Extending User Controlled Security Domain with the TPM/TCG in Grid based Virtual Collaborative Environment

Yuri Demchenko <demch@science.uva.nl>

(in collaboration with Leon Gommans, Cees de Laat)

System and Network Engineering Group

University of Amsterdam

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Outline

- Security and trust in Collaborative applications
  - User and Service Provider vs System and Data
- Virtual Workspace Service in Grids
- Trusted Computing Platform and Trusted Platform Module
- User Controlled Virtual Workspace (VWSS-UC) organisation
- AuthZ session management and AuthZ ticket format
- Summary and future development
- Discussion – Vision for use of TPM/TCG technology

Security and Trust in Collaborative applications and Content/Resource provisioning

Virtual Laboratory (VL) as a business Collaborative Environment

- Implementing Utility Computing paradigm
- Can a VL provider offer a trusted experiment environment from the competitor's point of view
  - Extreme usecase: *Will Pepsi Company trust to do analysis on the Coca-Cola VL facility?*
  - Common sense: *Remote System can be trusted as much as the system administrator is trusted*

Content providers (music, movie)

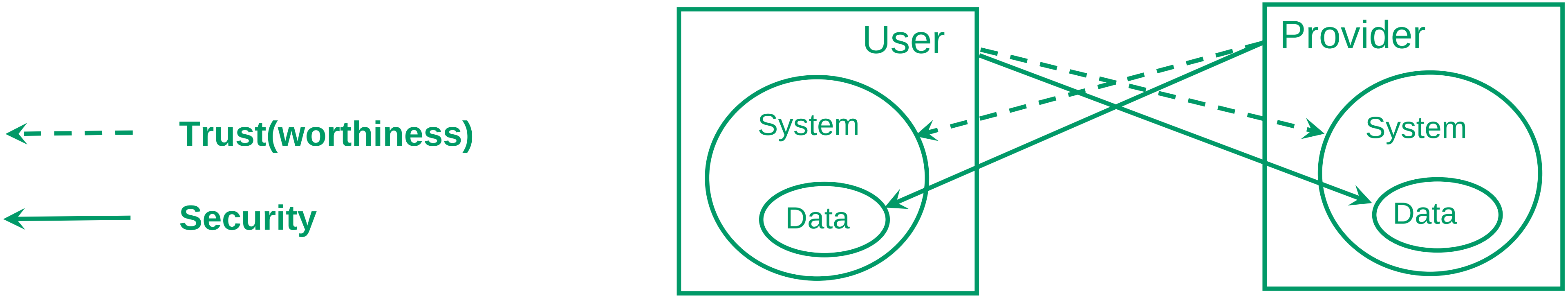
- Content played at the user PC/player should be protected from copying or useable during the service contract

Service/Resource providers (service on demand)

- Enforce use of on-demand provided resource and Policy Obligations

Different sides of the Security and Trust

- Modern paradigm of remote distributed services and digital content providing makes security and trust relations between User and Provider more complex
- User and Service Provider – two actors concerned with own Data/Content security and each other System/Platform trustworthiness
- Two other aspects of security/trust
  - Data stored vs Data accessed/processed
  - System Idle vs Active (running User session)
- Think about real life analogy: *Diplomatic/President’s visit*



