

# SPARC Systems

Crash Dump Analysis 2015/2016



CHARLES UNIVERSITY IN PRAGUE

faculty of mathematics and physics

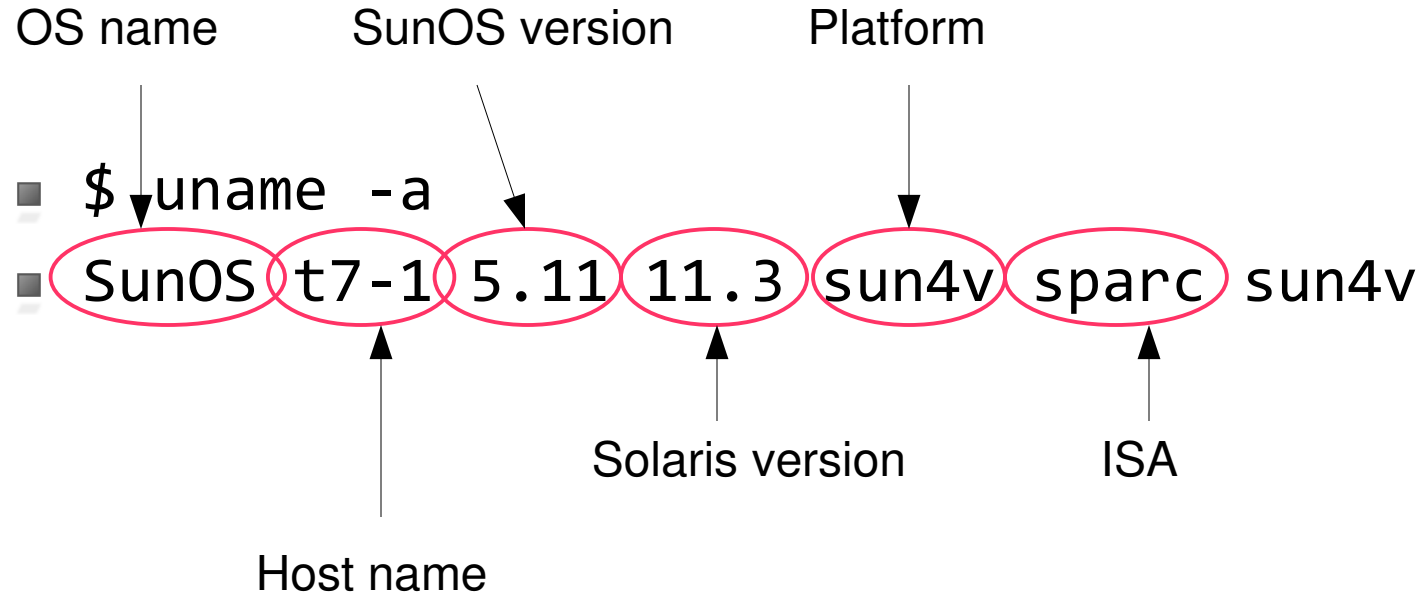
Department of  
Distributed and  
Dependable  
Systems



