

E2CC: Building **E**nergy **E**fficient **C**lass**C**loud using DRBL



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Outline

- The ClassCloud Project
- E2CC Experiment Design
- Discussion
- Conclusion
- Q&A



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The ClassCloud Project



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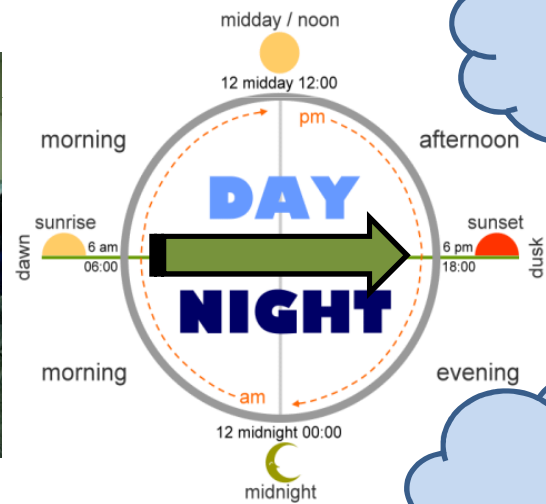
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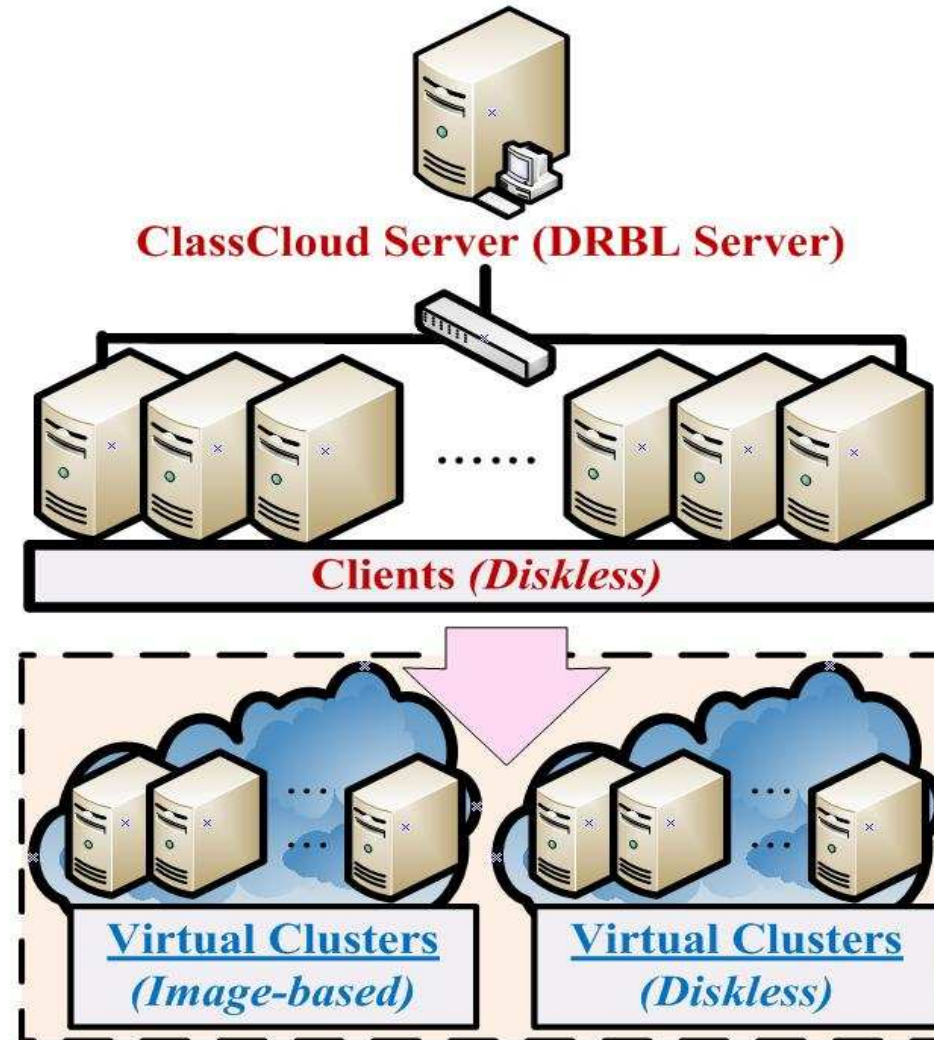
What is ClassCloud ?

