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 Requirements for Message Access Control

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Abstract

 S/MIME has a proven track record in delivering confidentiality, integrity,

 and data origination authentication for email. However, there are many

 situations where organizations also want robust access control applied to

 information in messages. The Enhanced Security Services (ESS) RFC5035

 for S/MIME defines an access control mechanism for email, but the

 access check happens after the data is decrypted by the recipient

 which devalues the protection afforded by the cryptography and

 provides very weak guarantees of policy compliance. Another major

 issue for S/MIME is its dependency on a single type of identity

 credential, an X.509 certificate. Many users on the Internet today do

 not have X.509 certificates and therefore cannot use S/MIME.

 Furthermore, the requirement to discover the X.509 certificate for

 every recipient of an encrypted message by the sender has proven to be

 an unreliable process for a number of reasons.

 This document presents requirements for an alternative model to ESS to

 address the identified issues with access control in order to deliver more

 robust compliance for S/MIME protected messages. This document

 describes an access control model which uses cryptographic keys to

 enforce access control policy decisions where the policy check is

 performed prior to the decryption of the message contents. The model

 also abstracts the specifics of the authentication technology thereby

 removing the dependency on X.509 certificates, making it possible for

 other forms of credential to be used for S/MIME thereby enabling much broader

 adoption. This model can be instantiated in many areas using existing

 standards, or with only minor updates to existing standards. This

 model in not intended to be a one-off just for email and can also be

 applied to other data types. The model also removes the dependency on

 the need to discover encryption certificates at send time.

 The name Plasma was assigned to this effort as part of the IETF

 process. It is derived from PoLicy enhAnced Secure eMAil.

Status of this Memo

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Keywords

 The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",

 "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this

 document are to be interpreted as described in RFC 2119.

1 Policy Based Management Vocabulary

 This document uses the established terminology for policy based

 management [RFC3198] where applicable. The following list supplements

 the terms defined in [RFC3198] as well as defining some new

 combinations of terms used in [RFC3198].

 Attribute Based Where the access control policy is specified

 Access Control by a set of attributes, their values, and any

 (ABAC) relationship between attributes required to

 authorize an action on a resource. These

 attributes may be provided by the subject as part

 of the decision request (Front End Attribute

 Exchange) or discovered by the policy decision

 service itself (Back End Attribute Exchange). The

 policy, for example, may require attributes about

 the subject, their device or environment, a

 resource, or the intended use of the information.

 Back End Attribute When subject attributes are directly sent from

 Exchange (BAE) the Policy Information Point (PIP) to the Policy

 Decision and Enforcement Point (PDEP), i.e., they

 are not relayed via the Decision Requestor (DR).

 Capability Based Where access control is via a communicable,

 Access Control unforgeable token. A capability token is a

 (CBAC) protected object which, by virtue of its

 possession by a subject, grants that subject the

 capability.

 Decision Requester The service responsible for making policy

 (DR) decision requests to the PDEP. In this model the

 policy decision is enforced by the PDEP through its

 control of cryptographic keys. The DR enforces any

 obligations the PDEP may require such as signing

 or encryption of the data, generating audit events

 etc. A DR is distinct from a PEP in other models

 such as XACML in that a DR is not by default

 trusted with the clear text data. Policy

 enforcement is performed by the PDEP. A DR may

 establish trust by presentation of attributes

 about itself and its environment to show it is

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 trustworthy.

 Front End Attribute When subject attributes are relayed by the DR

 Exchange (FEE) from the PIP to the PDEP, i.e., they are not sent

 directly.

 Level of Assurance A quality grade assigned following the completion

 (LoA) of a security evaluation. For example, it can be

 used for an Identity where it provides the quality

 of the identity of a subject. It can also be used

 to represent the quality of a products or services

 Common criteria evaluation.

 Metadata Metadata is data about data. There are three kinds

 of metadata:

 (1) Content metadata is metadata about an instance

 of data, the actual data content. An example of

 content metadata would be "this data contains

 Company Foo intellectual Property" or "this is a

 patient record".

 (2) Policy metadata is metadata about the policies

 to apply to an instance of data. An example of

 policy metadata would be "apply Company Foo XYZ

 policy".

 (3) Structural metadata is metadata about the

 design and specification of the data. An example

 of structural metadata would be "this is a patient

 record table".

 Orthonym The correct or legal name of a place, person, or

 thing. (See Pseudonym.)

 Policy The system entity that creates, maintains, and

 Administration publishes policies or policy collections. The

 Point (PAP) policies define the rules, their conditions, and

 actions associated with the policy.

 Policy Collection A collection of one or more policies which is

 associated with a role. The policy collection may

 also define the logical relationship between the

 policies. Each collection is identified by a name

 known as a role name.

 Policy Decision The system entity that evaluates the policy

 and Enforcement criteria published by a PAP, using attributes

 Point (PDEP) supplied by a PIP to render decisions on requests

 made by DRs. The PDEP is able to enforce its

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 decision via the use of cryptographic keys.

 Policy Identifier The tag that is used to identify a policy. For the

 purposes of this document the focus is on two

 different types of policy identifiers. Object

 Identifiers (OIDs) are what are currently used in

 many security policy systems and are the only

 method of policy identification supported by ESS

 security labels. Additionally URIs are supported

 as policy identifiers as they provide a more

 user-friendly method to uniquely identify a policy

 and allow discovery of the policy.

 Policy Information A service which issues assertions, for example

 Point (PIP) about a subject, their device, or environment,

 e.g., an LDAP directory or SAML Security Token

 Service.

 Policy Label The data structure which holds one or more policy

 identifiers and their logical relationship.

