

Security Models for Contextual Based Global Processing an Architecture and Overview

Dr. Gregory Vert
Dr. S.S. Iyengar
Department of Computer Science
LSU

Dr. V. Phoha
Department of Computer Science
LaTech

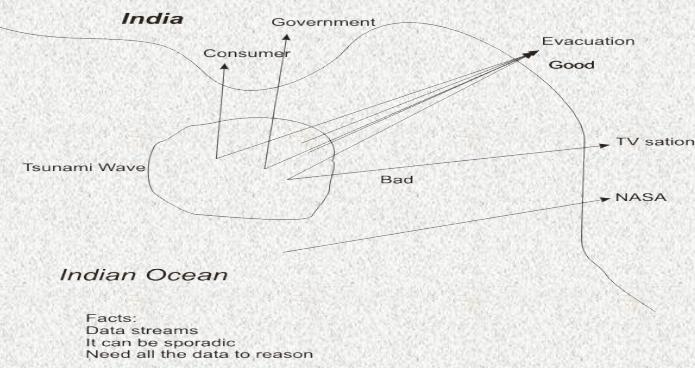
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Team

- **LSU**
 - Dr. Vert – overall model definition, architecture, integration, security (attached to CSC LaTech)
 - Dr. Iyengar – contextual data fusion
- **LaTech - *Center for Secure Cyberspace***
 - Dr. Phoha – first order logic and reasoning, “originator of initial idea” spring 2008
 - Dr. Gourd – hyper distribution of contexts
 - Dr. Kiram – first order logic

Example

- Multiple type of data collected for Tsunami needs to get to variety of consumers



Contextual Concept

- Build a new paradigm where global information:
 - can consist of any type of data ever created AND the data is interrelated for the derivation of knowledge
 - flows (continuously) to where its needed
 - crosses geopolitical boundaries seamlessly
 - has a new, advanced type of security model
 - has a semantic syntax that controls its processing based on context of collection
 - Problem: Never been done before on this *scale*

Concept Application

- Motivation
 - get data where its needed, providing a situational comprehensive view of events
 - limited computational resources – limits security processing
- Many Applications:
 - natural disasters
 - Indian ocean Tsunami
 - man made disasters
 - 911
 - abstract modeling spaces - research
 - application of theory to new areas of computer science

What Is A Context

- What is a context
 - what comprises a context
 - data, images, audio, meta data??
 - how are contexts built ?
 - similarity v ambiguity
 - how does one deal with ambiguity and failure in context collection ?
 - missing data, sporadic sampling

What Is A Context

- How does one reason about contexts and their similarities ?
 - $F_n < a_1,..a_n >$ feature vector of data of any type ever conceived
 - *definition: A context is a collection of attributes aggregated into a feature vector describing a natural or abstract event.*
- How does one store manage and retrieve context data?
 - its can be ambiguous, overlapping
 - relevance to a theme ?
 - contains any type of data ever created

What Is A Context

- Data fusion
 - Contexts are very similar to sensor networks but on a global scale
- Data aggregation of feature vectors into super contexts (via similarity analysis, FOL, Bayes, etc)
 - $S_n = (C_n, R_n, S_n)$ – rules, data and security vector
 - *definition: A super context is a collection of contexts with a feature vector describing the processing of the super context and a security vector that contains security level and other types of security information.*

Security Issues of Contexts

- Want the information to flow to where its needed over the internet
- How does one hyper distribute information globally ?
 - producers of information (event objects)
 - consumers and super consumers
 - how to get information to them
 - LaTech researcher Dr. Gourd, Dr. Kiran

Security Issues of Context

- Geopolitical security issues lead to security considerations
 - sharing
 - trust
 - authentication
 - need to know
- Probably not a *global context* due to security concerns but perhaps a *core context* can be built

Security Issues of Contexts

- Data Streams continuously from N event objects, *sources of data aggregated into a super context*
 - computationally impractical to secure
 - pretty good security idea
 - not all information needs to be secured just information related to a *theme*
- Need to *relate* event objects thematically in order to determine what to secure, the *dimensions of contexts*:
 - temporally
 - spatially
 - impact
 - similarity

Security Issues of Contexts

- Existing methods (encryption, auth.) pretty good
 - no need to reinvent the wheel
- Goal:
Find a way to suggest the level of relationship of the dimensions of a context as a way to determine security level – pretty good security concept, a level of security
 Open architected s.t. users know the suggested security level they determine how to implement it.

Branes and Their Application

- From Cosmology
 - well established mathematics
 - n dimensional surfaces
 - a mathematical surface that separates abstract spaces
 - 3p brane a 3D surface
 - an application to suggesting the level of security

Branes Have Properties

- Idea:
 - 1) reference and overlay a brane over a thematic event object surface , the T_{eo}
 - 2) project the event objects onto the brane surface
 - 3) use the intersection of the projection with the surface as a measure of relationship to the T_{eo}
 - This becomes a measure of security based on *dimensional relationship*
 - works well for temporal and spatial objects
 - probably works for abstract objects

Branes Have Properties

- Properties of a brane affect
 - how it classifies
 - its computation overhead
 - the application of a brane type based on need
- Properties
 - *Inclusivity*
 - complete[all] *full frustum*
 - partial [based on parameters of the surface] *partial frustum*
 - exclusive [point]

