# T-110.5121 Mobile Cloud Computing
# Business in Cloud Computing
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# History

- ”*The horse is here to stay, but the automobile is only a novelty - a fad*”, **President of the Michigan Savings Bank, 1903**
- “*..we expected to get orders for five machines, we came home with orders for 18.*”, **Thomas Watson, Jr., April 28, 1953**
- “*There is no reason for any individual to have a personal computer in their home.*” **Ken Olsen, President, Digital Equipment Corp., 1980**

**FIG. 2:** CLOUD OPPORTUNITY

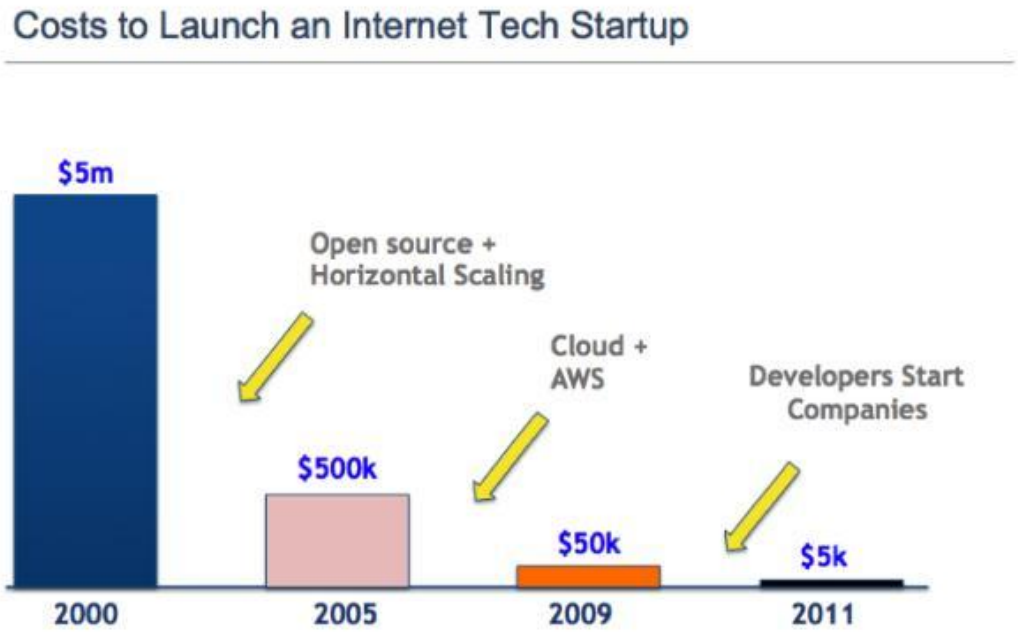
| | Technology | Economic | Business Model |
|---|---|---|---|
| Mainframe  | Centralized compute and storage Thin clients | Optimized for efficiency because of the high cost | High up-front costs for hardware and software |
| Client/ Server  | PCs and servers for distributed compute, storage, and so on | Optimized for agility because of the low cost | Perpetual license for OS and application software |
| Cloud  | Large DCs, ability to scale, commodity hardware, devices | Efficiency and agility an order of magnitude better | Ability to pay as you go, and only for what you use |

*Source: Microsoft.*

Sources: Joe Sherlock, The View Though The Windshield, available at: http://www.joesherlock.com/nwsltr1.html ; Rolf Harms and Michael Yamartino: The Economics of the Cloud, Nov. 2010.