ClassCloud helps to easily build
economical Cloud infrastructure in
PC classrooms !



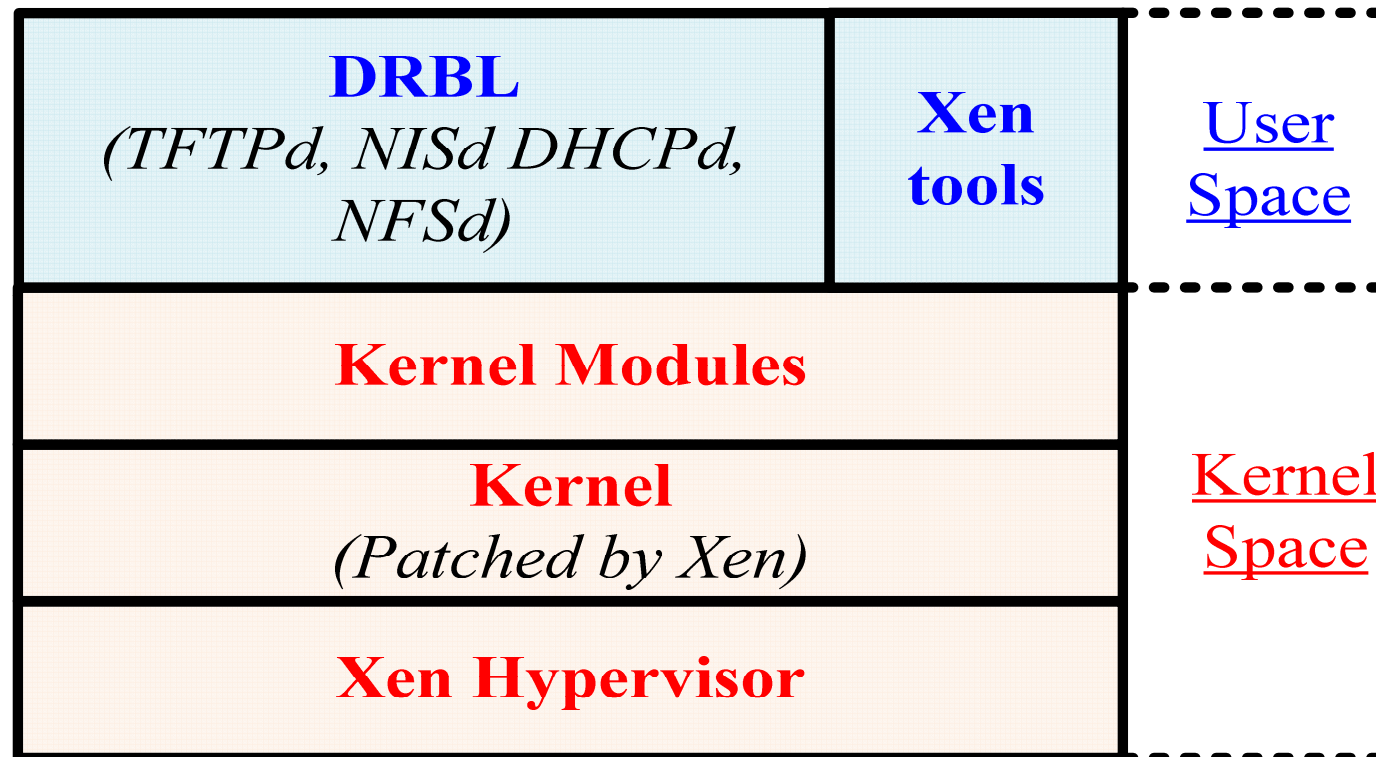


The ClassCloud Architecture





The ClassCloud Software stack





Why Xen ?

