

# Unified error reporting -- A worthy goal?

Andi Kleen, Intel Corporation

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[andi@firstfloor.org](mailto:andi@firstfloor.org)

# errors

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- standardized errors
  - machine checks
  - pci-express errors
- platform errors
  - thermal errors
  - APEI
- storage errors
  - IO errors
  - SMART events
- network errors
  - link lost
- random errors from drivers
  - failover
- software errors
  - out of memory

# scope

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- concentrating on platform hardware errors for now
- the others possibly later
- but especially software errors are hard
  - because there are so many of them

# what can you do with errors:

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- log them
  
- categorize them: display critical ones on the desktop as pop up
- account them, keep statistics
  - that many errors on device X in last 24hours
  
- trigger events
  - e.g. when more than X errors in 24h call this shell script
  - which pages admin, support, triggers failover
  - or on a small home servers starts blinking the red LED
    - ▷ (after all what else is the "LED subsystem" good for?)

# audiences

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- desktop user
- normal system administrator
- expert
- automated analysis tool
- cluster logging

# the desktop user

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- don't really understand errors
  - at best a very high level summary
  
- should not be unnecessarily concerned
  - needs classification, hiding
  
- graphical interface
  
- localization
  
- details should still be available for expert support

# normal system administrator

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- largely same as desktop user
- only really needs high level summary
- should not be unnecessary alarmed
- really wants to identify failed part
- graphical interface not as important
  - can access log files
  - but still useful if not intrusive
  - needs reporting to the console

# expert / automatic tools

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- compatibility crucial
  
- still want high level summary
  - but all the details should be available
  
- interface to other tools
  - might put error from a cluster in central database

# so what's wrong with printk?

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- difficult to parse
- good errors are verbose
- printk is traditionally for 1-2 lines
  - most printks with more information are a mess
  - no clear record boundaries
- categorization / severity important
- good errors too verbose for kernel log

# what's good with printk

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- it's the standard
  - a lot of people know where to look
  
- there are lots of tools to handle it
  - including network servers
  - but often not very good
  
- should be used for some high level categorization
  - but only those errors that don't make sense to hide

# error metadata

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- hardware errors
  - ultimate goal is to identify the failed part
  - various other information
  
- various other data useful
  - for example dropped event count
  
- advantage of standard records
  - they tend to be reasonably well documented
  - so you can point sophisticated users to documents
  - make it easier to process
  
- rich errors are important
  - need more data per error
  - but don't display it all by default

# why should some errors be hidden?

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- some "errors" are normal and expected
  - if you ever saw a noisy SMART daemon...
  - or ECC memory has a expected corrected error rate
  
- let's call them events
  - they're not really errors
  
- hardware errors are often bursty
  - but individual events in a burst not too interesting
  - and on large clusters too much data
  
- they're still useful to see trends
  - and should be accounted per component
  - don't belong in normal kernel logs

# error processing

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- good error processing needs a lot of state
  - and also policy
  - GUI interfaces for important errors
  - or triggering events
- with triggers when exceeding thresholds
- complex decoding
  - identifying components using firmware help
  - probably not a good idea in the kernel
- one corner case is fatal errors where the kernel has to panic
  - the kernel needs to do limited decoding at least
  - but most errors are not fatal
- need user space for rich error processing
  - we already have it with klogd/syslogd
  - just too dumb

# errors vs event tracing

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- normal event tracing aimed at debugging
  - so higher overhead is ok
  
- error handling should be always on
  - has to work seamlessly in the background
  
- small footprint crucial
  - particularly in memory
  - and in dependencies
  
- requirements and tools are quite different
  - should not be mixed up
  - possibly reuse some infrastructure
  - but only if it has extremely low overhead

