

MULTE: Multimedia Middleware for *Low Latency* High Throughput Environment

COTS Based Combat Management System Architecture

by

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COTS insertion into CMS

1. The development trends of COTS IT (information technology) is dominated and guided by non-military applications / requirements

the so-called “dual-use” problem

2. The military systems are increasingly getting more dependent on COTS IT

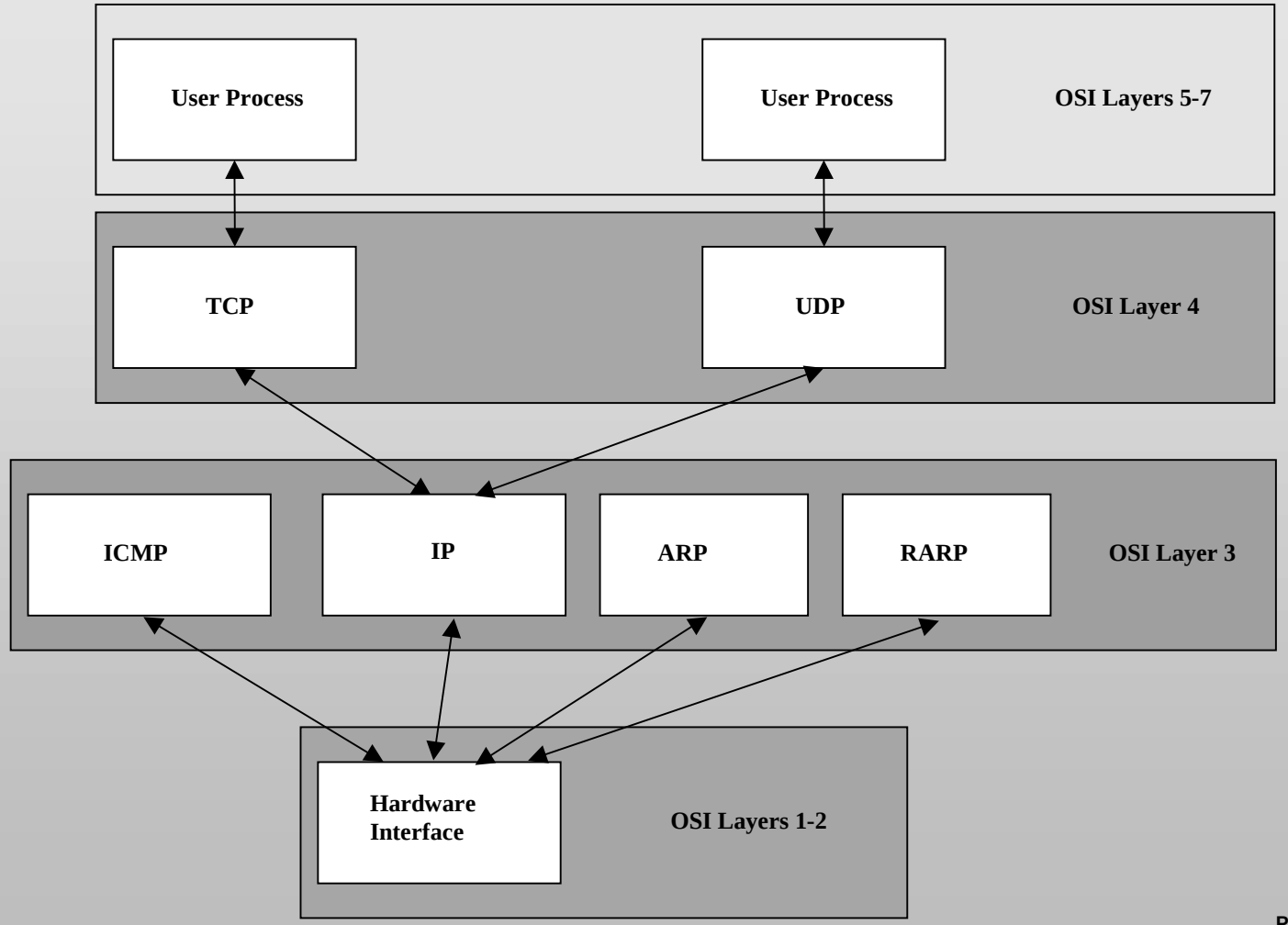
serious problems with maintainability, logistic support etc