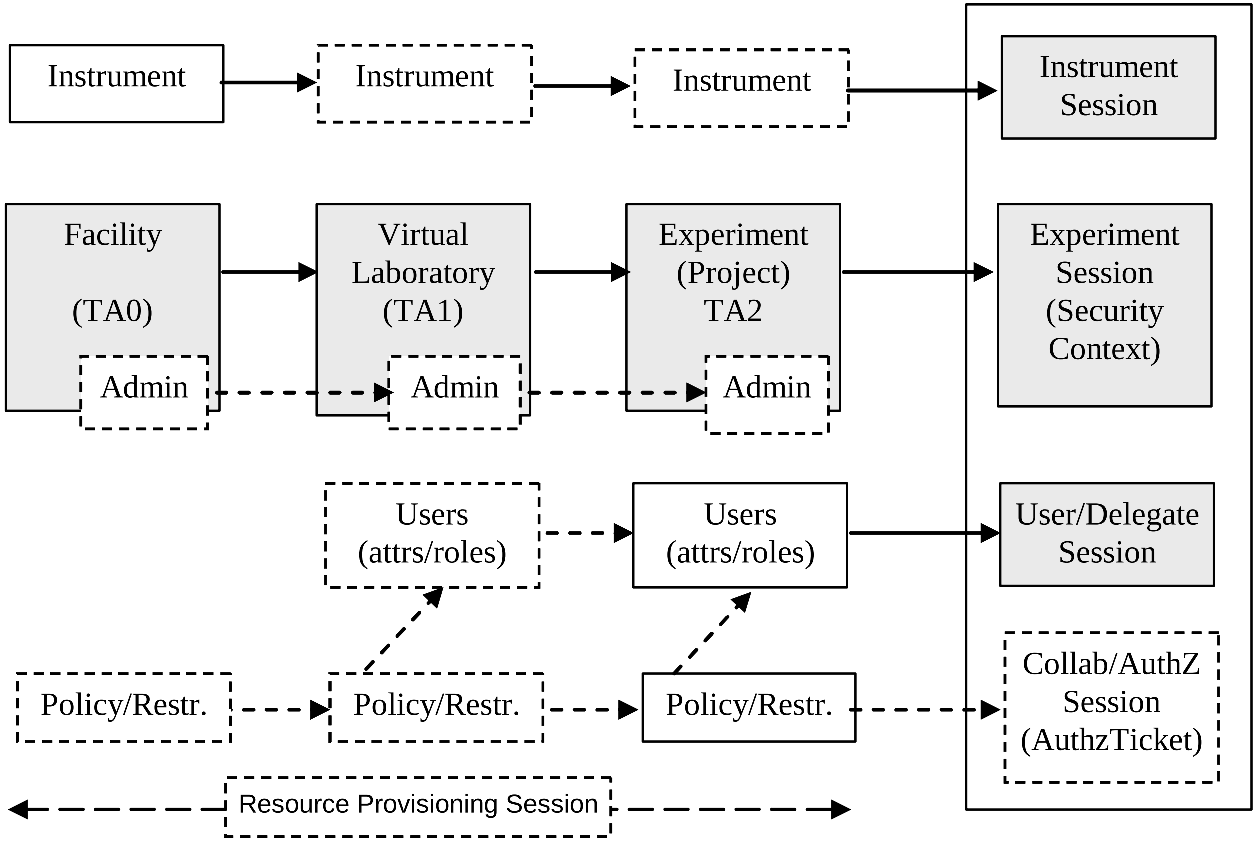
← - - - **Trust(worthiness)**

← **Security**

Background research and target projects

- Distributed Authorisation infrastructure for Grid based Collaborative applications
  - GAAA-AuthZ Architecture and implementation (Collaboratory.nl, VL-e)
    - AuthZ session/ticket for AuthZ service performance optimisation (@ CTS2006)
    - Domain based hierarchical resource management (GAAA-DM)
- Distributed multidomain Authorisation service for network on-demand services and OLPP
  - EU Project PHOSPHORUS and NL national project RoN GP-NG
    - Extended AuthZ session context and trust management in multidomain scenario
- Open Grid Forum (OGF) Grid and Virtualisation WG (https://forge.fridforum.org/sf/projects/gridvirt-wg)
  - Security model for virtualised Grid applications

Domain based Resource management in GCE



Implements RBAC3 model + Experiment AuthZ session management

Uses XACML RBAC profile and XACML v3.0 administrative policy profile

Full Resource URI/ID –

CNL:Facility:VirtualLab:Experiment:InstrModel

Full User Session context –

Facility < Virtual Lab < Experiment < Experiment Session < Collaborative Session

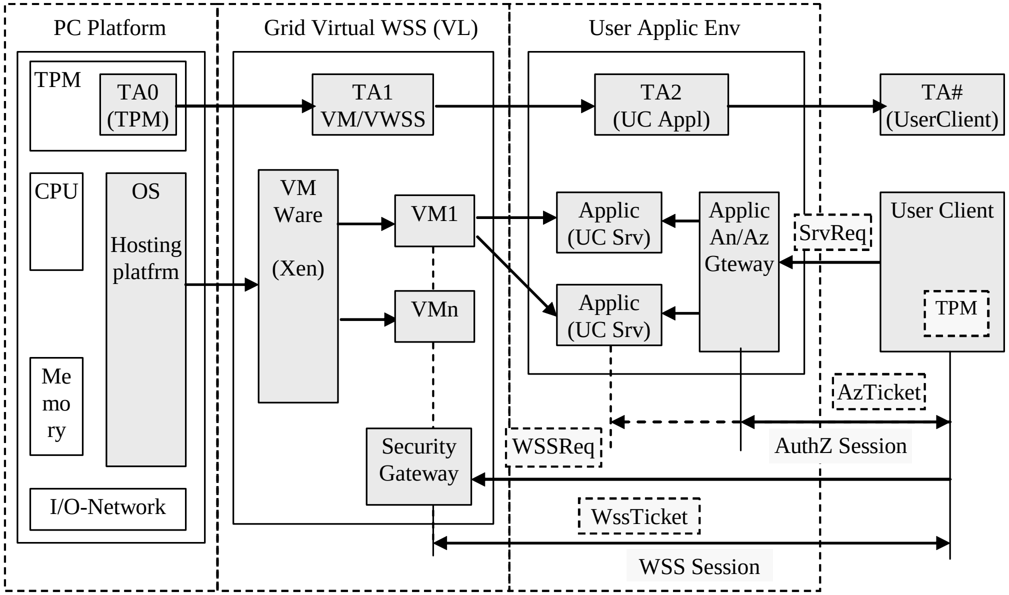
GCE/VL Security infrastructure requirements

- Dynamically create user/application workspaces (together with related security services)
- Dynamically create user accounts and handle different/multiple user identities and credentials
- (Securely) associate multiple administrative and trust domains (e.g., by means of the Virtual Organisation (VO) or other Identity federation forms)
- Negotiate and handle multiple security and access control policies (for both resource provisioning and access stages)
- Manage session based user and application security context
- Allow for user rights/roles delegation, including delegated hierarchical policies administration
- Allow for binding the whole chain of trust in dynamic collaborative sessions to the VL facilities/platform root of trust or to User credentials

Trusted Collaborative Environment components

- Trusted Computing Platform
- Virtual Workspace Service (VWSS)
- Application/Resource (dynamic) access control service

- 3 layer User Controlled VWSS (VWSS-UC)



Globus Toolkit Virtual Workspace Service (VWSS)

- Configurable execution environment for running Grid services deployed dynamically - http://workspace.globus.org/index.html
  - ◆ Comprises of the Workspace Factory Service (WFS) and the Workspace service
  - ◆ Built as VM/Xen-based virtual environment
- Current security model provides only WFS access control using basic GT4-AuthZ service
  - ◆ Can use also (trusted) secure storage for user pre-configured VM images
  - ◆ Relies on the Grid service provider trust

TCG Trusted Computing Platform

Promoted by the Trusted Computing Group (TCG)

- Basis for building and managing controlled secure environment for running applications and processing (protected) content
  - https://www.trustedcomputinggroup.org/home
- Standards for trusted network, client, server and mobile agent
- TMP software stack (TSS) defines API's for remote access, Identity Mngnt, PKI, Secure e-mail, file/folder encryption, etc.

