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➢ **"Internalising Externalities for Improving Computing Architectures: Trust, Privacy, Regulation, and Intellectual Property Rights"**

1st February 2012

Western ⛨ Law

Internalising Externalities…

(notably for Clouds)

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Western ⚜ Law

1ˢᵗ February 2012

Today's Agenda

✧ What's a cloud
✧ Research in context of distributed computing evolution
✧ Cloud issues
✧ Some externalities
✧ 'x by design'
✧ What next?

why cloud?

– Nearly one third of organizations either already use or plan to use cloud or software-as-a-service (SaaS) offerings to augment their core business intelligence (BI) functions, according to (Gartner Jan 2012)

– http://www.gartner.com/it/page.jsp?id=1903814

Clouds

- "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." NIST 25th Oct 2011

per NIST

- Finally the National Institute of Standards and Technology (NIST) has published their cloud definitions…. these are reviewed here….

-

- **The five "Essential Characteristics"**
- **The three "Service Models"**
- **The four "Deployment Models"**

if you are current on this please sleep for 5 mins

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Essential Characteristics

- *see*

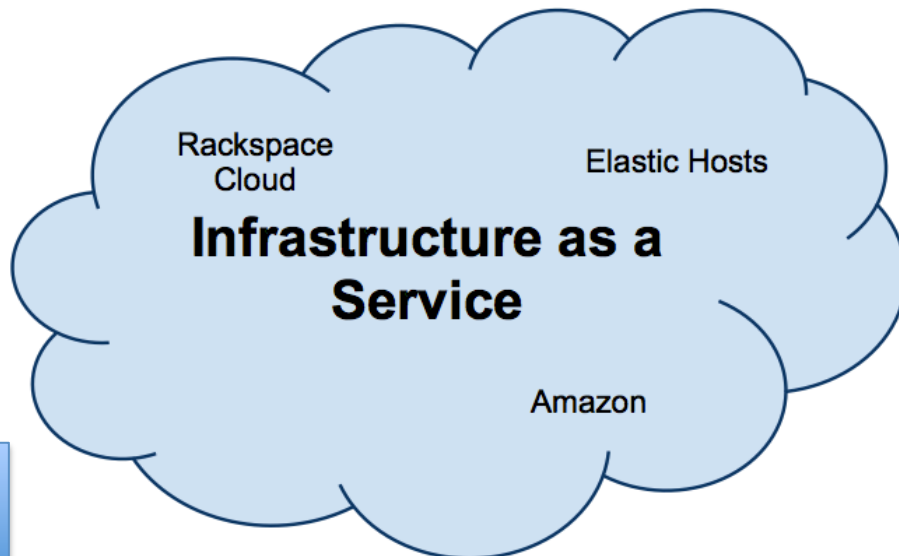- *[The NIST Definition of Cloud Computing (NIST Special Publication 800-145).](#)* Oct 2011
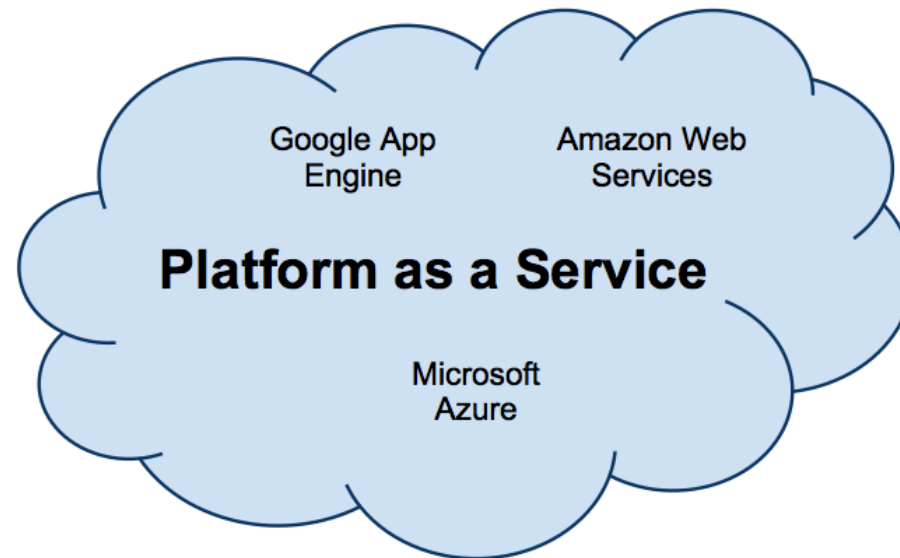
Service Modes

- *Software as a Service (SaaS)*
- *Platform as a Service (PaaS)*
- *Infrastructure as a Service (IaaS)*

Deployment Models

- *Private cloud*
  - Single organisation
- *Community cloud*
  - Specific community
- *Public cloud*
  - *Open use*
- *Hybrid cloud*
  - More than one of the above
  - *[See The NIST Definition of Cloud Computing (NIST Special Publication 800-145).](#) Oct 2011*

Cloud infrastructures

Platform as a Service

Google App Engine

Amazon Web Services

Microsoft Azure

Infrastructure as a Service

Rackspace Cloud

Elastic Hosts

Amazon

Software as a Service

Google Apps

Salesforce.com

Microsoft Online Services

So what have I been doing?

Internalising externalities
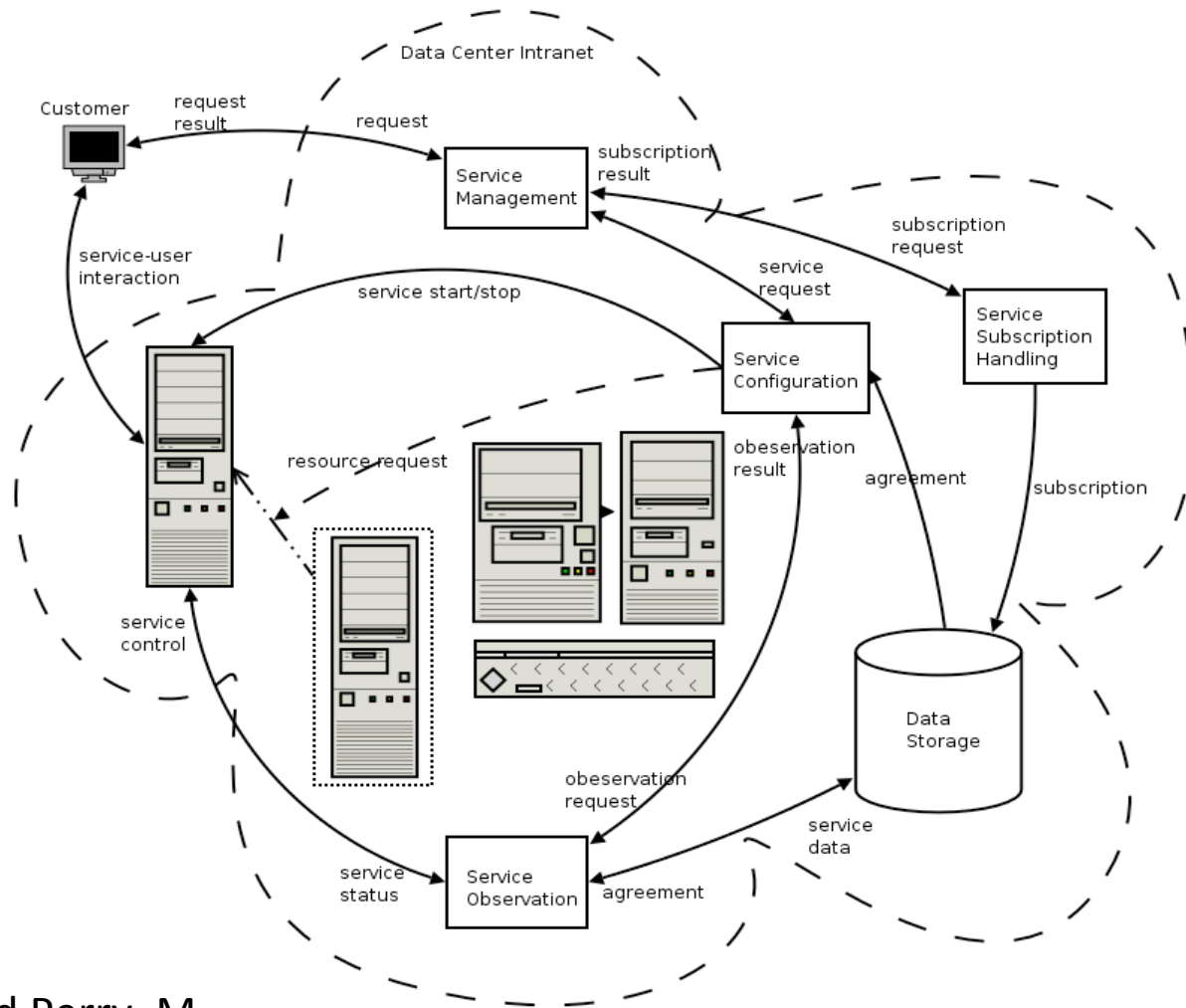
Last century….

- automation of licensing for various Intellectual Property rights
- allow for flexible licensing
- grants from NSERC and IBM
- ontologies and policies to drive automation of licensing, treating as resource/ constraint
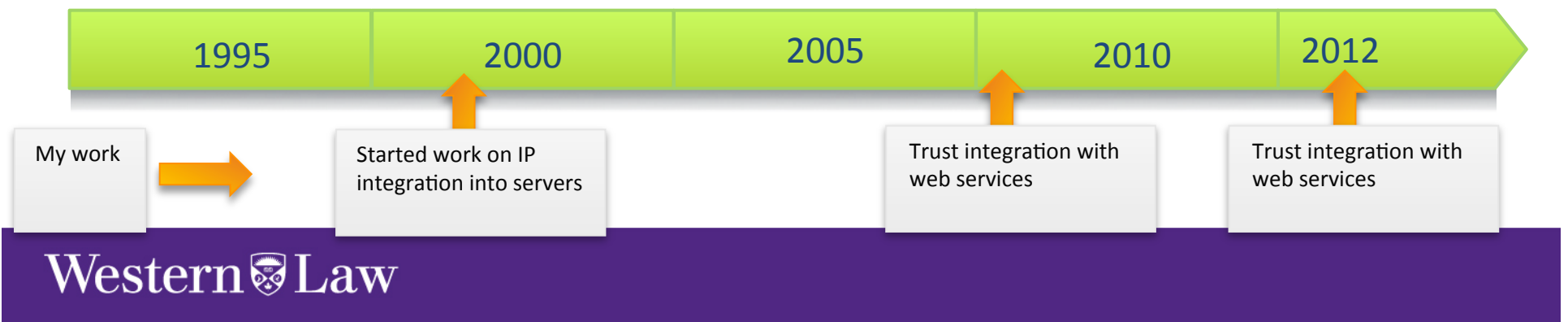
autonomic license management

Zhao, Q, and Perry, M.

