Information Intelligence in Cloud Computing-How can Vijjana, a Collaborative, Self-organizing, Domain Centric Knowledge Network Model Help

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ABSTRACT

This research reports agent activities in a collaborative, self-organizing, domain centric knowledge network, called Vijjana. Vijjana means classified knowledge in Sanskrit language. This model has been designed and implemented to assist users engaged in web activities, limiting the data retrieval to desired material only. The model Vijjana sits on the top layer of the cloud computing architecture, and with its agent activities develops a body of intelligent reasoning system which can semantically connect different dispersed users with their own knowledge nets. Vijjana model makes the cloud computing intelligibly usable for connecting different people working with the same domain specific interest. This provides a high order of accountability with assurance on confidentiality, integrity and availability.

Categories and Subject Descriptors

I.2.4 [**Artificial Intelligence**]:Knowledge Representation & Methods, Semantic Networks; H.4.3 [**Information Systems Applications**]: Communication Applications; H.3.5 [**Information Storage & Retrieval**]:Online Information Services-web based services.

General Terms

Management, Performance, Design, Security, Human Factors, Theory.

Keywords

1. INTRODUCTION

The internet and World Wide Web have become a 24 hours usable commodity to all of us, and this is supported with numerous language-specific and website specific search engines existing. However, while searching, we are always frustrated with too much over-burdening display of information---a good amount of which probably is not even close to what we are looking for. Is there a way to overcome this frustrating problem? One solution to this problem has become well known: We need to semantically associate syntactically retrievable data in the web-- the technology of Semantic Web [1] is needed.

A vital question remains open: Can the machine be made to understand what we are doing? Can this understanding be organized in such a way that all meaningfully kept data become available to whoever is interested in that subject domain? It was realized that a domain-centric [of cross-interest] knowledge network will help here. This realization was materialized in **VIJJANA**, a model for an interactive knowledge network which has been already developed and implemented [2, 3]. The word Vijjana comes from the Sanskrit language, which is used to imply knowledge created for classification and analysis collectively. Creating and maintaining large networks made of domain-centric knowledge, embedded purposefully to create a typical topology—that help every user—have become the ultimate aim of the model Vijjana.

This research will report on how the architecture of Vijjana can be used to address information accountability problems associated with semantic web operations [4]. The essential argument is this: The domain-centric knowledge network model Vijjana is a naturally occurring *layer* in "cloud computing" architecture [5].

This Vijjana layer is supported with a set of reasoning tools often used in artificial intelligence. One of the major aims of Vijjana is to develop a strong body of knowledge sieving and intelligent reasoning tools which can connect different knowledge domains in the cloud safely.

To address the aforesaid problem, we have organized the paper in this following way. The section 2 describes the problem domain. The section 3 describes the Vijjana model. The section 4 describes the cloud computing architecture and explains where does the Vijjana model fits. The section 5 introduces reasoning modules working for the Vijjana agents. The section 6 concludes with the claim that the Vijjana layer in the cloud can be empowered with intelligent reasoning systems to addressing information assurance in interactive knowledge network operations.

2. PROBLEM DOMAIN

To realize the domain, let us type the word SECURITY in a web search engine. Numerous security related items are retrieved by the search engine. The Figure 1 is a visual thesaurus to describe the dreadful situation partially.