TCG components

- **Trusted Platform Module (TPM)**
- "Curtained memory" in the CPU
- Security kernel in the OS and security kernel in each application
- Back-end infrastructure of online security servers maintained by hardware and software vendors

Trusted Network Connect (TNC) – to enforce security policies before and after endpoints or clients connect to multi-vendor environment

Trusted Platform Module (TPM)

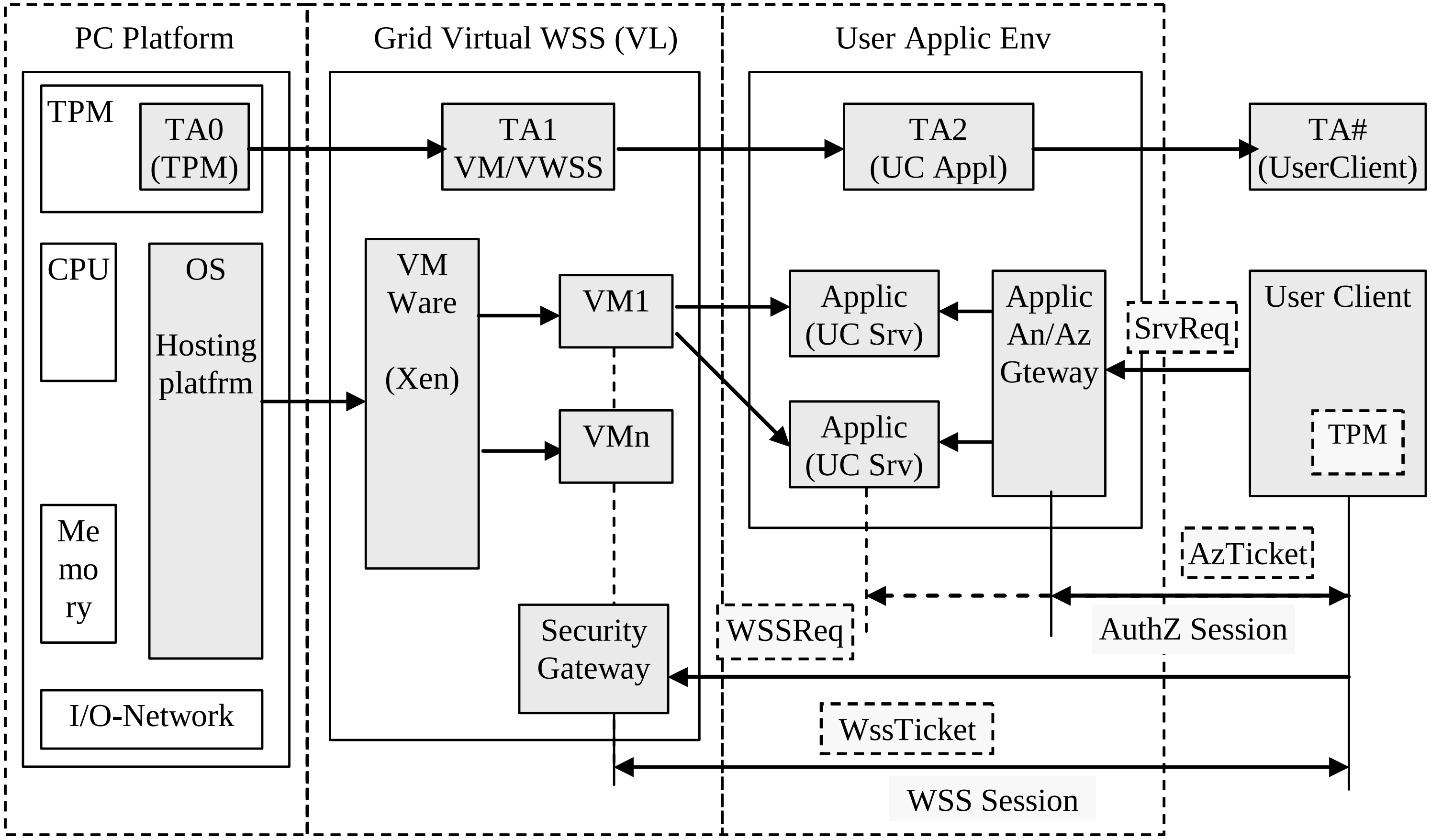
Chip built-in into the computer system or a smartcard chip

- Can be considered as a platform tied “root-of-trust” and used for trusted platform registration and integrity assurance

Provides a number of hardware-based cryptographic functions

- **Asymmetric key functions** for on-chip key pair generation using hardware random key generation; private key signatures; public key encryption and private key decryption
- An **Endorsement key** that can be used by a platform owner to establish that identity keys were generated in a TPM, without disclosing its identity
- **Direct Anonymous Attestation (DAA)** that securely communicates information about the static or dynamic platform configuration, which is internally stored in TPM in the form of hashed values (based on Zero-knowledge cryptography)
- Monotonic counter and the tick counter to enable **transaction timing and sequencing**
- Protection of communication between two TPM’s
- Secure key/data backup to another TPM

User-controlled Virtual Workspace Service (VWSS-UC) – 3 layer model



- Trust Anchors: T0 (TPM) – TA1 (VM/VWSS) – TA2 (Application) – TA# (User)
- WVSS session and Application AuthZ sessions

VWSS-UC – Implementation Suggestions

TPM Enabled computer platform

- http://www.tonymcfadden.net/tpmvendors.html

Growing number of TCG/TPM oriented projects to develop TMP oriented firmware and middleware

- Daonity (HP), OpenTC (EU), number of nationally funded projects in Germany, Czech Republic, associated research in EGEE and UvA