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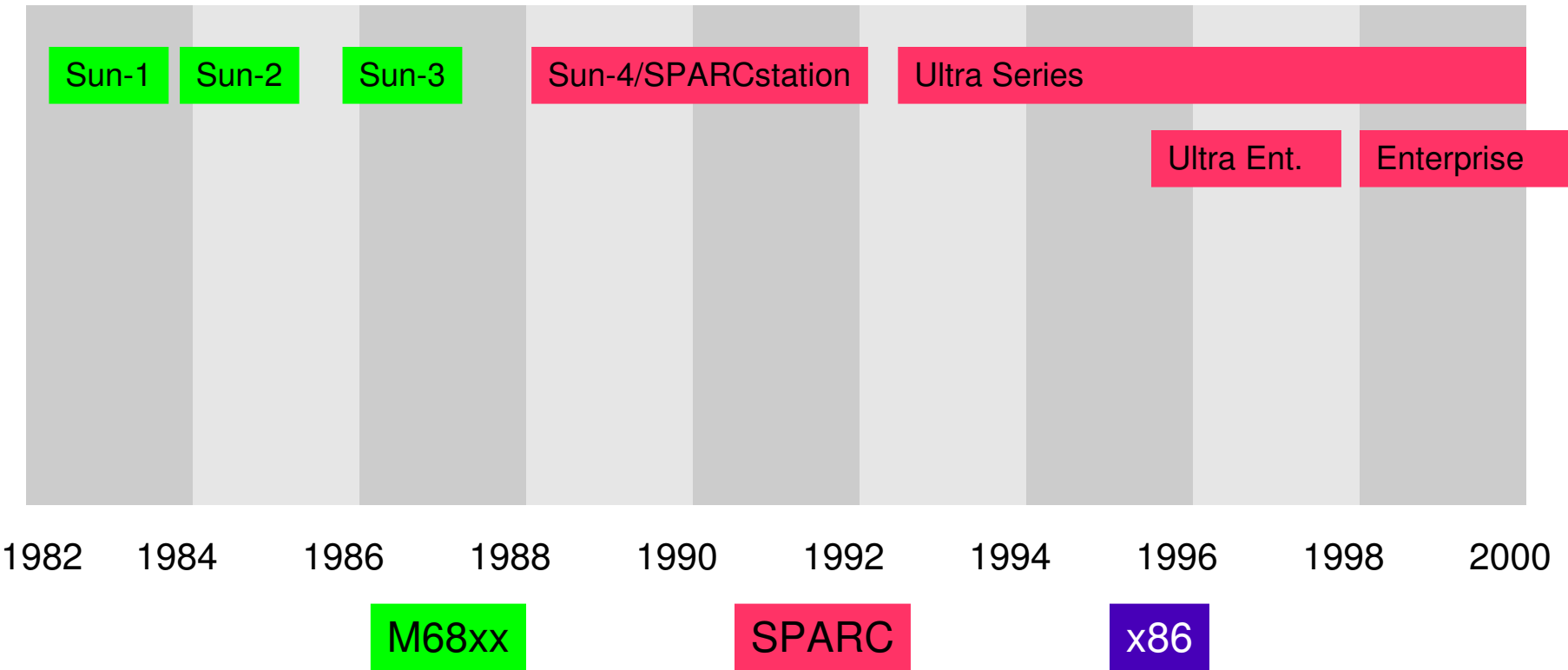
# Motivation