Figure 1
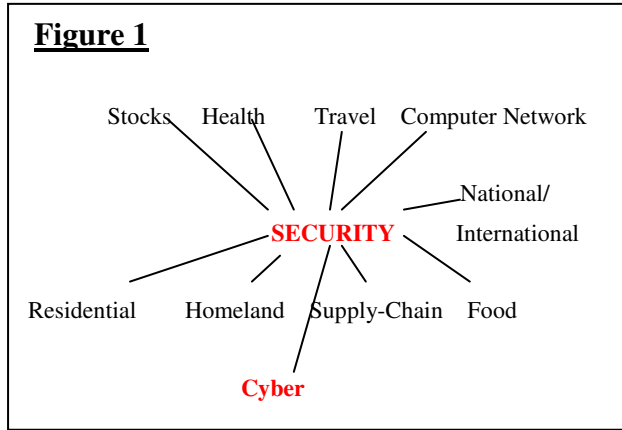
The agents of the Vijjana system can construct several different types of security related *semantically-bonded* knowledge networks, where any particularly desired security related knowledge network will be retrievable using web agents. Vijjana web agents generate domains sharing similar meaning. In the model, these are domain engineering agents, which are capable of forming varying knowledge networks facilitating further work on searching and researching.

3. The VIJJANA MODEL

In the most abbreviated symbolic form, the Vijjana model is represented in the following way.

$$\text{Vijjana-X} = \{J, T, R, d_A, o_A, c_A, v_A, s_A, r_A\} \qquad (1)$$

Where: X = the domain name, J= the collection of Jans in the domain Vijjana-X, T = the taxonomy used for classification of Jans, R= the domain specific relations, d_A = the discovery agent which find relevant Jans, o_A = the organizing agent which interlinks the Jans based on R, c_A = the domain consistency/completeness agent, v_A = the visualization agent, s_A

= the Jans search agent, and r_A = the Jans rating agent In this model users are contributors too, and they share domains of common interest. This model provides appropriate knowledge based schemata and identifies all *knowledge units* creating the knowledge base. The knowledge units in Vijjana are called *Jans* (a derivative from the Sanskrit word **Jnan**, which means knowledge). Such knowledge units have been popularized by Google in past, and have been called, *Knol* [6]

In the model Vijjana, all types of Jans are discoverable in the domain ontology and classifiable categorically depending on their context of existence, which can be visually displayed.

4. THE CLOUD

The cloud computing is essentially using internet to perform any desired operations with the aid of software/hardware services [7]. In this type of computing network resources are scalable and virtualized, peer-to-peer computing takes a profound order, and distributed grid computing is taking place. The Figure 2 below is an abstraction for the Vijjana adapted cloud computing architecture.
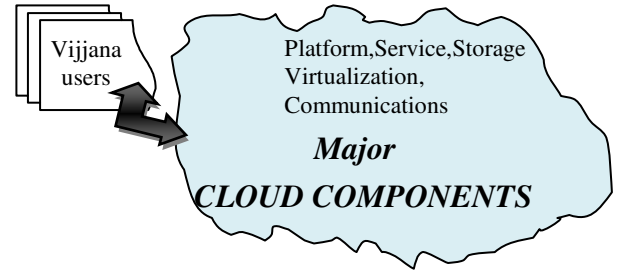

Figure 2

The Vijjana model's claim here is this: Vijjana agent activities are addressing cloud applications layer and are strong members of cloud software environment. The idea is that since Vijjana users are in a common-user-platform group sharing knowledge networks, acquiring the knowledge network itself has gone through the cloud architecture already. Then, the above architecture in the Figure 2 reduces to the following form (the Figure 3)

$$\text{Vijjana-X} = \{J, T, R, d_A, o_A, c_A, v_A, s_A, r_A\} \quad \text{as in} \quad (1)$$

CLOUD COMPONENTS

Operating Systems

Figure 3

5. THE REASONING FOR THE AGENTS
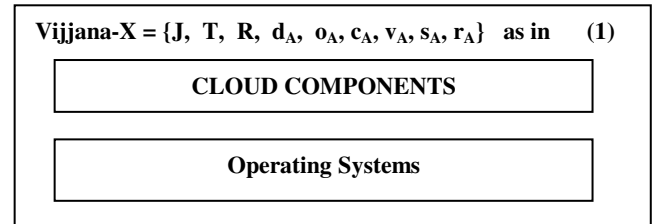
Jans in Vijjana – the domain-centric knowledge network [Eq. 1] are knowledge units searched, collected, organized with semantic logics for a user in such a way that, any other users can have access to these collections of Jans, and vice versa. In the model there are Jans rating agents too. Here typical users will be able to rate and label their findings in the web forming a classificatory

structure of knowledge nets. This simply means that the user is stressing "context"—the context that is most important gets the highest rating. What will be the implication of labeling a highly rated context? To address this issue, the following architecture has become worth addressing [8].