- Xen aims to be able to execute multiple operating systems on one physical x86 machine
 - Support popular OS (Linux, Windows XP, NetBSD)
 - Scalable up to around 100 VMs
 - Securely
 - With close-to-native performance.
- Support heterogeneous applications using one physical machine (I.E. Win32 and Linux apps)
- Suspend / Resume & Live Migration

Reference: http://acet.reading.ac.uk/~mjeg/docs/xen_hantslug_08-2005.ppt

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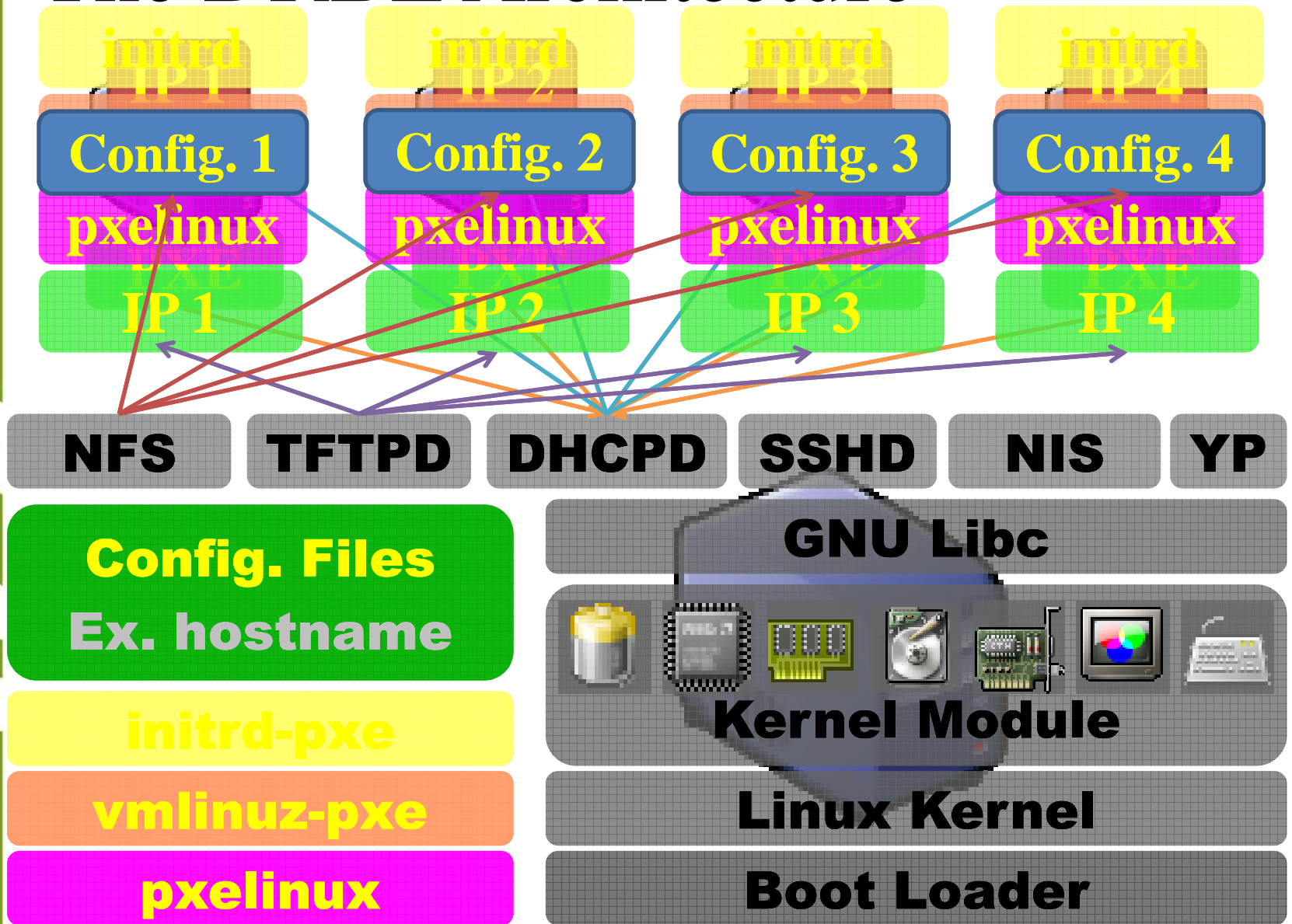
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The DRBL Architecture