# so what's the master plan?

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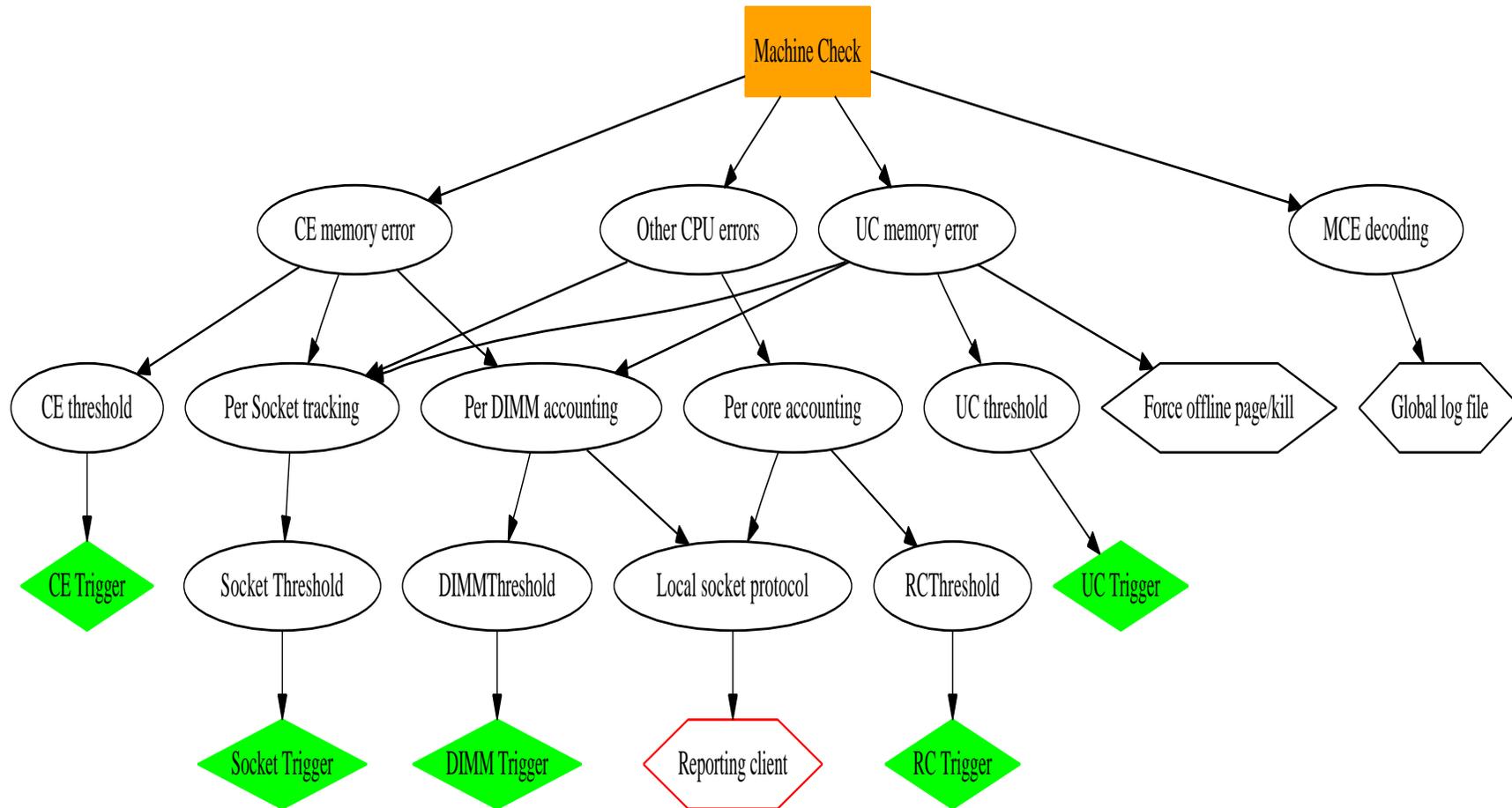
- right now for platform errors (MCE, APEI, PCI-AER)
  
- keep basic one line errors in printk with an identifier
  - but only for serious errors or occasionally output for trends
  - strictly rate limited
  - possibly extend KERN\_\* for severity
  
- but add structured record on second channel
  - similar to /dev/mcelog, but ascii in sysfs
  - few record types for different types
  - using standard formats (e.g. CPER)

# master plan user space

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- a standard error daemon
  - light weight to always run
  - has knowledge over basic error types
  - accounts events
  - hooks for automated action
  - simple network protocol interfaces
  
- extension of mcelog for more errors
  - PCI errors, APEI
  - more in the future?

# mcelog



# Questions?

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# Backup

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# kernel error problems

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- some happen from NMI like contexts
- have to use lockless data structures
  - can cause problems like livelocks
- requires preallocation, potentially wasting a lot of memory