{**Forms, Structures, Intentions**} ➔ **Implications**, or

$$<F,S,I> ➔ Implication \qquad (2)$$

In the simplest form, **Intentions** are user intentions as depicted by agent's [Jan rating agent r_A] ranking in the Vijjana model, **Structure** is the semantically associated knowledge assembly structure that Vijjana displays. **Forms** are made of: R= the domain specific relations activated and worked on with the discovery agents which find relevant Jans (d_A), and the organizing agents (r_O) which interlink the Jans based on R. **Implication** is what matters to any user of the Vijjana model. Implications are ranked by the agent r_A.

Reasoning System-1:

This research claims that, if Implications in (2) have been carefully ranked by agents (r_A), then either all three or any two or even any one item from {**Forms, Structures, Intentions**} will invoke a class of default reasoning—sufficient to attach different knowledge networks to different user groups. *The claim is that, this mechanism of reasoning will bypass some computational difficulties in the cloud environment*. Relation (2) represents a mechanism for capturing ontology [9]. Since the Vijjana model exists in the cloud, <F,S,I> in relation (2) will be used as a modal operator:

$$Cloud ⟷ <F,S,I> ➔ Modal\ Operator \qquad (3),$$

Then for all adaptable ontology, the following default mechanism is valid: $\forall(F,S,I):Form➔Implication(F,S,I) \wedge$ Modal operator($<F,S,I> ➔$ Implication) $\Rightarrow$ Form -- *will be enough to determine all adaptable implications*. In traditional default logic form this amounts to saying: {Form **.** <FSI>/ Implication}. What if Form (<FSI>)$➔ \neg$ Implication? This implies that, captured Forms were not bona fide members of the <FSI>➔Implication group. A justification-based truth maintenance system [TMS] will be required to support the ontology capture mechanism shown in the relation (2).

Reasoning System-2:

If different users are in Vijjana architecture and are in quest of well-delivered knowledge nets, and if reasoning system-1 above is not practical, a fuzzy reasoning system can be invoked. This reasoning will focus a degree of membership for the Intentions in to the Implications experienced. This happens again by using agents r_A. For example, if the degree of membership is >= 70% on that <F,S,I> is giving error–free result, then <F,S,I>=1, that is 100% acceptable. Similarly, if 90% > (F,S,I) > 60%, then <F,S,I> = 90 - <F,S,I>/30, and if (F,S,I) <=10, then <F,S,I> =0.

