

CORDS —Communication Objects for Real-time Dependable Systems

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CORDS

It builds upon x-kernel
(University of Arizona)

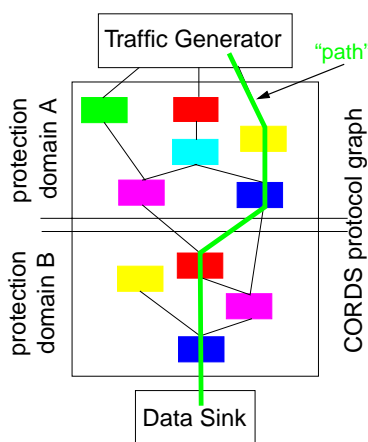
Innovation: Paths for
advanced resource control

Real-time framework

Library of protocols for
clusters and fault tolerance

Few OS dependencies in the
framework only

Middleware (MK, NT, UNIX)



Mission

First, build real-time, dependable distributed services for mission-critical applications

E.g.: control of factory floors, combat systems, medical tools

- Predictable behaviors, even in the presence of failures
- Real-time, fault tolerant, security properties in a single system
- Configurable and adaptive services throughout the various layers
- Unforgiving mechanical apparatus is often the consumer

Then, leverage services' high configurability and re-use parts to build services for less stringent environments

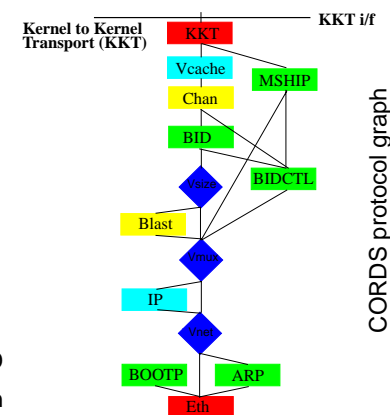
E.g.: white-board, video-conferencing, Web clusters

- Soft real-time guarantees
- Typically, a human is the consumer, via sophisticated CHIs
- Scalability along various dimensions

Using CORDS for ...

KKT, a communication fabric
for clusters

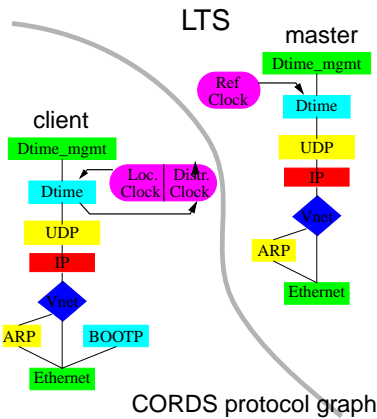
- Designed for unreliable interconnects (i.e., Ethernet)
- It supports and leverages protocol standards (i.e., IP, BOOTP)
- Optimized for very small and large messages (tens of KB)
- Used over Ethernet, FDDI, Myrinet
- Served as transport for MK/AD
- Recently being used to sustain trans-node RPCs



Using CORDS for ...(cont.)

LTS, a **distributed clock service** for external clock synchronization

- Probabilistic clock synchronization algorithm (F. Cristian)
- Upper bound on master/client deviation (unlike NTP, DTS)
- Bounded network traffic
- Failure semantics
- Example: client-master max-dev = +/- 1.25 ms; request interval = 4 secs avg., 400 ms worst case



Using CORDS for ...(cont.)

a **real-time characterization framework** that comprises

- Utilities to reconcile log trails from different systems
- CORDS built-in instrumentation and configuration tools
- ORCHESTRA—fault injection facilities contributed and ported to CORDS by University of Michigan

We used it extensively to characterize GIPC

Using CORDS for ...(cont.)

GIPC, a **group service** that provides ISIS-like functionality

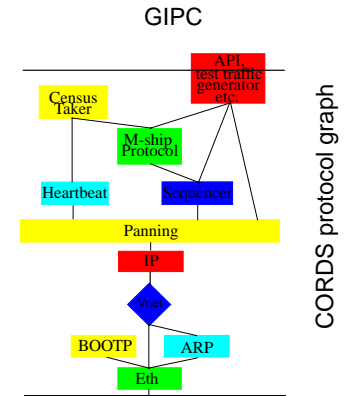
- Process groups
- Several delivery semantics (including atomic broadcasts).

with **predictable** behaviors even in adverse circumstances

- Failures
- Competing traffic

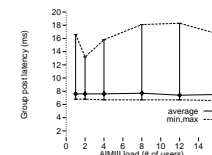
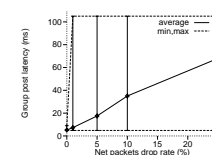
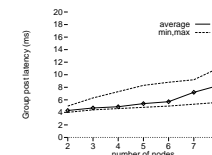
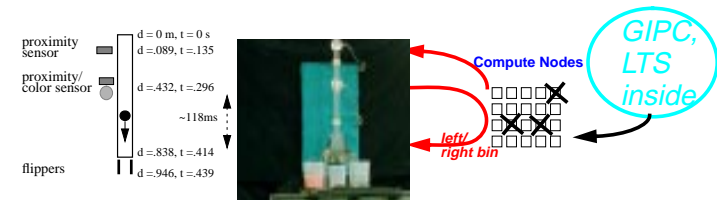
Paths enable fine-grain resource management

Demonstrated sub-second failure detection and recovery



Demos & Measurements

With CORDS, we have built and characterized real systems



CORDS' Impact

Since '94, CORDS has been funded by DARPA and commercial sponsorship

DASCOM has announced use of CORDS for secure routers

Alacron/Honeywell AVIS system uses CORDS w/ Myrinet for node interconnect

Results of CORDS/Myrinet use returned to Myricom

CORDS is base of research at UofA, UMich

CORDS is used in SHAWS, our clustered, HA Web Server

Ball-sorter demonstration featured at several public events

References

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Summary and Conclusions

CORDS results from a LEGO™ approach to Comm Services

It exploits real-time facilities of the host OS

CORDS path programming enables real-time Communication

We have challenged CORDS in different Comm scenarios

All benefit from an open architecture & substantial code reuse

In the CORDS-based GIPC, we have forged the integration of real-time and fault management disciplines

The CORDS framework is the catalyst of this integration

There is now a CORDS community out there

References (cont'd)

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