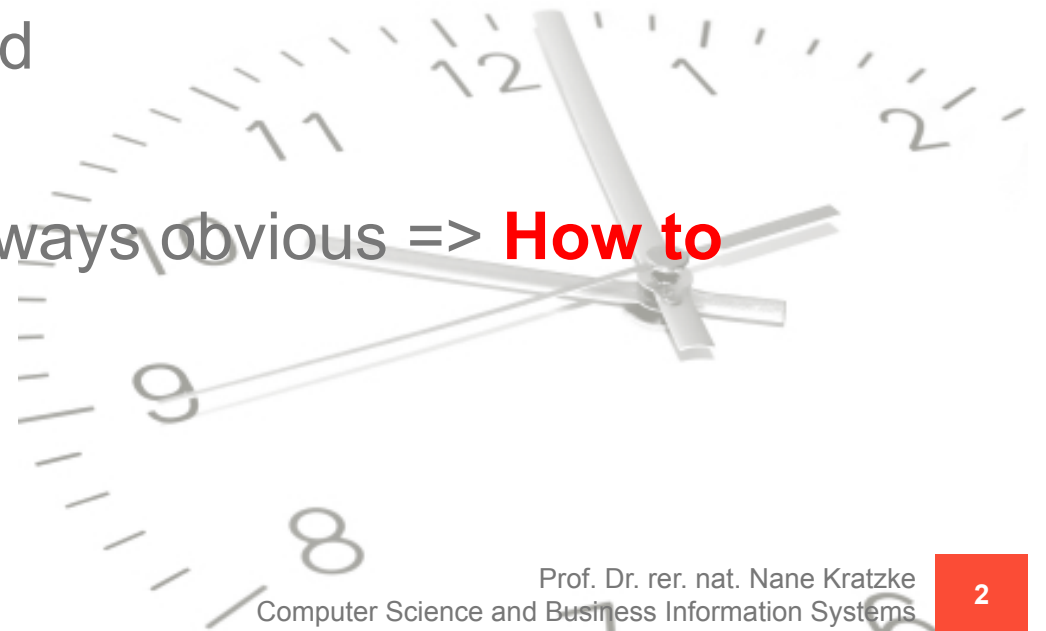


Nane Kratzke

CLOUD ECONOMICS IN TRAINING AND SIMULATION

The next 20 to 25 minutes are about ...

- What is cloud computing?
- (Economical) characteristics of cloud computing
- Postulated use cases for cloud computing
- Some data from real world
- Decision making is not always obvious => **How to decide?**
- Some findings



What is a cloud computing (definition)

„Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.“



Programmable Data Center
Software defined Infrastructure

National Institute of Standards and Technology
NIST: „The NIST definition of cloud computing“;
Peter Mell, Timothy Grance, 2011

