musings on software engineering

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(Please ask questions during the talk)

An accidental linux box ...

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Software Engineering Progress

- What has been happening in practical software engieering?
  - 10 years ago, I think that most free software projects were behind most proprietary projects in terms of software engineering techniques
  - now, I think that free software is leading the way

New tools - new approaches

- The last few years has seen a new emphasis on good software engineering techniques
  - talked about for a long time, but now being widely adopted
  - a combination of tools and techniques
- Types of tools
  - static analysis
  - runtime analysis and simulation
  - memory management tools
  - code generation
  - much improved infrastructure libraries

Static Analysis

- Static code analysis has been around for a long time.
    - Lint has been around for well over 20 years!
- Now starting to be applied much more widely
    - advanced gcc warnings
    - 'sparse' analysis for kernel
    - stanford checker
    - findstatic.pl, minimal_includes.pl in Samba

Runtime analysis

- Runtime analysis also has a long history
    - when was the first profiler written? The first runtime heap checker?
- Recent advances have revolutionised runtime analysis
    - valgrind - perhaps the most important advance in recent years
    - tracing infrastructures

Code Generation

- Code generation has had a huge impact on the design of Samba4
  - A bit over 50% of code in Samba4 is now auto-generated
  - Mostly based on IDL, using pidl
  - some based on swig, for python bindings
- Could this be generalised?
  - more general code generators also become more unwieldy
  - different projects have quite different generator requirements
  - IDL compilers - Samba vs Wine vs Ethereal

Non-traditional IDL

- Initial motivation for IDL was for DCE/RPC
  - DCE/RPC is natually IDL based
  - code generation rules are quite simple
- Once we got the IDL bug ...
  - used for on-disk xattr format
  - used for NBT/WINS packets
  - used for datagram and mailslot code
- Lots of extension to IDL
  - non NDR formats, alignment rules, sub-contexts etc

The async problem

- Projects that implement network protocols tend to start out as “do one thing at a time” systems
  - very simple to code and understand
  - can suffer very badly from latency problems
  - some environments exacerbate this - like HSM
- There are three commonly used solutions
  - use threads
  - break up into separate processes
  - use a state machine

Threads are evil

processes are ugly

state machines send you mad

Samba4 - choose your own combination of evil, ugly and mad

A events/async framework

- We eventually settled on a system that provides flexibility while (hopefully) maintaining sanity
  - runtime chosen process models
  - a sane events framework
  - composite functions for taming state machines

Looking for an embedded solution?

- The end result is we can have a single non-blocking process that has
  - a ldap server
  - a CIFS server
  - a NBT server
  - a dgram server
  - a rpc server
  - and soon .... a web server

Composite Functions

- Composite functions keep us (relatively) sane
  - build higher level async functions out of lower level functions
  - a single coherent framework for state machine handling
  - sane error handling (thanks to talloc)
- Allows linkage between protocol subsystems
  - composite 'connect' does ...
    - DNS and NBT and /etc/hosts
    - SMB connection
    - spnego, NTLM etc
    - all in parallel!

Memory Management

- Memory management has always been a key problem is software engineering
- One solution - a new language?
    - Java, mono, python etc
- Another common solution has been pool based memory managers
    - apache runtime, old talloc
    - these help, but memory management is still painful

talloc - sane memory handling in C

- Pool based memory managers have been around for a long time
  - get a handle, alloc some chunks on that handle, destroy the handle
- Last year we noticed 'halloc' on freshmeat.net
  - hierarchical pool allocation? Could this be useful?
- Revolution!
  - new talloc implemented
  - destructors allow huge lumps of complex code to be removed
  - easy integration with existing resources