 Pseudonym A name that a person or group assumes for a

 particular purpose, which differs from their

 original or true name. (See Orthonym.)

 Role Token A token issued to a subject, containing one or more

 Policy Collections. The role token is used as part

 of policy discovery and management in Plasma. It

 is not used as part of access control decisions in

 any way.

2 Introduction

 The S/MIME standard [RFC5751] provides a method to send and receive

 secure MIME messages. S/MIME uses CMS [RFC5652] as the means to protect

 the message. While CMS allows for many types of key exchange

 mechanisms to be used, S/MIME [RFC5750] exclusively uses X.509

 certificates [RFC5280] for the security credentials for signing and

 encryption operations. S/MIME also uses an early binding mechanism

 for encryption keys where the sender needs to discover the public key

 for every recipient of an encrypted message before it can be sent.

 This requires the sender to maintain a cache of all potential

 recipient certificates (e.g., in a personal address book) and/or have

 the ability to find an acceptable certificate for every recipient from

 a repository at message creation. This key management model has

 limited the use of S/MIME for encryption for a variety of reasons and

 is a major factor in the lack of adoption of S/MIME. The S/MIME key

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 management model is fragile. For example:

 o The recipient may not have an X.509 encryption certificate

 o The sender may not have previously received a signed email with the

 recipient's certificate

 o The recipient may not have an available repository from which to

 publish their certificate for senders to discover

 o The sender may be unaware of the location of the recipient's

 repository

 o The recipient's repository may not be accessible to the sender,

 e.g., it's behind a firewall

 o The sender may not have a valid certificate path to a trust anchor

 for the recipient's certificate

 If one or more recipient certificates are missing, then the sender is

 left with a stark choice: send the message unencrypted or remove the

 recipients without valid certificates from the message.

 The use of secure mailing lists has the ability to provide some relief

 to the problem. The original sender does not need to know the

 appropriate encryption information for all of the recipients of the

 mailing list, just for the mailing list itself. It can thus be

 thought of as a form of late-binding of recipient information for the

 originating sender. However it is still early-binding encryption for

 the mail list agent; as it needs to perform all of the gathering and

 processing of certificate information for every recipient that the

 agent will relay the message to.

 In many regulated environments end-to-end confidentiality between

 sender and recipients by itself is not enough. The regulatory policy

 requires some form of access control check before access to the data

 should be granted. In many inter-organization collaboration scenarios

 it's impossible for the sender to satisfy the access checks on behalf

 of all recipients since they don't have, and frequently should not

 have access to, all the recipient's attributes because to do so may be

 a breach of the recipient’s privacy. Indeed to release the attributes

 to the sender may require that the sender's attributes first be

 released to the recipient's attributes provider. It's a fundamental

 tenet of good security practice that users should control the release

 of data about themselves.

 ESS Security labels are an optional security service for S/MIME. The

 ESS security label allows classification of the sensitivity of the

 message contents using a hierarchical taxonomy in terms of the impact

 of unauthorized disclosure of the information [RFC3114]. The security

 label can also indicate access control policy. ESS security labels

 are authenticated attributes of a CMS signer-info structure in a

 SignedData object. The label, when applied to signed clear text data,

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 provides the access-control decisions for the plain text. If applied

 to cipher text such as the outer layer of a triple-wrapped S/MIME

 message the label is used for coarse-grained optimization such as

 routing.

 ESS Security Labels have been found to have a number of limitations.

 1. When the label is on the innermost content, access to the plain

 text is provided to the recipient (in some form) independent of

 the label evaluation as it will be processed for the purpose of

 hash computation as part of signature validation. Depending on

 how a triple-wrapped message is processed by the recipient's CMS

 code, the inner content may be processed for signature validation

 even before the outer signature is validated. This would happen

 for a stream-based CMS processor which starts processing inner-

 layers immediately rather than finishing processing of each layer

 and caching the intermediate results.

 2. While labels cannot be altered, they can be removed in transit. If a

 signed layer is seen then it can be removed by any agent that

 processes the message (such as a Message Transfer Agent). If the

 label is protected by an encryption layer then it can only be

 removed by any agent that has a decryption key (Encryption Mail

 List agents or Spam Filtering software would be two such

 examples).

 3. Policies are identified by Object Identifiers. This makes for a

 small tight encoding, but it does not provide any mechanism for an

 email client to discover how to enforce an access control policy if

 the message contains a policy the client is unaware of. This

 provides an impossible choice: ignore the access control policy

 and grant access to the message or block access to the message.

 Object identifiers also do not provide a good display name for

 users so that they could manually find and download a new policy.

 4. The current ESS standard only allows for a single policy label in

 a message; no standardized method of composing multiple policy

 labels together has been defined. This is adequate for coarse-

 grained policy binding to express a limited set of choices such as

 with information sensitivity which typically provides a hierarchy

 of 3-5 choices. Many data sets need to be subject to multiple

 access control policies. For instance, a message may contain

 information that is both propriety and export controlled. Trying

 to represent combinations of policies via a single policy label

 would lead to an exponential growth in the number of policy

 labels.

 5. ESS Labels do not provide for any robust auditing of who has been

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 granted access to the message. All policy evaluation is local to

 the recipient's machine; no centralized logging of access to the

 message can be performed

 6. The biggest issue with ESS labels is enforcement of the policy

 occurs on the recipient's machine; the compliance with the policy

 is dependent on the state of the configuration of every receiving

 agent. The policy is enforced by whatever module is located on

 the user's system. For cross corporate systems, this means that

 the policy provided by Company A must be installed on Company B

 machines, or Company B must install a policy that Company A will

 accept as being equivalent to their own policy. Additionally, any

 time that a new version of the policy module is rolled out, there

 will be a time lag before every recipients machine will have the

 updated module. This makes policy compliance practically

 impossible in anything but a small, closed environment.