How the Vijjana model will reason for security in the cloud is illustrated in the Figure 4. It is argued that nonmonotonic reasoning systems or fuzzy reasoning systems can be utilized to associate different user classes subjected to security violation given in the Figure 4.
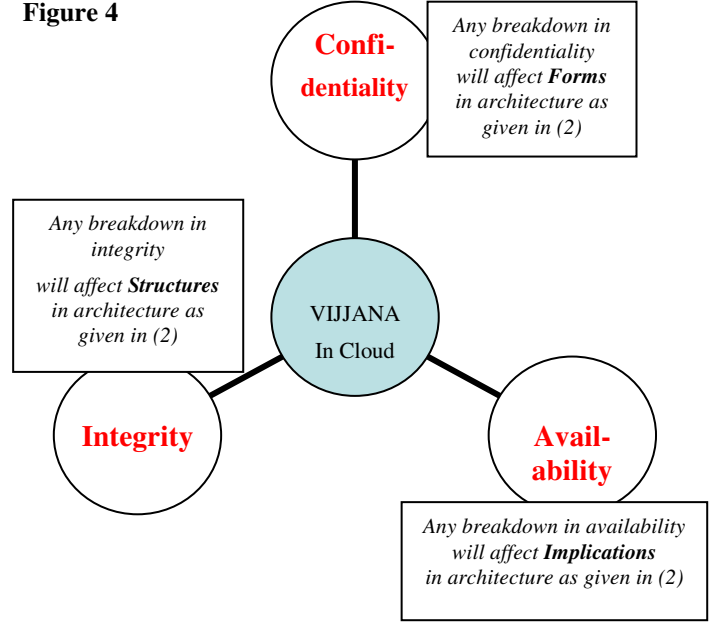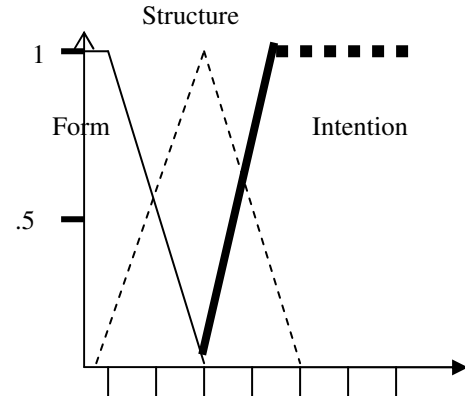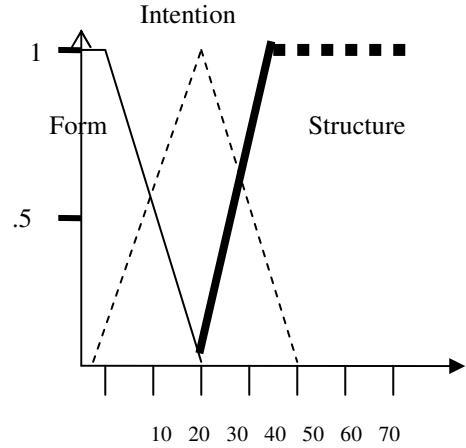
Figure 4

Figure 5

In the Figure 5 the vertical axis represents degree of membership into the Implication acceptability criteria, and the horizontal axis gives a calibrated order of numbers representing Implication. Intention and structure interchanged positions in the two diagrams.

6. DISCUSSION & CONCLUSION

In the model Vijjana, users create their own ontology on a typical subject. This is a sieving mechanism, of which the relation (2) is an example. The user-specific ontology capture on a given subject and connecting them in a network are agent-driven engineering activities. In such an activity agents are capable of ranking usability (order-of-importance) factors in captured ontology. When different Vijjana users are dispersed all over the world, in spite of having tightly bound domain specific operations, users will be subjected to utility programming paradigms present in the cloud. This simply means that, while creating own ontology, Vijjana users were taking help of cloud computing. Another claim here has been is that, the default or fuzzy reasoning system mentioned in previous section will be able to by-pass many unwarranted cloud computing problems including accountability problems. It is because each ontology network domain is individually acquired and ranked by each individual user. Under that condition, a major demand on Vijjana's *trust* on cloud interactions is in order. Each individual domain-specific knowledge network ontology captured by each user must be a trusted system [10]:

A trusted system is a system that has been shown to meet well-defined requirements under an evaluation by a credible body of experts who are certified to assign trust ratings to evaluated products and systems.

Vijjana model has a rating agent r_A which is able to assign trust rankings in some controlled order. Such rankings throw light on flaws in requirement specifications, hardware/software misuse, and communication malfunctioning. In the cloud computing environment, would there be a separately existing, independent body of trust provider while the Vijjana users are engaged in ontology capture? This is a natural claim.

The cloud computing interactions of a Vijjana user can be seen in a simple way as follows [11].

> Client = {(User interface, query), (Response received), (user's extended intention other LANs), Active Portals}.