Code Coverage

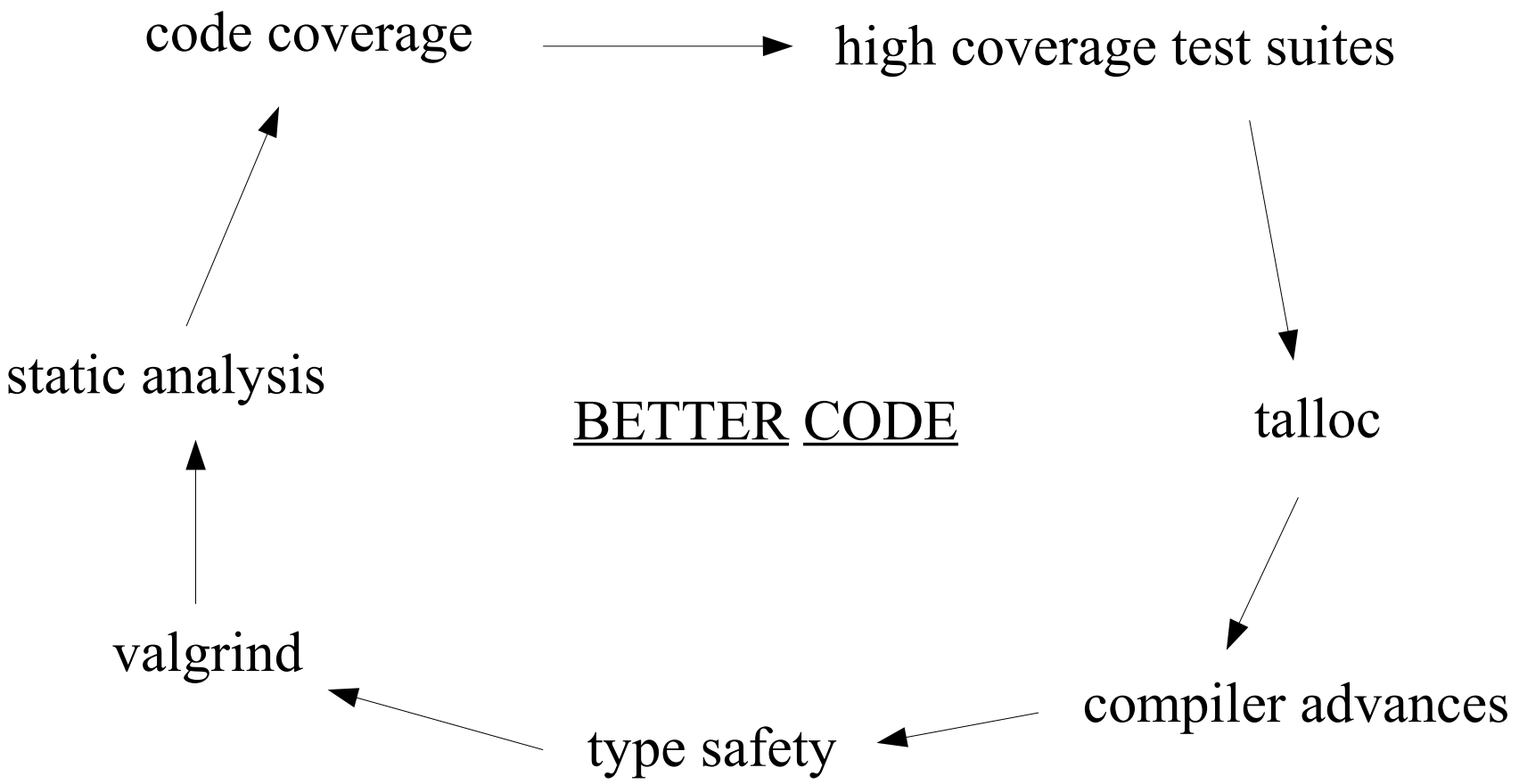
- Code coverage tools have been around for ages
  - like most people, I ignored them
  - started playing with gcov for small bits of code
- Eureka!
  - code coverage + good test suites + valgrind == wonderful!

The usability problem

- Oh the embarrassment!
  - ADS - Microsoft has taken traditional unix subsystems and integrated them better than the originals
    - krb5 + DNS + LDAP + RPC + CIFS
- For Samba, the problem was LDAP
  - OpenLDAP + SSL + SASL + krb5 == nightmare
  - How important is the standards focus of OpenLDAP for Samba?
- The solution was ldb

ldb - sane but minimal 'LDAP'

- Is LDAP without a schema useful?
  - Yes!
  - An empty file is a valid database
  - for embedded LDAP, trusting the application is OK
- ldb grows up
  - schema module added
  - ldap protocol server added
  - still allows for sane 'no schema' embedded usage


code coverage
high coverage test suites
talloc
compiler advances
type safety
valgrind
static analysis
BETTER CODE

Life at the bleeding edge

- A new filesystem, a new way to lose your data!
  - STFS - a filesystem for high decibel storage systems
- What happens if .....
  - we run smbtorture CHARSET test against Win32 STFS
  - ... and it tests all UCS2 characters
  - ... including character 0x12F
  - ... and we mount the same filesystem via STFS for Linux
  - ... and we want to cleanup the test using
    `rm -rf testdir`

When all else fails ... brute force

- The LSA session key problem
  - on ncacn_np transport session key is obvious
  - on ncacn_ip_tcp what is the key??
- re-cast problem as a public challenge
  - clarifies problem a lot, and sometimes gives a solution
  - noticed that encryption was the same on all servers!
  - a fixed key?!?
- How far do changes propogate?
  - input appears to be in 7 byte blocks. What could that be?

smart brute force

- bitslice DES
  - 32 DES calls in parallel
  - full search would still take years
- Could the key be human readable?
  - search weighted by character frequency
  - attack 51 bits at a time
  - 2 days of CPU later solution is “SystemLibraryDTC”

Questions?