 From a regulatory enforcement perspective, ESS labels are an extremely

 weak form of access control because cryptographic access to the data

 is given before the access check. The correct enforcement of the

 access check is dependent on the configuration of every recipient's

 email client. Since the cryptographic access is granted before the

 access policy check, there is no cryptographic impediment for a

 recipient who is able to decrypt the data but is unauthorized under

 the policy, to ignore the policy and access the data. A stronger

 enforcement model is needed for regulatory control for email where

 cryptographic access is only granted after the access check is

 successful.

 S/MIME today can only use X.509 certificates to protect the

 confidentiality or the data origin authentication and integrity of the

 messages. There are many users on the Internet today who have other

 forms of authentication credentials. This means the many users without

 X.509 certificates cannot use S/MIME. There have been many

 developments in authentication technology and best practices since

 S/MIME was developed over a decade ago, and example of which is SAML

 [SAML-core]. The critical difference between SAML and X.509

 certificates is that SAML abstracts the details of the authentication

 protocol from the protocol. The PIP can use a broad range of

 authentication mechanisms such as passwords, one-time passwords,

 biometrics, X.509 certificates, etc., to authenticate the subject

 without impacting the protocol. Adopting the abstraction

 model for S/MIME would enable almost anybody with any kind of

 authentication credential registered with one of the many identity

 providers on the Internet today to use S/MIME making it possible that

 S/MIME use may become as pervasive as TLS is today.

 There are many other non-email use cases which would be subject to the

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 same access policy requirements. Email allows users to create content

 and distribute it to a set of recipients. Similar use cases can be

 performed with other data formats or applications such as documents

 and instant messages. Policy is tied to the information, not the data

 format or application, therefore if an organization has a policy

 relating to a type of information, then that same policy would apply

 to the same information in any form; email, document, or instant

 message. While some aspects of this work will be specific to email,

 there will be many which would be reusable in other areas.

3. Access Control Models

 Access control is the process whereby systems are able to decide

 whether to grant a request to access a resource from a subject. There

 are a number of models the system can follow to make the decision.

 These are two types of models, those based on a subject attributes and

 those based on a subjects capabilities. For models based on subject

 attributes, the system obtains a set of attributes about the subject

 then applies a policy expression using the attributes as input to the

 policy to determine the result. For model based on subject

 capabilities, the subject has an unforgeable token or reference to a

 token attesting to an access to a resource.

 The simplest model based on subject attributes is Discretionary Access

 Control (DAC) where attributes are the subject’s group membership and

 the policy is expressed as an Access Control List (ACL) which is a

 list of groups and grants (or deny's) access to individual groups. The

 list is evaluated sequentially, and the first match is the result.

 Role Based Access Control (RBAC) is a refinement of DAC where the role

 is an abstract subject which is granted a set of permissions. The role

 used to simplify management, in essence it is a collection of groups.

 Attribute Based Access Control (ABAC), where policies are defined in

 terms of arbitrary attributes of the subject, their device or

 environment, their intended action on or use of the information. ABAC

 requires the definition of the policy in a policy expression language,

 e.g., eXtensible Access Control Markup Language [XACML-core]. ABAC

 also requires a secure way to exchange arbitrary attributes, e.g., via

 the Security Assertion Markup Language [SAML-core] or via an LDAP

 directory.

 SAML [SAML-core] defines an XML framework for describing and

 exchanging assertion tokens containing attributes. The entity issuing

 the assertion tokens is a Policy Information Point. The entity

 consuming the assertion with the attributes is known as the relying

 party (RP). The well-known scenarios for using SAML are:

 o Single Sign-On across systems on different platform technology

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 o Federated Identity between business partners

 o Web Services and other standards, e.g., -SOAP based protocols

 SAML tokens can be either Bearer Tokens or Holder-of-Key tokens.

 Bearer tokens have no cryptographic key and their security is based on

 the time between when the token was issued and time it was presented

 to the relying party together with the token being issued for use with

 the RP. Low-value transactions can use Bearer tokens where possession

 of the token alone is considered acceptable for the transaction risk.

 Holder-of-Key tokens contain a cryptographic key (either public or

 symmetric) and like X.509 identity certificates the subject proves

 its identity to the RP by demonstrating control over the key, e.g.,

 signature or HMAC over some data. The RP can therefore have a stronger

 proof of identity by the demonstration of possession of

 cryptographic keys. SAML can also be used to express attributes about

 a subject to an RP where the subject has authenticated to the RP by

 some means.

3.1 Generic Access Control Model

 The terminology defined in [RFC] uses a generic information model

 for the actors and the way they relate to each other.