<http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf>

Business Characteristics

Pay as you go

Fixed costs become variable

Cost are associative

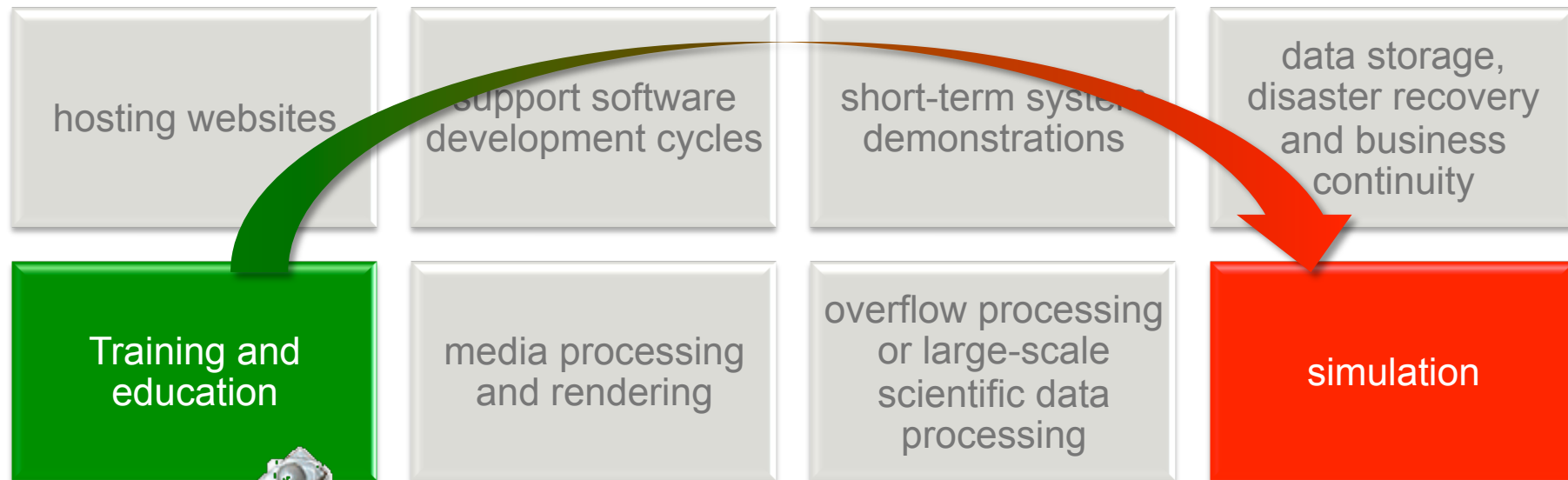
- 100 servers for one hour
- 1 server for 100 hours
- (Almost) same price

Business gains flexibility

- no long-term financial commitment to resources

Postulated use cases

These use cases (among others) are postulated to be cloud compatible:



- Research shows that cost advantages of cloud computing are deeply use case specific
- Be aware of comparing non comparable use cases
- This contribution presents some data of educational use cases (similar usage characteristics of simulation use cases)