Xen v3.0 has already so-called Virtual TPM module

- http://www.cl.cam.ac.uk/Research/SRG/netos/xen/readmes/user

Grid Virtual Workspace Service (VWSS) – GT4 candidate component

- http://workspace.globus.org/

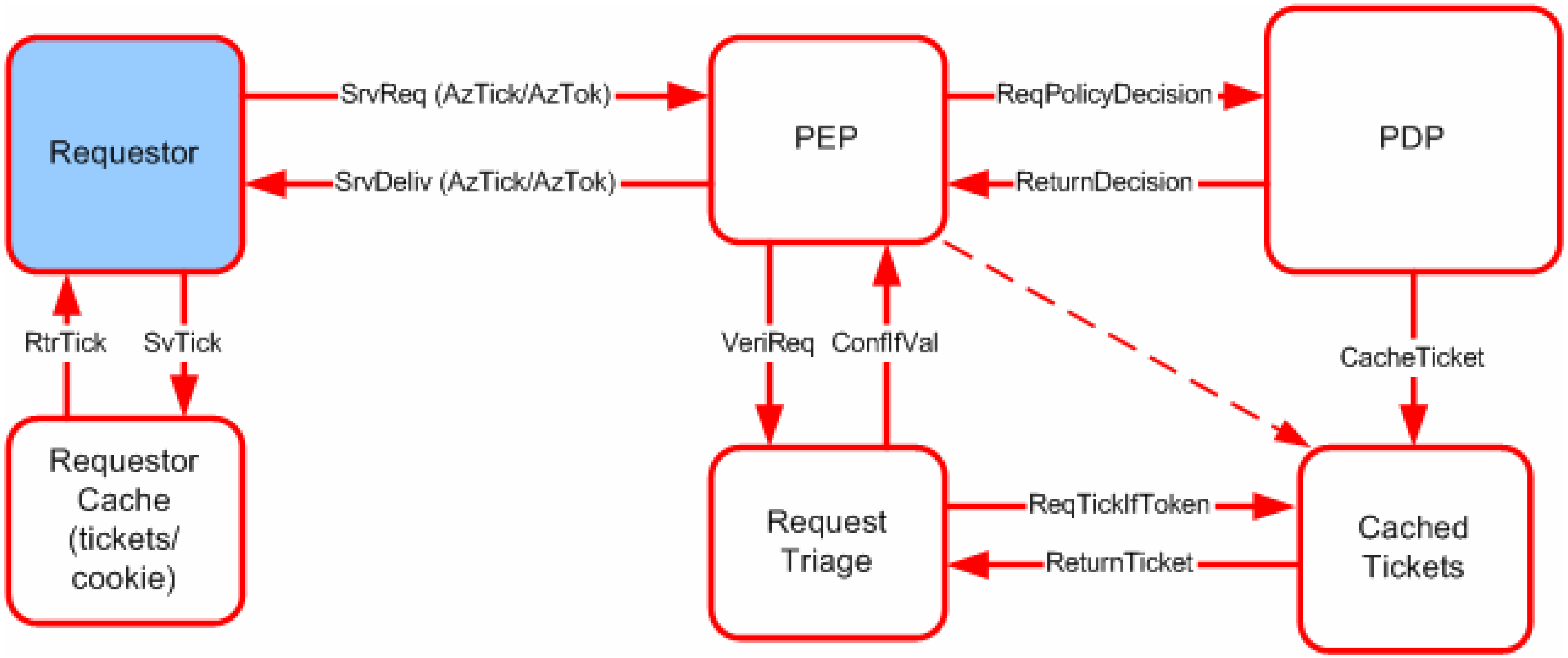
GAAA-AuthZ Authorisation session management supported by GAAAPI

- Proprietary and SAML based AuthZ ticket formats

AuthZ Session management in GAAA-AuthZ

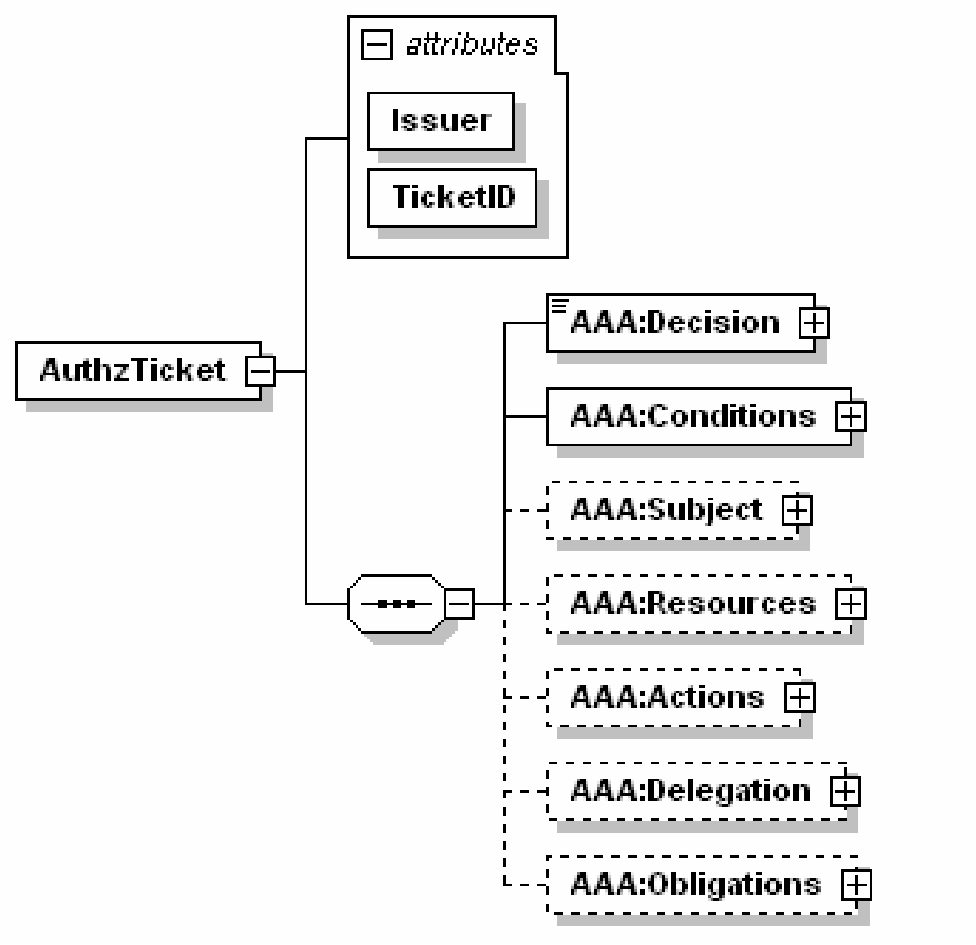
- AuthZ session is a part of the generic AAA-AuthZ functionality
- Session can be started only by an authorised Subject/Role
  - Session can be joined by other less privileged users
  - Session permissions/credentials can be delegated to (subordinate) subjects
- Session context includes Request/Decision information and may include any other environment or process data/information
  - AuthZ Session context is communicated in a form of extended AuthZ Assertion or AuthZ ticket
  - SessionID is included into AuthzTicket together with other AuthZ Ctx information
  - Signed AuthzTicket is cached by PEP (Policy Enforcement Point) or PDP (Policy Decision Point)
- If session is terminated, cached AuthzTicket is deleted
  - Note: AuthzTicket revocation should be done globally for the AuthZ trust domain