seemingly a good thing for cost/effectiveness figures

3. Insertion of COTS IT into naval CMS cause problems of a technological nature

the “internet technologies” are designed for something else

Internet IS Architecture



Introduction

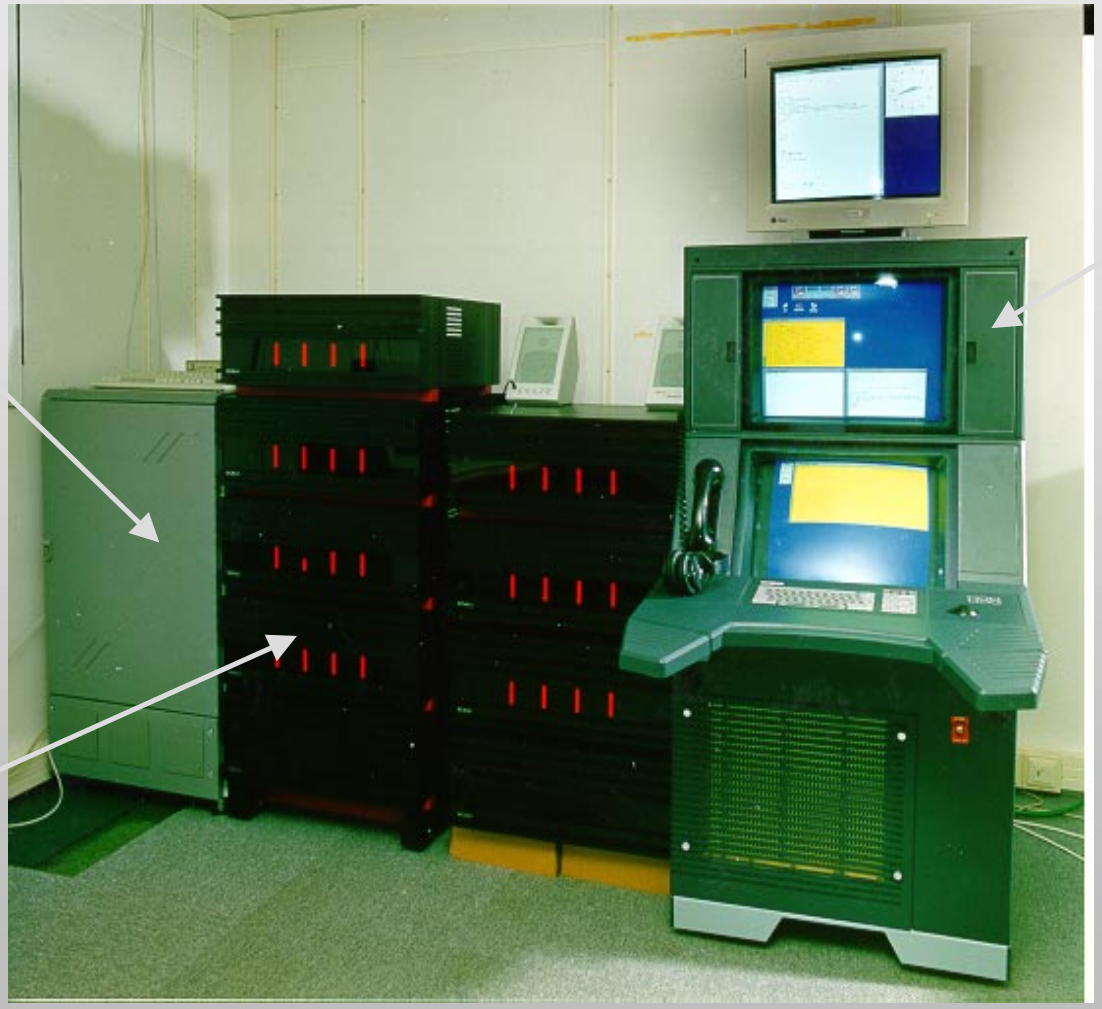
- Modern COTS technologies offer :
  - high speed ATM
  - internet protocols (TCP, UDP, IP)
  - CORBA middleware solutions
- We wished to explore how these could handle
  - real-time traffic
  - video
  - sensor data
  - asynchronous data
- Requirement was to comply with end-to-end quality of service requirements according to real world CMS systems
  - latency, jitter, hard & soft real-time deadlines
  - bandwidth allocation, resource allocation
  - fault tolerance and battle resiliance