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 ------------------

 | |

 | Policy |

 | Administration |

 | Point |

 | |

 ------------------

 ----------------- |

 | | |

 | Policy | | Read

 | Information | | Policy

 | Point | |

 | | |

 ----------------- v

 | | v

 | | -----------------

 | | | |

 | | Back end Exchange | Policy |

 | ------------------------->>| Decision |

 | Issue | Point |

 | Attributes | |

 | -----------------

 | ^

 | Front End ^ Decision

 | Exchange | Request +

 v | Attributes

 v |

 ----------------- -----------------

 | | Request + | |

 | Subject | Attributes | Policy |

 | Decision | -------------->>| Enforcement |

 | Requestor | | Point |

 | | | |

 ----------------- -----------------

 Figure 1 Generic Access Control Model

 o Administrators manage and publish policies using the PAP. The

 published policies are then available to the PDP

 o A decision requestor sends a request together with its attributes

 to the PEP

 o The PEP sends a decision request to the PDP together with the

 subject attributes

 o The PDP obtains the necessary policy from the PAP

 o The PDP can request additional attributes from the PIP

 o The PDP returns the decision request to the PEP

 o The PEP enforces the decision request

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 This generic model assumes the PEP has control over the data, i.e., when

 it gets the permit decision it releases the data to the subject. This

 works well in client-server situations like access to a web site or

 database where there is a clear trust boundary between the subject and

 the PEP with the data. However it does not work well with applications

 like email where the data is delivered to the subject prior to

 the access check. The model needs to be extended to allow the data to

 be encrypted and the access check be performed prior to release of the

 decryption key.

 A dependency in the model is the reliability of the policy selection

 for the request by the PDP. The implementation of the policy selection

 process can make either a closed- or open-world assumption. Closed

 world assumes the policy set on the PDP is complete therefore there is

 a policy in the store for every request. Open world assumes the

 policy store is incomplete and there is a need to discover new policies

 as appropriate. Closed-world implementations work when there is

 reasonable control over the sets of data managed by the PEP and

 policies known to the PDP. However, they result in unreliable results

 with mobile data, i.e., if data is received from a partner and an attempt is made to

 process it via the recipient’s PEP and PDP. There is no linkage between the

 distribution of the data and the distribution of the policies in closed-

 world models. It is therefore possible that data will be received for which the matching policy is not available from the recipient’s policy store.

 Access control models based on subject attributes depend upon the availability

 of assertions with attributes about subjects. The model has the PIP

 issuing attributes about subjects and the RP consuming attributes about

 subjects. A subject can be a human, a device, or a service. The subject

 must have a relationship with the PIP since it has been through

 some form of registration process with the PIP. There is no

 requirement to have a relationship between the PIP and an RP. The RP

 must trust the PIP, but not vice versa. This is the same model as

 exists with X.509. The subject must have a relationship with the CA,

 the RP must trust the certificates issued by the CA, but there is no

 requirement for the CA to have any form of relationship or trust with

 the RP. Release of subject attributes to an RP must be under a policy

 due to the sensitivity of the data. The subjects themselves can

 request and give approval for the release of attributes from the PIP

 and relay them to the RP (Front End Attribute Exchange). If the

 subject has given prior consent, the RP may receive attributes

 directly from the PIP (Back End Attribute Exchange). Subject

 attributes are potentially sensitive data and are similarly subject to

 access control. SAML has the capability to encrypt sensitive data in

 the token. The PIP would also develop policy to regulate the set of

 data it would release to an RP.

 The challenges for S/MIME are therefore:

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 o How to apply this generic access control model to the email

 scenarios so there is convergence with other applications, i.e.,

 email access control is not a one-off, vertical solution

 o How to ensure the access check is possible prior to the recipient

 having access to the clear text so the access check is sufficiently robust for

 regulators

 o How to abstract the authentication credential technology use from

 the S/MIME protocol to enable use of the many forms of

 authentication in widespread use today on the Internet.

4 Use Case Scenarios

 This section documents some email-based use cases that the new

 protocol aims to support. Also included are some related scenarios

 where the same underlying theme of consistent policy enforcement

 equally applies.

4.1 Consumer-to-Consumer Secure Email

 One of the issues that is stopping the use of secure email in

 personal mail is the fact that consumers find X.509 certificates

 difficult and expensive to obtain and then use - especially across

 a set of devices (phone, tablet, workstation). One of the possible

 use cases of Plasma is to try and deal with this issue by removing the

 dependency on X.509 certificates. The details of the use case are

 therefore: Alice wants to send an email message to Bob that

 contains sensitive, personal data so she is concerned about

 ensuring only Bob can read it. Bob has a strong credential he can

 use to identity himself, but it's not an X.509 certificate. Alice

 needs to ensure the following:

 (a) Only Bob can read the email.

 (b) Bob has the ability to verify the email is from Alice.

 (c) Bob has the ability to verify the email message has not been

 modified since Alice sent it.

 The sequence of events could be as follows:

 1. Alice composes the email to Bob.

 2. Alice's email client allows her to classify the email. Alice

 classifies the email as Personal Communication which is a policy

 provided by her ISP.

 3. Alice's email client knows the protections to apply to a Personal

 Communication; it knows to encrypt and sign the message.

 4. The protected email is able to flow securely and seamlessly

 through existing email infrastructure to Bob. The data is

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 protected while in transit and at rest.

 5. Bob receives the email and sees that it is a secure message. Bob

 can verify that the secure message has not been altered. Bob

 attempts to open and decrypt the email. If Bob is on the same

 ISP as Alice, then the same username/password as he uses to get

 his email is used to obtain the needed keys. If Bob is on an ISP

 that is federated with Alice's ISP then an infrastructure such as

 SAML, OpenID, OAUTH, or ABFAB could be used to validate Bob's

 identity and allow the needed decryption keys to be released.

4.2 Business-to-Consumer Secure Email

 There are many examples of business-to-consumer secure email scenarios

 where the email could potentially contain sensitive medical or

 financial data. This would include doctor-patient, bank-account

 holder, medical insurance-insured person, and mortgage broker-customer

 communications. This example is illustrative of the many use cases for

 business-to-consumer email.

 A bank (The Bank of Foo) has determined that it will be using email to

 distribute statements to its customer (Bob). The information is

 confidential, so any channel of communication the bank selects must

 protect Bob's privacy. The bank needs to ensure the following:

 (a) Only Bob (or additional owners of the account) can read the email.