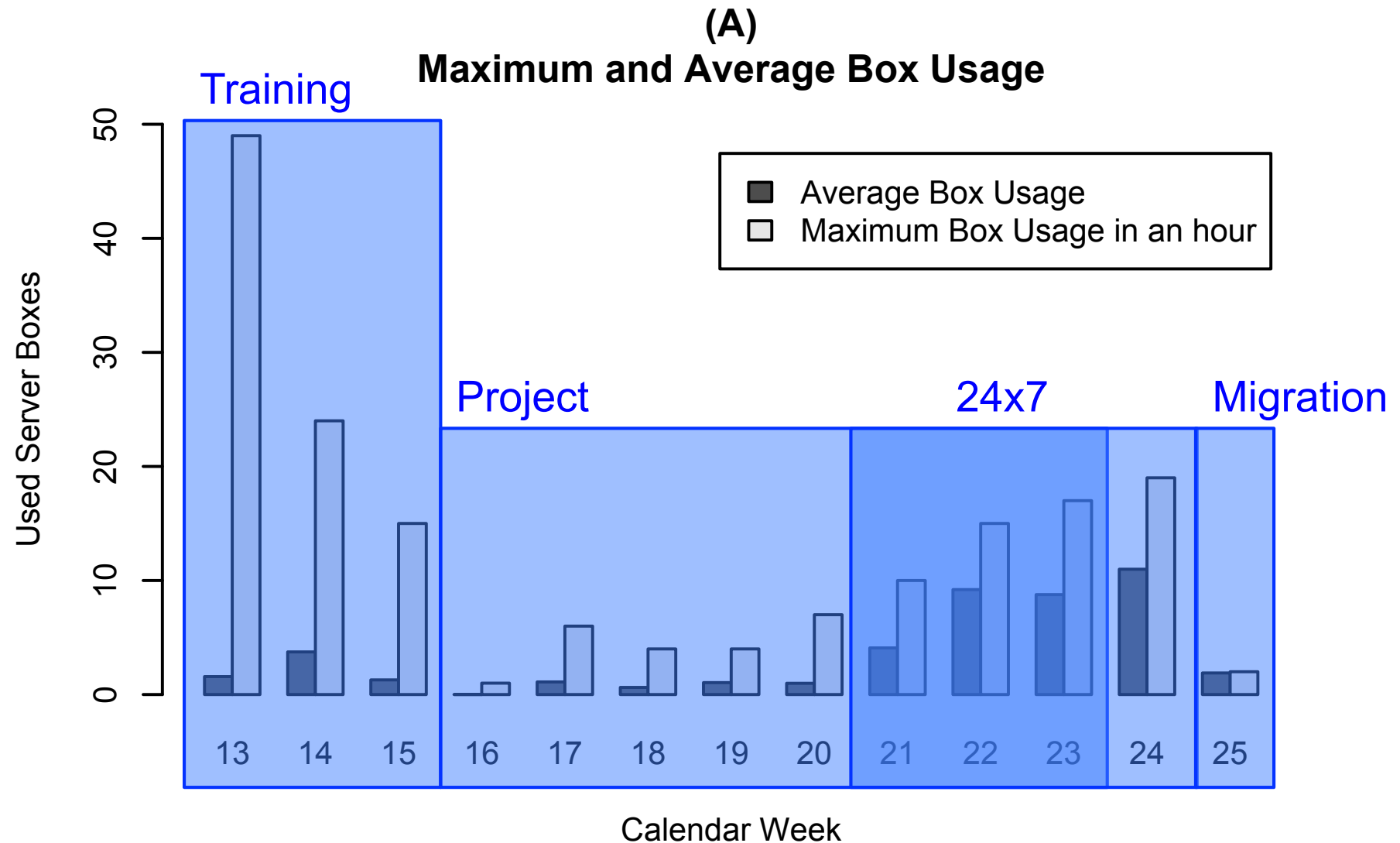
Analyzed use case

- **Web technology lecture/practical course** for computer science students (bachelor) in summer 2011 and summer/winter 2012.
- **Projects:** Development of web information systems (Drupal based)
- All groups were assigned cloud service accounts provided by **Amazon Web Services (AWS)**.
- Analysis of billing as well as usage data provided by AWS.