COTS Protocols

- Current protocols are designed for reliable point-to-point links for such applications as messaging, file transfer etc
  - TCP, UDP
  - IP
- Multimedia applications (voice and video) require new things :
  - Synchronism & scheduling
  - End-to-end “Quality of Service” (QoS)

Technology demonstrator

2.4 Gigabit ATM



COTS MFC (Multi Function Console)

COTS Processor Farm

Testing the system

- Developed a network traffic generator system
- Nodes are producing traffic according to defined end-to-end Quality of Service parameters
  - could be using real-world sensors
- This is measured on actual real-world networks and protocols, and errors are flagged
  - benchmark system is relying on a seperate Fast Ethernet LAN
- Based on analyses performed on the nature of information flow on military CMS systems carried out for the New Frigate program
  - models made for several systems : New MTB, New Frigate
  - doctorate thesis in progress

Load analysis

Type of Data Load	Modernised Hauk MTB CS	Estimated New Frigate CS
Tactical Data Load	1.5 Mbit/s	3-4 Mbit/s
Video Data Load	3-5 channels of compressed video	8-12 channels of non-compressed video
Real-time Data Load	11 links, low bandwidth	32-48 links, low bandwidth

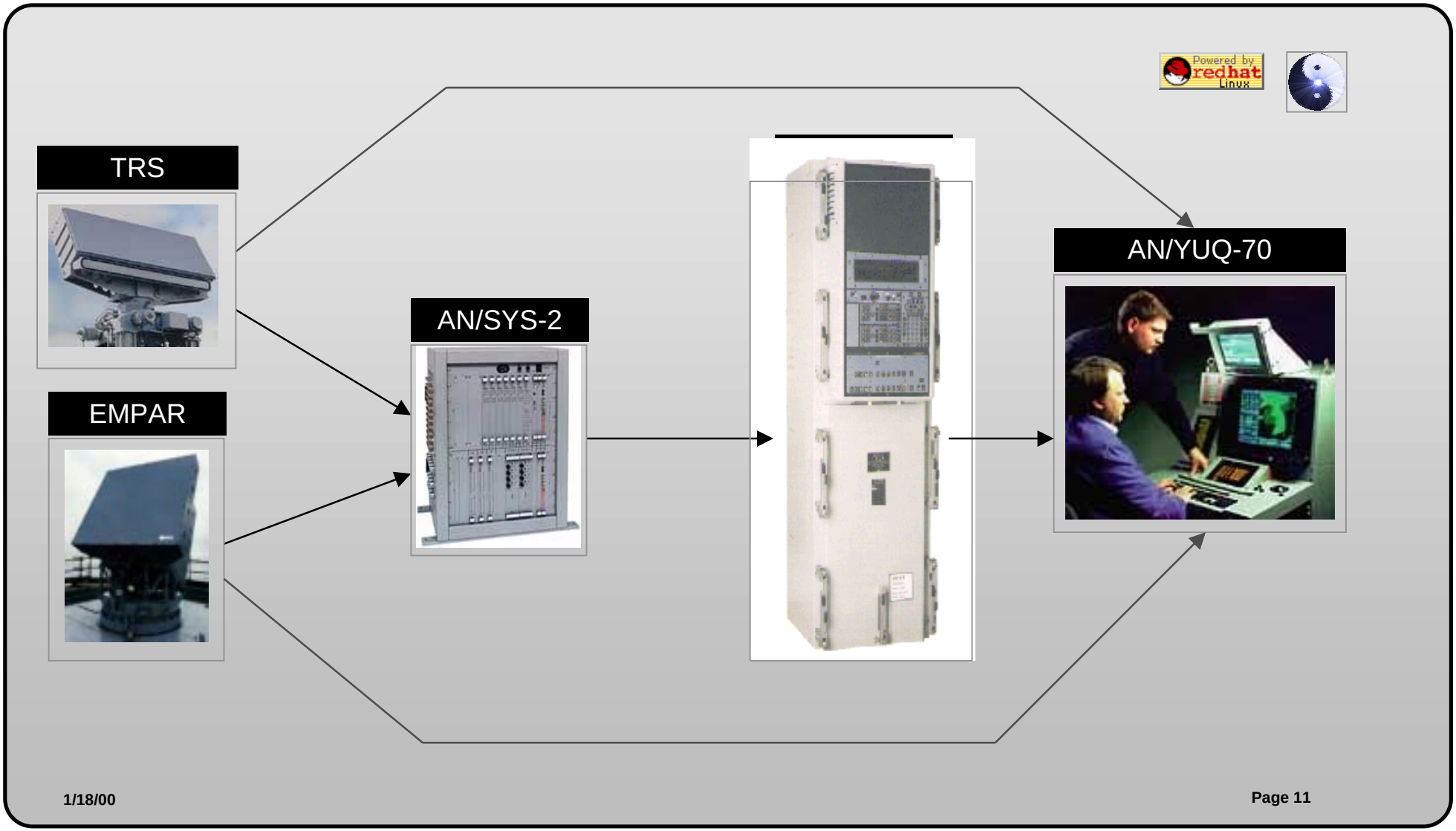
Load analysis

Name	Type	Protocol	Apparant Max Capacity	Relevance
TBase-10	Standard Ethernet	CSMA/CD	10 Mbit/s	for reference
Recital	Real Time Ethernet	DTR	10 Mbit/s	Modernised Hauk CS
ATM	Gigabit ATM	Switched ATM	2.4 Gbit/s	New frigates

Load analysis

Data Type	Size of basic package
Tactical Data (Track, Plot, Commands)	64 - 128 byte packages, soft real-time
Video Data - Compressed	10 Mbit/s (1024 x 1024 pixel image, 2 Hz)
Video Data - Non-compressed lossless	20 Mbit/s (1024x 1024 pixel image, 2 Hz)
Real-time Data	32 - 256 byte packages, hard real-time