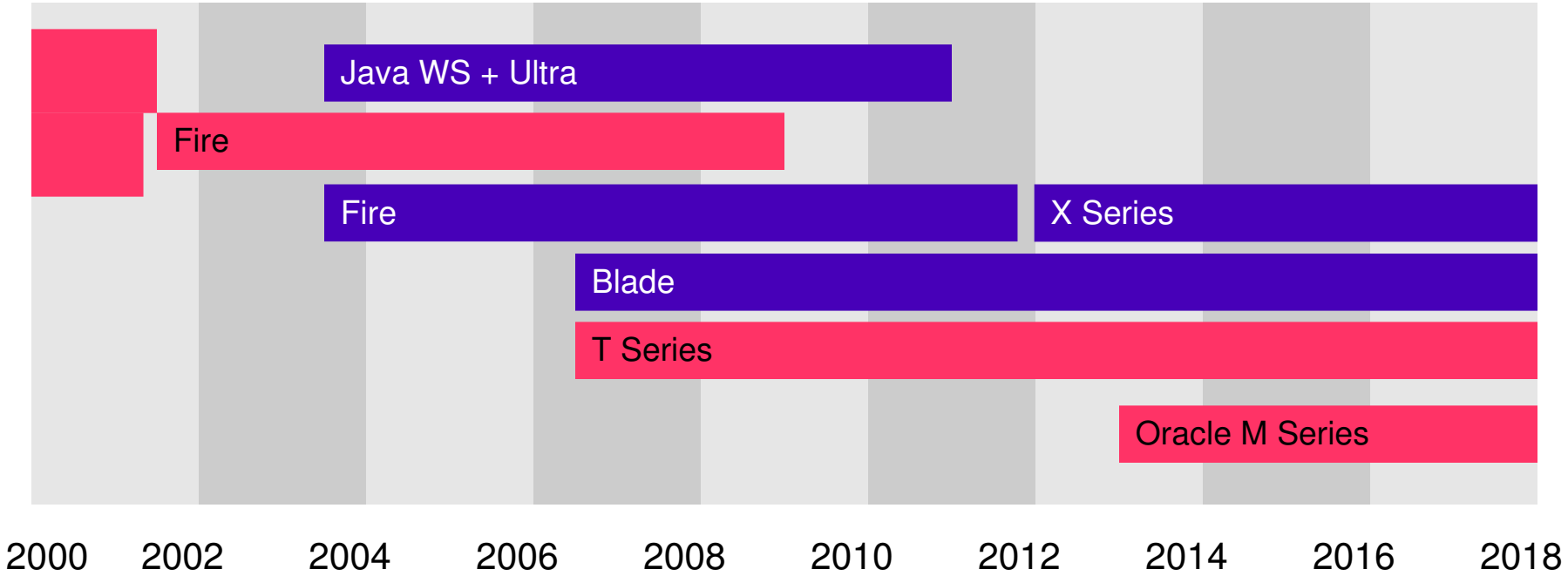
# Workstation and Server

- **(Graphical) Workstation**
  - Desktop computer with lots of RAM and CPU power
  - High-resolution color monitor
  - Storage: SCSI tape (LTO), Fibre Channel...
- **(Enterprise) Server**
  - Rackmount computer with lots of RAM and CPU power
  - No monitor
  - Storage: Lots of disks, tape, ...

# Timeline



# Timeline (continued)



M68xx

SPARC

x86



# Platform

- **Motorola 68xx**
  - sun1, sun2, sun3
- **32-bit SPARC**
  - sun4, sun4c, sun4m, sun4d...
- **64-bit SPARC**
  - sun4u (u for UltraSPARC)
  - sun4v (v for Virtualization) – T Series and current M Series

# T Series

- **UltraSPARC T1**

- Sun Fire/Sun SPARC Enterprise T1000, T2000

- **UltraSPARC T2**

- Sun SPARC Enterprise T5120/5140/5220/5240/5440

- **SPARC T3**

- SPARC T3-1, T3-2, T3-4

- **SPARC T4**

- SPARC T4-1, T4-2, T4-4

- **SPARC T5**

- SPARC T5-2, T5-4, T5-8

- **SPARC M7**

- SPARC T7-1, T7-2, T7-4



# M Series

- **SPARC64**

- Sun SPARC Enterprise M3000, M4000, M5000, M8000, M9000

- **SPARC M5**

- M5-32

- **SPARC M6**

- M6-32

- **SPARC M7**

- M7-8, M7-16



# Reliability, Availability, Serviceability

## ● ISA Features

- Defined behavior in different error scenarios

## ● CPU Features

- Register content protection
- Instruction restarting

## ● System Features

- Redundant components
- Hot-replacable components
- Service Processor (monitoring, alerts)

## ● OS Features

- Predictive self-healing (FMA)
- Hot-replacable components



# Hardware Partitioning

- **System consist of modules**
  - C (Compute), M (Memory), IO (I/O)
  - CU+MU+IOU, CMU+IOU, CMIOU
  - Older systems use different terminology
- **Can be partitioned into domains**
  - Electrically isolated
  - Configured by service processor
  - Can be changed dynamically at run time
  - Typically on module boundaries

# Firmware

- **IEEE 1275-1994 (Open Firmware, OpenBoot, OBP)**
  - IEEE standard (now considered withdrawn)
  - Used with POWER/PowerPC (incl. Mac) and SPARC
  - Based on Forth language interpreter
  - 'OK' prompt
  - Can be used to examine HW, debug the OS kernel
  - FCode – architecture-independent driver/plugin residing on an add-on card or board
  - Workstations use a graphical console
    - Solaris now does something similar on x86, too

# Concurrent Multi-Threading

- **1 core – 8 concurrent instruction streams**
  - Called strands
  - Eliminates waiting for memory
  - Alternative to out-of-order execution
  - Works well for parallel workloads
  - Intel's HT is somewhat similar (but only 2 streams)
  - e.g. M7 has 32 cores,  $32 \times 8 = 256$  strands
  - Static vs. dynamic scheduling
  - Later combined with out-of-order

# Hyperprivileged mode

- **Extra privilege level**
  - Unprivileged -> Privileged -> Hyperprivileged
- **Extra level of addressing**
  - Virtual -> Real -> Physical
- **Hypervisor**
  - Part of platform firmware, always present
  - Address translation, resource partitioning
- **Used with different V18n technologies**
  - Logical Domains (Oracle VM for SPARC)
  - Solaris Kernel Zones