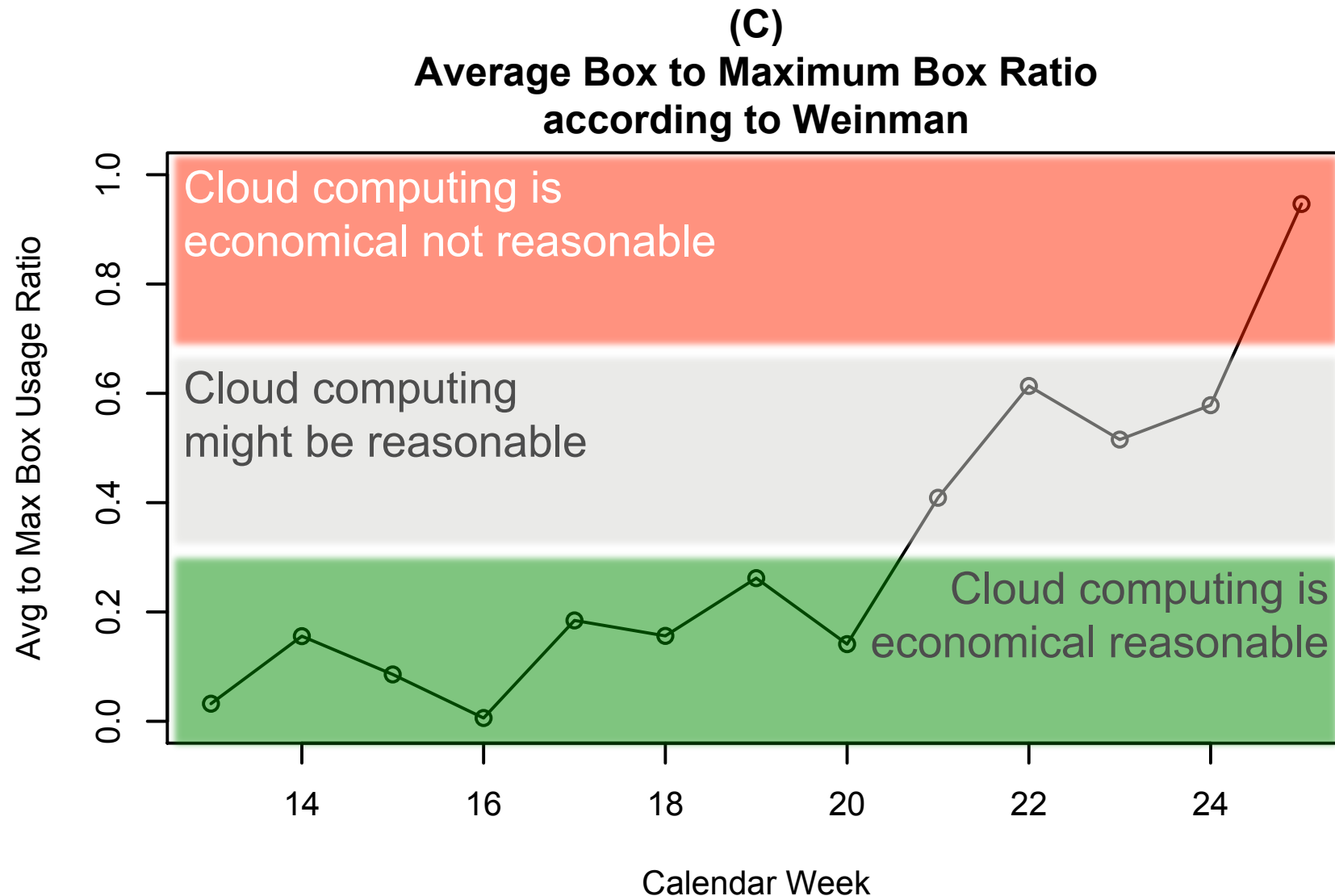


Training			Project								P	M
CW 13	CW 14	CW 14	CW 15	CW 16	CW 18	CW 19	CW 20	CW 21	CW 22	CW 23	CW 24	CW 25
P	=	Presentation				M	=	Migration				
CW	=	Calendar Week										

Figure 1: Project phases



Average to Peak Ratio per Week



Economical Decision Analysis

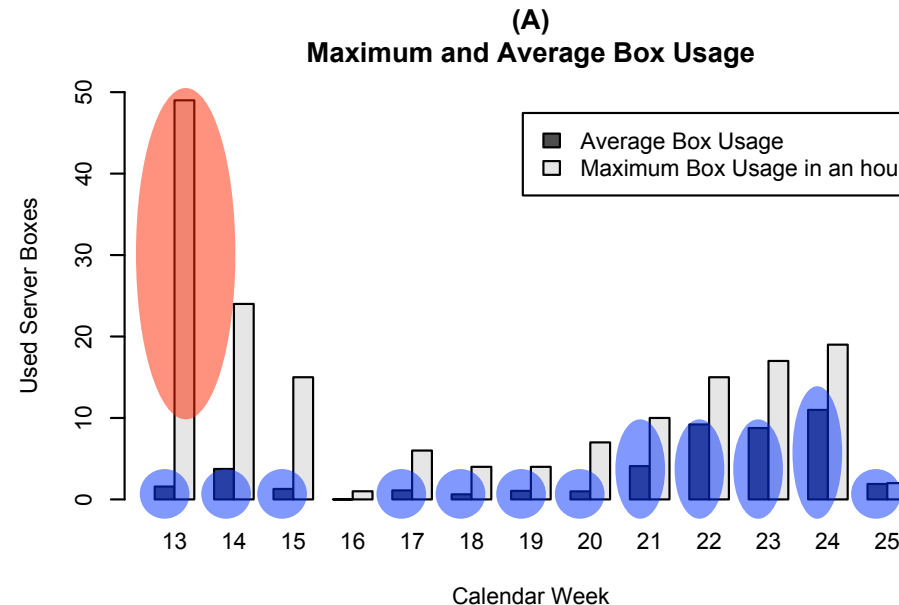
A four step process to decide for or against cloud based solutions