# Some numbers

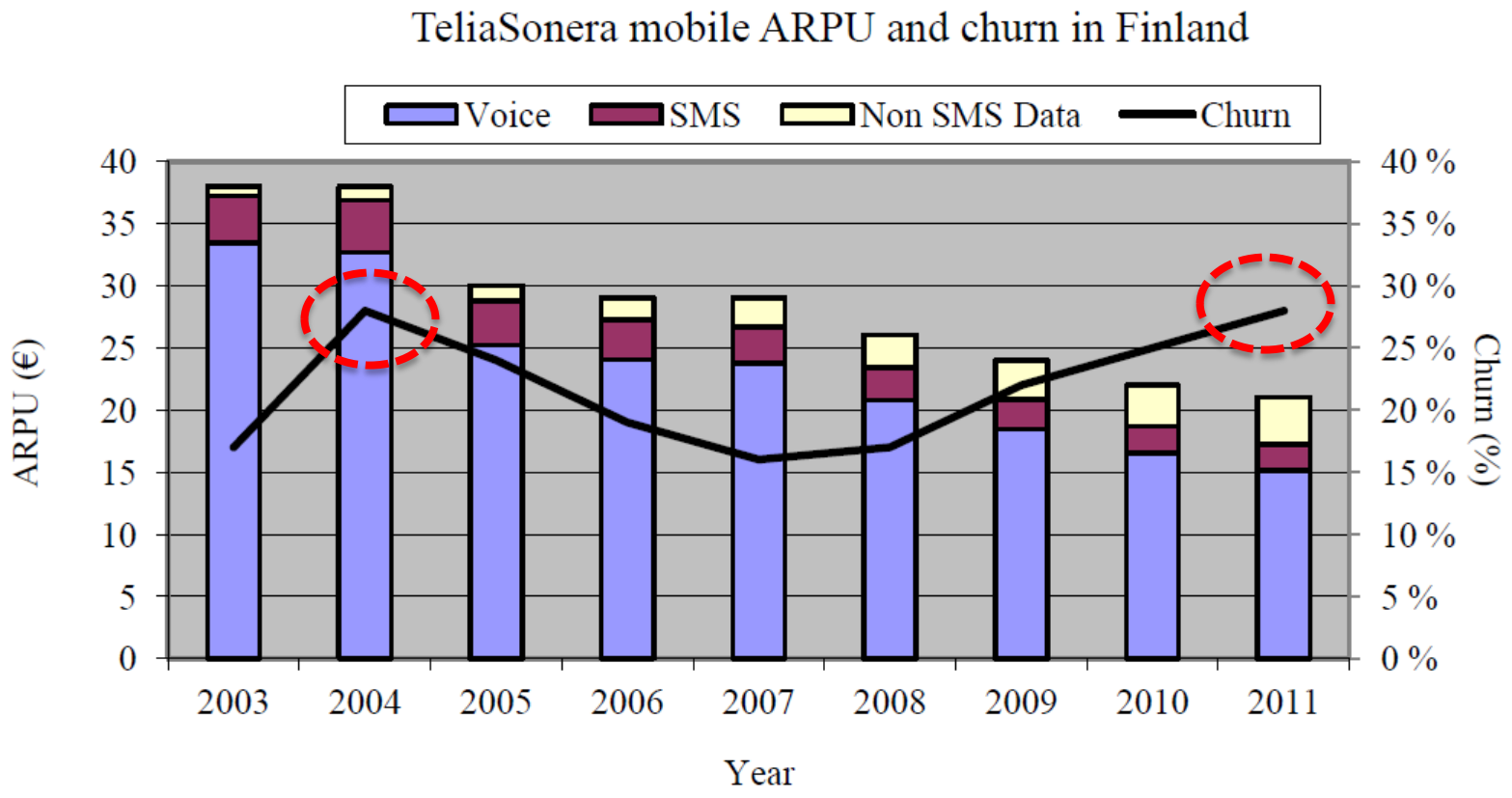
- **Global ICT business size**
  - 2008: $ 383 B, 4% cloud
  - 2012: $494 B, 9% cloud
- **Largest growth in storage**
- **SMEs have best opportunities to adapt**
- **Also small countries with good infrastructure**
- **Startup costs for SMEs dropped dramatically**