The client seeks trust in human interface layer and requirements execution on workload type. The server is:

> Server = {(Distributed hardware & software, LAN/WANs), (Thin/thick clients) }.

This is the cloud to the Vijjana client. The Vijjana users are constrained by this following principle (known as the *principle of fail-safe defaults* [10]:

> "*Unless an object is given explicit access to an object, it should be denied access to that object*".

It is amusing to note that, the Vijjana users may apply default reasoning while looking for the guarantor of the aforesaid principle.

While the claim here has been to address the cloud computing architecture with intelligence using Vijjana model, it is also clear that capturing the similarity of user cognition and identifying user interest and setting up their mutual communications are prime duties of the model. Isolating, grouping and organizing Jans (knowledge units) have become a heavy task in the model. At the same time, this brings challenges to the Vijjana team. The model has provided ample scopes to test reasoning systemic with default reasoning, fuzzy reasoning, circumscription, etc. The use of Vijjana model throws more lights on to the abundance of challenges in the cloud computing world.

7. ACKNOWLEDGEMENT

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CSIIRW09

1

- Type the word SECURITY in a search engine
- An over-burdening number of many different items will appear.
- The situation becomes frustrating.

Stocks   Health   Travel   Computer Network

National/
International

SECURITY

Residential   Homeland   Supply-Chain   Food

Cyber

CSIIRW09

2

1
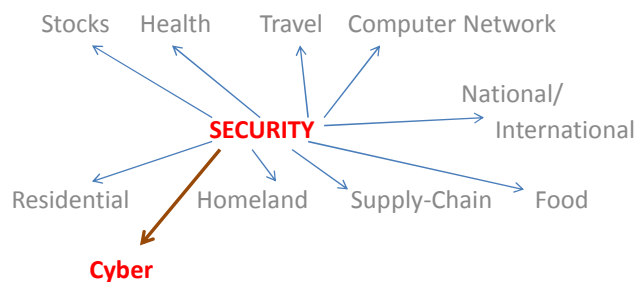
The model VIJJANA addresses that problem.

Vijjana is a Collaborative, Self-organizing, Domain Centric Knowledge Network

$$\text{Vijjana-X} = \{ J, \ T, \ R, \qquad d_A, \ o_A, \ c_A, \ v_A, \ s_A, \ r_A \ \}$$

Relation

Domain Name

Taxonomy on Knowledge

Agents

Collection of Knowledge Units

→ Discovery agent finding knowledge units
→ Knowledge interlinking agent
→ Domain consistency agent
→ Visualization agent
→ Knowledge searching agent
→ Knowledge rating agent

CSIIRW09   3

Example-radial graph display

prefuse | radialgraphview

Algorithms
Artificial_Intelligence
Artificial_Life
Bulletin_Board_Systems
CAD_and_CAM
Chats_and_For_ims
Companies
Computer_Science
Arts
Death_and_Gore
Games
Image_Galleres
News
Recreation
Regional
Shopping
Society
World
Business
Computers
Animation
Architecture
Art_History

Shopping Sports World
Science Regional
Reference
Recreation
News
Kids_and_Teens
Home
Health
Top
ogy_and_Pharmaceuticals
Business
Automotive
Associations
Arts_and_Entertainment
Agriculture_and_Forestry
Aerospace_and_Defense
Accounting
Classical_Studies
Chats_and_F
Computers
Adult
Arts

search >>

CSIIRW09   4

VIJJANA model sits as a top layer In the cloud

Platform, Service ,Storage Virtualization, Communications

Major CLOUD COMPONENTS

CSIIRW09   5

In cloud computing
•network resources are scalable and virtualized,
•peer-to-peer computing takes a profound order,
•and distributed grid computing is taking place.