Determine your atp ratio

Determine your dedicated costs

Determine your maximal cloud costs

Determine appropriate cloud resources



Max instances: 49

Processing hours: 7612

Average: $7612 / (26 * 7 * 24) = 1.74$

Overall atp ratio: $1.74 / 49 = \underline{\underline{0.035}}$

Economical Decision Analysis

A four step process to decide for or against cloud based solutions

Determine your atp
ratio



Determine your
dedicated costs



Determine your
maximal cloud costs



Determine appropriate
cloud ressources

„In other words, even if cloud services cost, say, twice as much, a pure cloud solution makes sense for those demand curves where the peak-to-average ratio is two-to-one or higher.“

Weinman, *Mathematical Proof of the Inevitability of Cloud Computing*, 2011

Example Server: 500 US Dollar
Amortization: 3 years

$$d_{3years}(500\$) = \frac{500\$}{3 \cdot 365 \cdot 24h} = 0.019 \$/h$$

Economical Decision Analysis

A four step process to decide for or against cloud based solutions

Determine your atp
ratio



Determine your
dedicated costs



Determine your
maximal cloud costs



Determine appropriate
cloud ressources

According to Weinman the peak-to-average ratio should be greater than the ratio between the variable costs c and your (assumed) dedicated costs d :

$$pta > \frac{c}{d} \Leftrightarrow pta \cdot d > c \Leftrightarrow c < \frac{d}{atp} \quad (4)$$

$$c_{MAX} := \frac{d}{atp} \quad (5)$$

$$c_{Max} = \frac{0.019 \frac{\$}{h}}{0.035} = 0.54 \frac{\$}{h}$$

Economical Decision Analysis

A four step process to decide for or against cloud based solutions



$$c_{Max} = \frac{0.019 \frac{\$}{h}}{0.035} \approx 0.54 \frac{\$}{h}$$

Example: Amazon Web Services EC2-
Pricings for EU region, 19th March, 2012

Region: EU (Ireland)	
Linux/UNIX Usage	
Standard On-Demand Instances	
Small (Default)	\$0.090 per Hour
Medium	\$0.180 per Hour
Large	\$0.360 per Hour
Extra Large	\$0.720 per Hour
Micro On-Demand Instances	
Micro	\$0.025 per Hour
Hi-Memory On-Demand Instances	
Extra Large	\$0.506 per Hour
Double Extra Large	\$1.012 per Hour
Quadruple Extra Large	\$2.024 per Hour
Hi-CPU On-Demand Instances	
Medium	\$0.186 per Hour
Extra Large	\$0.744 per Hour

Economical Decision Analysis

A four step process to decide for or against cloud based virtual labs

The measured ATP ratio of 0.035 means in fact a $1/0.035 == 28.57$ times cost advantage.