 (b) Bob authenticates with a sufficient level of identity assurance.

 The same identity assurance authentication level used to do on-

 line banking would be considered sufficient.

 (c) Bob can verify the statement is from his bank.

 (d) Bob can verify the statement has not been modified since his bank

 sent it.

 The sequence of events would be as follows:

 1. As part of routine end-of-the-month processing, the bank composes

 an email to Bob. They include the statement of balances and

 activity either as an attachment or as the body of the message.

 2. The statement mailer for the Bank of Foo has been configured to

 apply a specific policy to the email.

 3. The statement mailer for the Bank of Foo knows the protections to

 apply based on the policy; it knows to encrypt and integrity-

 protect the message and what level of assurance is required for

 the recipient's identity.

 4. The protected email is able to flow securely and seamlessly

 through existing email infrastructure to Bob. The data is

 protected while in transit and at rest.

 5. Bob receives the email and sees it is a secure message from the

 Bank of Foo. Bob can verify the message has not been altered as

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 it is signed by his bank. Bob uses the same credential as he

 would for on-line banking to prove his identity to the email

 system and obtain the keys necessary to decrypt the message.

 The same process could be used for any messages sent between the

 business or organization and its customers. Thus, messages

 dealing with loan applications and changes in bank policies can be

 sent out in the same manner, potentially using different policies. In

 some of these cases it might be in the bank's interests to record in

 an audit trail if and when the keys were handed out on certain emails.

 For a statement, the bank would not expect a reply to occur, however,

 for other types of messages it should be possible for Bob to reply

 under the same level of protection. Bob is able to use the same

 credential when sending or replying to a message from the bank, as he

 uses for accessing the bank's Web site then the bank has the same

 assurance of Bob's identity for all transactions.

4.3 Business-to-Business Ad-Hoc Email

 Early in the relationship between two companies, it is frequently

 necessary to exchange sensitive information as a preliminary to a more

 formal business relationship, e.g., for contract negotiations. This level of security is

 similar to guarantees to the security afforded by mail, i.e., you enclose

 a letter in an envelope which provides a level of security to the

 contents while in transit. There is an expectation that only

 the recipient or their delegate would open the envelope. Once the

 recipient has the letter, you trust them to treat the contents

 appropriately.

 As an example, Charlie works for Company Foo. He has just met Dave

 from Company Bar to discuss the prospect of a potential new business

 opportunity. Following the meeting, Charlie wants to send Dave some

 sensitive information relating to the new business opportunity.

 Charlie trusts Dave to treat the information appropriately. When

 Charlie sends the email to Dave with the sensitive content, he must

 ensure the following objectives:

 (a) Only Dave or his delegate can read the email.

 (b) Dave or his delegate is required to authenticate with an identity

 assurance level 2 or above.

 (c) That Dave can verify the email is from Charlie

 (d) That Dave can verify the email has not been tampered with

 (e) Charlie may also need to keep a record of the fact that Dave

 accessed the message and when it was done.

 The sequence of events Charlie would use is as follows:

 1. Charlie composes the email to Dave. He include some sensitive

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 information relating to potential terms and conditions for the

 new contract that Foo and Bar would sign to form a partnership

 for the business opportunity.

 2. Charlie's email client allows him to classify the email. He

 classifies the email as an ad-hoc pre-contractual communication.

 3. Charlie's client knows the protections to apply to ad-hoc pre-

 contractual communication; it knows to encrypt and integrity-

 protect the message and the level of assurance required for the

 recipient’s identity.

 4. The protected email is able to flow securely and seamlessly

 through the existing email infrastructure to the recipient (Dave in

 this case). The data is protected while in transit and at rest.

 5. Dave receives the email and sees it is a secure message from

 Charlie. (Charlie’s policy requires level 2 authentication. for

 which Dave uses a password). Dave is able to prove his identity

 to the level of assurance requested by Charlie so he is able to

 read the email. The organization Dave works for has an identity

 service which he uses to prove his identity for Charlie's email.

 Dave opens the email.

 If Dave or his delegate replies to the email from Charlie, the new

 message inherits the policy from the original messages so the entire

 message thread has the same policy. The policy also applies to

 messages forwarded by Dave because it contains information from

 Charlie and Company Foo wants consistent policy enforcement on its

 information.

4.4 Business-to-Business Regulated Email

 As business relationships mature they often result in a formal

 contractual agreement to work together. Contractual agreements would

 define a number of work areas and deliverables. These deliverables may

 be subject to multiple corporate and/or regulatory policies for access

 control, authentication, and integrity. Some classes of email may have

 information which is legally binding or the sender needs to

 demonstrate authorization to send some types of messages where

 authority to send the message is derived from their role or function.

 Also many regulated environments need to be able to verify the

 information for an extended period - well beyond the typical lifetime

 of a user's certificate. The set of policies applicable to an email

 is potentially subject to change as the different user's contribute

 information to the email thread.

4.4.1 Regulated Email Requiring a Confidentiality Policy

 Company Foo has been awarded a contract to build some equipment

 (Program X). The equipment is covered by export control which

 requires information only be released to authorized recipients under

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 the terms of the export control license. Company Bar is a foreign

 subcontractor to Company Foo working on Program X. Company Foo sets up

 some business rules for access to Program X data to ensure compliance

 with the export control license requirements. Company Foo also sets

 up separate rules to cover the confidentiality of its intellectual

 property contributed to Program X. Company Bar also sets up its own

 policies to protect the confidentiality of its own intellectual

 property it contributes to Program X. As part of the agreement between

 Foo and Bar, they have agreed to mutually respect each other's

 policies.