From standalone to clouds

- see Forrester timeline

| 1995 | 2000 | 2005 | 2010 | 2012 |

My work →

Started work on IP integration into servers

Trust integration with web services

Trust integration with web services

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Seven Worries (Gartner)

1. Privileged users
2. Regulatory compliance
3. Data location
4. Data segregation
5. Recovery
6. Investigative support
7. Long-term viability

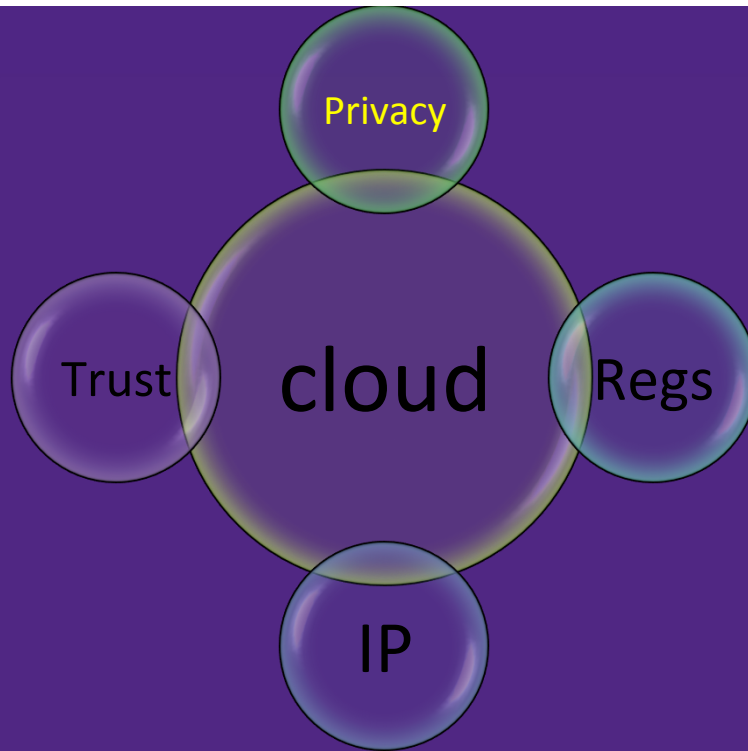# Problems with clouds

- If the cloud goes down then your business goes down…. eg Google Apps as well as Gmail in Feb 2009

- By End of 2014 at Least 10 Percent of Enterprise Email Seats Will Be Based on a Cloud or Software-as-a-Service Model (Gartner Sept 2011)

  http://www.gartner.com/it/page.jsp?id=1796914

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Can cloud externalities be internalised?
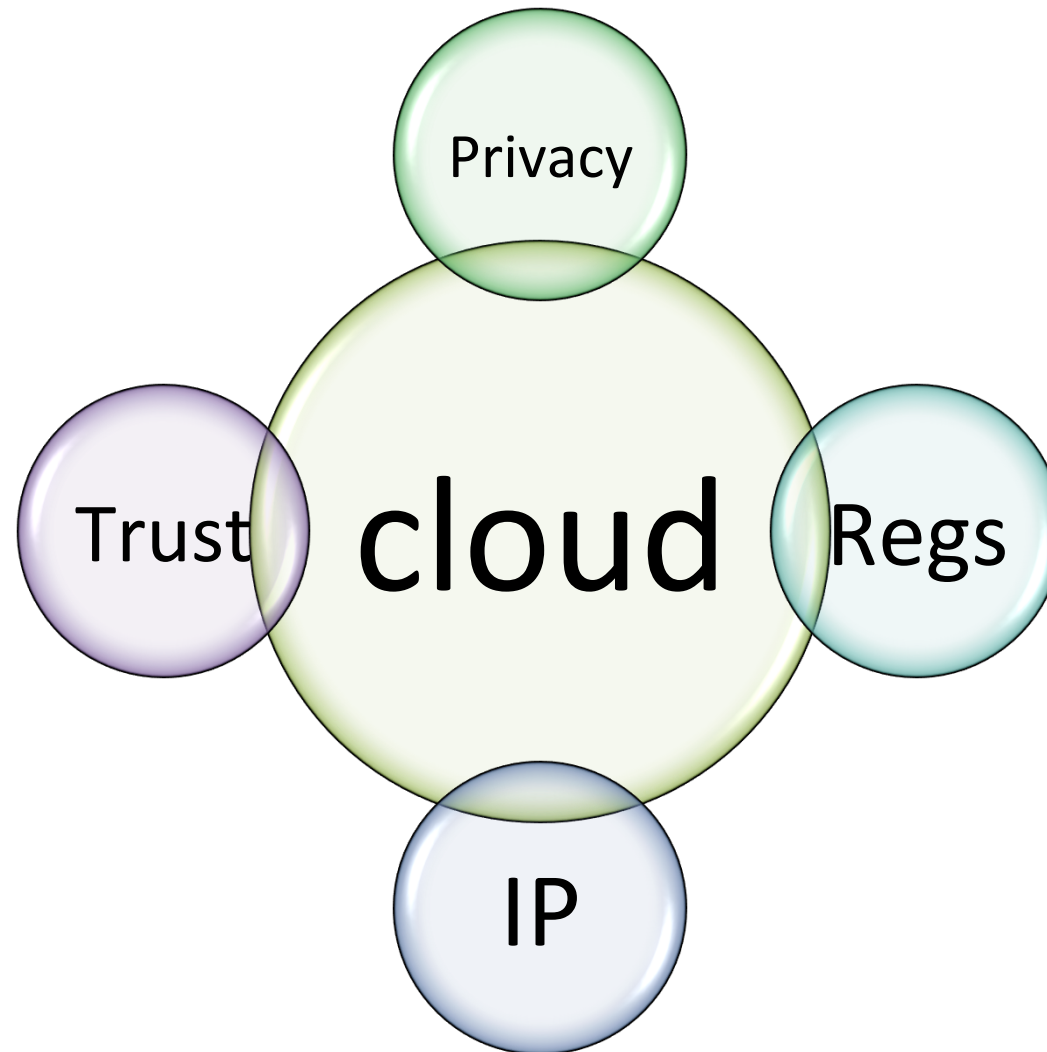
Privacy

Karthick Ramachandran is working on this

Internalising externalities

Privacy

- From "break open doors, locks, and boxes, and to seize a man and all his books … for papers are often the dearest property any man can have"
- Tort of trespass (protects person and property)
  - but indirectly protected also privacy, for the technology available at that time did not permit to invade privacy without invading property (trespassing...)
- Technological advances allowed what was not possible: wire-tapping a phone line permitted to access infos without trespassing the property...

Privacy

- The *Right to Privacy*, Warren and Brandeis Harvard Law Review. Vol. IV, 5   December 15, 1890 defined it as "The right to be let alone"

- Olmstead v. United States, 277 U.S. 438 (1928) holding that wire-tapping is not violation of P.

- Katz v. United States, 389 U.S. 347 (1967), overruling Olmstead and extending forth amendment wherever a person has a "reasonable expectation of privacy".

Privacy

- Technology develops...
- Kyllo v. United States, 533 U.S. 27 (2001), "the use of a thermal imaging device from a public vantage point to monitor the radiation of heat from a person's home was a "search" within the meaning of the Fourth Amendment, and thus required a warrant. Because the police in this case did not have a warrant, the Court reversed Kyllo's conviction for growing marijuana"

Privacy

- To "data protection and the right to be informed how our data are stored and used"

- 1980 Organization for Economic Cooperation and Development, issued Guidelines Governing the Protection of Privacy and Trans-Border Flows of Personal Data

- Offers a set of principles that have been enacted into many different jurisdictions

Privacy

- Europe: Data Protection Directive (officially Directive 95/46/EC on the protection of individuals with regard to the processing of personal data and on the free movement of such data)

- USA: sectoral approach (financial, health, credit, debit, etc)

- Canada: public, private, commercial (PIPEDA)

Privacy

- Canadian Charter of Rights and Freedoms protects against unreasonable search and seizure, SCC stated that it must be interpreted extensively
- PIPEDA = Personal Information Protection and Electronic Documents Act applies to commercial activities (there is similar legislation for public federal and provincial bodies)
- Implements OECD principles

Privacy

- Accountability
- Identifying purpose
- Consent
- Limiting Collection
- Limiting Use
- Accuracy
- Safeguards
- Safeguards
- Individual Access
- Challenging compliance

Privacy

- Where are our data stored?
- Do we even know?
- Isn't cloud computing business model and technological paradigm about not caring where the data are stored?

- Do all these privacy regulations make any sense for the protection of our data considering the technologies we are using nowadays?

- Trans-border flows of Data to non-compliant jurisdictions...
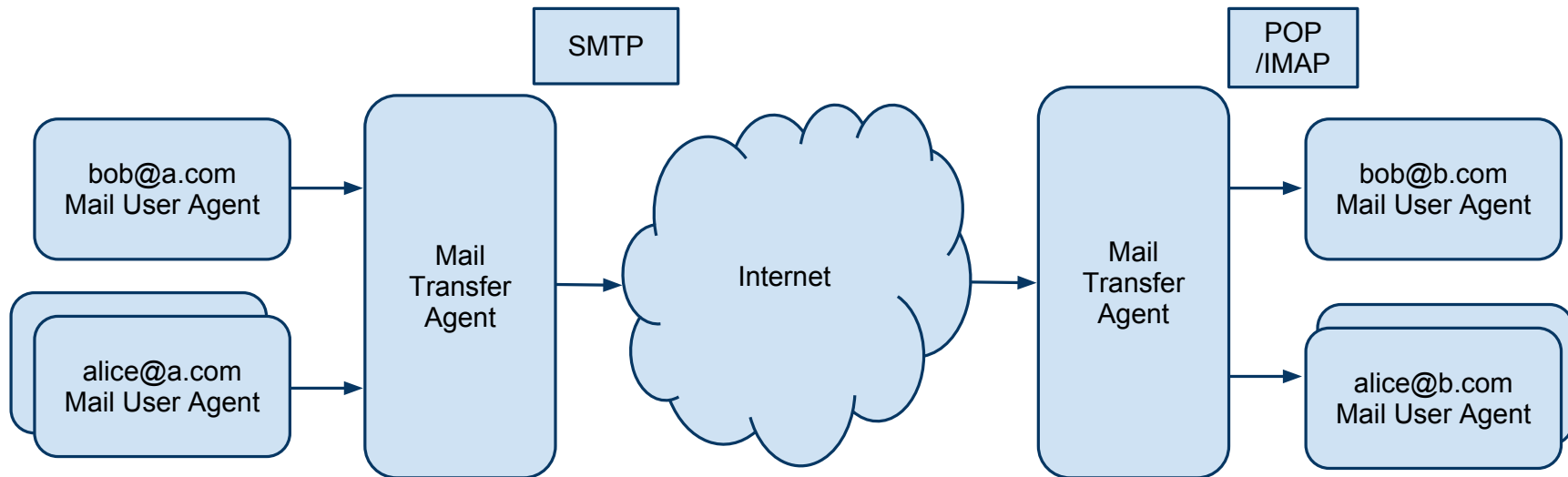
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Threats to privacy in clouds

- Sharing of data with an unauthorized party
- Corruption of data stored
- Malicious internal users
- Data loss and leakage
- Account or service hijacking

a simple email solution

- The problem
  - to ensure that email kept private
- A solution
  - encrypt it all
    - but then hard to search
- Our CHAAVI solution….

