UNIVERSITY OF WISCONSIN MADISON

Paradyn v2.1 Release

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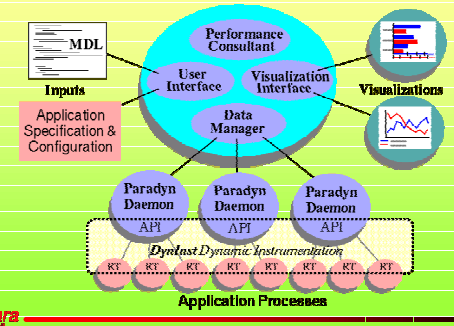
Outline

- Review of _Paradyn_ **v2.0** (Sept.'97)
  - Synchronized _DynInstAPI_ **v1.0** release (U. Maryland)
- Developments since **v2.0**
  - Extended capabilities
  - Performance enhancements
  - Generic maintenance
  - Miscellaneous bug-fixes
- Current status

Paradyn & _DynInst_ Architecture



Summary of _Paradyn_ **v2.0**

- Key features:
  - Basic support for MPI [under POE on SP2-AIX]
  - New x86-WindowsNT platform [_paradynd_]
  - Dynamic linking of _libdyninstRT_ [SPARC-Solaris]
  - No re-linking requirement [x86-WindowsNT]
- Released Sept.'97 (sources & binaries)
  - Synchronized initial _DynInstAPI_ **v1.0** release
  - Occasional subsequent interim releases

Paradyn **v2** functionality summary

Key:
- Support currently under development
- Applications compiled by VC++ only
- Support added in _DyninstAPI_ **v1.1** only
- Programs started under SP2 POE only

	SPARC Solaris	x86 Solaris	x86 WinNT	RS6000 AIX
Front-end/GUI (_paradyn_ & _Visi_)	✔	✔	✘	✔
Daemon (_paradynd_ & _libdyninstRT_)	✔	✔	✔♠	✔
DyninstAPI library	✔	✔	✔ ✘v2.1	✔
Shared-objects / dynamic linking	✔	✔	✔	✘
libdyninstRT as a shared library	✔	✘ ⇄v2.1 ✔	✔	✘
Dynamic loading of _libdyninstRT_	✘v2.1 ✔	✘♥	✔	✘
Attach to running process(es)	✔	✔	✔	✘♦
Supported parallel execution modes	PVM	PVM	PVM	PVM MPI♣

Example of "linking" revisions

`Makefile`:

```
SYSLIBS  = -lm -lsocket -lnsl
OBJECTS  = main.o this.o that.o
- PDOBJECTDIR=$PARADYN_ROOT/lib/$PLATFORM
~ PARADYN_LIB=$PARADYN_ROOT/lib/$PLATFORM/libdyninstRT.so
app:    $(OBJECTS)
        $(CC) -g -o app \
-           $(PDOBJDIR)/DYNINSTstartCode.o \
            $(OBJECTS) \
-           $(PDOBJDIR)/DYNINSTendCode.o \
-           $(PARADYN_LIB) \
            liblots_of_stuff.a $(SYSLIBS)
```

`paradyn.rc` or **`app.pcl`**:

```
  exclude "/Code/libc.so.1";              // 1000's of fns
+ exclude "/Code/liblots_of_stuff.a";     // uninteresting
  ...
```

v2.1 extended capabilities (&)

- Automatic code block identification [Solaris]
  - eliminates requirement for application re-linking using explicit dyninstSTART/ENDcode markers
  - exclusion of statically-linked modules & functions
- 2-pass function re-locator/expander [SPARC/Solaris]
  - undoes (some) tail-call optimizations to allow full instrumentation of highly-optimized functions
- Handling stripped *dynamic* libraries [Solaris]
  - use run-time linker's dynamic symbol table (.dynsym)

v2.1 extended capabilities (& cont.)

- Robust handling of larger processor sets
  - Multiple retries of *paradynd* connections
- Handling multiple *paradynd*s per processor

DynInstAPI **v1.1** only:

- Blocking option to wait for any events
- Parsing gcc-compiled executables [x86-WNT]

v2.1 extended capabilities (UI)

- More powerful MDL syntax
- Metrics for I/O in MPI programs [SP2-AIX]
- External *paradynd* start-up support
  - `UW-SP2> paradyn -f app.pcl -x ~/.paradynd`
  - `$ paradynd -z<flavor> -l2 -m*UW-SP2* -p*12345*`
- Refined user interface
  - Scalable process status area (with scrollbar!)
  - Distinct information & error message displays
  - Handling goofy characters in function identifiers

MDL: Metric Description Language

Specification of instrumentation operations which can be applied by paradynd to application instrumentation points

```
if (<metric_expr>) {                    // v2.0
    foreach func in <metric_expr>
        (* if (<inst_expr>) <inst_request_expr>; *)
}
```

- More powerful, consistent expression syntax

```
if (<expr>) {                           // v2.1+
    foreach func in <expr>
        (* if (<expr>) <expr>; *)
}
```

- any valid expression now acceptable as function arguments
- replace/update **`paradyn.rc`** configuration files!