Network Traffic Generator



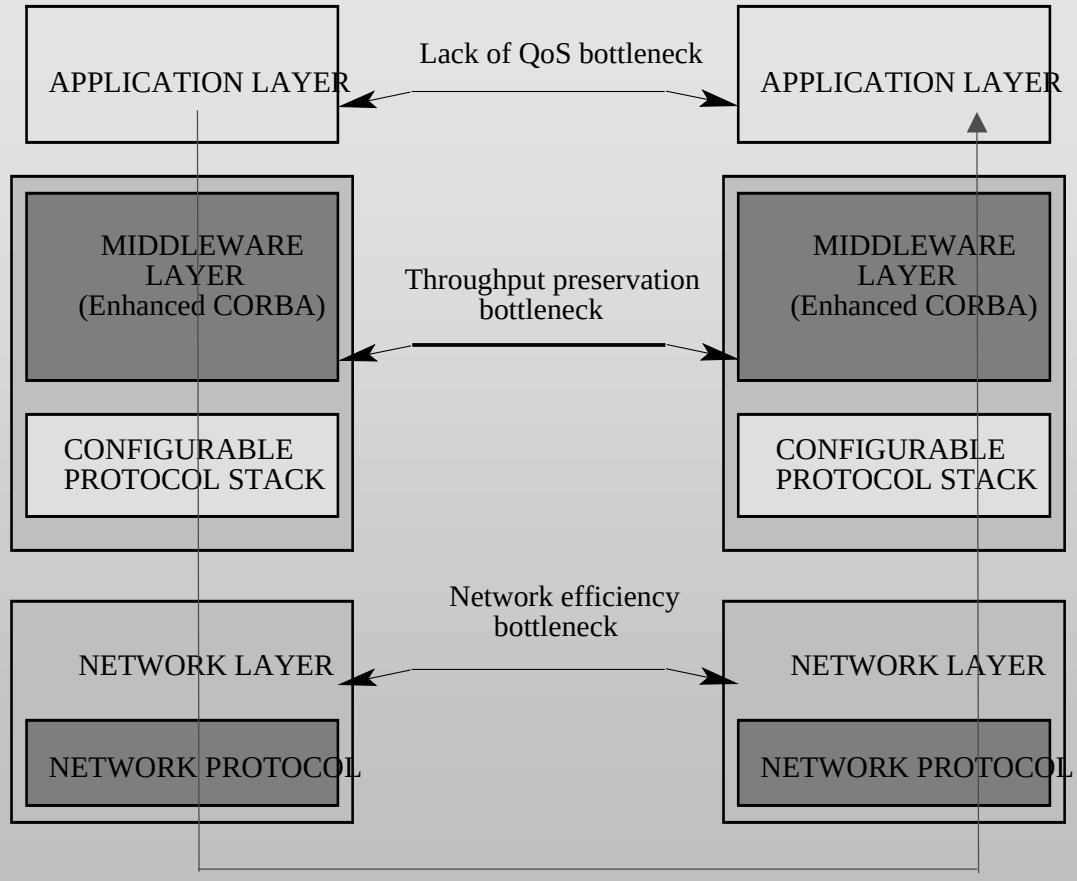
Node Parameter Settings ...

NodeName	Channel	QoS	Notes
AN/SPY1-F	1 Out	534 plot/s even_distr rt_max=1ms	plot
	2 Out	20 Mbit/s 2 Hz HDTV	video
AWS-9	1 Out	224 plot/s bursty rt_max=1ms	plot
AN/SYS-2	1 In	1000 plot/s	plot
	2 In	1000 plot/s	plot
	3 Out	128 track/s even_distr rt_max=1ms	track
AN/YUK-43	1 In	128 track/s	track
	2 Out	256 track/s 256 msg/s bursty rt_max=1ms	track & msg
AN/YUQ-70	1 In	20 Mbit/s	video
		2 Hz HDTV	