 Confidentiality policies can change over time. It is important to be

 able to implement the changes without the need to update the data

 itself to reflect the change, as finding all instances of the data is

 an intrinsically impossible problem to solve.

 Frank is an employee of Company Foo. He has been assigned as a design

 team leader on Program X and as an individual contributor on Program X

 integration. Frank wants to send some email as a team leader to

 colleagues working on Program X in both Companies Foo and Bar.

 Grace is an employee of Company Bar. She has also been assigned to the

 design team of Program X.

 When Frank sends the email with Program X regulated content he must

 ensure compliance with the export control policies. When Frank sends a

 Program X email he must ensure recipients are authorized to read the

 contents to ensure Company Foo remains in compliance with its export

 control license.

 If Frank also includes Company Foo intellectual property in an email,

 he must also ensure recipients are authorized to read the

 intellectual property contents.

 When Grace receives a Program X email, she must provide attributes

 about herself to prove compliance with the export control policy. If

 the email also contains Company Foo intellectual property, she must

 also provide attributes to show she is authorized to read the

 information under the agreement between Company Foo and Company Bar.

 Grace would not know the complete set of attributes, so she would start

 with a basic set of attributes to identify herself. The PDEP may be able to discover

 more attributes about Grace, and if it is still missing some, it can

 request those from Grace.

 If Grace sends an email with Company Bar intellectual property, she

 must ensure recipients are authorized to read the contents under the

 agreement between Company Bar and Company Foo.

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 When Frank sends a Program X email he must ensure the following

 objectives:

 (a) Only recipients who meet the Program X export control policy

 and/or Company Foo's intellectual property protection policy can

 read the email.

 (b) Recipients authenticate with an identity assurance level 3 or

 above.

 (c) Recipients present all other attributes about themselves

 necessary to verify compliance with the applicable policies

 (their program assignment, nationality, professional or industry

 certifications, etc.).

 (d) Recipients can verify the email is from Frank to the level of

 identity assurance as defined by the message policy (i.e., level

 3 or above).

 (e) Recipients can verify the email has not been tampered with to the

 level of identity assurance as defined by the message policy.

 (f) Recipients are made aware that the message is a Program X email

 (and the contents can only be shared with other Program X

 workers) and/or the message contains Company Foo's intellectual

 property.

 The sequence of events Frank would use is as follows:

 (1) Frank composes the email and includes a Program X distribution

 list as a recipient. He include some information related to

 Program X. Frank also includes some information which is Company

 Foo's Intellectual Property.

 (2) Frank's email client allows him to select the Program X role. The

 client then allows Frank to select from a set of policies

 appropriate for Program X.

 (3) Frank selects the Program X content and Company Foo IP policies

 from the list of available policies.

 (4) The email client knows to encrypt the message, the key size, and

 algorithm to use. It also knows that the message needs to be

 signed with a level 3 or above private key.

 (5) Frank clicks the "send email" button. The client signs the email

 using his smart card private key and includes the certificate

 with the appropriate public key for verification of the signature

 by recipients. The client then encrypts the message and obtains

 data from a server that will enforce the access control

 requirements for Frank, and sends it to his email server.

 The email is able to flow securely and seamlessly through existing

 email infrastructure to recipients of the distribution list. Grace is

 on the distribution list so she receives the email from Frank.

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 (6) Grace receives the email. Grace's client provides the attributes

 necessary to comply with the policy which includes her level 3

 encryption certificate to the PDEP.

 (7) Once Grace has shown she passes the policy requirements, the PDEP

 releases the message CEK to Grace using her level 3 encryption

 certificate.

 (8) Grace uses her smart card to open the message. She sees the

 message is signed by Frank and marked with both the Program X and

 Company Foo IP policies.

 If Grace replies to the email from Frank, the new message inherits the

 policy from the original message. If Grace includes some information

 which is Company Bar's IP she also adds her company's IP protection

 policy requirements to the message.

 Frank receives the reply from Grace. Frank is able to prove his

 identity to the level requested by Grace and provides the requested

 attributes about himself to satisfy both the Program X export control,

 the Company Foo IP protection policies, as well as the Company Bar IP

 protection policies. Frank opens the email.

 The policy also applies to messages forwarded by Frank and Grace

 because they contain information from Company Foo and Company Bar and

 both companies want consistent policy enforcement on their

 information.

 After some time, Company Bar fails an audit to show they are complying

 with all the requirements for Program X. As a result, Company Foo

 updates its policies for Program X to remove Company Bar as an entity

 approved to access Program X data. Grace will no longer be able to

 receive CEKs for Program X email as she can no longer satisfy the

 Program X policy requirements.

4.4.2 Regulated Email Requiring an Integrity Policy

 Company Foo has been awarded a contract to build some equipment

 (Program X). This equipment is regulated by the National Aviation

 Authority (NAA) that has oversight of Company Foo. The NAA requires

 strict procedures at a number of significant events for Program X such

 as in the design and maintenance of Program X (e.g., when a design

 is complete and released to manufacturing). The sign-off process

 requires personnel be suitability qualified and that the documentation

 needs to be maintained for the service life of the project (25 years

 for Program X).

 Company Foo has instigated an email-based sign off procedure to

 simplify sign-off and reduce costs. It also has authored a policy for

 compliance with the NAA requirements. At the appropriate time, a sign-off

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 Request email is sent to the designated program members. Recipients apply the

 NAA policy when they reply to the sign-off request message.