Vijjana-X = {J, T, R, d_A, o_A, c_A, v_A, s_A, r_A}

CLOUD

Operating System

CSIIRW09   6

Vijjana's mechanism of reasoning in cloud:

{**Forms, Structures, Intentions**} ➔ **Implications**,

This is directly related to the CIA triad for
information assurance and accountability.
C=Confidentiality
S=Security
A=Availability

CSIIRW09   7

CONFIDEN
TIALITY

*Any breakdown in
confidentiality   will
affect **FORMS***

*Any breakdown in
integrity*

will affect
STRUCTURES

INTEGRITY

AVAIL-
ABILITY

VIJJANA
In
CLOUD

*Any breakdown in
availability will
affect*
IMPLICATIOPNS

CSIIRW09   8

Intention

Form

Structure

<Forms, Structure, Intention>➔Implications

Structure

Form

Intention

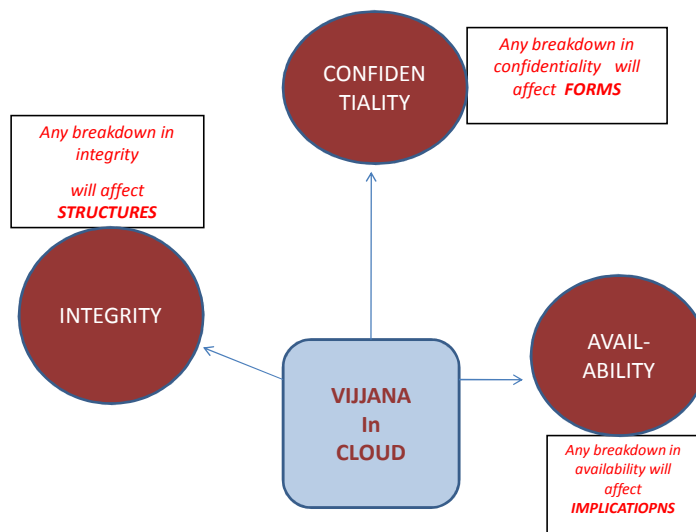The vertical axis represents degree of membership into the Implication acceptability criteria, and the horizontal axis gives a calibrated order of numbers   representing Implication. Intention and structure interchanged positions in the two diagrams.
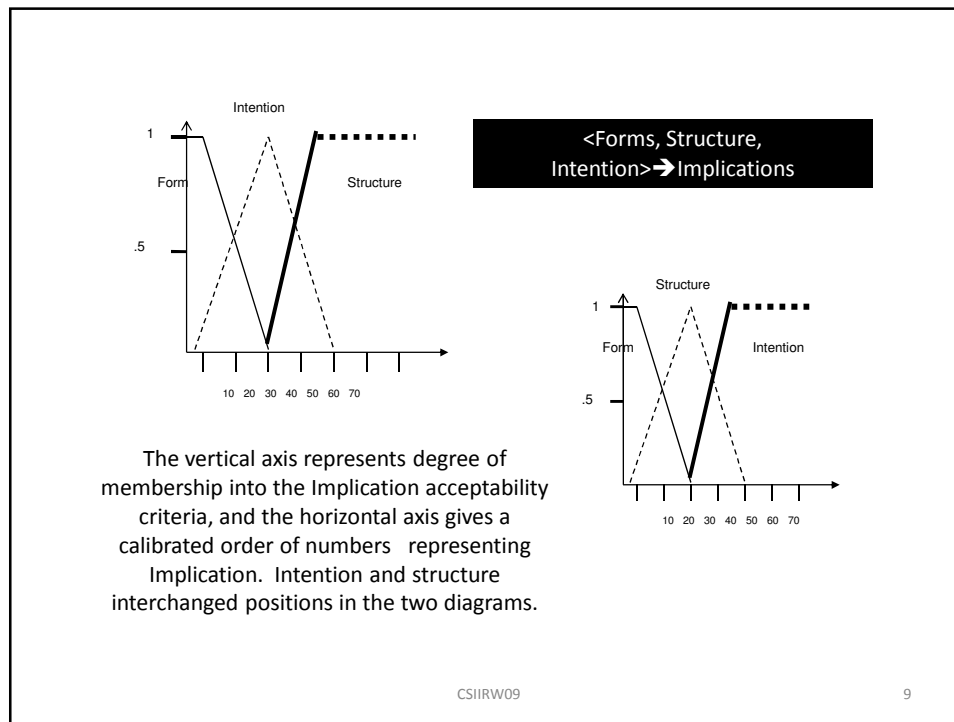
CSIIRW09

9

What is happening in the model?

