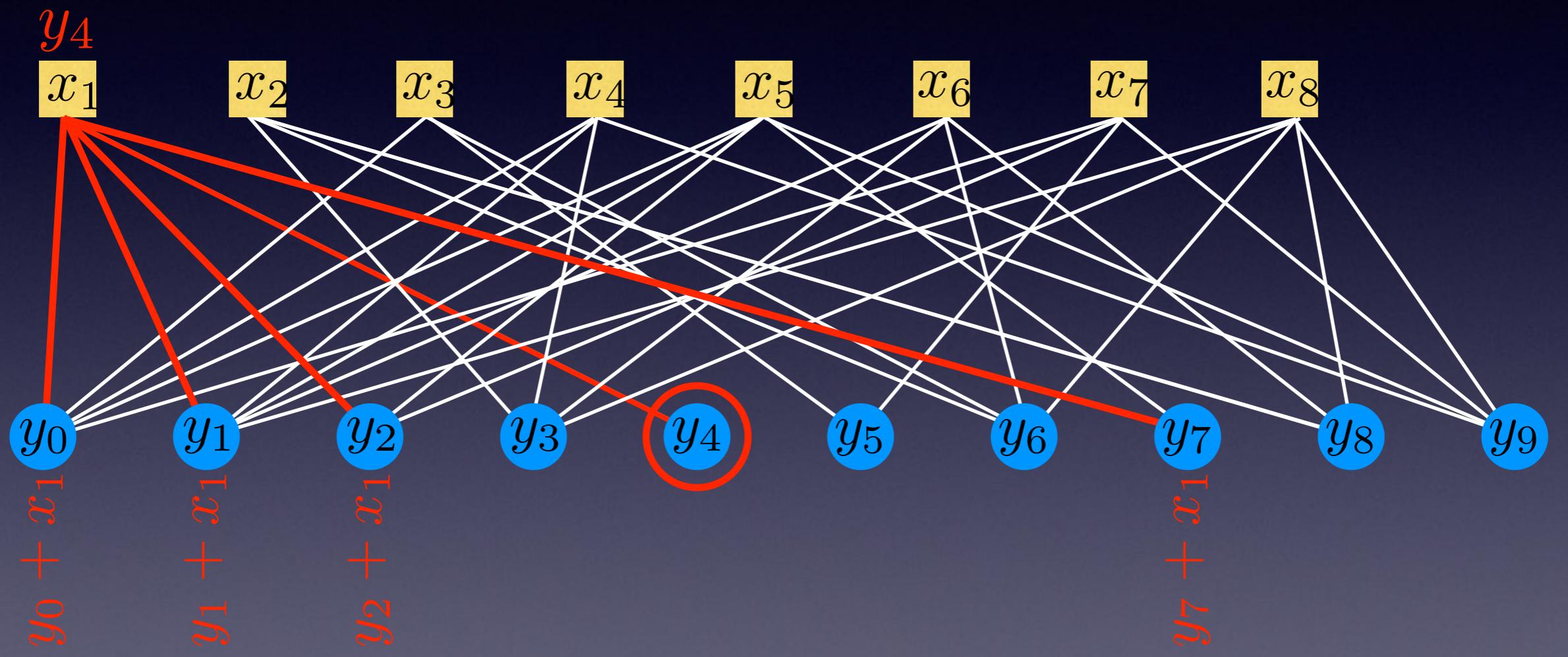
$$x_1 + x_4 + x_7 =$$

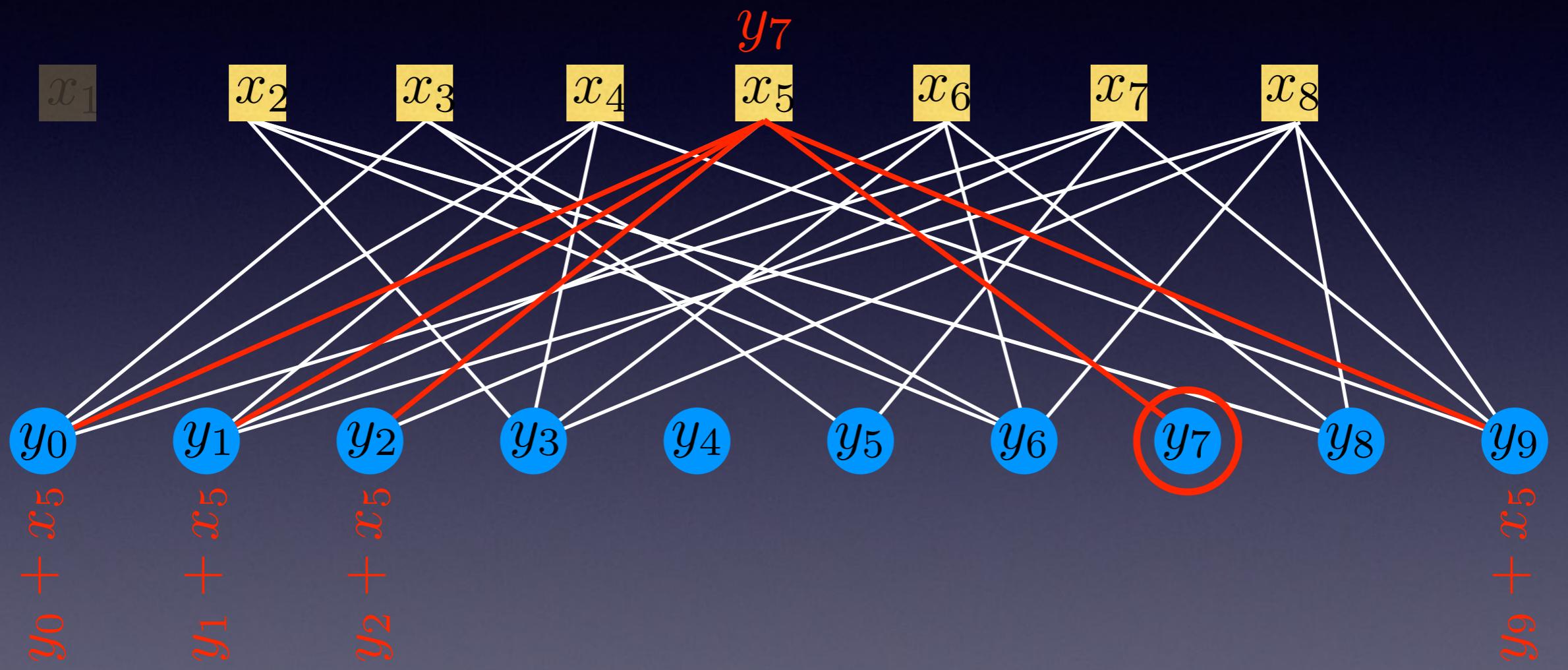

$$x_4 + x_6 =$$

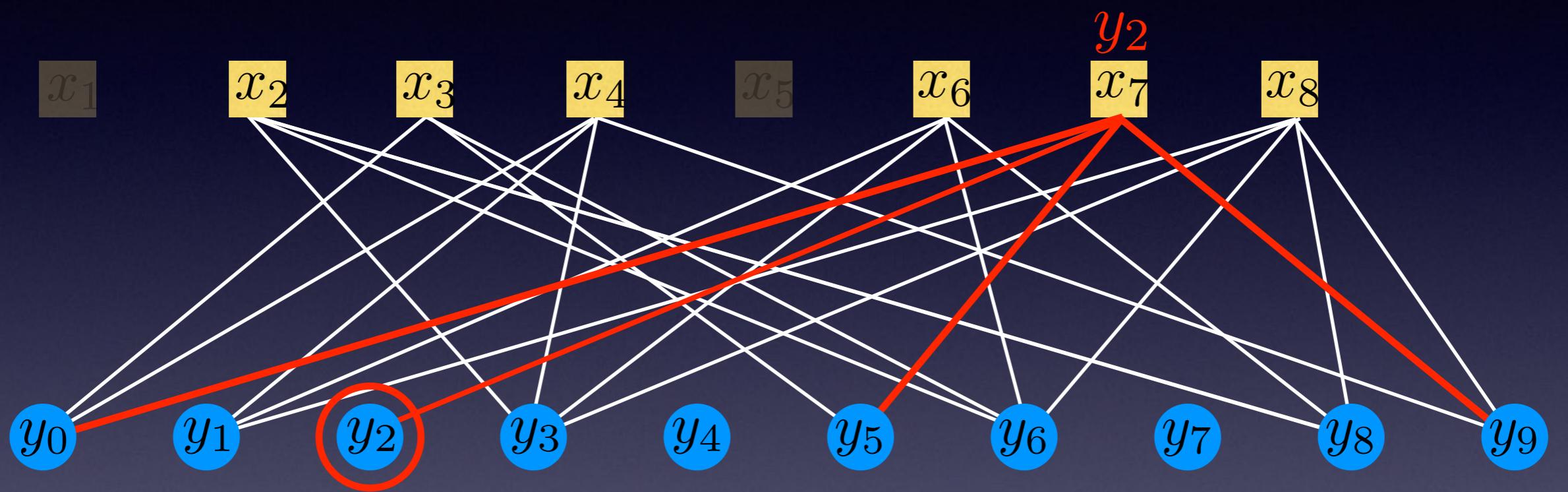

$$x_7 + x_3 + x_8 + x_2 =$$


$$x_5 + x_1 =$$

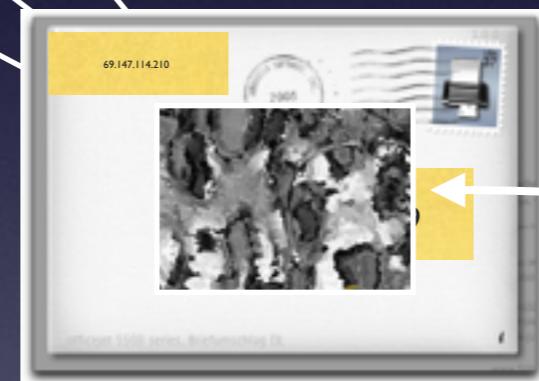









LT Codes



3

deg	probability
1	0.001
2	0.5
3	0.16
4	0.83
5	0.05
6	0.033
7	0.024
8	0.018
9	0.011
.....

deg	probability