 Frank is the lead on the Program X design team. They have a design

 which they believe can be released to the integration team. Frank

 initiates the sign-off process for the design.

 Grace is one of the sign-off design team members for Program X. She

 receives the sign-off email. Grace responds and applies the sign-off

 signature policy to the email. The policy requires Grace to

 authenticate with the required level of assurance, present attributes

 about herself, her work effort assignments, and professional

 qualifications to demonstrate compliance with the policy to send the

 message. The message is signed to indicate Grace met the policy. It is

 a matter of the LoA of the sign-off process if Grace signs first,

 followed by the policy compliance signature or just the policy

 compliance signature which attests that Grace initiated the process.

 When Frank initiates a Program X sign-off email, the system must ensure

 the following objectives:

 (a) Frank was authenticated to the level of identity assurance

 required under the policy to initiate the sign-off process.

 (b) Frank possessed the necessary attributes as required by policy to

 initiate the sign-off process.

 (c) The contents of the email are accurate to the level of integrity

 assurance required by the policy.

 (d) Frank was fully aware and intended to initiate the sign-off

 process.

 (e) The state of Frank's system was known to the level of assurance

 required under the policy to be free from agents which might

 interfere with the sign-off process.

 (f) Recipients can easily confirm over the lifetime of the design as

 required by the policy that the sign-off process met the policy

 without having to know the specifics of what the policy

 entailed.

 The sequence of events Grace would use is as follows:

 (1) Grace receives the sign-off request email.

 (2) Grace replies to the email and completes the form data in the

 email to show she is approving the sign-off.

 (3) Grace clicks the send button to send the email.

 (4) Grace receives a sign-off confirmation dialogue before the email

 is sent where she is able to confirm her intent is to approve the

 sign-off of the component.

 Grace's system submits the decision request to send the sign-off

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 email. Her system is asked to provide attributes about Grace, the

 state of her system and the data being authenticated as part of the

 decision request. Grace would not know the complete set of attributes

 required to submit and would start with a basic set to identify

 herself. The PDEP may be able to discover additional attributes about

 Grace, and if it is still missing some, can request those from Grace. If

 Grace's request meets the policy, her system receives a signed

 statement that the message meets the policy which is attached to the

 email and the message sent.

4.5 Delegation of Access to Email

 There are a number of times when others are given access to a

 recipient's mailbox or email is forwarded to other recipients based on

 the original recipient's rules. This may be a long-standing

 relationship such as when an assistant is given access to an

 executive's mailbox. Alternatively, it may be a temporary relationship

 due to short-term needs (e.g., to cover for a vacation). There are

 also organizational role mailboxes where the recipient is a role and

 one or more users are assigned to the role.

 Grace is going on vacation. While Grace is away, Brian will act as a

 delegate for Grace. Grace configures a mailbox rule to forward Program

 X email to Brian for the duration of her vacation. Brian is able to

 satisfy the policy requirements for the Program X email as outlined

 above and is therefore able to open the protected email sent to Grace.

 Frank does not need to take any actions to allow Brian to access the

 email.

4.6 Email Compliance Verification

 Verification is an essential part of compliance. Verification may be

 conducted by internal staff or external auditors. The verification

 needs to confirm that the policy rules are being enforced. Auditing

 relies on the generation of artifacts to capture information about

 events. Typically, this is done via some form of logging. A challenge

 here is that for distributed system, the set of logs which completely

 describes the transaction are scattered across many systems so

 consistency of the audit settings and correlating all the audit data

 is problematic. Another consideration is accurately capturing only the

 set of desired data, i.e., accurately targeting the set of events that

 needs to be logged

 Jerry is the compliance officer for Company Foo. He has a procedure

 for ensuring compliance for Program X. The procedure defines what to

 log and when to audit access to Program X data. Jerry has tools to

 collect the audit data and run an analysis to verify the policies are

 being followed.

 The sequence of events Jerry would use is as follows:

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 (1) Jerry configures an audit obligation for access to Program X

 data. The obligation defines the set of attributes to capture

 when Program X data is accessed. The obligation is part of the

 Program X policy. Part of the Program X policy is the set of

 PDEPs which can process policy decisions on Program X data.

 (2) Jerry configures his audit log collection to download Program X

 audit log entries from the designated PDEPs.

 (3) Jerry also has an audit confirmation tool which "pings" the PDEPs

 for access to Program X data. Jerry's audit log analysis tool

 looks for these pings to confirm that auditing is taking place as

 expected.

4.7 Email Pipeline Inspection

 Organizations have a huge incentive to inspect emails entering or

 leaving the organization. Such inspection is desired for many

 different reasons. Inspection of mail leaving an organization is

 targeted towards making sure that it does not leak confidential

 information. It also behooves organizations to check that they are not

 a source of malicious content or spam. Inbound mail is checked

 primarily for malicious content and phishing attempts as well as spam.

 For domains with a high volume of messages there is a strong need to

 process email with minimal overhead. Such domains may mandate that

 they be pre-authorized to process an email due to the overhead a per-

 message request to an external service would add to message

 processing.

 Company Foo has a policy to scan all inbound and outbound email to

 ensure it is free from malware. Company Foo also wants to ensure email

 is not spam. Company Foo can own their scanning servers or such checks

 may be outsourced to a third party service. Company Foo wants to

 ensure that its policy of scanning message contents also applies to

 encrypted email.

 The ability to decrypt and check the message content for malicious

 content is highly desirable. There are a number of methods that can

 accomplish this:

 1. When a Company Foo client requests to send a Plasma email, the

 PDEP is able to check to see if the policy allows email content

 inspection by the MTA for this policy, and if it does, that Company

 Foo has an outbound email scanning capability, and that the scanning servers

 meet the policy requirements. It is able to pre-authorize the

 Company Foo email scanning servers to access the email.

