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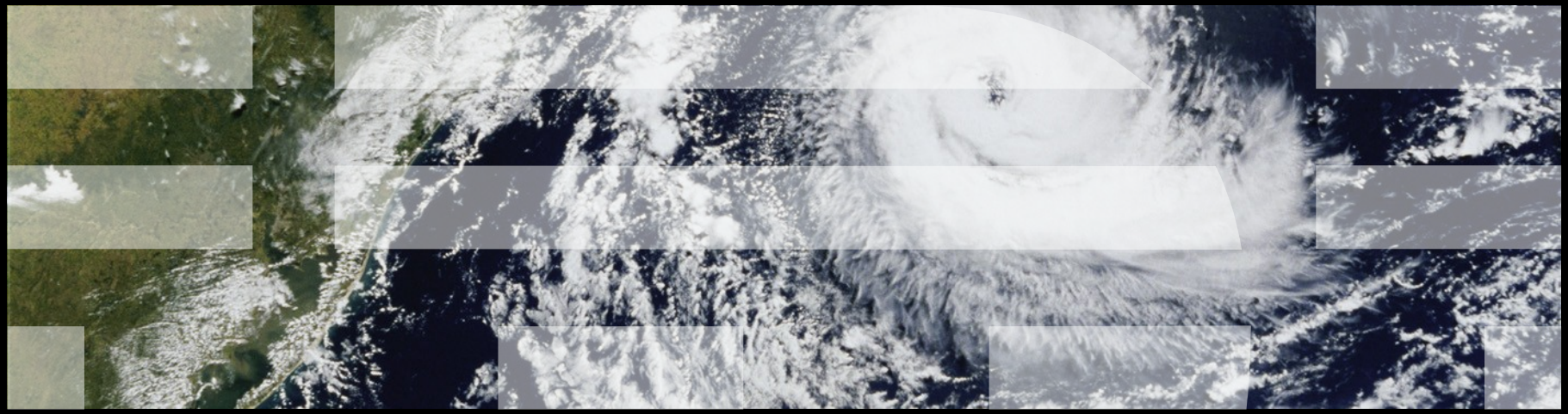
linux.conf.au Kernel Miniconfernece Lightning Talk, January 16, 2017

Does RCU Really Work?

And if so, how do we know?



More Than 1.5 Billion Linux Instances Running!!!

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- A race condition that occurs once in a million years happens ***several times per day*** across the installed base
  - I am very proud of rcutorture, but it simply cannot detect million-year races when running on a reasonable test setup
  - Even given expected rcutorture improvements

Maybe Formal Verification?

Maybe Formal Verification? Such as CBMC?

- C Bounded Model Checker (CBMC) applies long-standing hardware verification techniques to software
- Easy to use: Given recent Debian-derived distributions:

```
sudo apt-get install cbmc
```