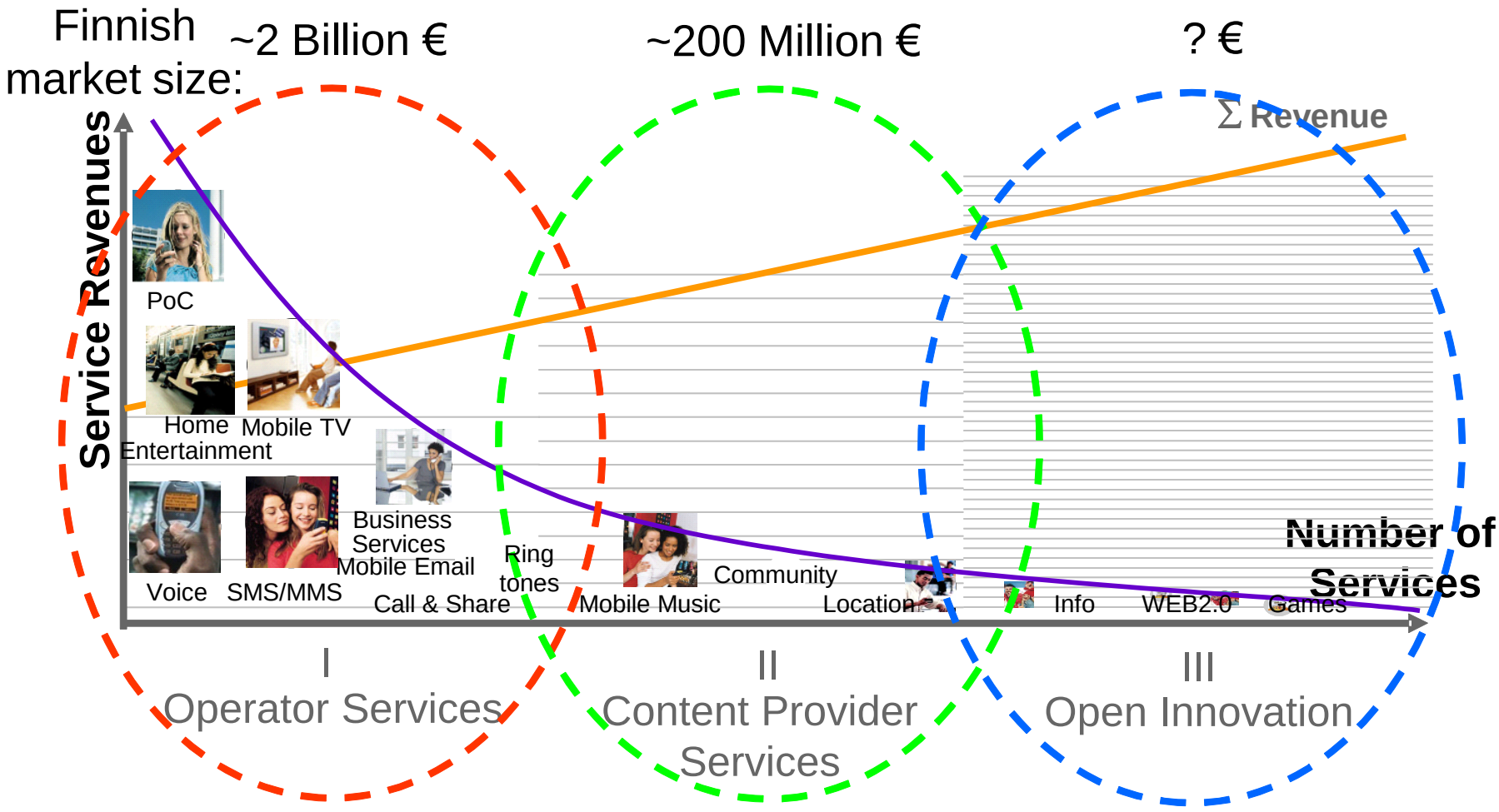

Source: F. Etro, The Economic Impact of Cloud Computing on Business Creation, Employment and Output in Europe, 2009