AuthZ session Tickets/Tokens handling in AuthZ system



- AuthzTicket is issued by PDP and may be issued by PEP
- AuthzTicket must be signed
- AuthzTicket contains all necessary information to make local PEP-Triage Request verification
- When using AuthzTokens, AuthzTickets must be cached; Resolution mechanism from token to ticket must be provided

AuthZ ticket/assertion for extended security context management – Data model (1) - Top elements



Required functionality to support multidomain provisioning scenarios

- Allows easy mapping to SAML and XACML related elements

Allows multiple Attributes format (semantics, namespaces)

Establish and maintain Trust relations between domains

- Including Delegation

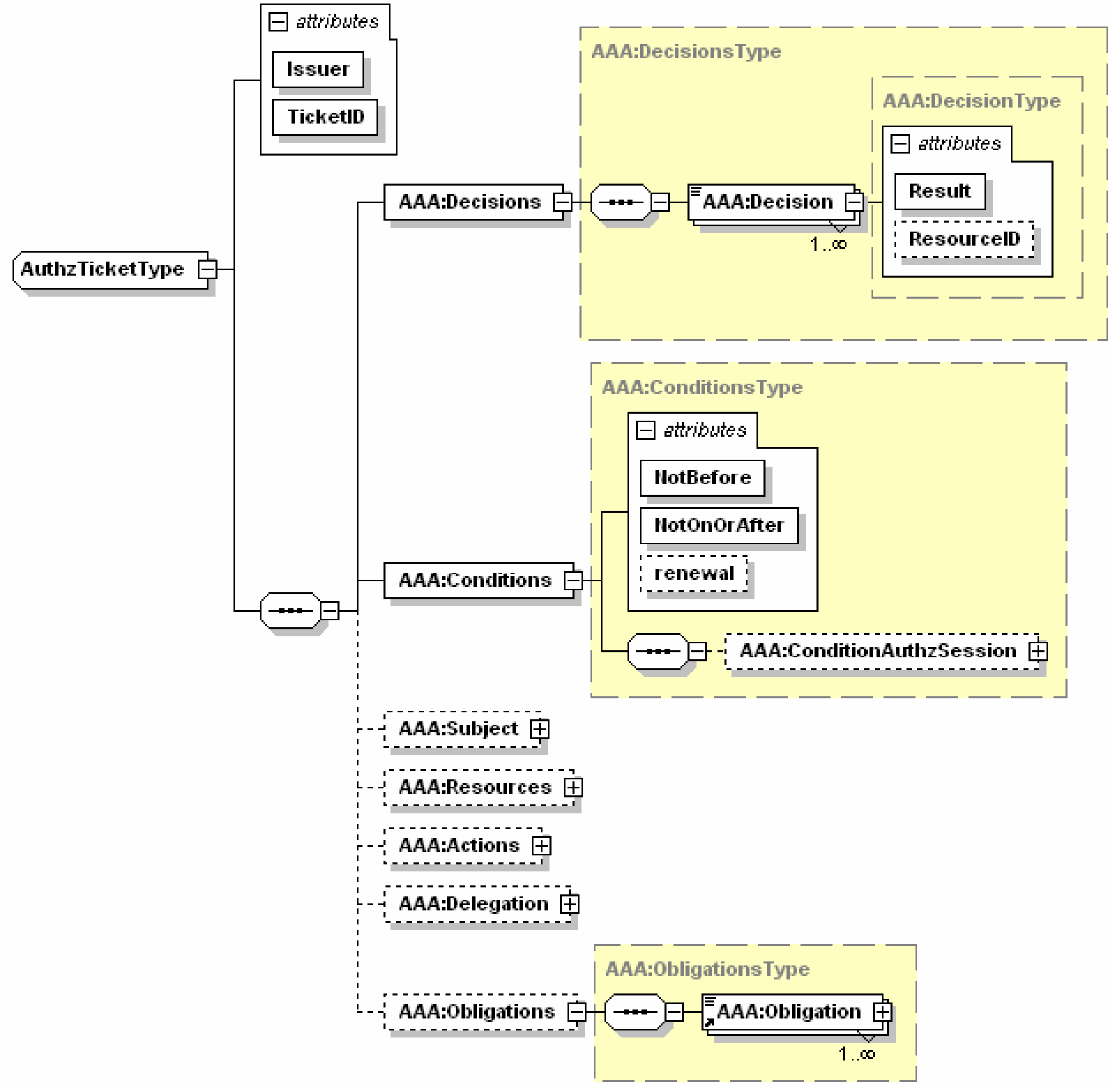
Ensure Integrity of the AuthZ decision

- Keeps AuthN/AuthZ context
- Allow Obligated Decisions (e.g. XACML)