usual

chaavi
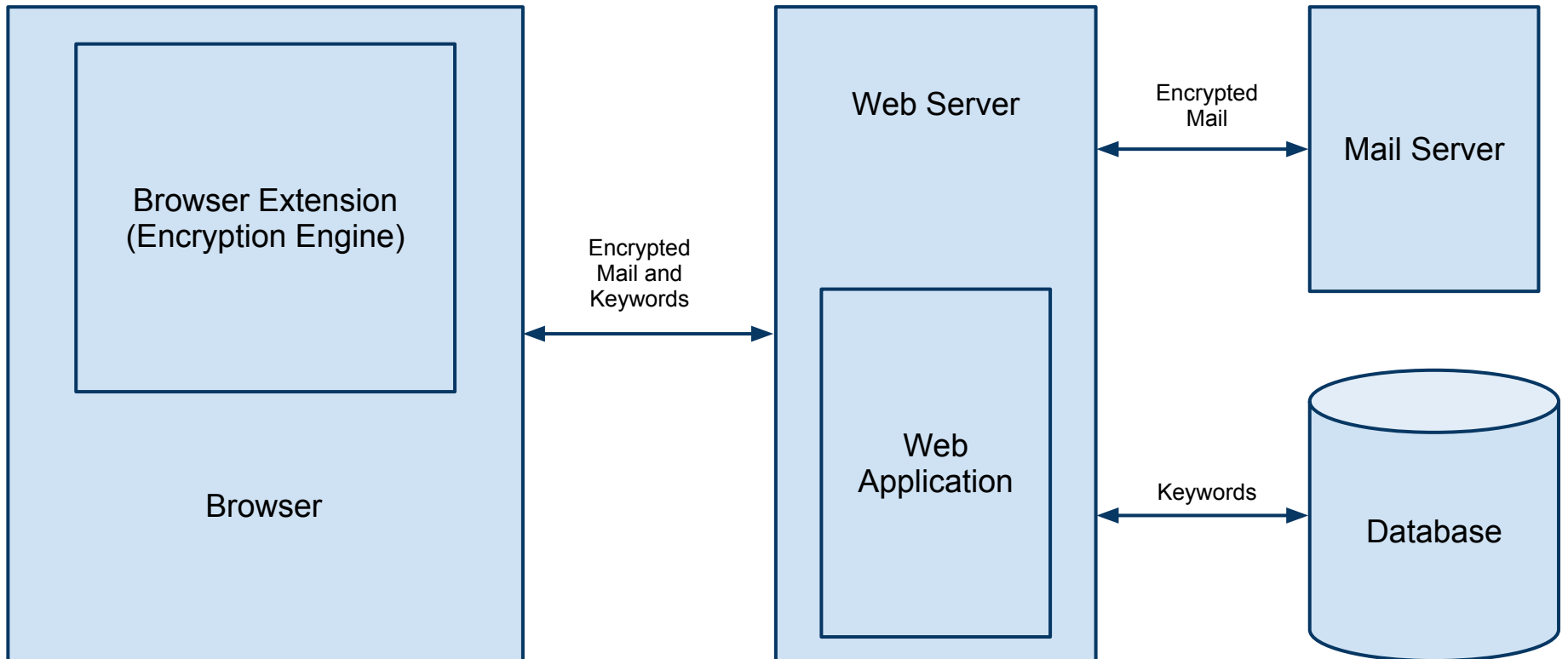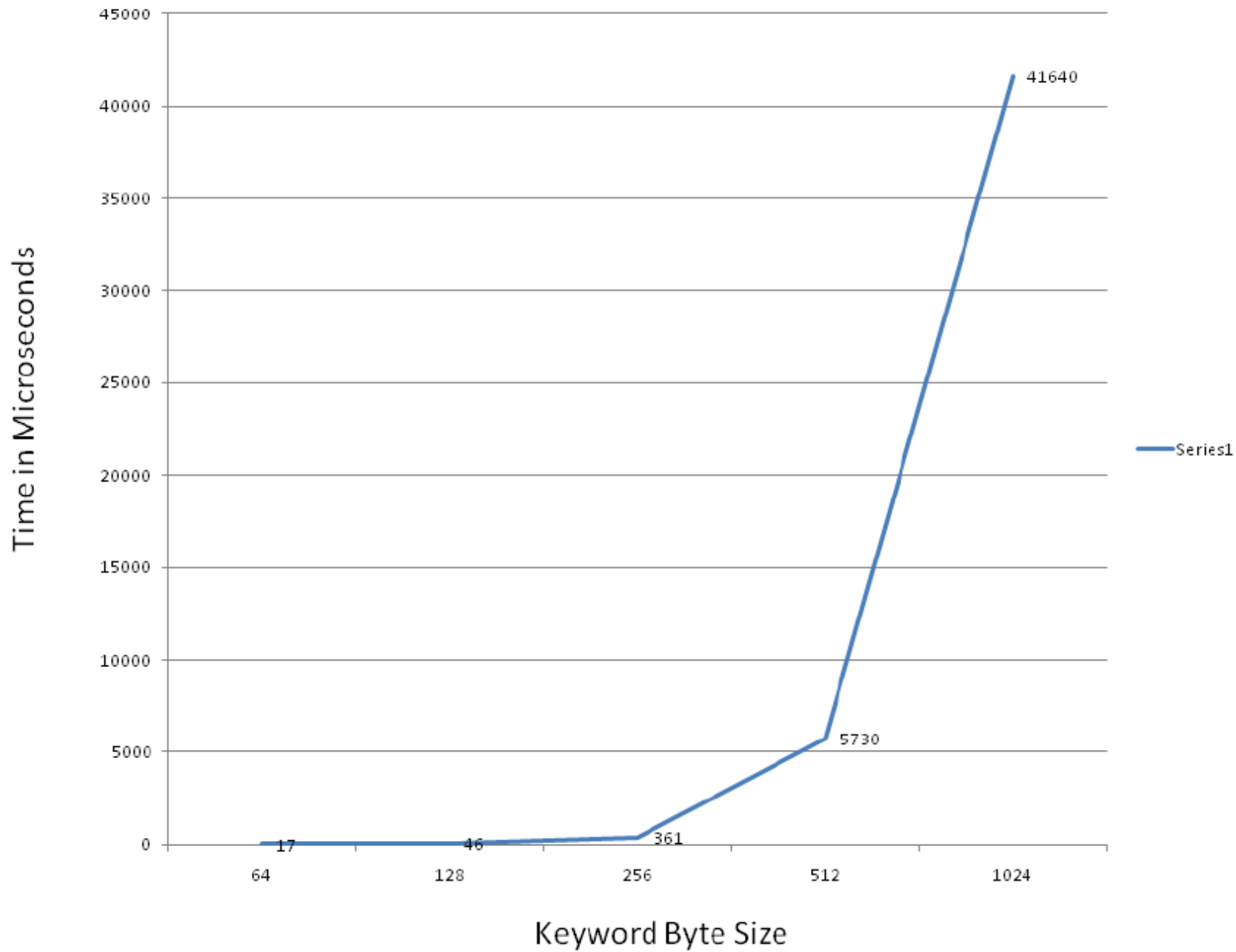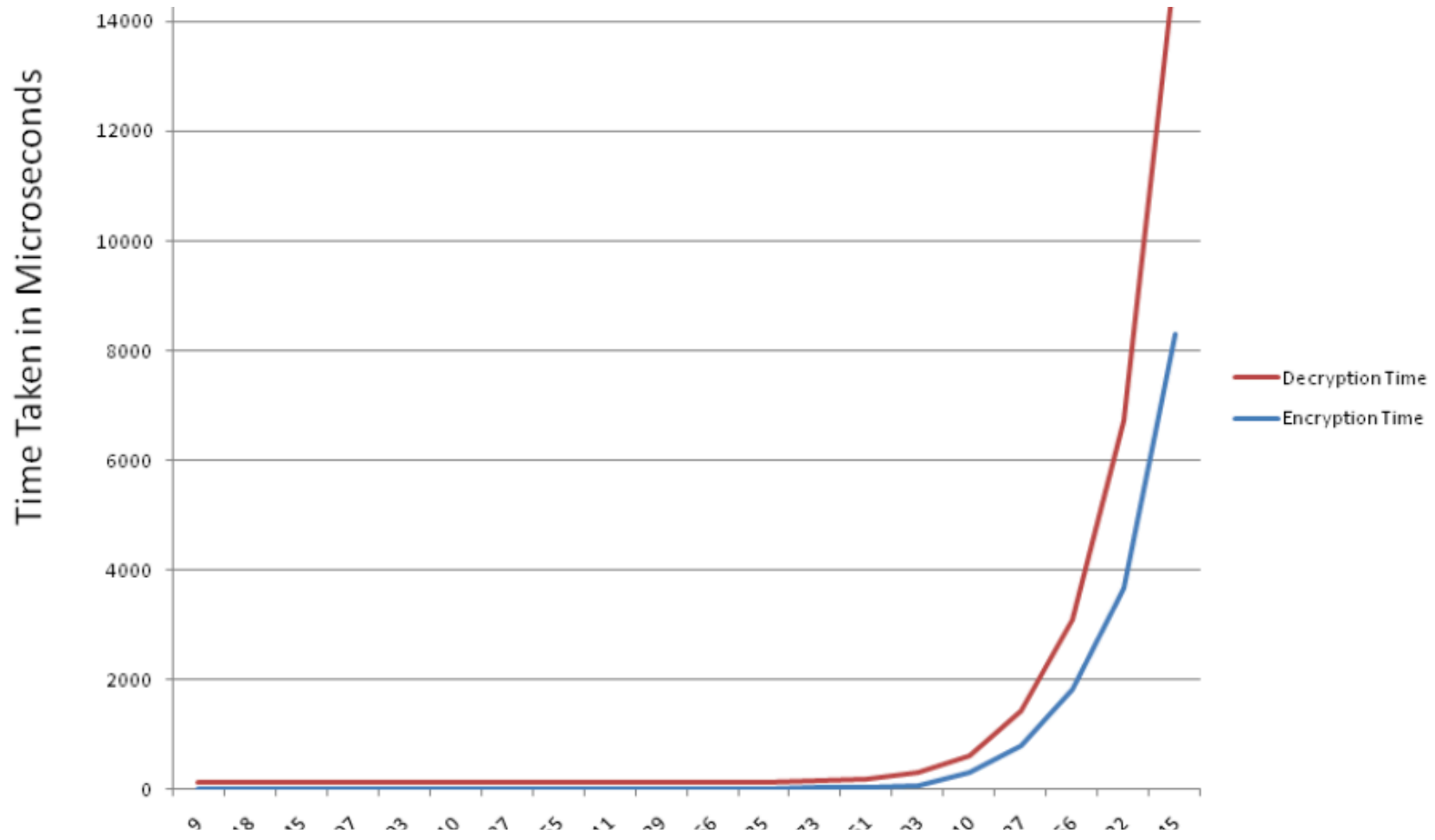
so what?