•Users create their own ontology on a typical subject.

•This is a sieving mechanism.

•The user-specific ontology capture on a given subject and connecting them in a network are agent-driven engineering activities.

•In such an activity agents are capable of ranking usability (order-of-importance) factors in captured ontology.

•When different Vijjana users are dispersed all over the world, in spite of having tightly bound domain specific operations, users will be subjected to utility programming paradigms present in the cloud.

•This simply means that, while creating own ontology, Vijjana users were taking help of cloud computing.

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10

VIJJANA Client = {(User interface, query), (Response received), (user's extended intention, other LANs), Active Knowledge Nets}

Human Interface Layer

Strong **accountability on CIA triad** will be required

Knowledge Network Type

Strong accountability on **<Form, Structure, Intention>➔Implications** will be required

Knowledge Network Domain Acquired

The **Principle of Fail-Safe Defaults** must be guaranteed

CSIIRW09   11

The VIJJANA client looks at the following cloud & reasons to acquire a trusted system

Servers = {(Distributed hardware & software, LAN/WANs), (Thin/thick clients) }

Enterprise storage Servers Virtualized

Service Request Processing

Virtualization
            Transaction Servers, Database Servers, Object Servers, Web servers, Groupware servers, Grids…etc

CSIIRW09   12
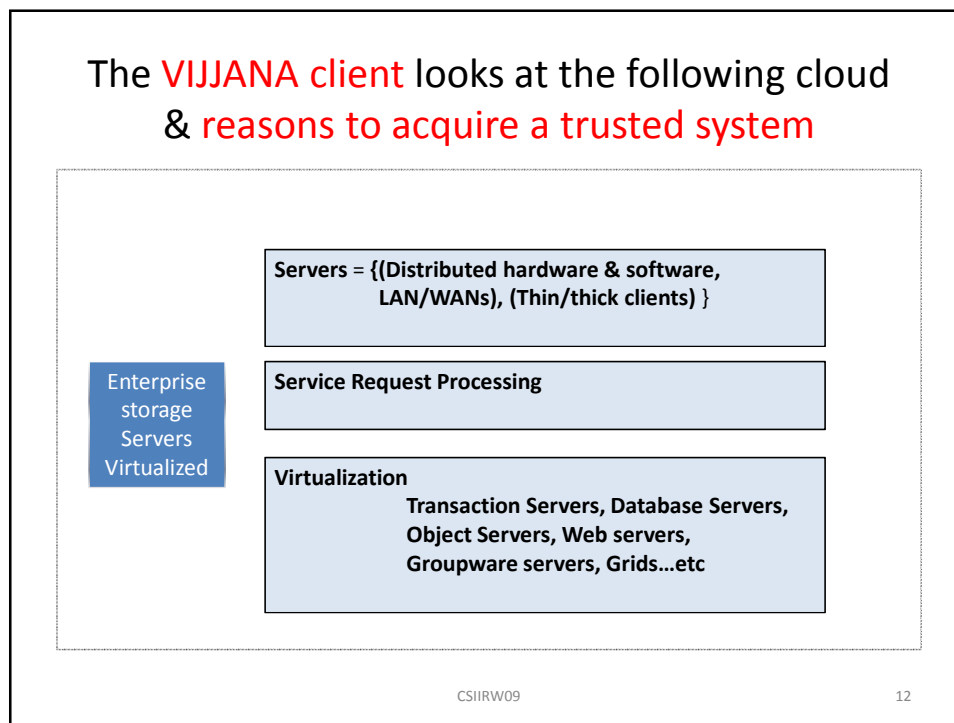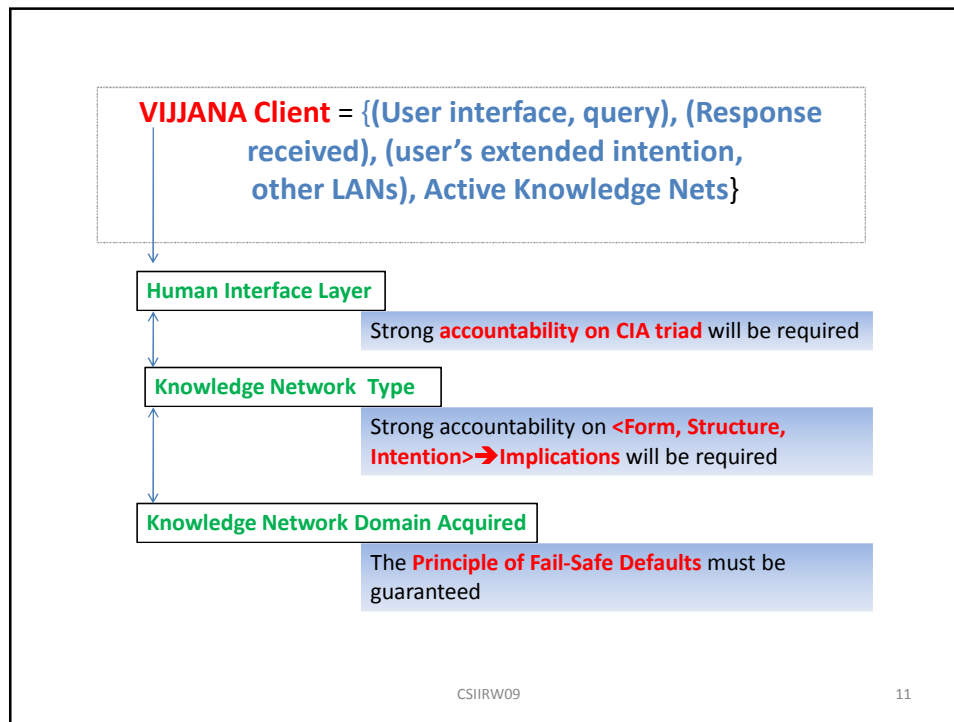