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.....

Probability Distributions

The design of the main probability distribution requires the introduction of new theoretical tools.

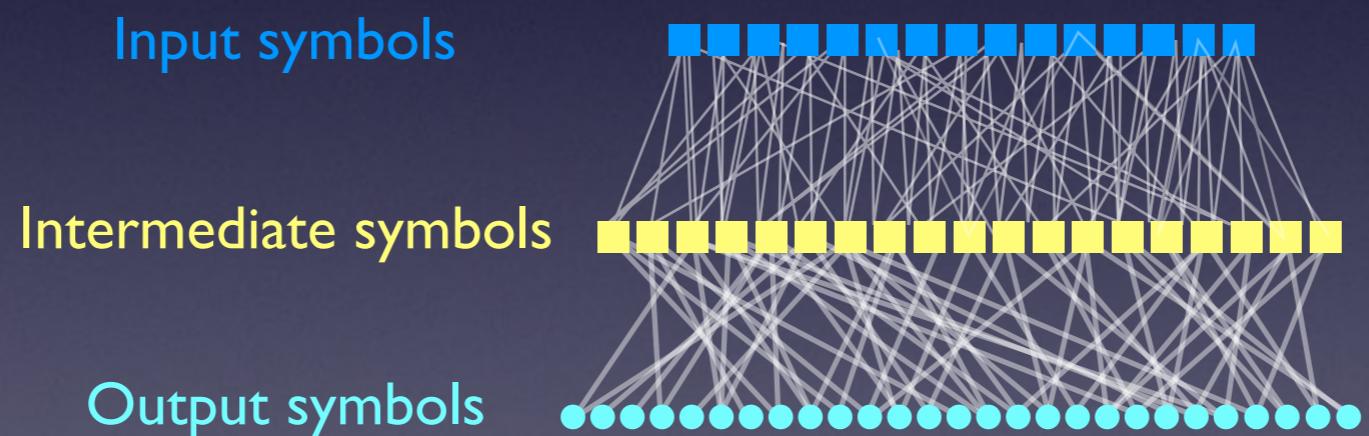
These tools have been developed by Digital Fountain, and later in collaboration with EPFL (ALGO).

Raptor Codes

LT-codes: Luby 1998.

Raptor codes: fountain codes with linear time encoding and decoding algorithms (Shokrollahi, 2000).

All fountain codes in use today are Raptor codes.



Technology Transfer

The newest versions of Raptor codes have been developed in close collaboration between Digital Fountain and the Laboratoire d'algorithmique of EPFL.

Raptor codes with faster encoding/decoding, smaller error probabilities, and smaller memory footprints are subject of ongoing research.