Confidentiality

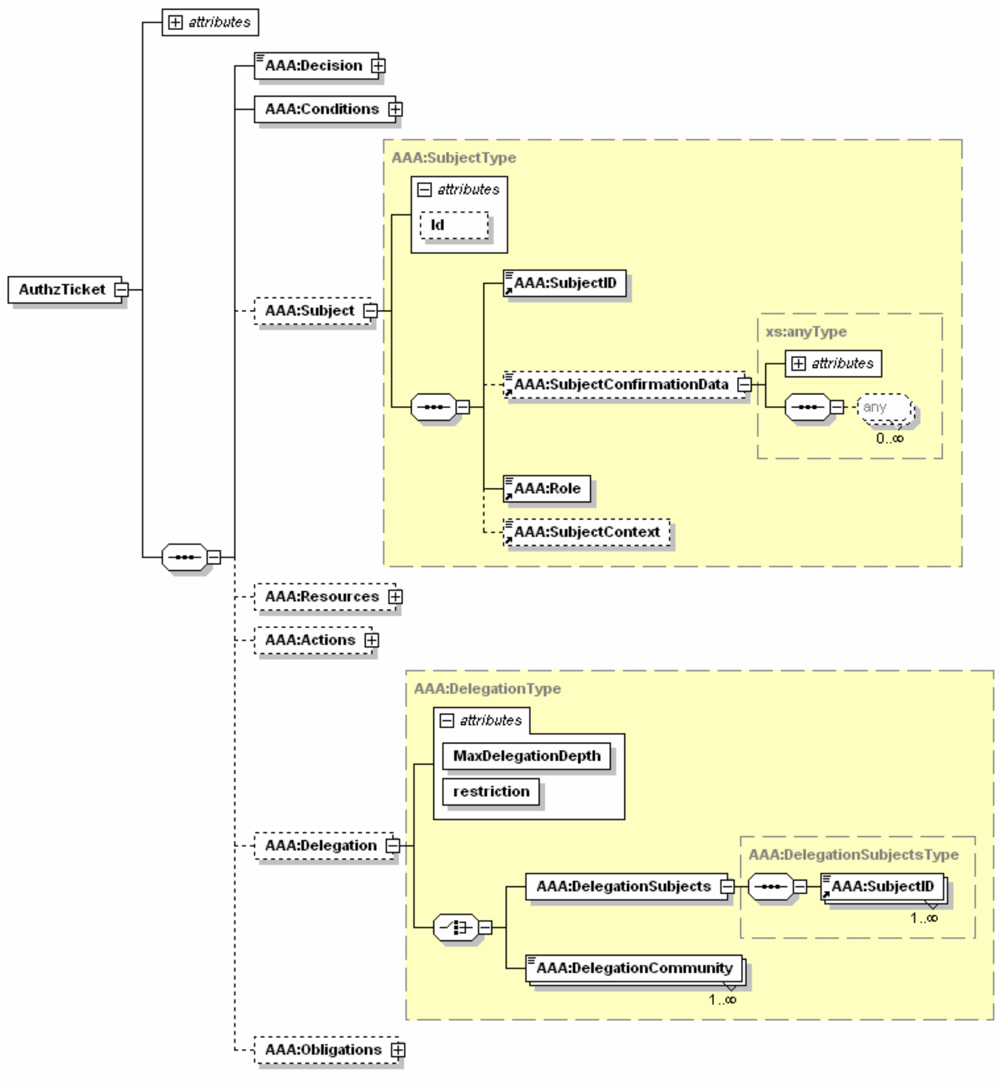
- Creates a basis for user-controlled Secure session

AuthZ ticket Data model (2) - Mandatory elements



- TicketID attribute
- Decisions element and ResourceID attribute
- Conditions Element and validity attributes
- Extensible element ConditionAuthzSession
  - Any AuthZ session related data

AuthZ ticket Data model (3) – Subject and Delegation elements



- Subject element to keep AuthN security context and Subject Attributes
- Delegation element to allow permissions/AuthZ decision delegation to other Subjects or groups/community

AuthZ ticket main elements

<Decision> element - holds the PDP AuthZ decision bound to the requested resource or service expressed as the ResourceID attribute.

<Conditions> element - specifies the validity constrains for the ticket, including validity time and AuthZ session identification and additionally context

- <ConditionAuthzSession> (extendable) - holds AuthZ session context

<Subject> complex element - contains all information related to the authenticated Subject who obtained permission to do the actions

- <Role> - holds subject’s capbilities
- <SubjectConfirmationData> - typically holds AuthN context
- <SubjectContext> (extendable) - provides additional security or session related information, e.g. Subject’s VO, project, or federation.

<Resources>/<Resource> - contains resources list, access to which is granted by the ticket

<Actions>/<Action> complex element - contains actions which are permitted for the Subject or its delegates

<Delegation> element – defines who the permission and/or capability are delegated to: another DelegationSubjects or DelegationCommunity

- attributes define restriction on type and depth of delegation

<Obligations>/<Obligation> element - holds obligations that PEP/Resource should perform in conjunction with the current PDP decision.

AuthZ ticket format (proprietary) for extended security context management – 3-10KB

```
<AAA:AuthzTicket xmlns:AAA="http://www.aaauthreach.org/ns/#AAA" Issuer="urn:cnl:trust:tickauth:pep"
    TicketID="cba06d1a9df148cf4200ef8f3e4fd2b3">
  <AAA:Decision ResourceID="http://resources.collaboratory.nl/Philips_XPS1">Permit</AAA:Decision>
    <!-- SAML mapping: <AuthorizationDecisionStatement Decision="*" Resource="*"> -->
  <AAA:Actions>
    <AAA:Action>cnl:actions:CtrlInstr</AAA:Action>     <!-- SAML mapping: <Action> -->
    <AAA:Action>cnl:actions:CtrlExper</AAA:Action>
  </AAA:Actions>
  <AAA:Subject Id="subject">
    <AAA:SubjectID>WHO740@users.collaboratory.nl</AAA:SubjectID>    <!-- SAML mapping: <Subject>/<NameIdentifier> -->
    <AAA:SubjectConfirmationData>IGhA11vwa8YQomTgB9Ege9JRNnld84AggaDkOb5WW4U=</AAA:SubjectConfirmationData>
    <!-- SAML mapping:  EXTENDED <SubjectConfirmationData/> -->
    <AAA:Role>analyst</AAA:Role>
    <!-- SAML mapping:  <Evidence>/<Assertion>/<AttributeStatement>/<Assertion>/<Attribute>/<AttributeValue> -->
    <AAA:SubjectContext>CNL2-XPS1-2005-02-02</AAA:SubjectContext>
    <!-- SAML mapping: <Evidence>/<Assertion>/<AttributeStatement>/<Assertion>/<Attribute>/<AttributeValue> -->
  </AAA:Subject>
  <AAA:Delegation MaxDelegationDepth="3" restriction="subjects">
    <!-- SAML mapping:  LIMITED <AudienceRestrictionCondition> (SAML1.1), or <ProxyRestriction>/<Audience> (SAML2.0)  -->
    <AAA:DelegationSubjects> <AAA:SubjectID>team-member-2</AAA:SubjectID> </AAA:DelegationSubjects>
  </AAA:Delegation>
  <AAA:Conditions NotBefore="2006-06-08T12:59:29.912Z" NotOnOrAfter="2006-06-09T12:59:29.912Z" renewal="no">
    <!-- SAML mapping: <Conditions NotBefore="*" NotOnOrAfter="*"> -->
    <AAA:ConditionAuthzSession PolicyRef="PolicyRef-GAAA-RBAC-test001" SessionID="JobXPS1-2006-001">
    <!-- SAML mapping: EXTENDED <SAMLConditionAuthzSession PolicyRef="*" SessionID="*"> -->
      <AAA:SessionData>put-session-data-Ctx-here</AAA:SessionData>  <!-- SAML EXTENDED: <SessionData/> -->
    </AAA:ConditionAuthzSession>
  </AAA:Conditions>
  <AAA:Obligations>
    <AAA:Obligation>put-policy-obligation(2)-here</AAA:Obligation>  <!-- SAML EXTENDED: <Advice>/<PolicyObligation> -->
    <AAA:Obligation>put-policy-obligation(1)-here</AAA:Obligation>
  </AAA:Obligations>
</AAA:AuthzTicket>
<ds:Signature> <ds:SignedInfo/> <ds:SignatureValue>e4E27kNwEXoVdnXIBpGVjpaBGVY71Nypos...</ds:SignatureValue></ds:Signature>
```