- we can use a cloud mail system with fairly strong encryption **and** maintain the ability to search the mail

- overheads 'not too bad'

- see *Chaavi: A Privacy Preserving architecture for Webmail Systems* Karthick Ramachandran, Hanan Lutfiyya and Mark Perry (cloud computing 2011)

Cloud Privacy
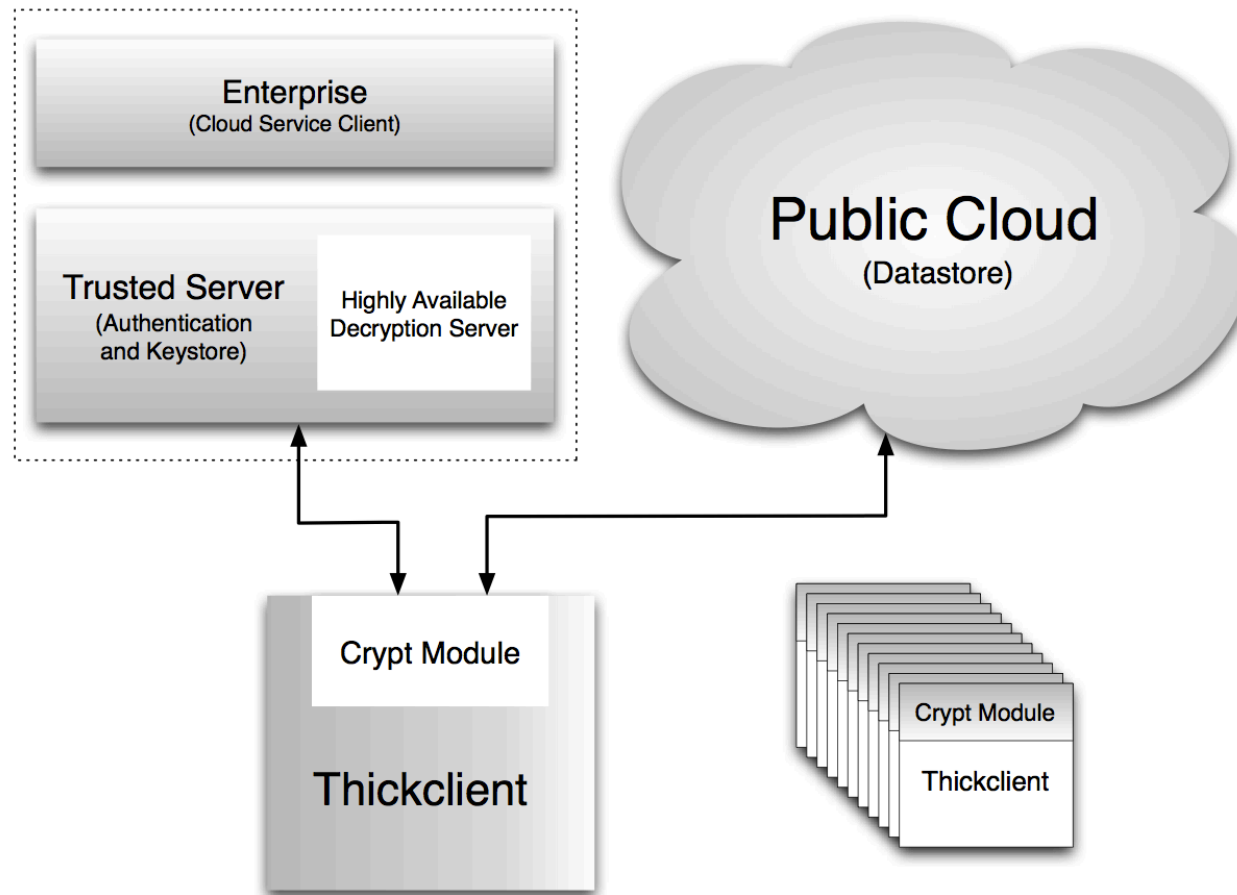
- see Margoni, Perry and Ramachandran, *Clarifying Privacy in the Clouds*. (Cyberlaws 2011). Available at SSRN: http://ssrn.com/abstract=1755225 or doi:10.2139/ssrn.1755225
- Ramachandran, Lutfiyya and Perry *Chaavi: A Privacy Preserving architecture for Webmail Systems* (cloud computing 2011)
- Ramachandran, Lutfiyya and Perry *an acrhictecture to preserve cloud privacy* (forthcoming)

Privacy

Trust

cloud

Regs

IP
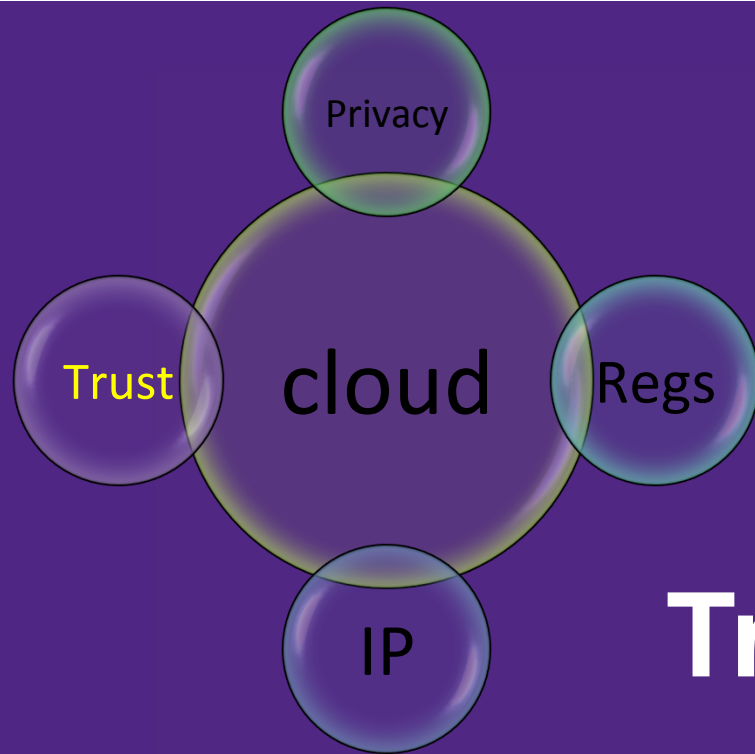
Trust

Zainab Al Jazaff has been working on this

Internalising externalities

Introduction:

Trust:

"the willingness of a trustor to rely on a trustee to do what is promised in a given context, irrespective of the ability to monitor or control the trustee, and even though negative consequences may occur"

Trustor   Trust   **Trustee**

Service Oriented Architecture (SOA)

$T_s = 5.7$

$T_s = /$

Services

$T_s = 4$

Service requestor

Service registry
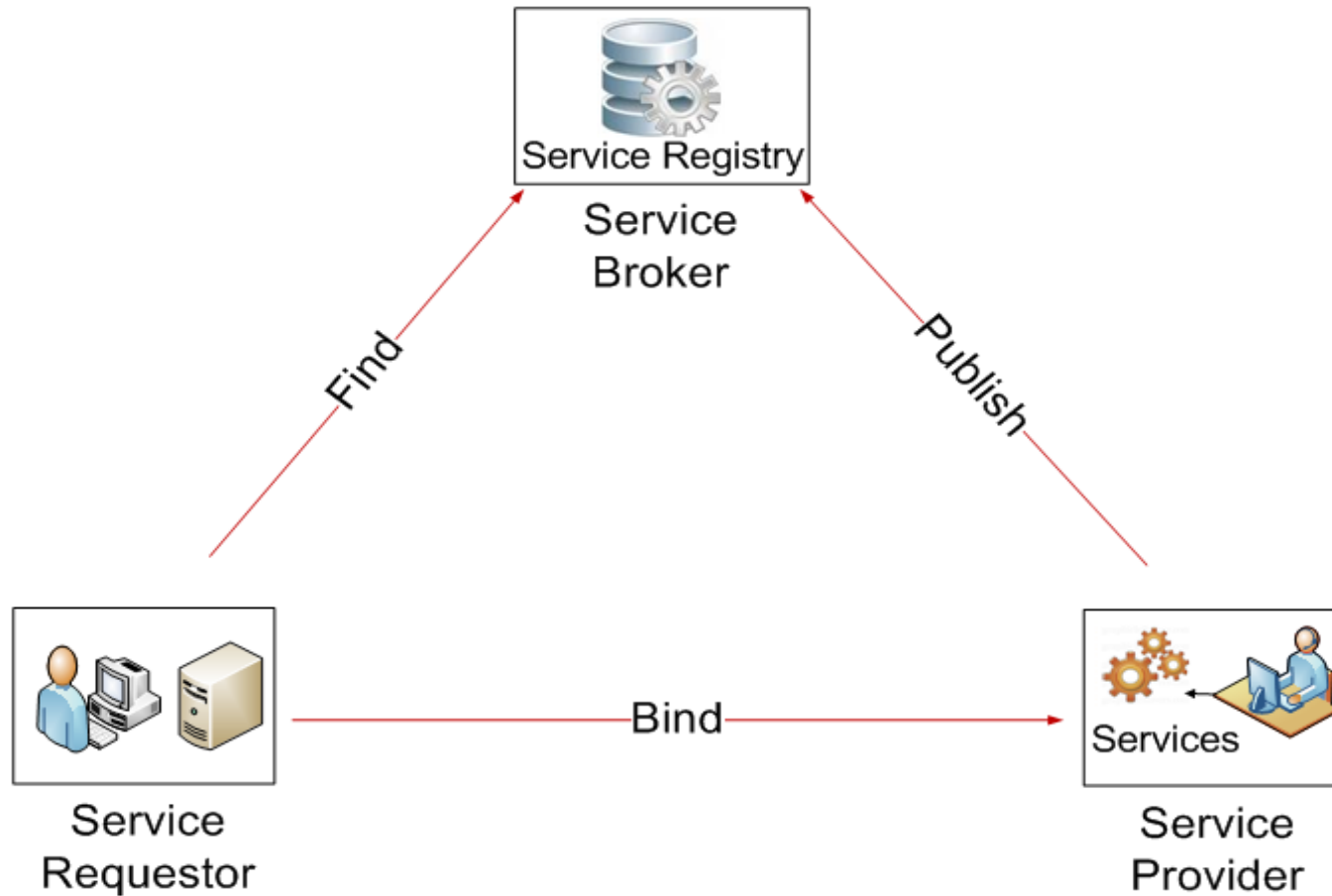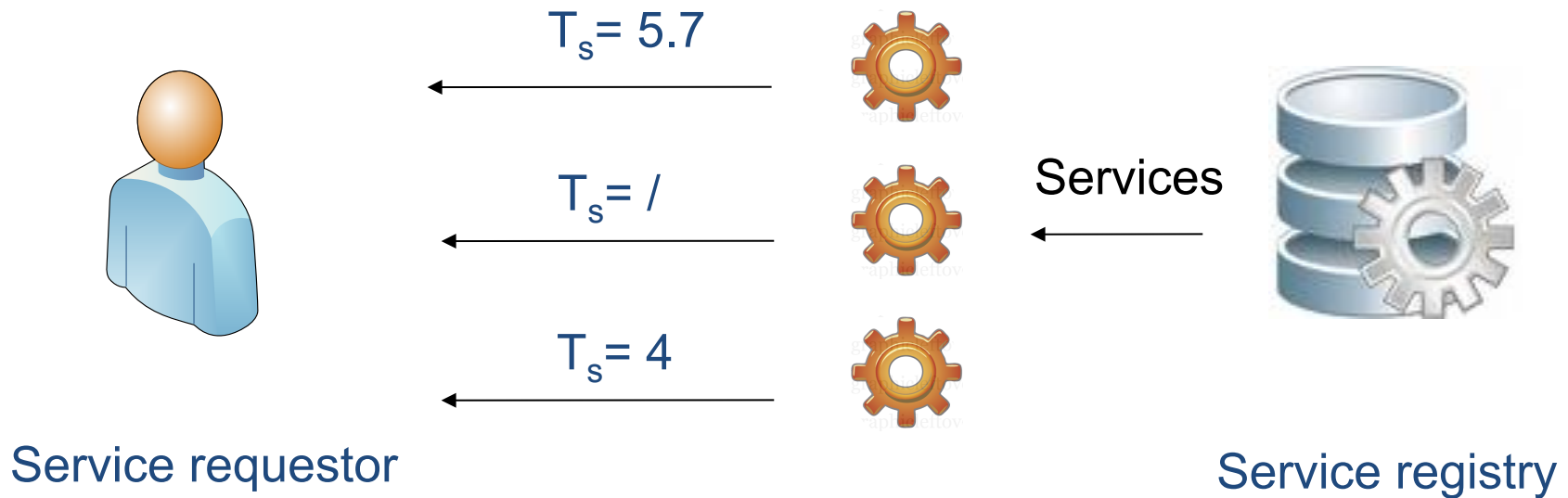
Trust bootstrapping

A mechanism to assign trust rate for a new service that its trustworthiness is unknown and before having any requestor interacted with it.