Source: M. Suster, It's Morning in Venture Capital, blog, May 23, 2012

# Operators have challenges ahead: decreasing ARPU and increasing churn



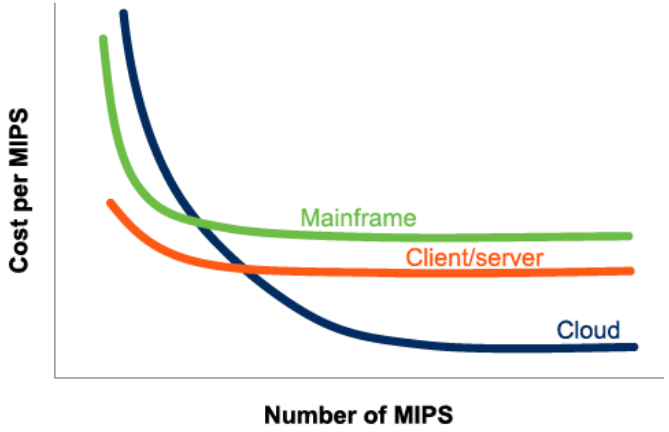
# Long Tail and Mobile service segments



# Economies of scale

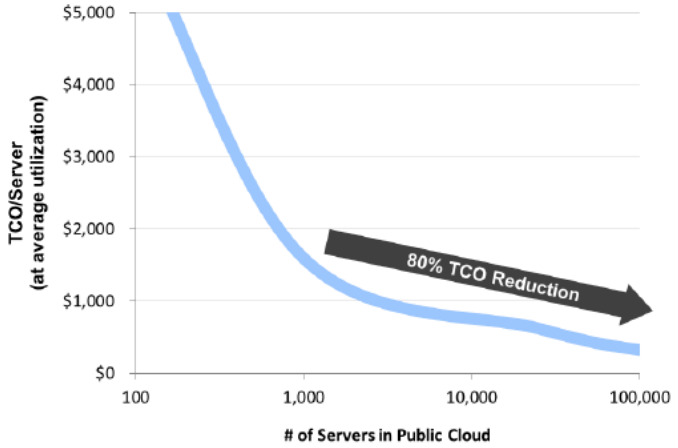
- Cheaper MIPS (5-7 times)
- Better utilization of computing resources (5-10% to 60-80%)
- Multi-tenancy: one instance can serve several customers
- Less admin people per server (from 1:100 up to 1:10 000)
- Worth 1$ IT requires 8$ admin costs

**FIG. 4:** ECONOMIES OF SCALE (ILLUSTRATIVE)




*Source: Microsoft.*

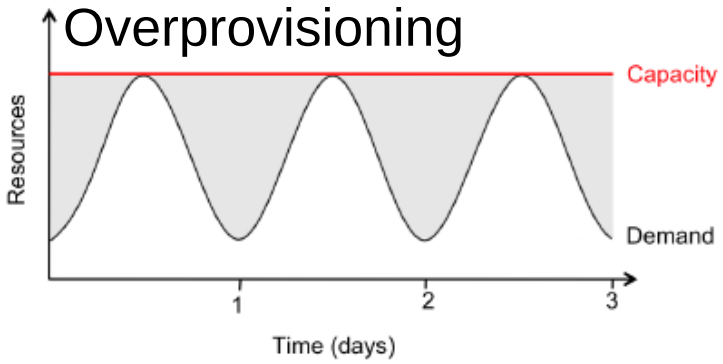
**FIG. 15:** ECONOMIES OF SCALE IN THE CLOUD



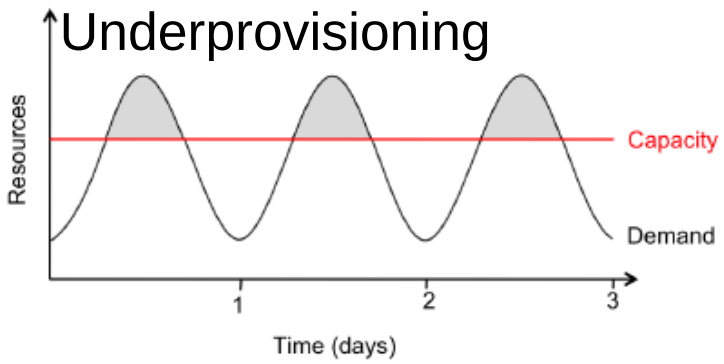

*Source: Microsoft.*

Source: Rolf Harms and Michael Yamartino: The Economics of the Cloud, Nov. 2010.