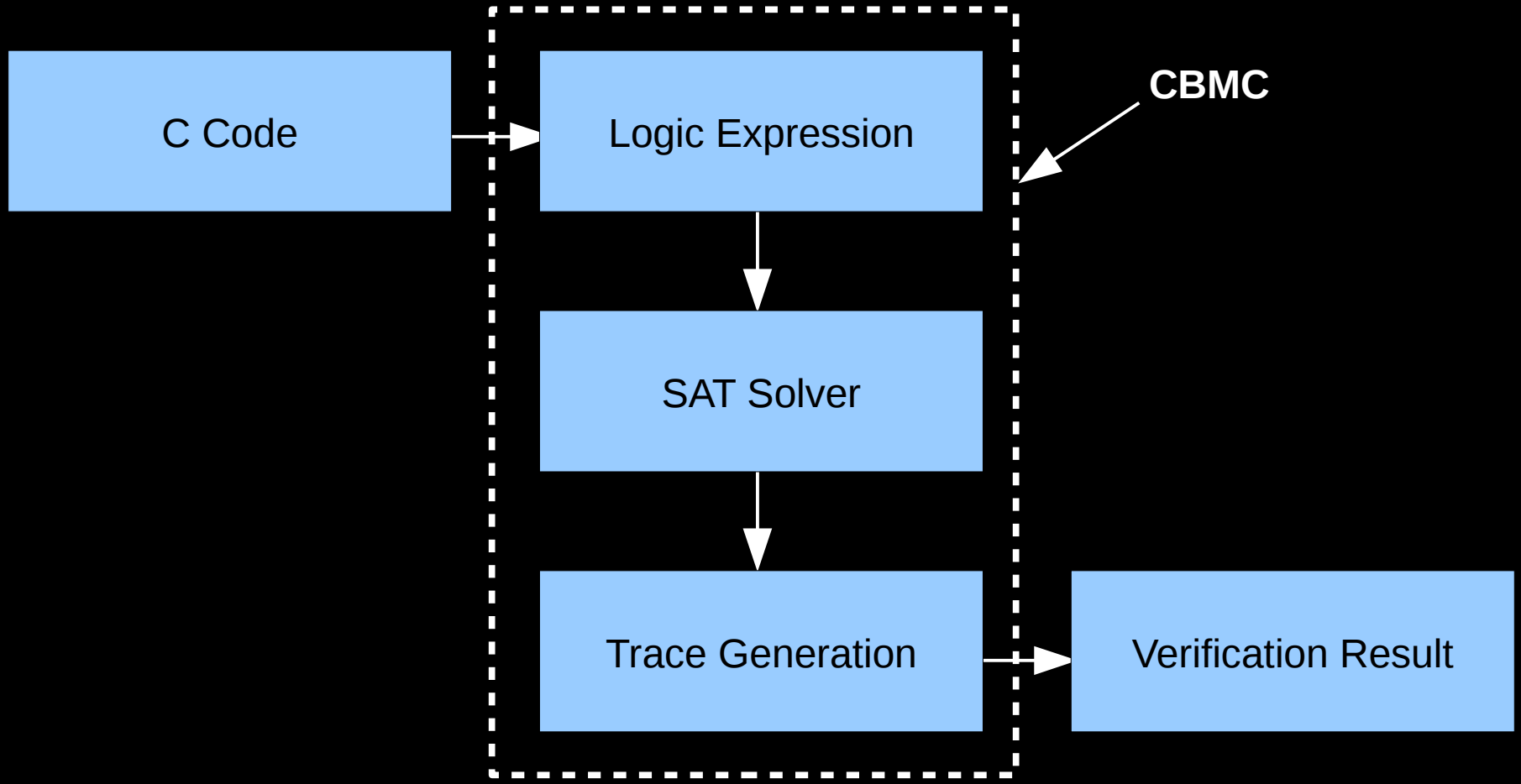
```
cbmc filename.c
```

- If no combination of inputs can trigger an assertion or cause an array-out-of-bounds error, it prints:

```
VERIFICATION SUCCESSFUL
```

- And since 2015, CBMC handles concurrency!!!

How Does CBMC Work?



A Few Questions/Objections You Might Have...

- But C is Turing-complete and logic expressions are not!!!
  - Yes, hence “bounded”. You can specify loop/recursion unrolling limits
- But SAT is NP-complete!!!
  - True, but there are now ***amazing*** heuristics for SAT
  - 1990: World-class solver handles 100 variables (three 32-bit variables)
  - 2015: x86 laptop does 2M variables. In ten seconds.
- How CBMC possibly handle concurrency???
  - Convert C program to SSA, wire reads to writes using memory model
- If this is really useful, why don't you apply it to RCU???
  - I checked CBMC verification of SRCU into -rcu on December 31, 2016
  - Implementation courtesy of Lance Roy
- Has CBMC really found any SRCU bugs???
  - Yes, though only injected bugs used to test the verification

Other Questions or Comments?

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