Priority Encoding Transmission

Andres Albanese
http://www.ICSI.berkeley.edu/~aa

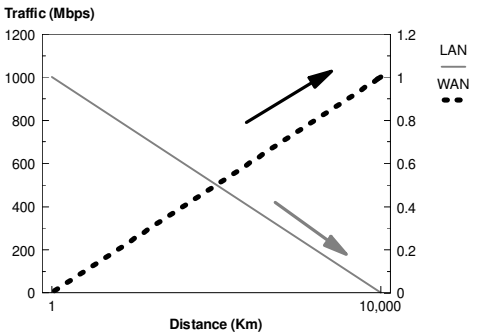
Outline

- Network Evolution Trend
- Packet Loss
- Priority Encoding
- MPEG video on Internet
- Conclusions

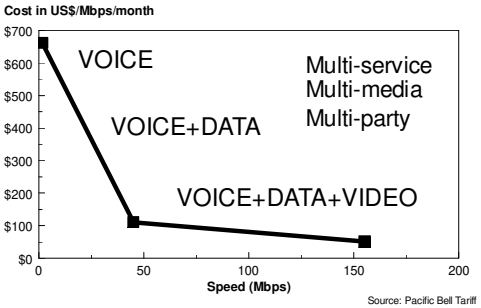
Application Requirements

- Wide Area Network Interfaces (Global Interoperability)
- Scaleability (Heterogeneity)
- Multicast (Groups)
- Realtime (Interactive)

Evolution Toward a WAN

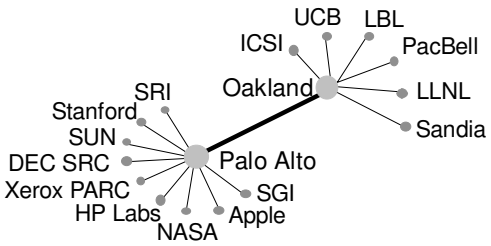


Economy of Scale
Customer Access Cost



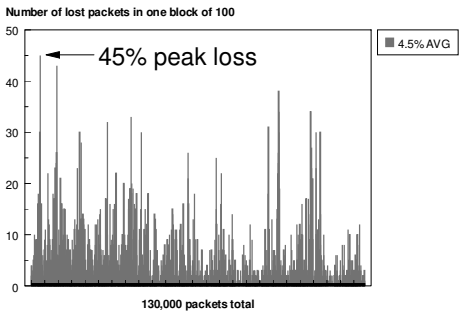
Source: Pacific Bell Tariff

Service Trial: BAGNet

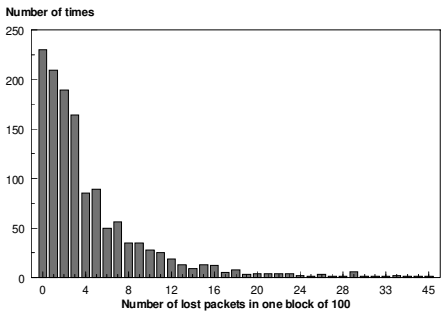


- ATM service 155 Mbps (SDH)
- Applications: multi-party collaborations (initially teleseminar)

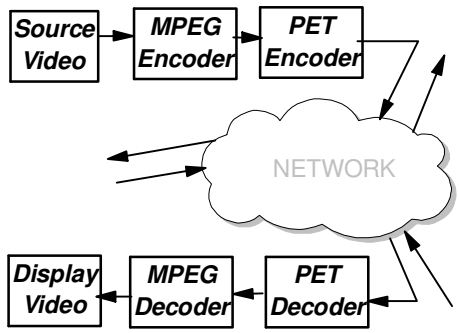
Packet Loss per 100
from Palo Alto to Berkeley