Related

- Reputation bootstrapping
- Assign default values (low, high, or average)
- Rated by a participant, which has a high rate
- A once rating approach
- Rating based on the aggregated information
- No trust bootstrapping for service providers

- Whitewashing - cold start - overhead on requestor side

.

Trust bootstrapping

- Trust metrics
- Trust services
- Trust service providers

Trust model: *to evaluate trust rates*

Abbreviations

- Terms:

  - Service: s

  - Service provider: pr

  - Trust Metrics: TM (STM (OSTM, SSTM), PTM).

- Trust rates:

  T_s , T_{pr} , T_{TM} , T_{OSTM} , T_{SSTM} , T_{PTM}

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Trust Metrics (TM)

Trust information on an entity that is required and used to evaluate the trustworthiness of the entity.

```
                          ┌─────────────────────┐
                          │  TM: Trust Metrics  │
                          └─────────────────────┘
                 ┌──────────────────┴──────────────────┐
        ┌─────────────────┐                  ┌──────────────────────┐
        │ STM: Service    │                  │ PTM: Service Provider│
        │ Trust Metrics   │                  │ Trust Metrics        │
        └─────────────────┘                  └──────────────────────┘
```

OSTM: Objective STM
- Execution Time
- Response Time
- Throughput
- Latency

SSTM: Subjective STM
- Remedies
- Security
- Privacy
- Payment Satisfaction
- Output/Item Satisfaction

STM
- Security
- Privacy
- Remedies

Important Clues
- Brand name
- Physical Location
- Web Site

Provider's Properties
- Competence
- Honesty

TM			Can TM be Published?
STM	OSTM	$OSTM_e$: Execution time	Yes
		$OSTM_r$: Response time	Yes
		$OSTM_l$: Latency	Yes
		$OSTM_{thr}$: Throughput	Yes
	SSTM	$SSTM_{rem}$: Remedies	Yes
		$SSTM_{sec}$: Security	Yes
		$SSTM_{prv}$: Privacy	Yes
		$SSTM_{pym}$: Payment satisfaction	-
		$SSTM_{out}$: Output satisfaction	-
PTM	STM	PTM_{rem}: Remedies	-
		PTM_{sec} : Security	-
		PTM_{prv} : Privacy	-
	Pr properties	PTM_{brand} : Brand	-
		PTM_{comp} : Competence	-
		PTM_{hons} : Honesty	-
	Clues	PTM_{wsite} : Web site	Yes
		PTM_{loc} : Physical location	Yes
TM: Trust metrics, STM : Service TM, PTM : provider TM			

TM trust models (T_{TM})

Trust rating the Trust Metrics T_{TM}

T_{TM}		Can TM be trust bootstrapped ?	Evaluation approaches
T_{STM}	T_{OSTM_e}	Yes	Monitoring
	T_{OSTM_r}	Yes	Monitoring
	T_{OSTM_l}	Yes	Monitoring
	$T_{OSTM_{thr}}$	Yes	Monitoring
	$T_{SSTM_{rem}}$	Yes	Certifying
	$T_{SSTM_{sec}}$	Yes	Certifying
	$T_{SSTM_{prv}}$	Yes	Certifying
	$T_{SSTM_{pym}}$	-	Feedback
	$T_{SSTM_{out}}$	-	Feedback
T_{PTM}	$T_{PTM_{rem}}$	Yes	$T_{SSTM_{rem}}$
	$T_{PTM_{sec}}$	Yes	$T_{SSTM_{sec}}$
	$T_{PTM_{prv}}$	Yes	$T_{SSTM_{prv}}$
	$T_{PTM_{brand}}$	-	Algorithm 3
	$T_{PTM_{comp}}$	-	Algorithm 3
	$T_{PTM_{hons}}$	-	Algorithm 3
	$T_{PTM_{wsite}}$	-	Feedback
	$T_{PTM_{loc}}$	-	Feedback
T_{STM}: Trust rate of STM, T_{PTM}: Trust rate of PTM			

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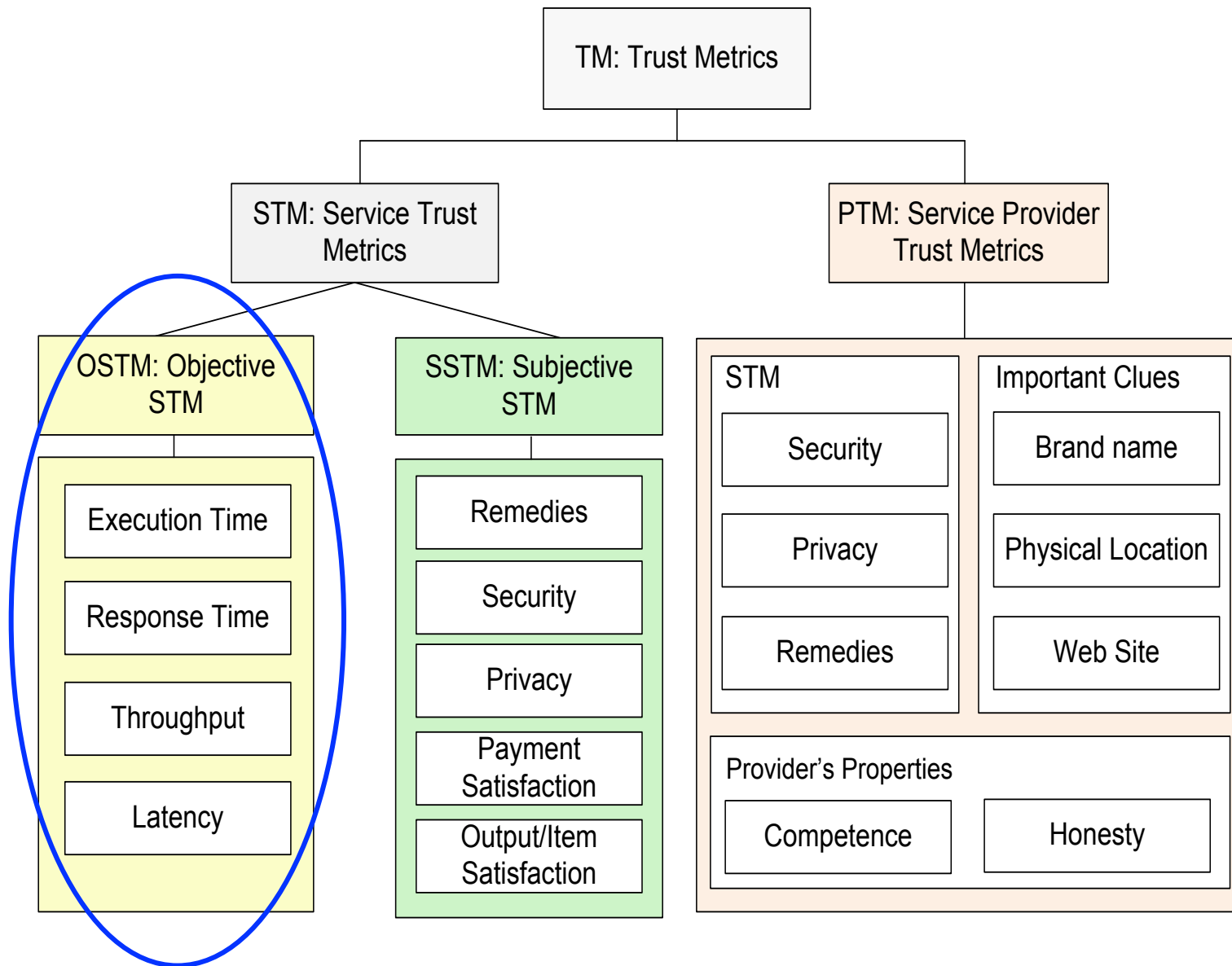
Trust rating OSTM

Algorithm 1 Lower OSTM is better

$T_{OSTM} = [0 - 10]$

if TM is a range of values **then**

    $OSTM_{provided} = Max\{value\ range\}$

end if

Lets $diff = \dfrac{OSTM_{provided} - OSTM_{collected}}{OSTM_{provided}} * 10$

if $diff < 0$ **then**

    $T_{OSTM} = 10 + diff$

else

    $T_{OSTM} = 10$

end if

OSTM:	....	28	26	24	22	**20**	10	8	6	4	2 ·	....
diff:	....	-4	-3	-2	-1	0 5		6	7	8	9	....
T$_{OSTM}$:	....	6	7	8	9	10 10		10	10	10	10	....
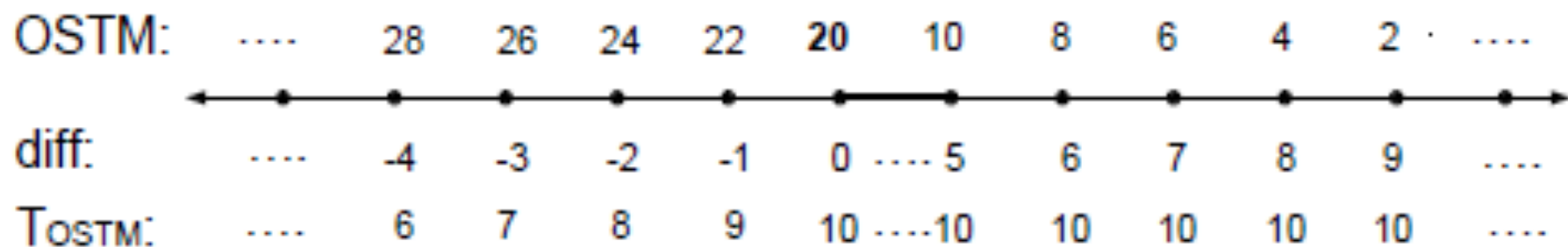
Low OSTM: range value and trust rate

OSTM:	....	1.5	1.4	1.3	1.2	1.1	**1**	0.9	0.8	0.7	0.6	....
diff:	....	-5	-4	-3	-2	-1 0		1	2	3	4	....
T$_{OSTM}$:	....	10	10	10	10	10 10		9	8	7	6	....
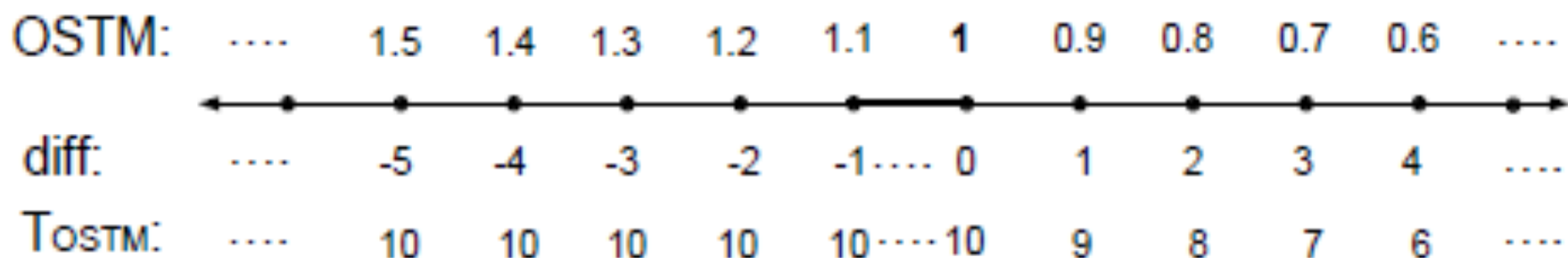
High OSTM: range values and trust rate

```
                        ┌──────────────────────────┐
                        │    TM: Trust Metrics     │
                        └──────────────────────────┘
              ┌────────────────────┴────────────────────┐
    ┌──────────────────────┐                  ┌──────────────────────────┐
    │  STM: Service Trust  │                  │  PTM: Service Provider   │
    │       Metrics        │                  │      Trust Metrics       │
    └──────────────────────┘                  └──────────────────────────┘
```