Some Applications of Raptor codes

- Delivery of data over long haul connections
- IPTV
- Disaster recovery
- Distributed storage
- Content delivery networks
- Data distribution to cars
- Multicast/broadcast over wireless
- Military
-

Standards



DVB-H file delivery



DVB IPTV streaming delivery



3GPP Multicast/Broadcast multimedia



ATIS IIF IPTV delivery



Raptor file delivery approved for publication as RFC (23.07.07)

More to follow.....

In the Press

IEEE TECHNICAL FIELD AWARDS

**2007 IEEE
Eric E. Sumner Award**

Sponsored by Alcatel-Lucent

Michael G. Luby & Amin Shokrollahi

For bridging mathematics, Internet design and mobile broadcasting as well as successful standardization

The collaborative work of Michael G. Luby and Amin Shokrollahi has led to breakthroughs in data transmission over packet-based networks that have resulted in global communications standards for mobile broadcasting, satellite data transmission, and Internet TV. The breakthroughs are based on a combination of the invention and practical implementations of a new class of FEC codes, called fountain codes, and the novel application of these codes to data transport. The fountain codes allow multiple senders to transmit information to multiple receivers with high quality and timely streaming media. There are several variations of these codes that are used today in a number of enterprises, military, and consumer devices and applications, supporting both wired and wireless telecommunications networks. While working together at the International Computer Science Institute, University of California, Berkeley, they also collaborated on the invention of Tornado codes, erasure protecting codes with super-fast encoding and decoding algorithms.

Dr. Luby is co-founder and chief technology officer of Digital Fountain, Inc. He is also the inventor of Luby Transform (LT) codes, the breakthrough technology that forms the basis of Digital Fountain's products. Dr. Luby received a doctorate in theoretical computer science from the University of California, Berkeley.

Dr. Shokrollahi, is currently a professor of mathematics and computer science at Ecole Polytechnique Fédérale de Lausanne, Switzerland, and chief scientist of Digital Fountain, Inc. He received his master's degree in mathematics from Karlsruhe University (Karlsruhe, Germany) and a doctorate in computer science and mathematics from the University of Bonn.



→ Mind The

Michael G. Luby & Amin Shokrollah

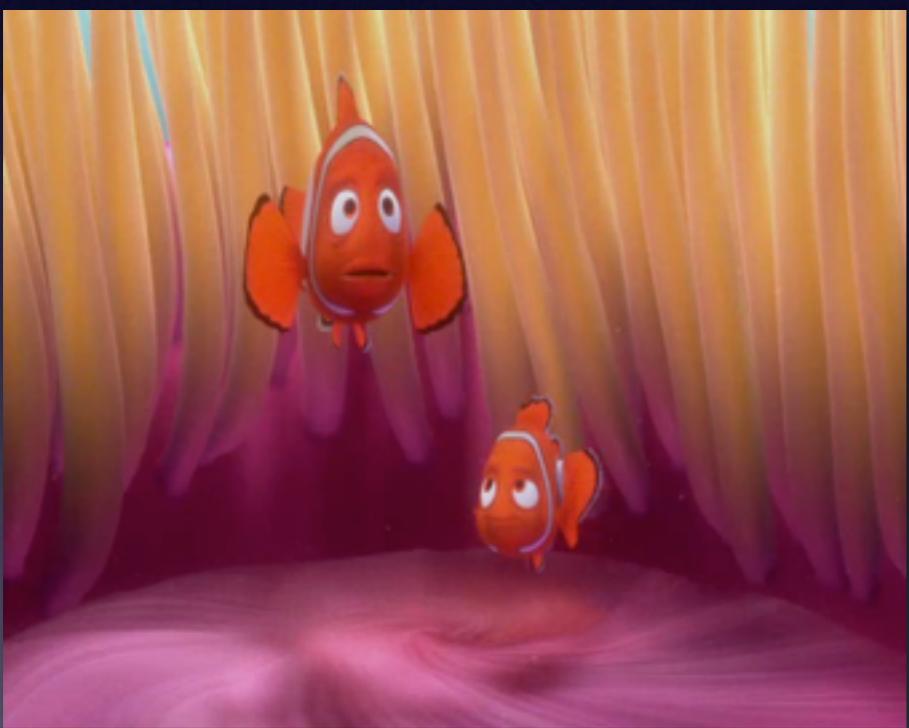
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IEEE Eric E. Sumner Award



With Raptor



Without Raptor

Thank You!