Packet Loss Histogram



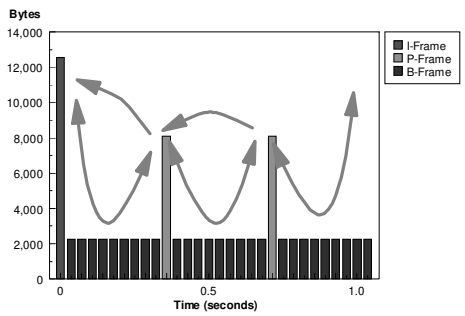
Multicast Network



PET algorithm

- sending information over lossy media
- dividing message into priority blocks
- encoding blocks into multiple packets
- packets are lost & delayed in transmission
- decoding blocks in priority order
- gracefully acquisition/degradation

Example: MPEG Group of Pictures



PET - Mechanism?

a1	b1	a2	b2	c2	a3	b3	c3	d3

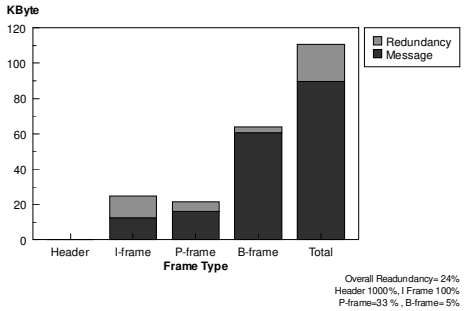
p1(x) = a1+b1.x [mod 2^16+1]
p2(x) = a2+b2.x+c2.x^2 "
p3(x) = a3+b3.x+c3.x^2+d3.x^3 "

0	p1(0)	p2(0)	p3(0)
1	p1(1)	p2(1)	p3(1)
2	p1(2)	p2(2)	p3(2)
3	p1(3)	p2(3)	p3(3)
4	p1(4)	p2(4)	p3(4)

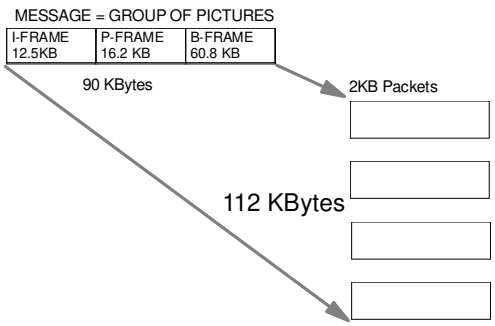
MPEG: Group of Pictures Information Distribution

	Length (KBytes)	Fraction Needed	Encoding (KBytes)
Header	0.012	0.10	0.12
I-Frames	12.5	0.50	25.00
P-Frames	16.2	0.75	21.60
B-Frames	60.8	0.95	64.00
Total	89.5		110.72

MPEG: Byte Distribution



Message Striping



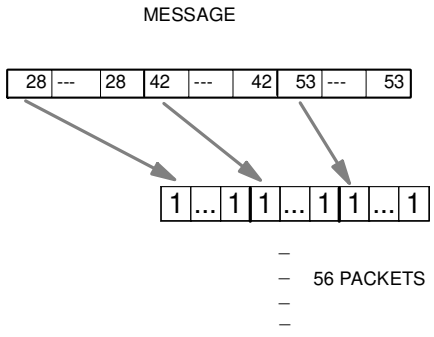
Message Striping (cont.)

$$\text{No. Packets} = \frac{\text{Total Encoding Length}}{\text{Packet Size}}$$

= 112 KB/2KB/packet
= 56 packets

Min. No. of packets for:
Header = 56x0.10= 6
I-frame = 56x0.50= 28
P-frame = 56x0.75= 42
B-frame = 56x0.95= 53

Striping Process (cont.)



PET Results

- **Feasible hardware and software solutions**
- **Sparc-10 can process more than 3 Mbps**
- **Several algorithms possible:**
  - **Deterministic**
  - **Probabilistic**
- **Exploit arithmetic properties of:**
  - **Polynomials over finite fields**
  - **Linear algebra over GF[2] (XOR, SHIFT are basic operations)**

Video Transmission Comparisons

	Bandwidth requirements	Quality degradation with losses
Full bit map	HIGH	LOW
MPEG	LOW	HIGH
MPEG + PET	LOW	LOW

Conclusions

- **Application Driven Solution**
- **Low Access Cost**
- **Graceful Acquisition/Degradation**
- **Distributed Solutions**
- **Simple Networks**
- **Global Coverage**