Updated MDL expression syntax

Former:

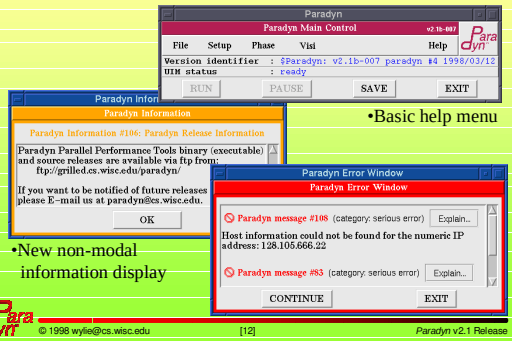
- `setCounter(i,j)` → `i=j`
- `addCounter(i,j)` → `i=i+j | i+=j` `// i++`
- `subCounter(i,j)` → `i=i-j | i-=j` `// i--`

Updated:

New from **v2.1**:

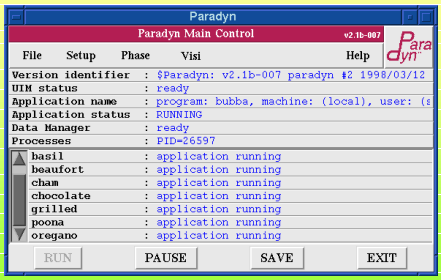
```
foreach callsite in func.calls {
    append preInsn callsite
  (* // any valid expression can be function args
     if ($arg[n1*(n2+n3)] == "xyz")
         counter = Func1(-(a*b),c) + Func2(d,e,f);
  *)
}
```


Paradyn **v2.1** error & info displays



- Basic help menu
- New non-modal information display

Paradyn v2.1 Main Control window

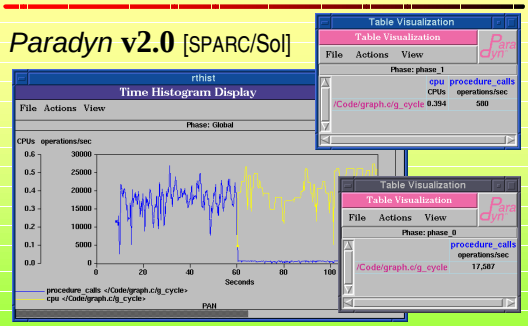


•Separate resizable, scrollable area for process status info.

v2.1 performance enhancements

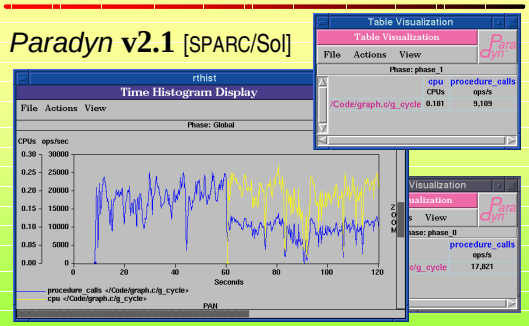
- Disclaimer: ***your actual mileage will vary!***
- Faster location of program symbols (typ. ×2)
  - part of executable parsing on start-up/attach
  - better handling of large numbers of functions in complex applications (& non-excluded libraries)
- Optimized instrumentation [x86-Solaris]
  - avoiding some of the use of costly traps ✦ *Buck*
- Switch to lower-overhead system timer [Solaris]
  - **/proc** PIOCUSAGE → gethrvtime() : 64µs → 2µs!

Paradyn v2.0 [SPARC/Sol]



CPU metric added (to procedure_calls base instrumentation) after 60s reduces effective performance *over **30**-fold!*

Paradyn v2.1 [SPARC/Sol]



Less intrusive timers only reduce performance around 50%, providing more accurate measurements (*c.f.* CPU in phase 1)

v2.1 performance enhancements (cont.)

- *Paradyn* used to analyze its own performance!
  - *Paradyn*/*paradynd* are analyzing a subject application
    - the *Perf. Consultant* is conducting an automated search
  - A 2nd *Paradyn*/*paradynd* is attached to the 1st *paradynd*
    - *Naím*'s expert analysis of performance of 1st *paradynd* identifies excessive pausing & continuing of application, **but** this is done in many different places inside *paradynd* !
    - *Figueira*'s prototype path-profiling tool isolates excesses to *paradynd* 's method of modifying subject instrumentation
- Faster instrumentation enabling/disabling (×16)
  - minimize *paradynd* interference with running processes

v2.1 generic software maintenance

- Easier source build strategy
  - Configurable from top-level **`Makefile`**s
  - Optional build to incorporate support for PVM
- Integrated build identification information
- Tcl/Tk upgrade to v8.0
  - X→Tk portable font substitution
- General source tidy and reduction of the number of warnings during compilation!

Elimination of key bugs in **v2.0**

- *Paradyn* front-end data-collection memory leak
- Handling pending system calls when application paused
- Improper *Visi* trace-stream closing
- *Igen* parsing of (invalid/incomplete) argument lists
- Race condition in *paradynd* main control loop
- ...

Fixes for *DynInstAPI* **v1.0**:

- Buffer mis-alignment to word boundaries [SPARC-Solaris]
- Improved parsing of Portable Executable format images and jump-tables [x86-WNT]

Beyond **v2.1** – the near future

- Support for multithreaded applications ❖ *Naím*
- Improved *Performance Consultant* search ❖ *Cheyney*
- Ports for DEC-Alpha, x86-Linux, MIPS-IRIX
- Handling machines/hosts specified by numeric IP addresses
- Dynamic loading of *libdyninstRT* on x86-Solaris
- Handling relocated dynamically-loaded libraries on x86-WinNT
- Guaranteed instrumentation of program `main()`
- Source code profile viewer & code-coverage *Visi*
- Portable (entirely) Tcl/Tk-based GUI
- Clean detach from attached application processes
- ... other exotica ...

Current status

- Release targeted for end of March '98
  - code freeze in effect — no new functionality
  - extensive testing in progress
  - documentation synchronization check
  - both source & binary packages will be available:
    `ftp://grilled.cs.wisc.edu/paradyn/`
    `http://www.cs.umd.edu/~hollings/dyninstAPI/`
- Provide your feedback (`paradyn@cs.wisc.edu`) about experiences, difficulties, priorities & requirements to guide us improving *Paradyn* & *DynInstAPI*