AuthzToken example – 293 bytes

```
<AAA:AuthzToken TokenID="c24d2c7dba476041b7853e63689193ad">
<AAA:TokenValue>
0IZt9WsJT6an+tIxhhTPtiztDpZ+iynx7K7X2Cxd2iBwCUTQ0n61Szv81DKllWsq75IsHfusnm56
zT3fhKU1zEUsob7p6oMLM7hb42+vjfvNeJu2roknhIDzruMrr6hMDsIfaotURepu7QCT0sADm9If
X89Et55EkSE9oE9qBD8=
</AAA:TokenValue>
</AAA:AuthzToken>
```

AuthzToken is constructed of the AuthzTicket TicketID and SignatureValue

AuthzToken use suggests caching AuthzTicket's

AuthzToken can be used as cookie in Web/portal based applications

Conclusion and Future developments

- TCG Trusted Computing platform allows for further extension of the user/provider controlled/trusted security domain
- Virtualised Workspace and dynamically provisioned resources can use TP security anchor(s) to provide User-Resource end-to-end trust
  - Proposed AuthZ session model and AuthZ ticket format are aimed for this

- More formal definition of the proposed model is needed
  - Contribute to the OGF Virtualisation WG use cases and security model
  - Propose AuthZ session management framework to OGSA-AUTHZ
- *Dynamic Trust management in multidomain Complex Resource Provisioning (CRP) for TPM enabled resources*
- *Implementation:* Add TPM support to GT4-VWSS and AuthZ support to Grid oriented AuthZ frameworks EGEE gJAF and GT4-AuthZ

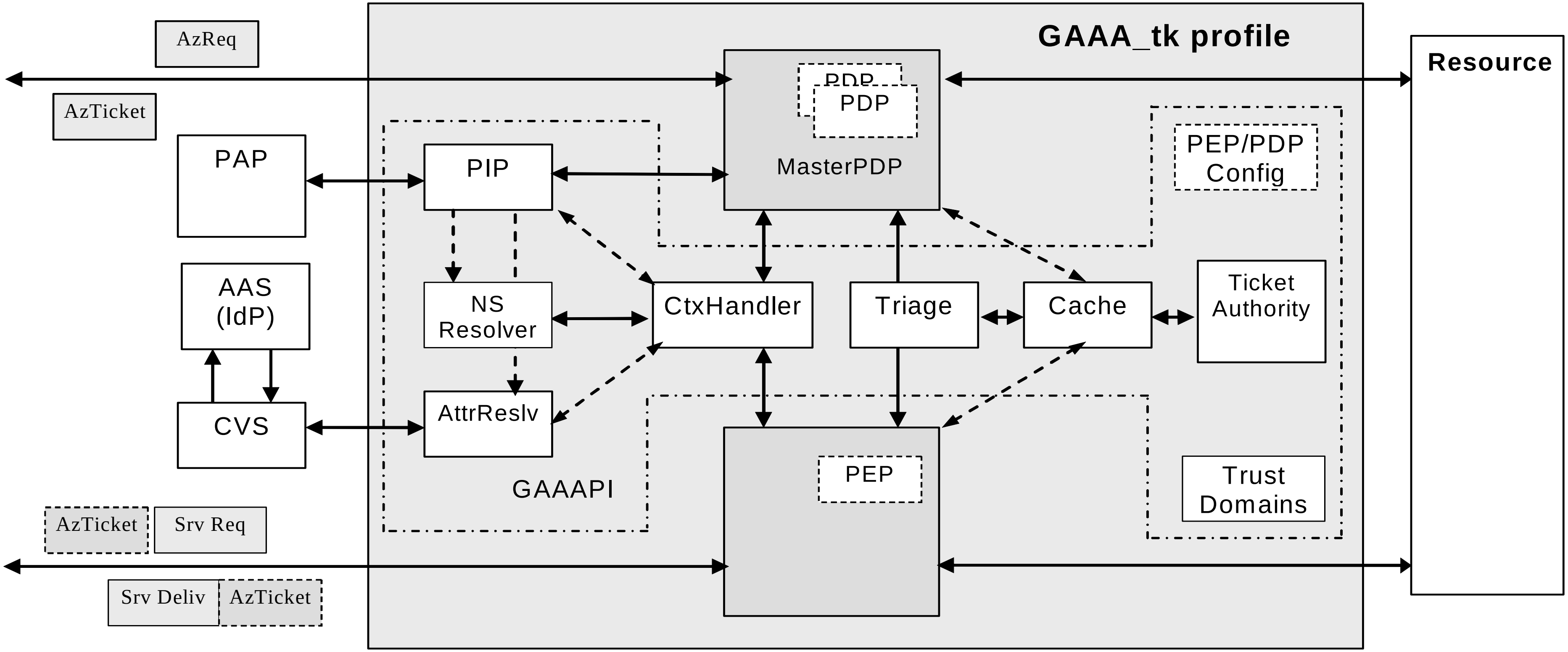
Discussion

Vision for wider use of TPM/TCG technology in Collaborative applications?