OSTM: Objective STM

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STM
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- Privacy
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Important Clues
- Brand name
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Provider's Properties
- Competence
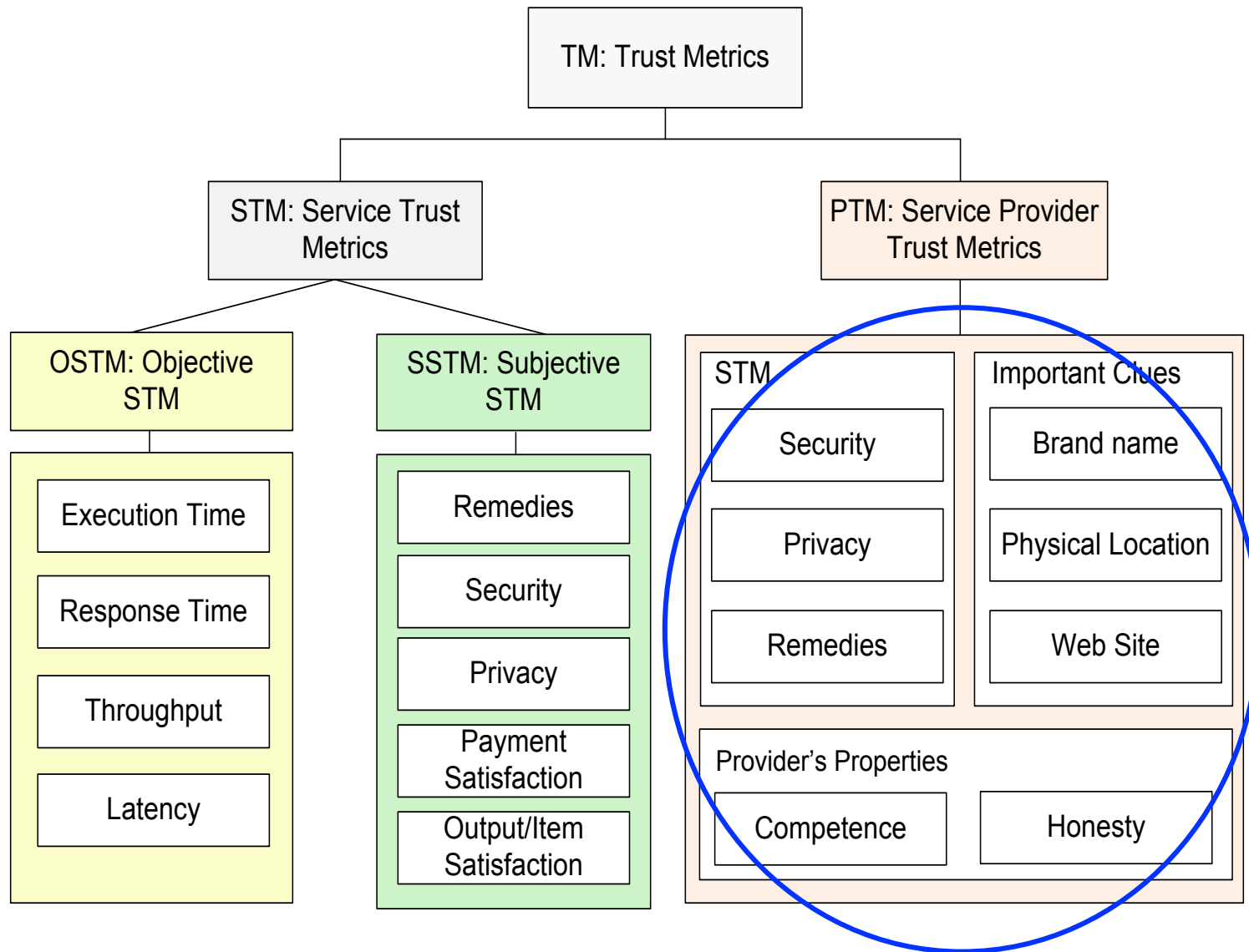- Honesty

Trust rating SSTM

- Feedback approach

  $T_{SSTM_{out}}$, $T_{SSTM_{pym}}$

  - (based on user satisfaction)

- Certification approach

  $T_{SSTM_{rem}}$, $T_{SSTM_{sec}}$, $T_{SSTM_{prv}}$

Trust rating PTM

- Feedback approach

$$T_{PTM_{wsite}} , T_{PTM_{loc}}$$

- Trust rating the STM

$$T_{PTM_{rem}} \rightarrow T_{SSTM_{rem}}$$

$$T_{PTM_{sec}} \rightarrow T_{SSTM_{sec}}$$

$$T_{PTM_{prv}} \rightarrow T_{SSTM_{prv}}$$

- Long term interactions:

$$T_{PTM_{comp}} , T_{PTM_{hons}} , T_{PTM_{brand}}$$

$$\mathsf{T}PTM_{comp}, \mathsf{T}PTM_{hons}, \mathsf{T}PTM_{brand}$$

Algorithm 3 Check provider's competence and honesty

Initialization: For pr_j, $c_j = c$ and $h_j = h$
if $h_j \neq 0$ **then**
    {the provider is not honest}
    if A provider is competent, $(T_{pr} \geq d)$ **then**
        $c_j = c_j - 1$
        if $c_j \leq 0$ **then**
            $T_{PTM_{comp_j}} = 1$
            $h_j = h_j - 1$
            $c_j = c$ *{to start a new competence iteration}*
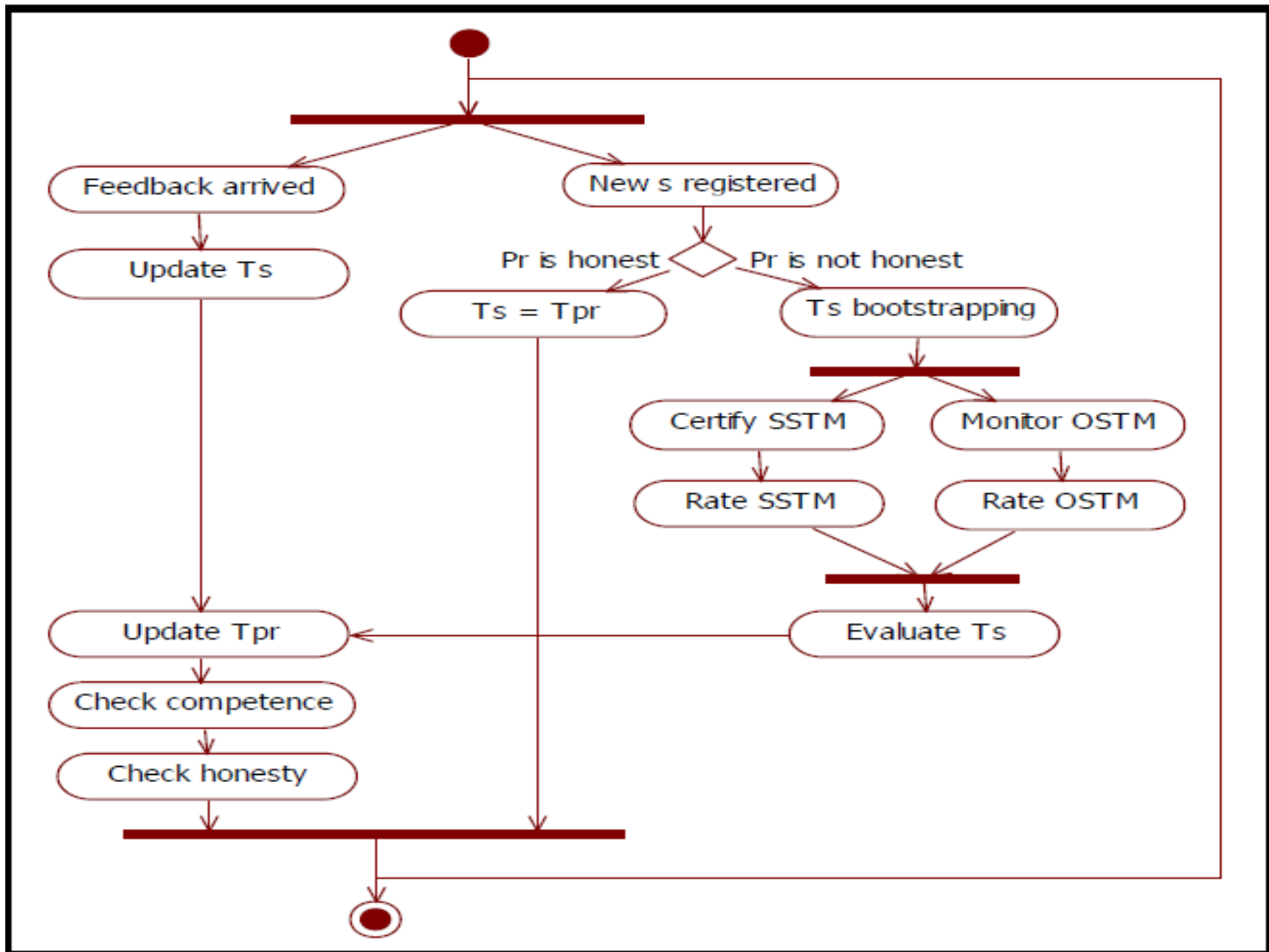   **if** $h_j \leq 0$ **then**
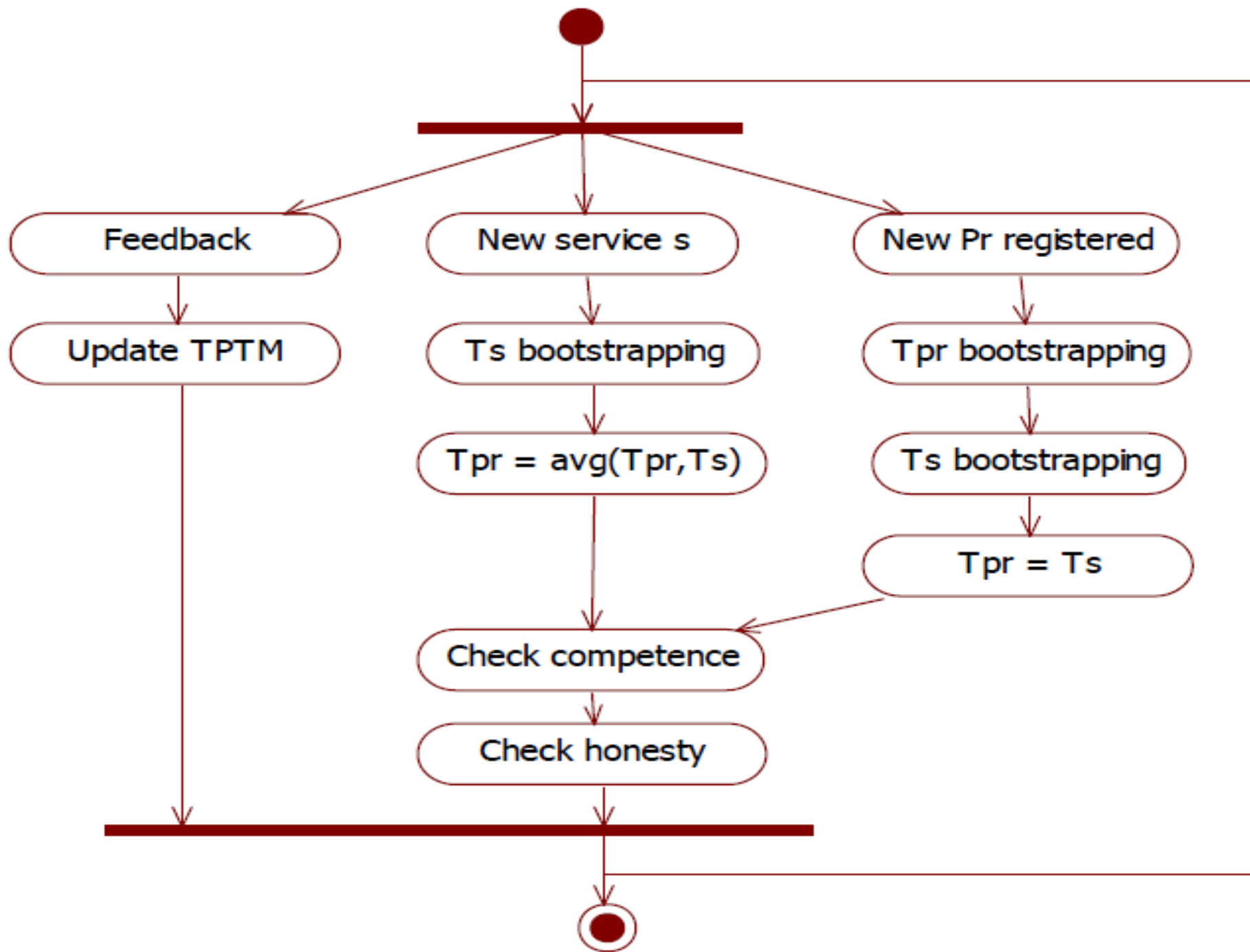 $T_{PTM_{hons_j}} = 1$ and $T_{PTM_{brand_j}} = 1$
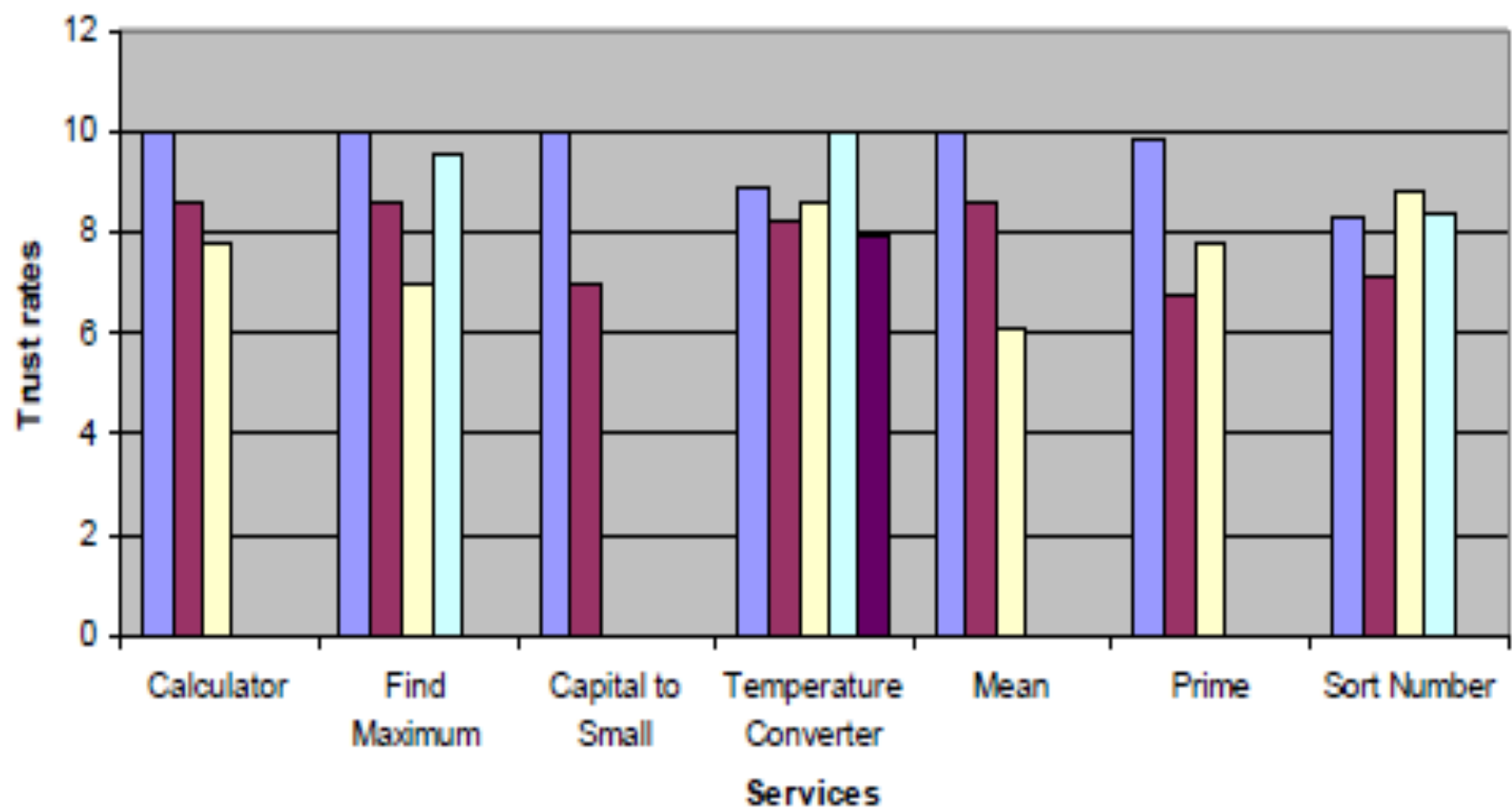   **end if**
        end if
    end if
end if

W

```
                    ●
                    │
        ┌───────────┼───────────┐
   ┌────▼───┐  ┌────▼────┐  ┌────▼──────────┐
   │Feedback│  │New service s│ │New Pr registered│
   └────┬───┘  └────┬────┘  └────┬──────────┘
        │           │            │
   ┌────▼──────┐ ┌──▼─────────┐ ┌▼──────────────┐
   │Update TPTM│ │Ts bootstrapping│ │Tpr bootstrapping│
   └────┬──────┘ └──┬─────────┘ └┬──────────────┘
        │           │            │
        │      ┌────▼────────┐  ┌▼──────────────┐
        │      │Tpr = avg(Tpr,Ts)│ │Ts bootstrapping│
        │      └────┬────────┘  └┬──────────────┘
        │           │            │
        │           │           ┌▼────────┐
        │           │           │Tpr = Ts │
        │           │           └┬────────┘
        │      ┌────▼────────┐    │
        │      │Check competence│◄─┘
        │      └────┬────────┐
        │      ┌────▼────────┐
        │      │Check honesty │
        │      └────┬────────┘
        └───────────┼
                    ●
```

- Feedback → Update TPTM
- New service s → Ts bootstrapping → Tpr = avg(Tpr,Ts) → Check competence → Check honesty
- New Pr registered → Tpr bootstrapping → Ts bootstrapping → Tpr = Ts → Check competence → Check honesty

Experiment

	Services						
Pr	Cal	FindMax	CTS	TempConv	Mean	Prime	Sort
Pr1	√	√	√	√	√	√	
Pr2	√		√	√			√
Pr3		√		√	√		
Pr4		√			√	√	√
Pr5		√		√			√
Pr6	√			√		√	√

Pr: Provider, Cal:Calculator, CTS: Capital to small

Trust rates of similar-functional services provided by different providers

Y-axis: Trust rates — 0, 2, 4, 6, 8, 10, 12

X-axis (Services): Calculator, Find Maximum, Capital to Small, Temperature Converter, Mean, Prime, Sort Number

Requestors' trust preferences:

Trust rates of services provided by service providers

Trust rates of the service providers

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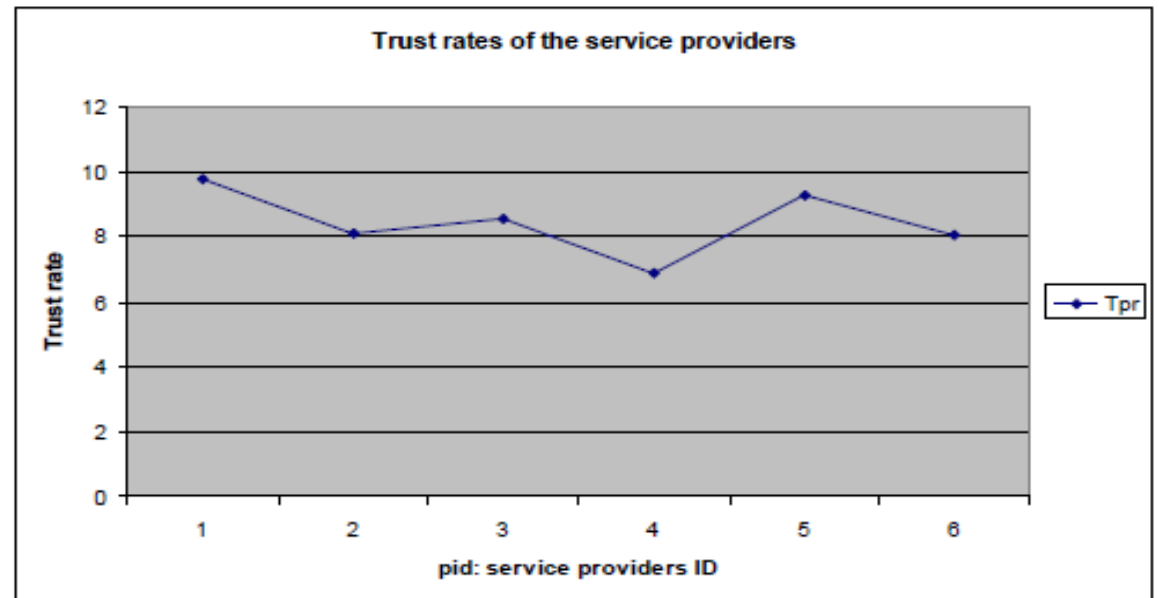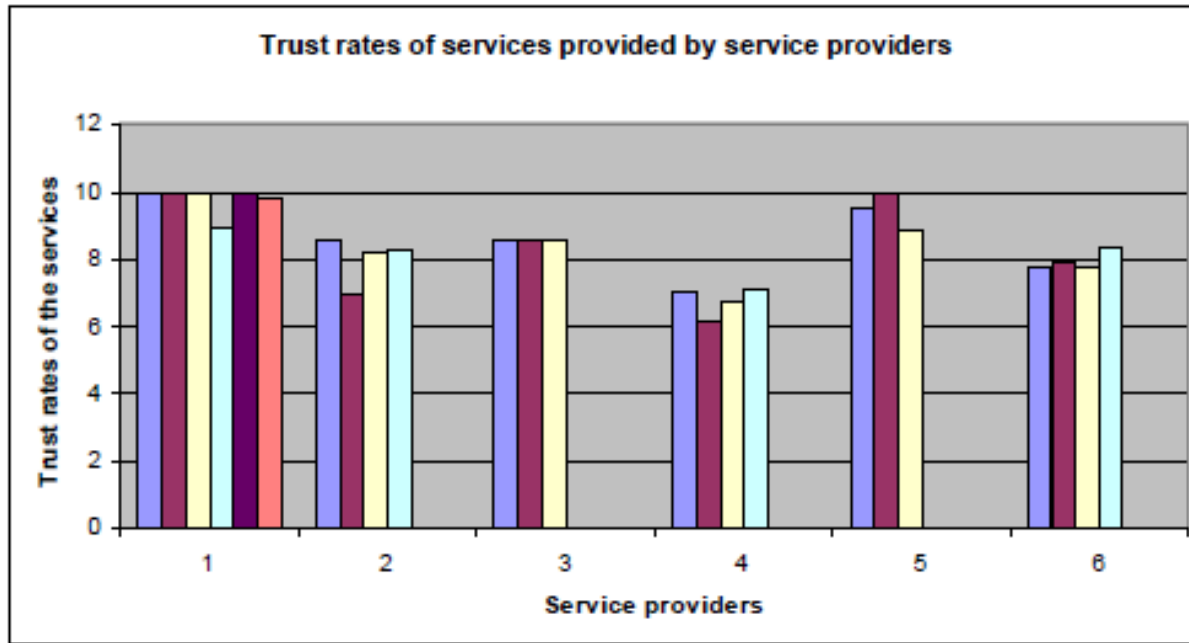
A few trust papers