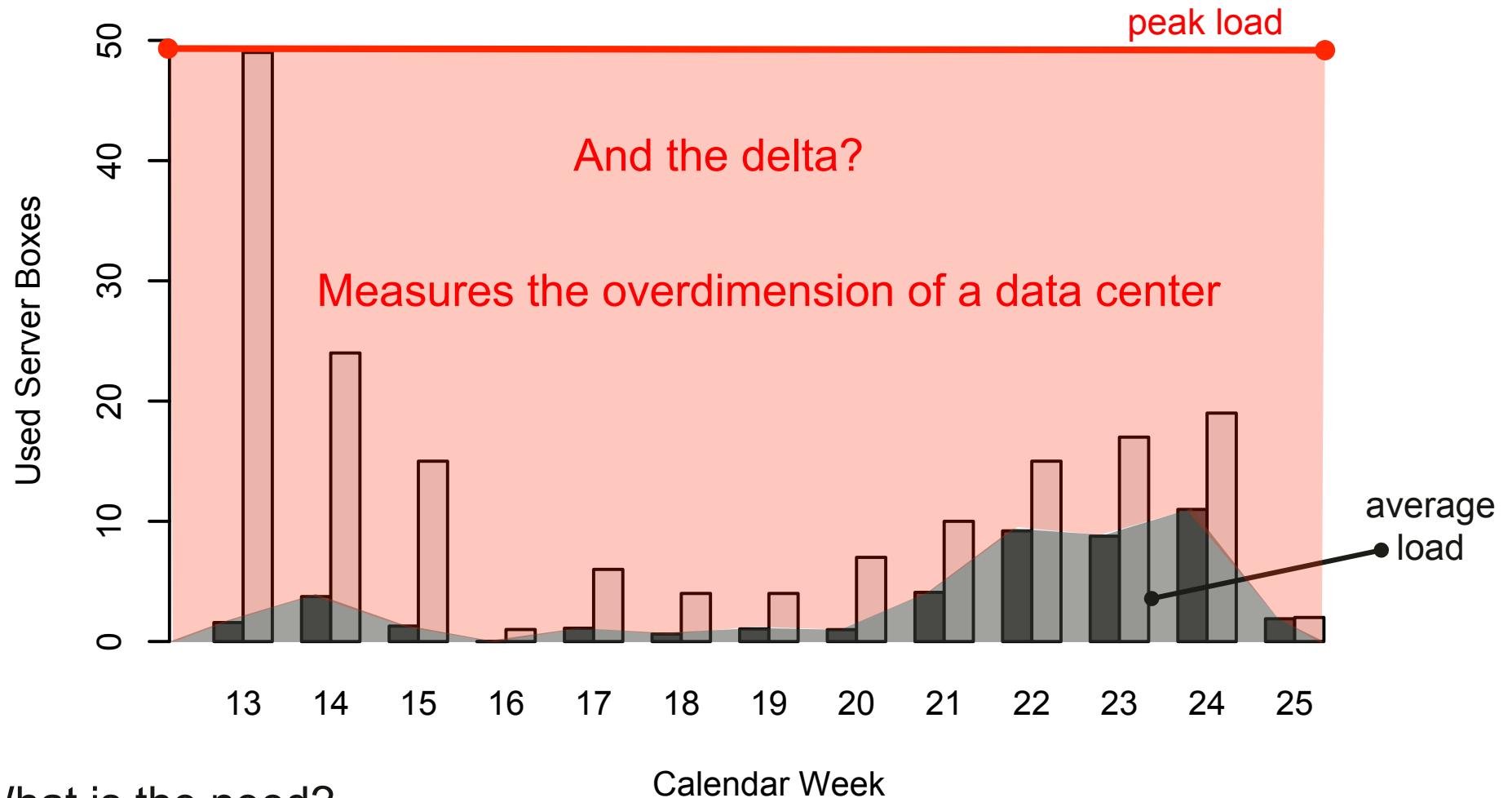
This means for the presented use case:

A cloud based solution provides a more than 25 times cost advantage.

Compared to necessary investment efforts for a classical dedicated system implementation.