E2CC Experiment Design



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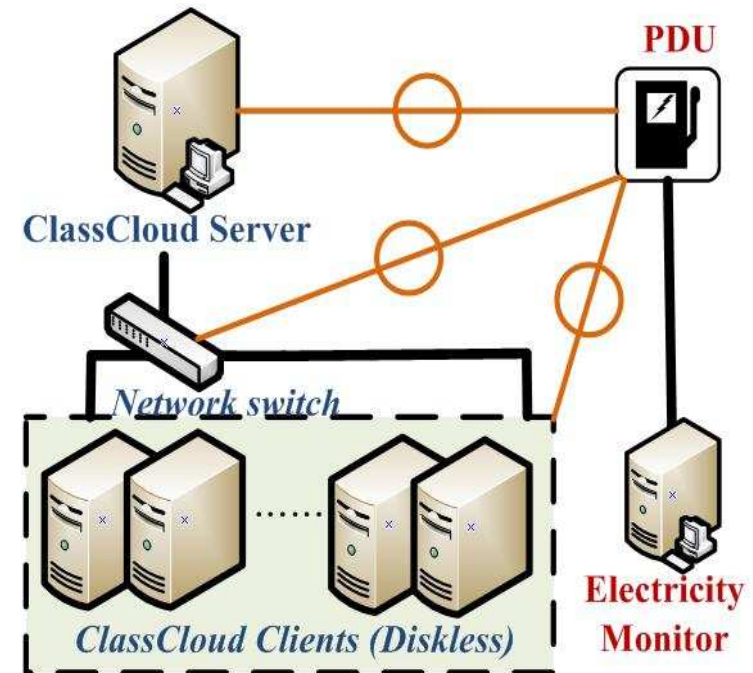
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Experiment Architecture

- 1 PDU
 - A device that distributes electric power
 - A device for taking high voltage and current
- 1 Electricity monitor
- 1 ClassCloud server
- 12 ClassCloud clients





Some pictures ...



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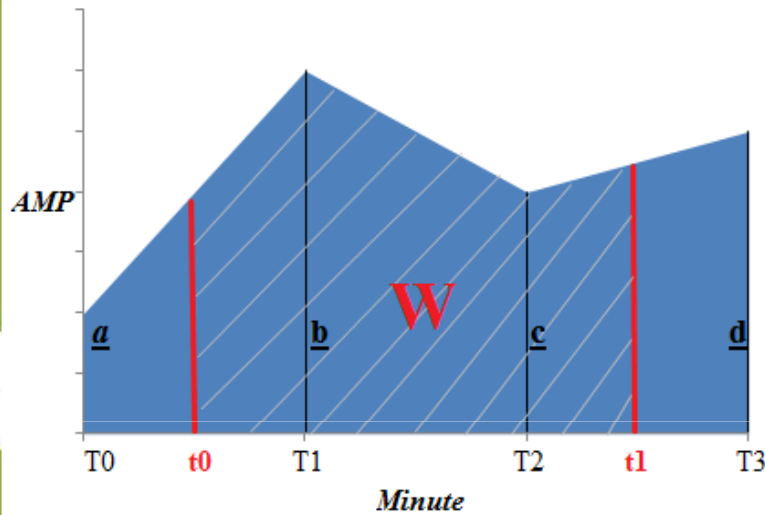


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Calculation Model



$$W = \left[\frac{(a+b)}{2} + \frac{(b+c)}{2} + \frac{(c+d)}{2} \right] \times \frac{1}{60} \times \frac{t_1 - t_0}{T_3 - T_0} \times \frac{V_s}{1000}$$
$$= \frac{(a+b) + (b+c) + (c+d)}{120} \times \frac{t_1 - t_0}{T_3 - T_0} \times \frac{V_s}{1000}$$

- W:* total power usage (Kilowatt hour)
V_s: utility power source voltage (Volt)
a, b, c, d: electric current usage (Amp)
T₀, T₃: PDU sample time duration (Minutes)
t₀, t₁: actual time duration (Minutes)