- 1- Z. M. Aljazzaf, M. Perry, and M. A.M. Capretz. Trust in Web Services. IEEE 6th World Congress on Services 2010, SERVICES 2010, pp. 189-190, Miami, FL, USA, 2010. IEEE Computer Society.

- 2- Z. M. Aljazzaf, M. Perry, and M. A.M. Capretz. Online Trust: Definition and principles. ICCGI 2010: The Fifth International Multi-Conference on Computing in the Global Information Technology, September 20-25, Valencia, Spain, 2010. IEEE Computer Society.

- 3- Z. M. Aljazzaf, M. Perry, and M. A.M. Capretz. Trust Metrics for Services and Service Providers. ICIW 2011: The Sixth International Conference on Internet and Web Applications and Services, March 20-25, St. Maarten, The Netherlands Antilles, 2011.

- 4- Z. M. Aljazzaf, M. Perry, and M. A.M. Capretz. Toward a Unified Trust Framework for Trust Establishment and Trust Based Service Selection. CCECE 2011: 24th Canadian Confer- ence on Electrical and Computer Engineering, May 8-11, Niagara Falls, Ontario, Canada, 2011. IEEE Canada.

- 5- Z. M. Aljazzaf, M. A.M. Capretz, and M. Perry. Trust Bootstrapping Services and Service Providers. PST 2011: The Ninth Annual International Conference on Privacy, Security and Trust, July 19-21, Montreal, Quebec, Canada, 2011. IEEE Computer Society.

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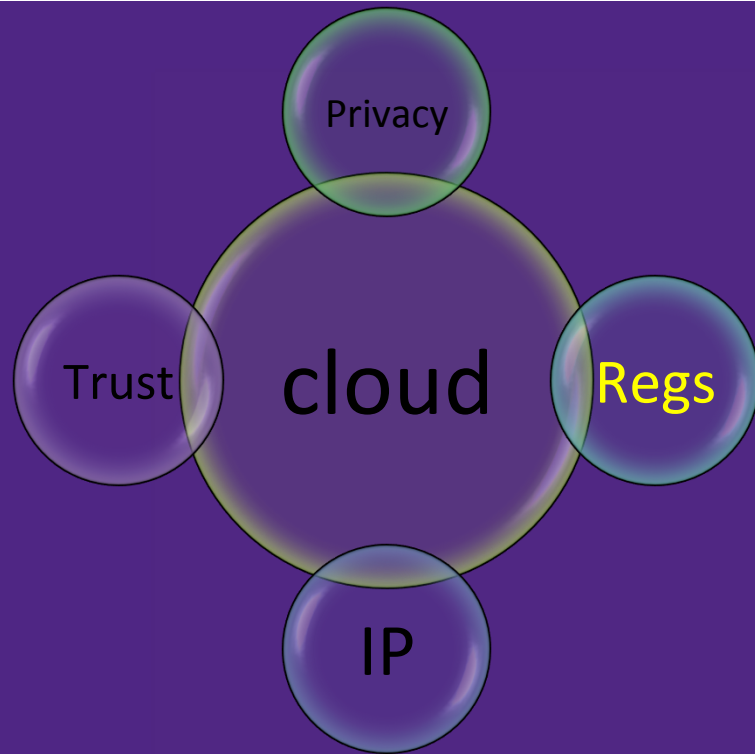
Regulations

...working on this

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Internalising externalities

the problems

- a bankruptcy filing by a cloud provider can have a major impact on users, the service agreement may not qualify as "intellectual property" under s. 365(n) Bankruptcy Code;

- the legal status of personal and business information (e.g., trade secrets) may be compromised or commingled with third party data, including that of competitors;

- businesses may be legally barred from placing certain types of information on the cloud (e.g. legally privileged information, health records, financial records);

- cloud providers may impose unreasonable privacy policies or terms of service;

Luis J. Diaz, Director in the Gibbons Intellectual Property Department

rule 404?

- For example, can we ensure that cloud users are easily able to comply with the requirements to have internal controls and procedures for financial reporting and be able to document, test and maintain those controls and procedures to ensure their effectiveness??
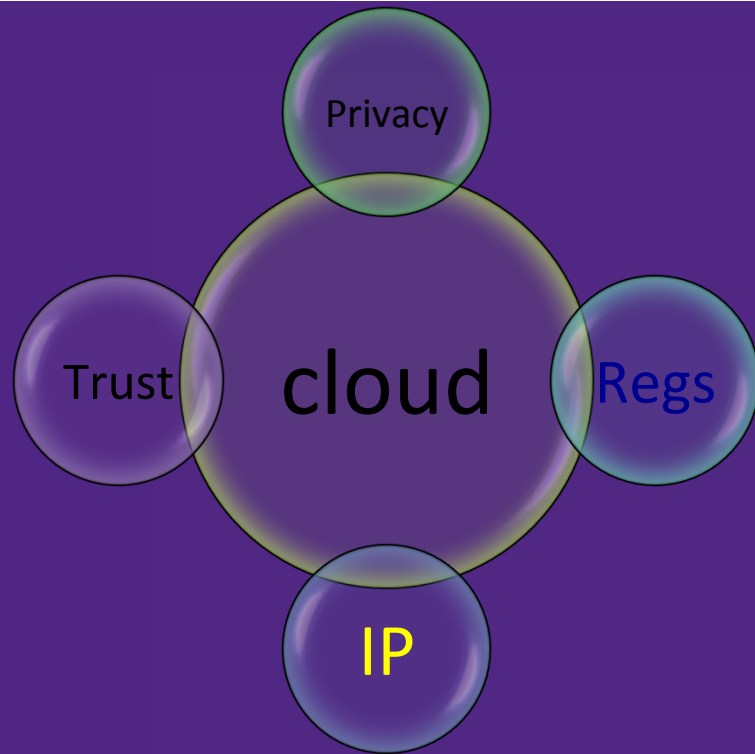
Exon

Intron

and regs

Rules

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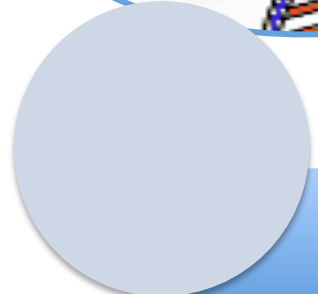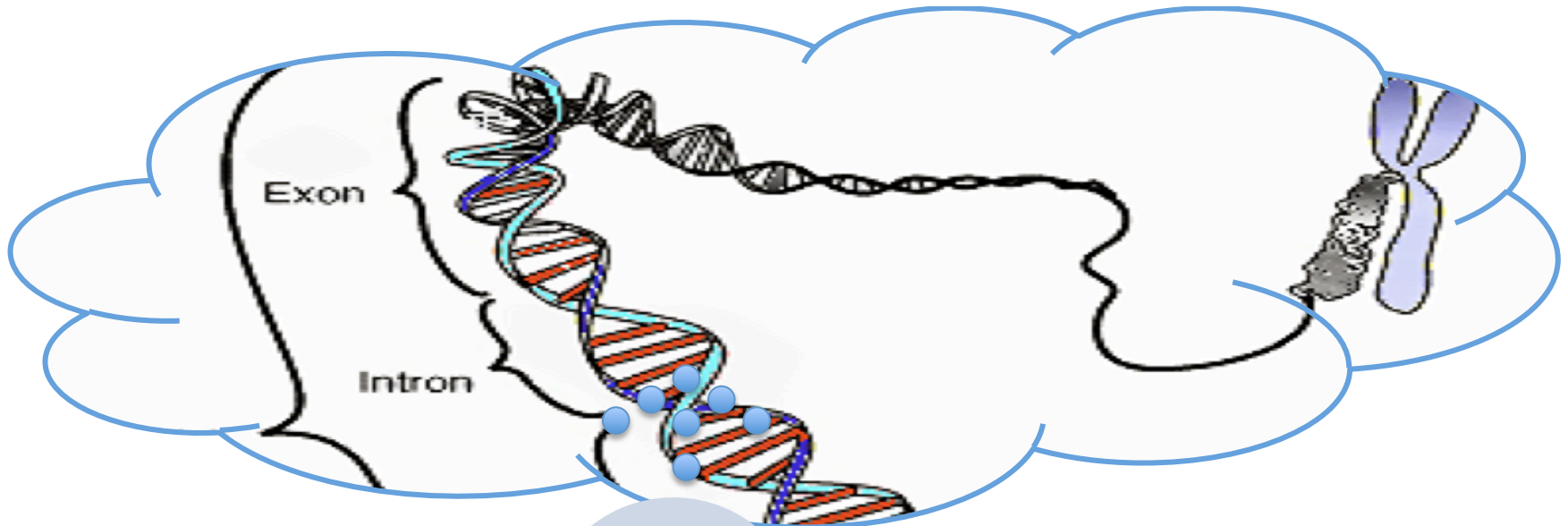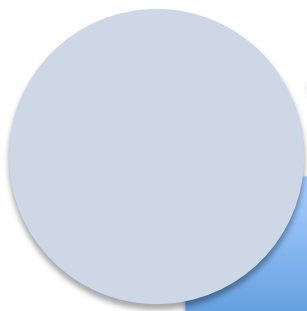
and

- There are many other externalities that will impact the operation of clouds — planning to manage these inside the cloud, or at least think of interfaces for clouds, will give a long term advantage.

Intellectual Property etc

...working on this

Western Law

Internalising externalities

Thanks for listening & any questions?

- See some publications at :

- http://ssrn.com/author=10510