Vijjana-X = {J, T, R, d_A, o_A, c_A, v_A, s_A, r_A}

TRUSTED
CLOUD

Operating System

A *trusted system* is a system that has been shown to meet well-defined requirements under an evaluation by a credible body of experts who are certified to assign trust ratings to evaluated products and systems.

Principle of Fail-Safe Defaults:- Unless an object is given explicit access to an object, it should be denied access to that object

CSIIRW09   13

Vijjana will by-pass many unwarranted cloud computing problems including accountability problems.

Each individual domain-specific knowledge network ontology captured by each user *is- a* trusted system .

Vijjana agents ranks knowledge nets as the user wanted:
➔identifying existing criticality
➔identifying existing risks
➔assessing associated costs

CSIIRW09   14

Immediate future plans

- Models are being researched for hand-held devices [e.g., internet phones]
- Highly-integrated and tightly bound system helps in decision making reliably-how fuzzy reasoning is developing
- Software/computational services in the cloud require lesser external resources-preferential attachment on a scale free network is to be justified
- Are there possibilities of graded semantic channel zones, where the grades come from degrees of ranking in knowledge units provided by agents in the model—is it generating a cyber-secured hierarchical model systemic for semantic webs?

CSIIRW09   15

The strong preferential attachment sieving out of a a scale free network should be itself a guarantee for strong assurance throughout the lifecycle of the Vijjana system operation.

CSIIRW09   16