Discussion



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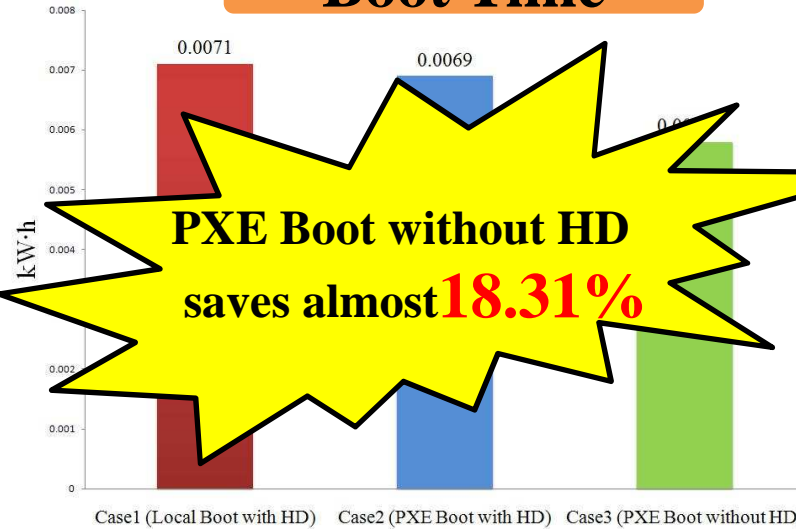
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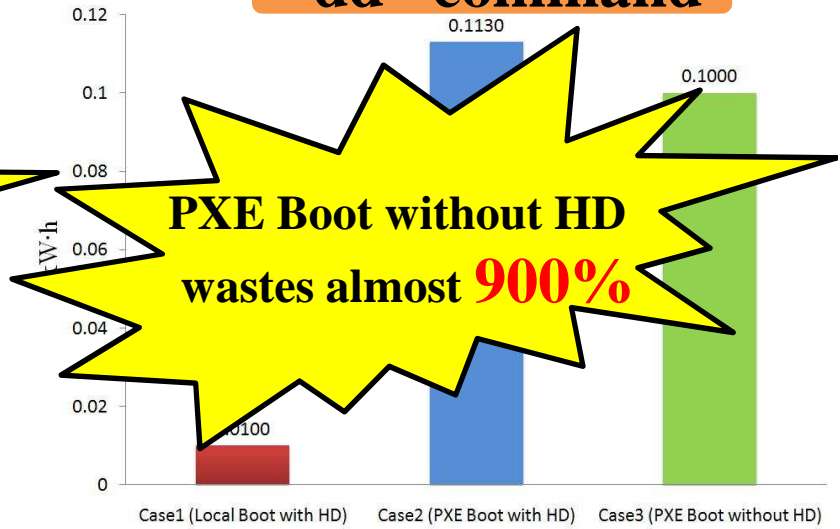