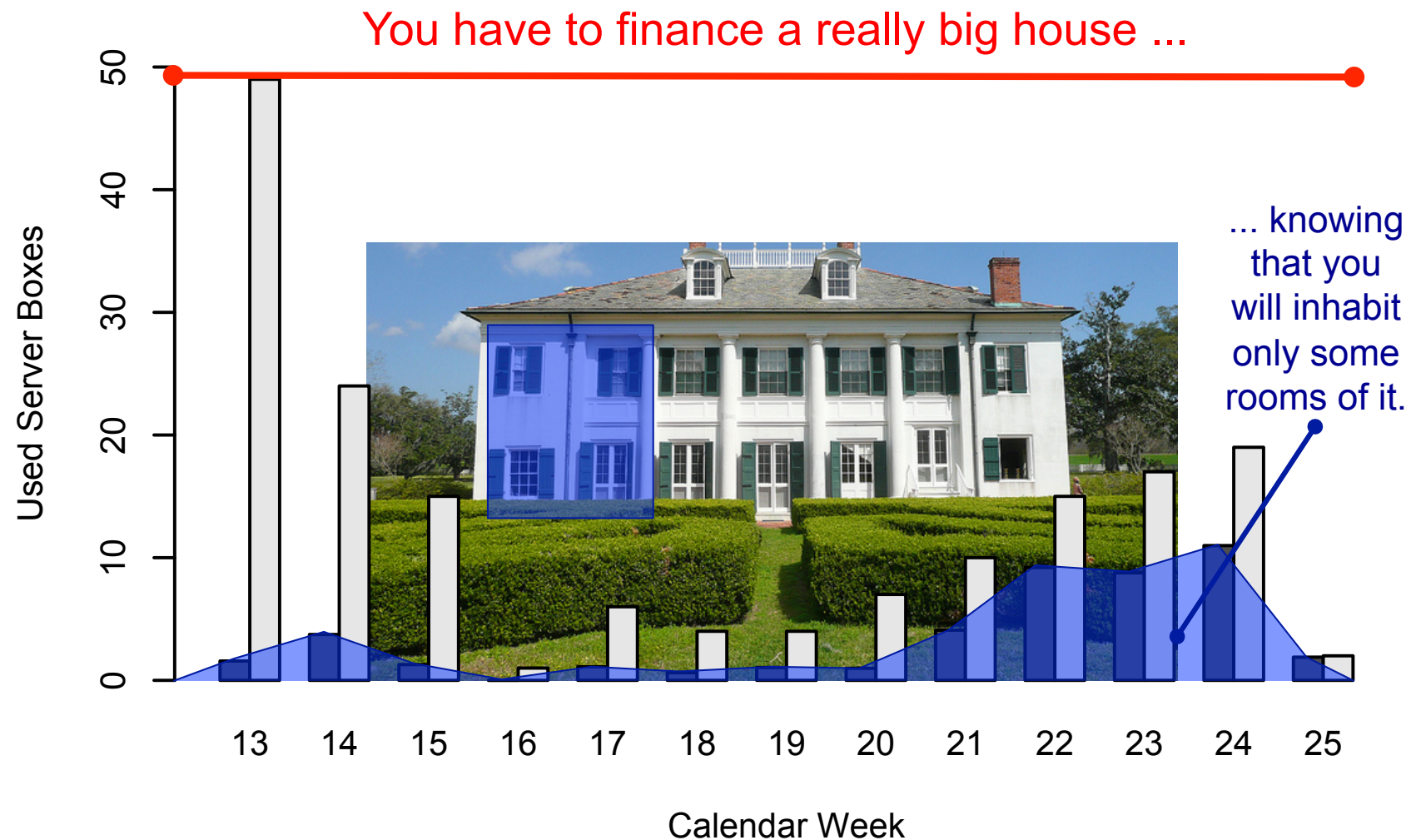
Why this big cost advantage?

How to dimensionize the data center?



What is the need?

In other words ...



- **Cloud computing loves peak load scenarios (be happy)**
 - 25 times cost advantage (analyzed use case)
- **Cloud generated costs are use case specific (be carefull)**
 - Decision making must not be obvious
 - Four step decision making model (to determine your ATP ratio)
- **Main cost drivers are (try to minimize)**
 - Server uptime
 - Data storage (server volumes)
 - Data transfer (in communication intensive use cases)
- **Uneconomical use cases (try to avoid)**
 - 24x7 and
 - constant loads



- **So if you have to deal with peak load scenerios it is likely that cloud based solutions might be an economical option ...**

Thank you for listening



Find this presentation here:

<http://www.slideshare.net/i21aneka/cloud-economics-in-training-and-simulation-16086721>



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