# Logical Domains (Oracle VM for SPARC)

- **Hardware Partitioning**
  - CPU, Memory, I/O (buses, slots, virtual functions)
  - More flexible than hardware partitions
- **I/O Virtualization**
  - Network, Disk, HBA
  - Virtualized domains can be live-migrated
- **OS-independent**
  - Different OS versions and possibly even brands

# Logical Domains continued

- **Domain roles**

- Control (a.k.a. primary), Service, I/O, Root, Guest

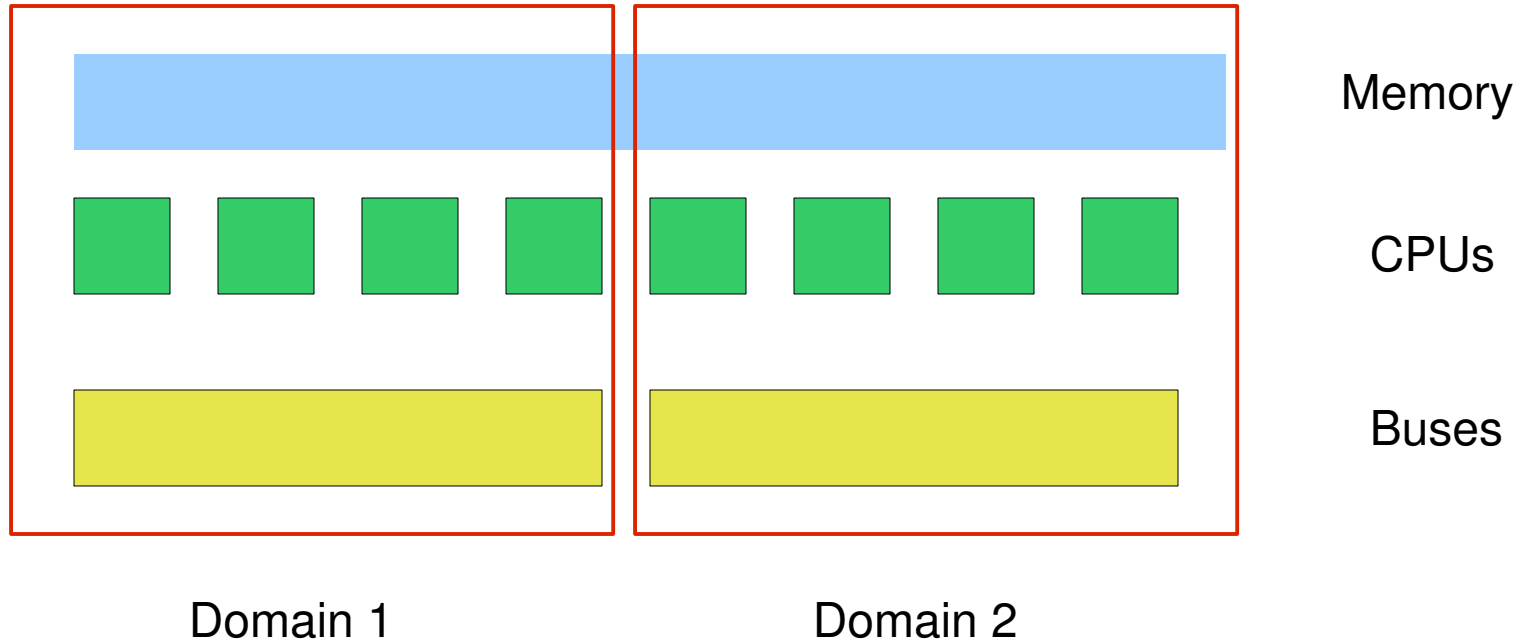
- **Initial configuration**

- Initially all resources belong to a single domain
- Remove some resources (CPUs, memory)
- Create new domain
- Assign resources to new domain

