The OSF Microkernel Event Trace Analysis Package

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Outline

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What is ETAP?

The Event Trace Analysis Package (ETAP)
is an OSF MK tracing facility, designed to provide users
with a robust set of tools to study system behavior.

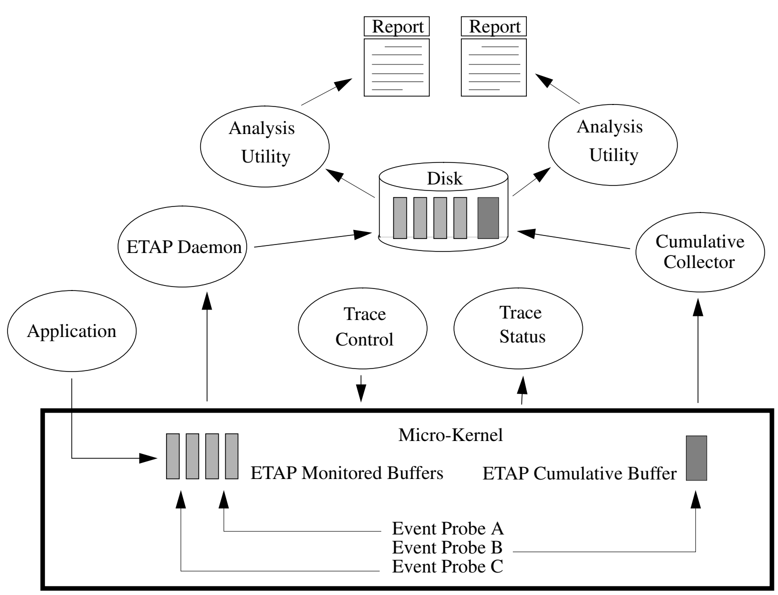
What Does ETAP Trace?

- Application level events
  - specific to the needs of the application
- Kernel internal events, such as:
  - system calls
  - context switches
  - interrupts
  - lock operations

ETAP Requirements

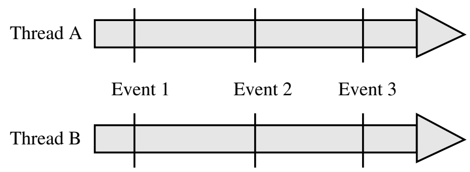
- Application-level event trace support
- Kernel-level event trace support
- Dynamic trace control
- Configurable (at compile time)
- Minimally intrusive
- High resolution clock (us granularity)
- Analysis tools

ETAP Architecture



ETAP Trace Control

ETAP implements a two-dimensional trace control filtering scheme, in order to keep data collection and trace skew to a minimum.



Users may select:

1) only those kernel events of interest
2) specific application threads of interest

ETAP Kernel Event Probes

- Mach system calls
- Unix system calls
- Thread creation and termination
- Context switches
- Exceptions
- Interrupts
- Remote procedure calls
- Priority changes

ETAP Event Probe Data

ETAP event probes (kernel and user-level) record the following information:

- Event ID
- Timestamp
- ID of invoking thread
- Program counter
- Event flags
- Event specific data

Applications of ETAP

The OSF/RI has worked closely with the Naval Surface Warfare Center (NSWC) to define the direction and exploit the uses of ETAP. The tracing facility has played a major role in the Navy's MARTi application development effort.

NSWC utilized ETAP to achieve:

- Application debugging
- Application optimization
- Performance analysis
- System behavior monitoring

ETAP at Work: Sample Code

```
main()
{
        int  x,  pid;

        etap_trace_thread(mach_thread_self(), TRUE);

        for (x=0; x<2; x++) {
                pid = getpid ();
                etap_probe (0xdeed, sizeof(int), &pid);
        }

        exit(0);
}
```


ETAP at Work: Data Collected

Active Probes: UNIX calls, thread life, context switches, interrupts, exceptions.

```
Thread ID       Time        Event
===================================================================
c215b690: 1297798924: thread created    [Task: c2192d8c / Activation: c219301c]  Priority = 96
c215b690: 1297799246: unix enter: getpid
c215b690: 1297799474: unix exit : getpid
c215b690: 1297799552: user probe: [deed] data = b8 0 0 0
c215b690: 1297799620: unix enter: getpid
c215b690: 1297799799: unix exit : getpid
c215b690: 1297799875: user probe: [deed] data = b8 0 0 0
c215b690: 1297790025: interrupt enter: hardclock
c215b690: 1297800180: interrupt exit
c215b690: 1297800791: unix enter: close
c215b690: 1297800983: unix exit : close
c215b690: 1297802028: exception: page fault
c215b690: 1297803792: exception: page fault
c215b690: 1297808358: thread terminated [Task: c2192d8c / Activation: c219301c] Priority = 96
c215b690: 1297808578: context switch to   c2153904   Reason: termination
```

ETAP Overhead

How much does it cost to “tap” a kernel?

1.5%

The number above was calculated on an HP Vectra 486 computer under the following conditions: 32 megabytes of memory, a collocated server, an ETAP configured kernel, 4k ETAP monitored buffer, ETAP event probes configured but not enabled, a workload of AIM III simulating 8 users.

Summary

The Event Trace Analysis Package is available in OSF MK7.

ETAP features:

- User and kernel-level event tracing
- Dynamic trace control
- Configurable
- Minimally intrusive
- High resolution clock
- Analysis tools

ETAP functions as:

- Application debugging tool
- Application optimization tool
- Performance analysis profiler
- System behavior monitor

Technology Transfer

Portions of the ETAP design were derived from The Lock Analysis Package developed at The Center for High Performance Computing (CHPC).

For more information on the CHPC Lock Analysis Package see:

- J. CaraDonna, N. Paciorek, C.E. Wills, “Measuring Lock Performance in Multiprocessor Operating System Kernels”, USENIX Symposium on Experience with Distributed and Multiprocessor Systems, September 1993.

- J. CaraDonna, “A Lock Performance Analysis of the Mach 3 Micro-kernel” Masters Thesis, Worcester Polytechnic Institute, May 1993.

More Information

For more information on ETAP see:

- J. CaraDonna, “OSF-RI MK7 The Event Trace Analysis Package: ETAP Users Guide”, MK7 Documentation Distribution, January 1995.

- “OSF-RI MK7 Release Notes”, MK7 Documentation Distribution, January 1995.