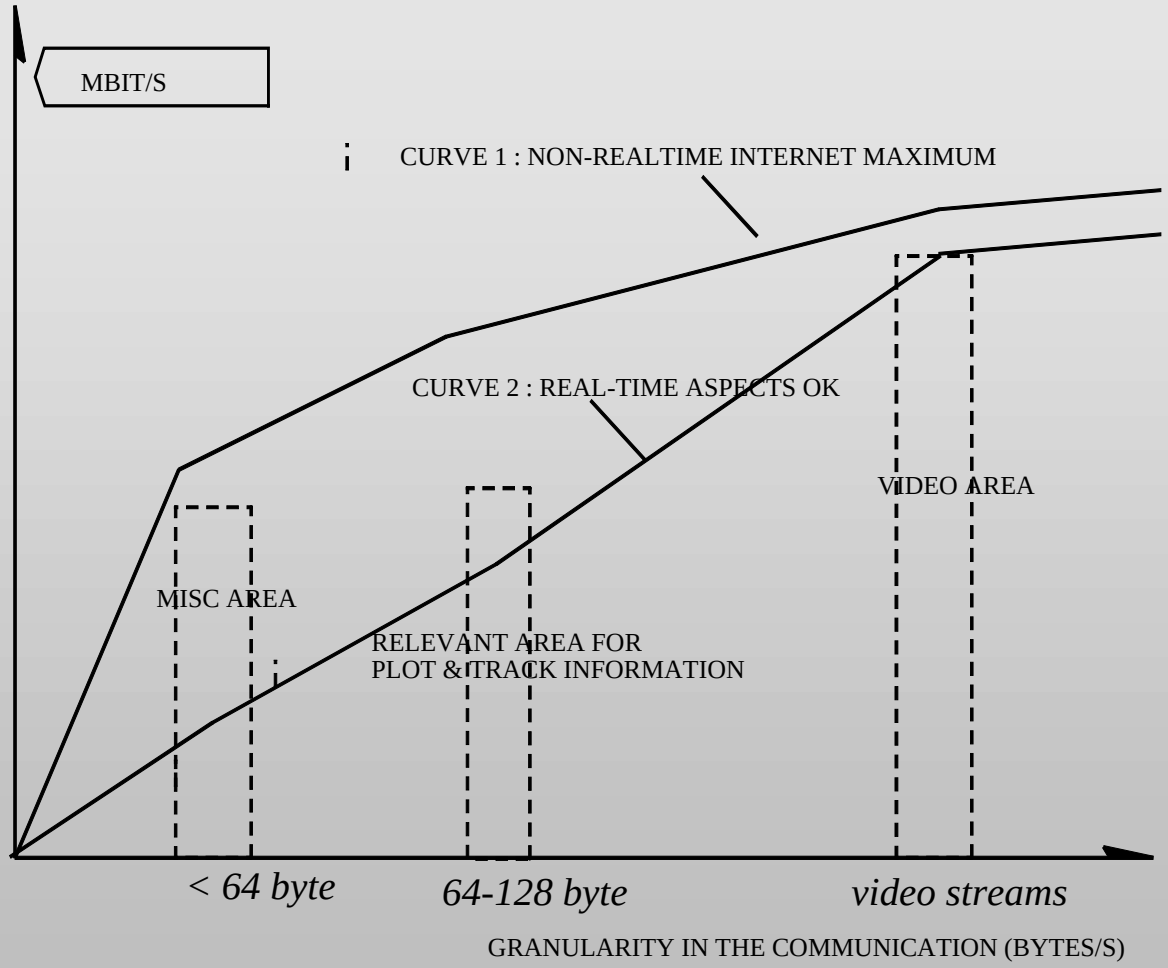
Network QoS & Configurations

ConnName	Stack	Conf setting
PlotStream 1	RTP UDP IPv4 ATM	packet=1.5K RSVP=33
VideoStream	RTP UDP IPv4 ATM	MBONE=ON HDTV=ON RSVP=2
PlotStream 2	TCP IPv4 ATM	packet=0.5 RSVP=0
TrackStream	TCP IPv6 ATM	packet=1.5
TrackStream	TCP IPv6 ATM	packet=1.5

Performance loss



Load analysis



What we are saying ...

- Basic COTS components generally work well as building blocks
  - especially those associated with multimedia applications
  - RTP, RSVP, IP, ATM, CORBA
  - end-to-end QoS negotiation
- Entire “COTS architectures” like the internet do not work well in CMS systems
  - for several good technological reasons
- New research in multimedia have provided us with new technology
  - support for negotiated quality of service from a system perspective
- We have made an “all-COTS” testbed of such a system integrating real-time traffic, video, sensor data and asynchronous traffic on a single “gigabit” ATM with end-to-end quality of service support
  - promising results so far