# Elasticity – pay-as-you-go

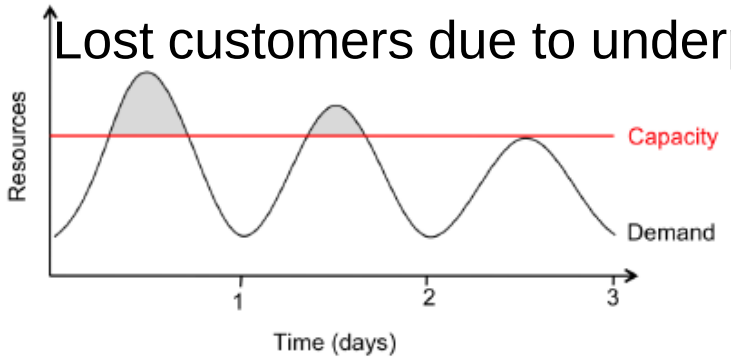



(a) Provisioning for peak load




(b) Underprovisioning 1

- **Avoid high upfront investment, avoid risk**
- **Adapt to changing business**
- **Buy or lease**
- **Amortizise value to investment period**




(c) Underprovisioning 2

Source: Ambrust et al, Above the Clouds: A Berkeley View of Cloud Computing, Feb 2009

# Amortization

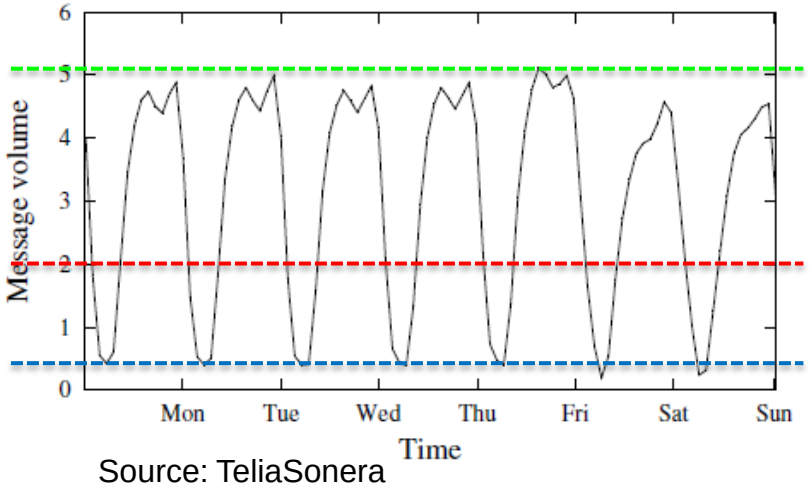
- **Hybrid cloud**
  - Public vs. Private
  - www.cloudonomics.com
- **Cost structure by Greenberg (2009):**
  - ~45% Servers CPU, memory, storage
  - ~25% Infrastructure
  - ~15% Power draw
  - ~15% Network Links
- **Staff? 1$ IT : 8$ Admin!**
- **Equated Monthly Installment**

$$A_m = E \frac{\frac{r}{12}(1+\frac{r}{12})^m}{(1+\frac{r}{12})^m - 1}$$

- **Net Present Value**

$$NPV = \sum_0^N \frac{P_T - C_T}{(1+r)^T} + \frac{S}{(1+r)^N} - E$$

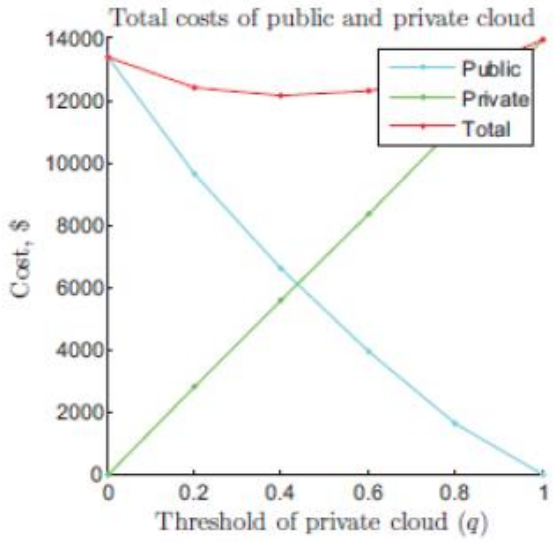
Case SMSC




Source: TeliaSonera

E = basic investment
N, m = length of the investment
R = rate of interest
Pt = annual revenue
Ct = annual cost
S = residual value