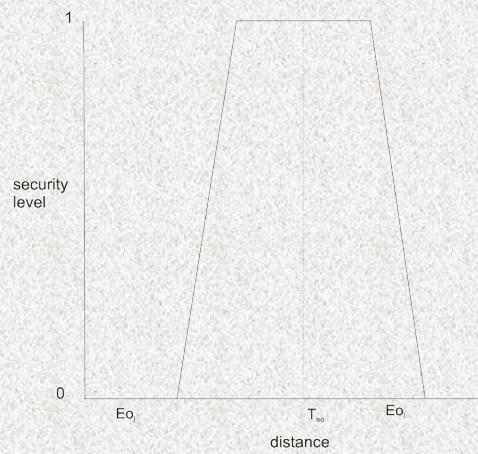
Branes Have Properties

- Properties
 - *Continuity*
 - no horizontal tangent vectors [f'] are the same
 - vertical tangent vectors point in the *same* directions
 - a super type with only one existing for any given form
 - computationally expensive
 - include more event objects
 - more objects have security levels
 - frustums in conjunction dramatically increase computational overhead

Branes Have Properties

- *Discreteness*
 - many sub types of a super type
 - tend to classify less event objects than a super type
 - lower computational overhead
 - morphs into a singular super type as n sides approaches infinity
 - can be utilized with a frustum

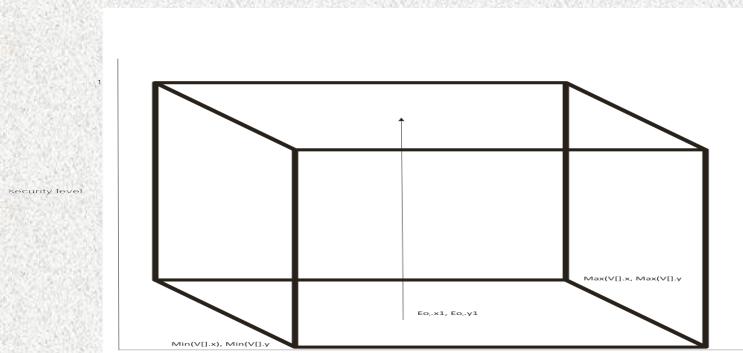
Sample Brane



Sample Branes

- **definition:** computational overhead and security level classification is directly related to the properties of a brane. Medium variable security level means classification on event objects will be a set of mixed values ranging from 0 to 1. A value of 1 means full security measures thus the highest computational overhead.

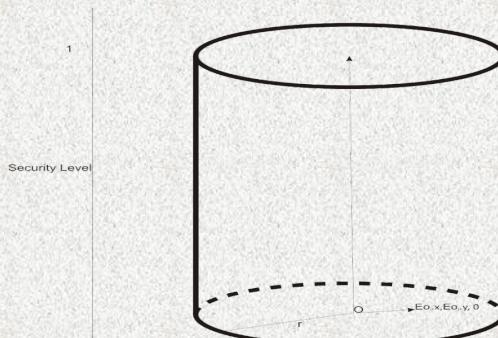
Hexahedron Brane



Hexahedron Properties

- **Inclusivity** Complete
- **Continuity** Discrete
- **Overhead Computational Medium / Variable**
- **Security Level Classification** Medium / Variable

Cylindrical Branes



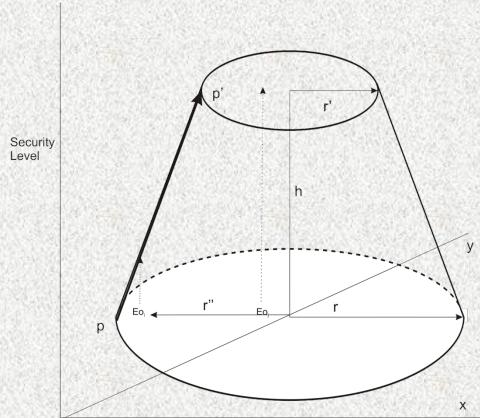
Cylindrical Brane

- **Inclusivity** Complete
- **Continuity** Continuous
- **Overhead Computational** Highest
- **Security Level Classification** Highest

Future Work Conclusions

- May have a *new paradigm* for creation of security levels based on spatial temporal relationship
- Initial conceptual work supports open architecture for implementation
- Evaluation of brane classifications properties essential to understand when to use what type
- Taxonomies of properties may be possible
- Many types of forms that need to be evaluated (2d, n d bounded, polynucleated meshes) empirically and have further properties defined relativistically

Sample of Advanced Branes Under Study - *Frustum of a Cone*, complex mathematics and classifications



Delivered and Future Deliverables

- New conceptual book on Contextually Based Processing and Security ready review app. May 30 (Vert, Iyengar, Phoha, et al)
- Oakridge National Lab Paper for the Security Workshop
- Papers in submitted WORLDCOMP 09, July Las Vegas
 - cosponsors, Argonne, MIT, Georgia Tech, Harvard, US Military Academy
- Journal paper in preparation (empirical studies)
- Springer Verlag book chapter on contextual *repository*, to publish 2009
- Presentation Center for Secure Cyberspace Advisory board meeting and Naval Research
- Visiting Faculty research at USAF Research Lab June 09

Questions