- **Many possible configurations**

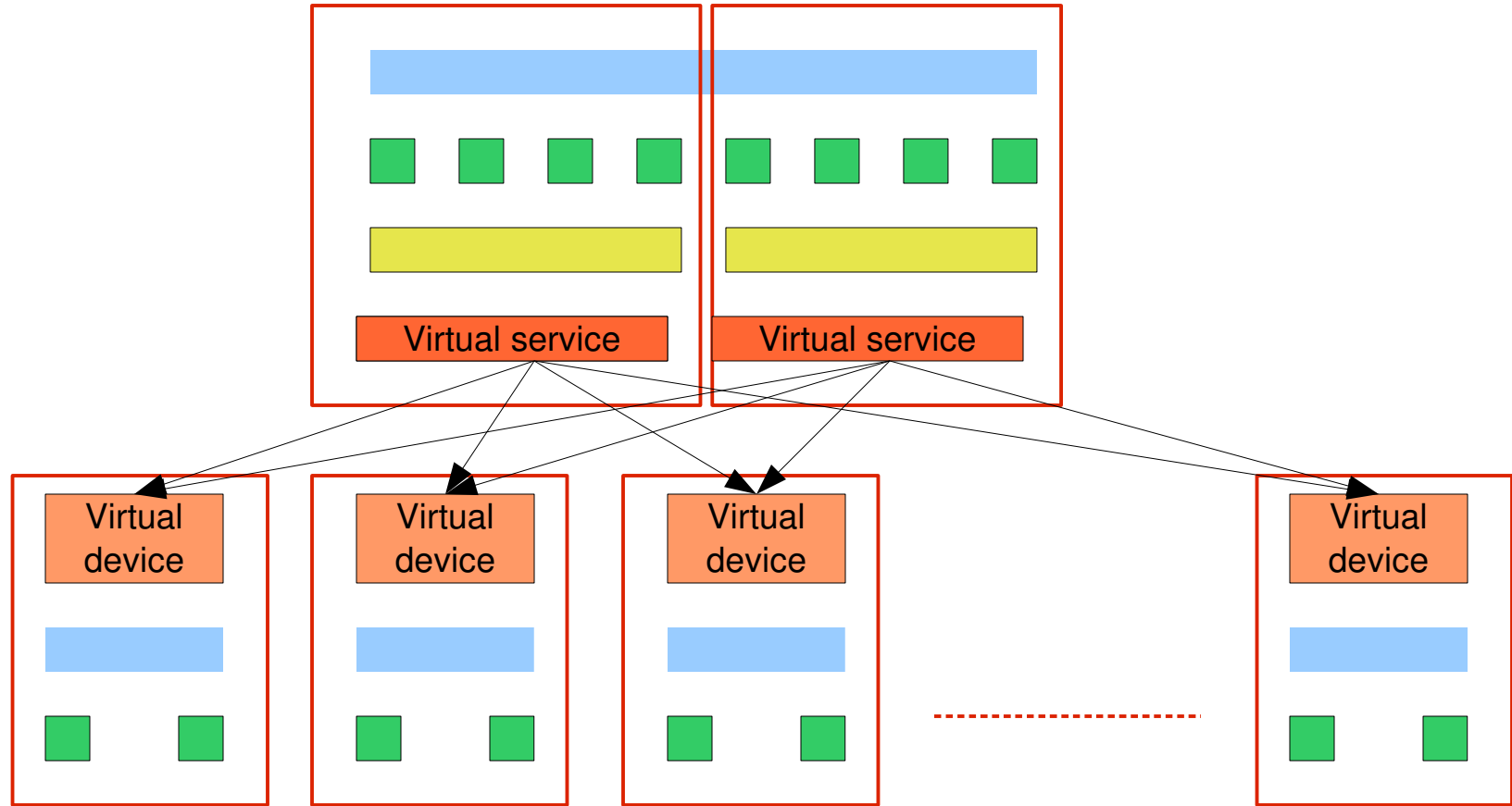
- Partitioning only, fully virtual, HW-virtualized

# Logical Domains Partitioning Only





# Logical Domains Virtualized



# Kernel Zones (Solaris)

## ● Solaris Zones

- Framework for creating virtual OS instances
- Simple user interface
- Support resource control
- Standard zones use OS-level virtualization

## ● Branded Zones

- Linux brand (defunct)
- S8, S9, S10

## ● Kernel Zones

- Use HW-based virtualization
- Intel-VT/AMD-V on x86
- sun4v virtualization on SPARC
- live migration