# Cost comparison




- **Public cloud**
  - example Amazon Elastic Compute Cloud (EC2)
  - Price per CPU hour and type, data transfer out, storage, additional services (monitoring, elastic IP, load balancing)
  - Spot pricing also supported
  - One Large instance (EU) = 245 $/month
  - Reserved 3 year Large instance = 101 $/month
- **Private cloud**
  - Case Aalto DCS private cloud
  - 192 cores, investment 50 k€
  - Monthly cost with 5% interest rate, 3 year amortization period

$$A_m = 50000 \frac{\frac{0.05}{12}(1+\frac{0.05}{12})^{36}}{(1+\frac{0.05}{12})^{36}-1} = 1512€ / month$$

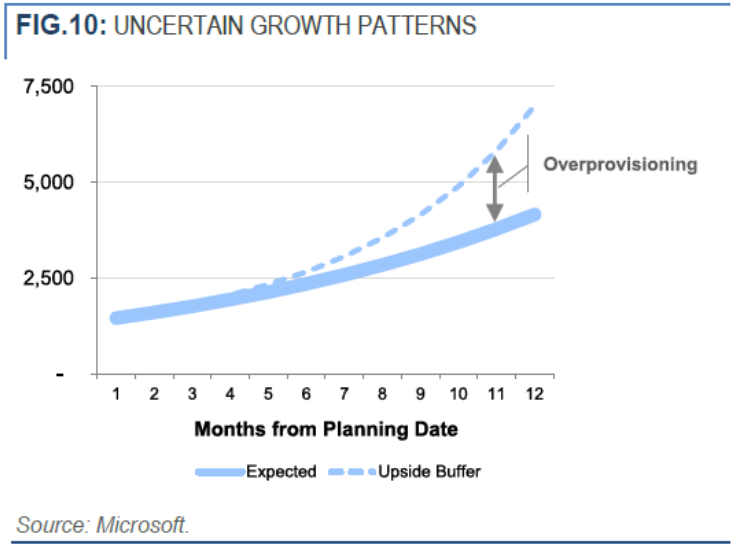
# Always available

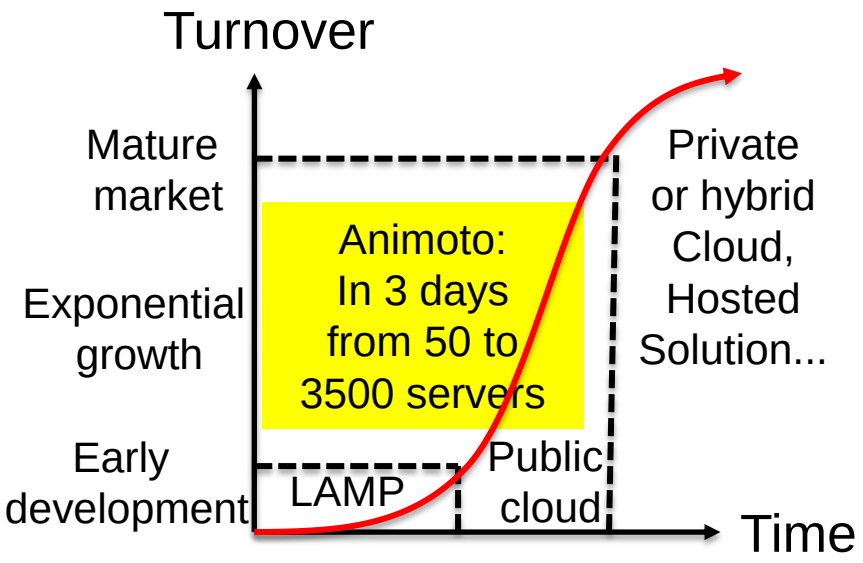
- **Anyone, anytime, anywhere**
- **High availability?**
- **Typical public cloud SLA promise**
  - 99.95% = max 4 h 23 min down time per year
- **Telecom**
  - 99.999% = 5 min
- **Availability Zone, fully (?) independent computing systems**
- **Using two Availability Zones**

$$P_P = 1 - P_F{}^2 = 1 - (1 - A)^2 = 99.9999\%$$

# Resource planning

- **Resources can be optimized to meet service needs**
- **Service integration time can be shortened, example Short Message Service Center setup from 2 weeks to 4 minutes**




Source: Rolf Harms and Michael Yamartino: The Economics of the Cloud, Nov. 2010.

# Questions?

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**Course staff: t-110.5121(at)tkk.fi**