Additional information

- AuthZ service components in GAAA-AuthZ and gJAF/GT4-AuthZ

GAAA-AuthZ/GAAAPI components to support dynamic security context management (1)

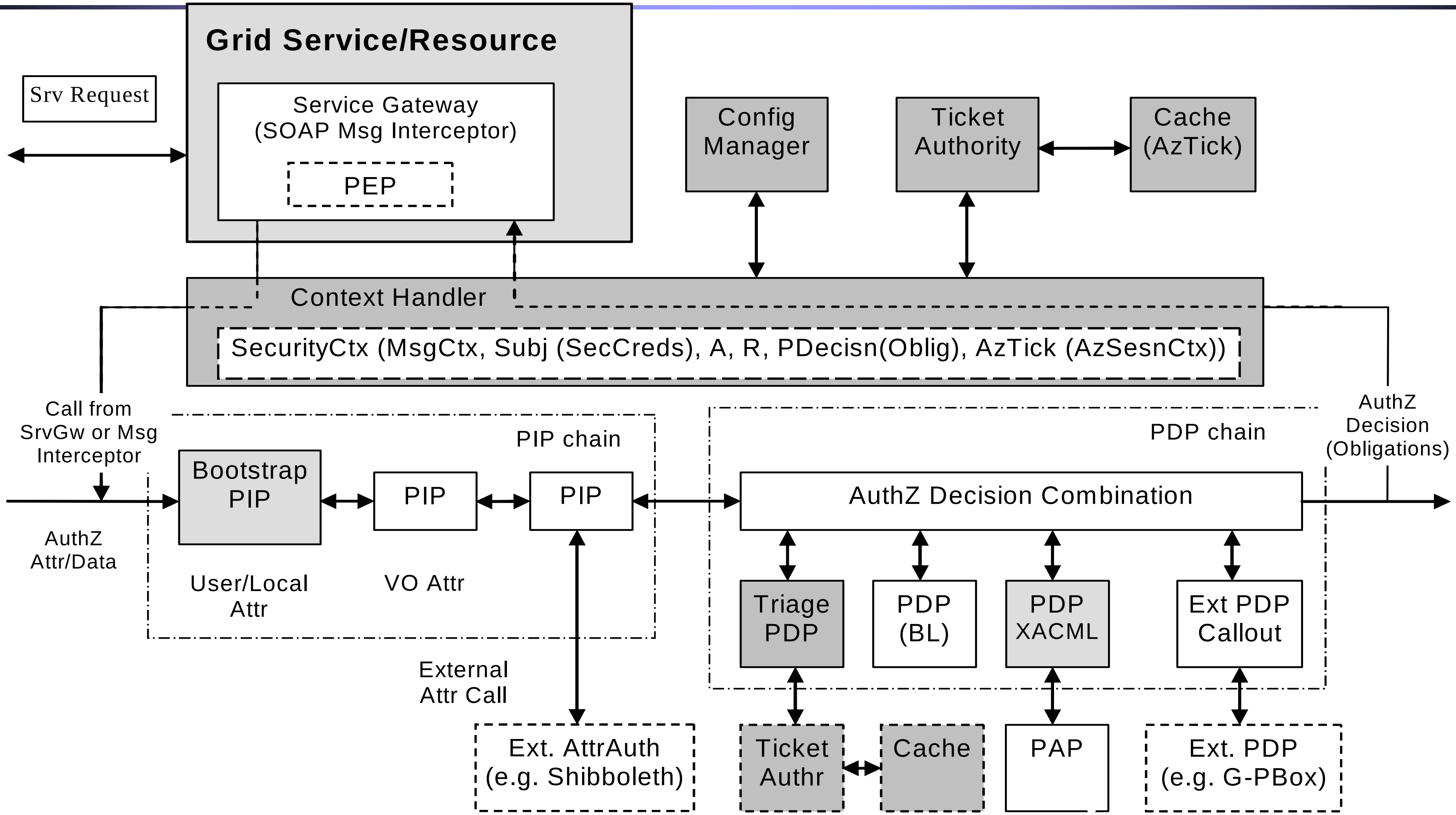


- GAAAPI is a collection of components to support PEP and PDP interaction, implemented in Java
- Needs Trust Anchor configuration in a distributed multidomain infrastructure

GAAAPI components to support dynamic security context management (2)

- Context Handler (CtxHandler) that calls to a namespace resolver (NS Resolver) and attribute resolver (AttrResolver), which in its own can call to external CVS or Attribute Authority Service (AAS) *to validate* presented attributes or obtain new ones
- Triage and Cache to provide an initial evaluation of the request, including the validity of the provided credentials
    - Used for handling AuthZ tickets/tokens, and also for AuthZ session management by evaluating service requests versus the provided AuthZ ticket/token claims
- Ticket Authority (TickAuth) generates and validates AuthZ tickets or tokens on the requests from PEP or PDP
    - to support AuthZ session, tickets are cached by TickAuth directly or by PEP/PDP
- Policy Information Point (PIP) that provides resolution and call-outs to related authoritative Policy Authority Points (PAP)

gJAF – Proposed Extensions for AuthZ Session Management


Grid Service/Resource
Srv Request
Service Gateway
(SOAP Msg Interceptor)
PEP
Config
Manager
Ticket
Authority
Cache
(AzTick)
Context Handler
SecurityCtx (MsgCtx, Subj (SecCreds), A, R, PDecisn(Oblig), AzTick (AzSesnCtx))
Call from
SrvGw or Msg
Interceptor
PIP chain
PDP chain
AuthZ
Decision
(Obligations)
Bootstrap
PIP
PIP
PIP
AuthZ Decision Combination
AuthZ
Attr/Data
User/Local
Attr
VO Attr
Triage
PDP
PDP
(BL)
PDP
XACML
Ext PDP
Callout
External
Attr Call
Ext. AttrAuth
(e.g. Shibboleth)
Ticket
Authr
Cache
PAP
Ext. PDP
(e.g. G-PBox)