Experiment result – Boot & I/O

Boot Time



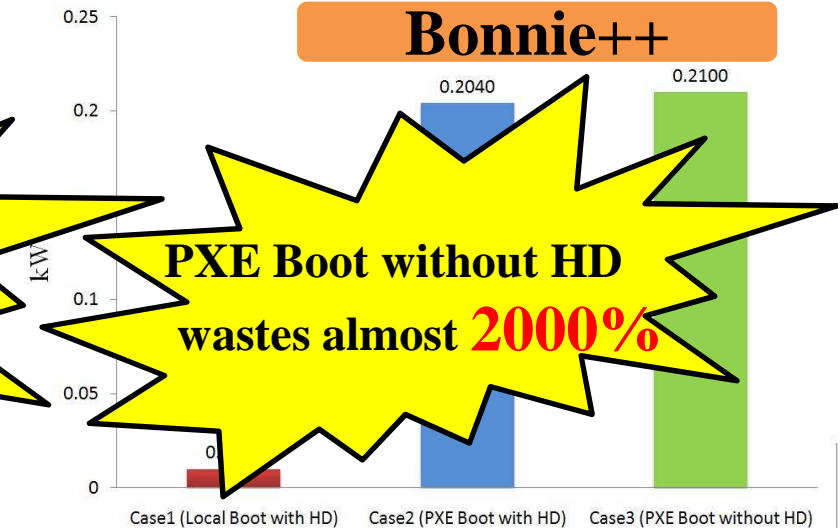
“dd” command



“tar” command

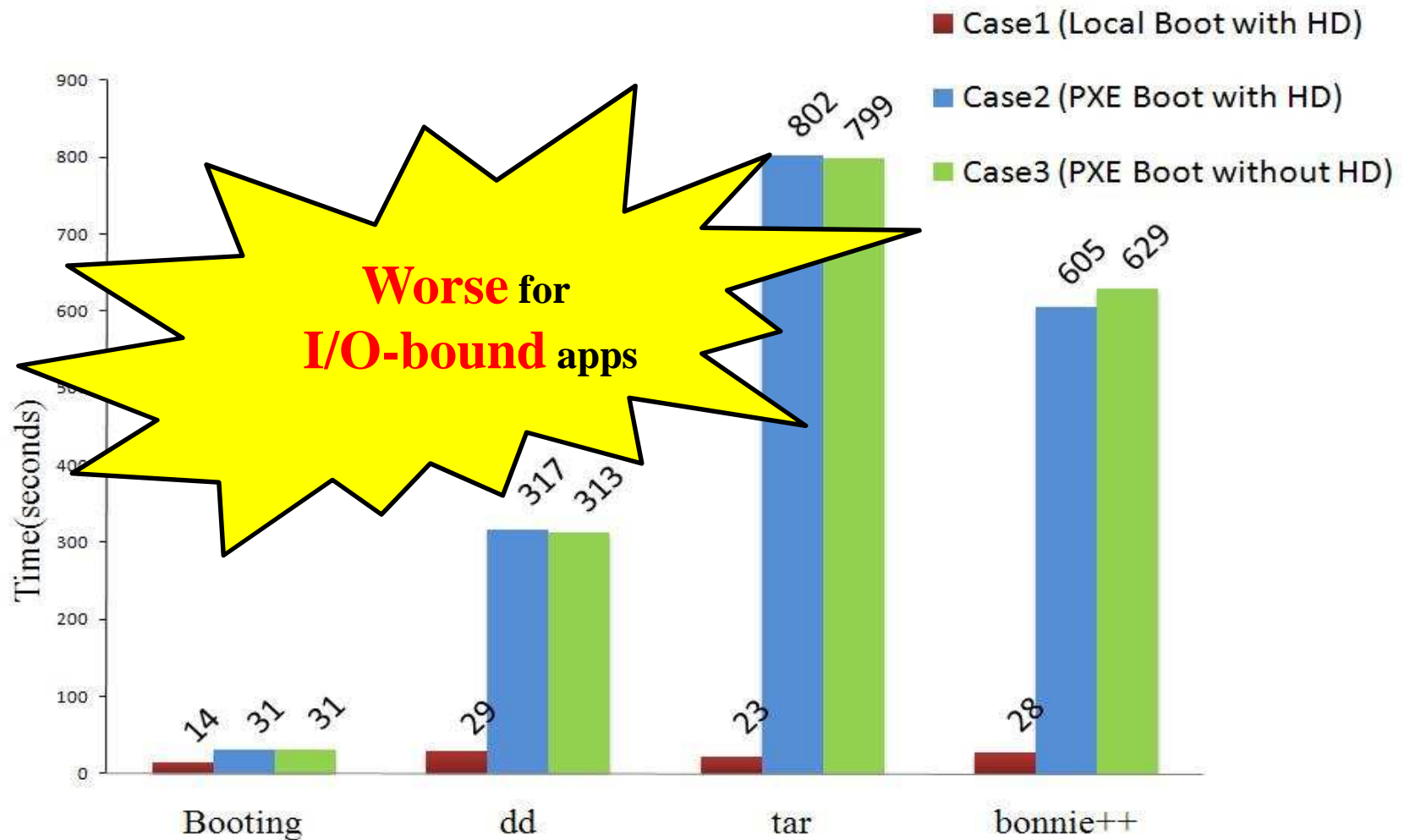


Bonnie++



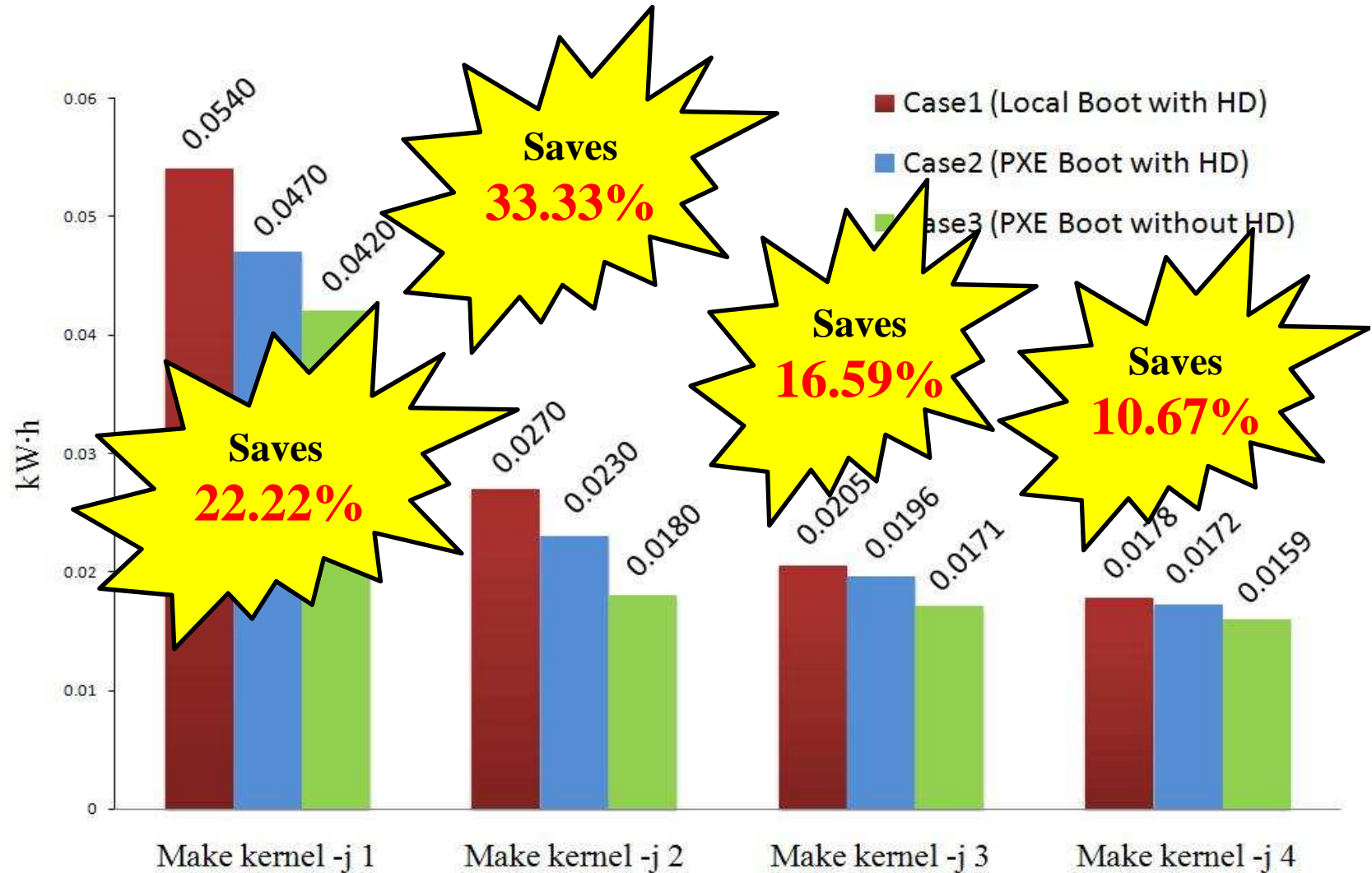


I/O Performance result



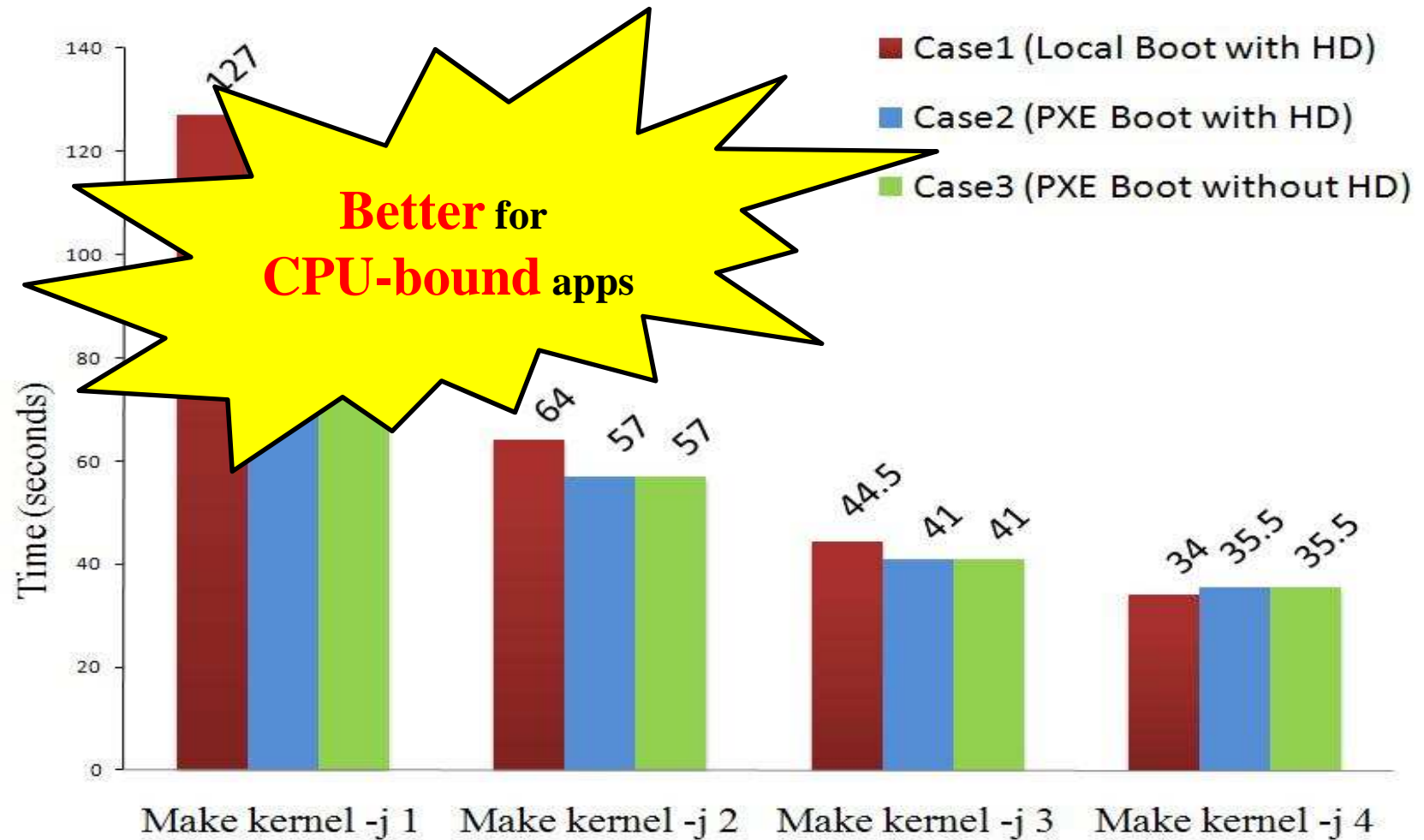


Experiment result – Make kernel





CPU Performance result



Conclusion

- DRBL helps to save **7% to 33%** power consumption for CPU intensive application.
- **Diskless design of DRBL** really brings notable effect on power saving for **CPU-bound applications**.
- ClassCloud helps to turn your PC classrooms into a **small-scale computing center for Cloud Computing** quickly and efficiently.



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Questions ?



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