 2. The scanning MTA authenticates to the PDEP as an entity doing

 virus and malware scanning on a protected message. If the PDEP

 has specific policy that allows for access to such a scanning MTA

 service, the appropriate decryption keys will be released and the

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 server will scan the mail and take appropriate action.

 3. The policy server is configured with information about various

 gateways (both internal and external) and has certificates for

 the known gateways. The policy server can then return a normal

 X.509 recipient info structure (cryptographic lockbox) to the

 sender of the message for direct inclusion in the recipient info

 list of the message. This allows normal S/MIME processing by the

 scanning MTA without the necessity to query the PDEP server for

 keys for specific messages.

 4. If the scanning MTA server cannot gain access to the decrypted

 content using one of the two proceeding methods, it either passes

 the encrypted mail on to the recipient(s) without scanning it or

 it rejects the mail. This decision is based on local policy of

 the scanning MTA. If the message is passed to the recipient(s),

 then the necessary scanning either will not be done, done by a

 downstream MTA, or done on the recipient's system after the

 message has been decrypted.

4.8 Distribution List Expansion

 A distribution list (DL) is a function of an MTA that allows a user to

 send an email to a group of recipients without having to address all

 the recipients individually. The membership of the DL may be

 confidential so the sender may not know all the recipients. The DL may

 be maintained by an external organization. Since a DL is identified by

 an email address, the user may be unaware they are sending to a DL.

 Plasma policies may have the list of recipients as a parameter, thus

 the fact that the message is being processed to a distribution list

 means the MTA processing the message needs to update the policy to

 allow the new recipients to access the message. Organizations may also

 require inbound scanning of email and have thus published keys to

 enable pre-authentication of the MTA by the sender to expedite

 processing. For both scenarios the DL MTA has to notify the Plasma

 server that it is adding recipients to the message and supply the list

 of new recipients. The Plasma server can then take appropriate action

 on the message token and return an updated token if required.

4.9 Scalable Decision Making

 Collaboration involves working with external organizations, e.g.,

 partners and suppliers. These collaborations may be short- or long-

 lived, with a small or very large number of participants.

 Organizations therefore need flexibility in deployment and scaling.

 Organizations do not want to be forced into having to provide capacity

 themselves for all decision-making over their data. Senders would be

 happy to delegate decisions where appropriate to partners or external

 services provided those decisions use the rules they define for their

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 data. Likewise, recipients might be happy to leverage their local

 decision capacity providing they don't have to duplicate the rules of

 the partners, and can simply and easily use policies published by

 their partners. An organization may also want to use cloud-based PDEPs

 where appropriate as a cost effective way to add capacity and to be

 able to respond to transient capacity fluctuations.

 See section 3.4.1 for a description of the scenario.

 The program managers for Program X at Companies Foo and Bar agree to a

 series of roles which are used to manage personnel and their assigned

 policy groups. The policy administrators for Company Foo and Bar

 respectively publish the roles and a policy collection for each role.

 There are rules associated with the policy collection, for example

 every role uses the Program X policies published by Company Foo.

 Employees from Company Foo also get the Company Foo Intellectual

 Property policies for those roles, whereas employees from Company Bar

 get the Company Bar intellectual property policies for Program X.

 Company Foo has also decided to allow enforcement of Program X

 policies by decision engines in both Company Foo and Company Bar.

 Company Foo has also decided to use a cloud-based decision engine for

 Program X to allow lower-cost capacity and scaling. Company Foo is

 able to add new instances of the cloud-based decision services as the

 program scales up and more users start working on the program. Each

 decision engine dynamically discovers the policies it needs from the

 set published by Company Foo and Company Bar. Both Company Foo and

 Company Bar can add new policies to the policy collections at any time

 and they are dynamically discovered by all the policy decision

 engines.

5 Plasma Security Model

 A common theme from these scenarios is the need to closely tie the

 information asset to the set of technical controls via the data

 owner's policies in such a way so it is possible to consistently apply

 the technical controls across a broad set of applications (not just

 email), for a broad set of users (not just those within an

 organization), and in a broad set of environments. Assumptions based

 on closed-world, enterprise security models are increasingly breaking

 down. Perimeter security continues to diminish in relevance and focus

 needs to be shifted to self-protecting data as opposed to protecting

 the machines that store such data. The binding between the data and

 the applicable policies needs to happen as close to the data creation

 time as possible so ad-hoc trust decisions are not required.

 The delivery of the documented use cases will require the integration

 of many existing and some new protocols. In order to ensure the right

 overall direction for Plasma as each part of the work proceeds, a high-

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 level data model is documented here to act as a guide. While this is

 technically informative to the developments of each individual

 component, it is normative to the work overall.

 This Data Centric Security model is based on a well-established set of

 actors for policy enforcement used elsewhere [RFC3198] [XACML-core].

 Figure 2 shows the relationship between the actors.

 ------------------

 | |

 | Policy |

 | Administration |

 | Point |

 | |

 ------------------

 |

 ----------------- | -----------------

 | | | | |

 | Policy | | Read | Policy |

 | Information | | Policy | Information |

 | Point | | | Point |

 | | | | |

 ----------------- v -----------------

 | | v | |

 | |Issue ----------------- Issue | |

 | |Attributes | | Attributes| |

 | |(BAE) | Policy | (BAE) | |

 | -------------->>| Decision |<<--------------- |

 | | and | |

 | | Enforcement | |

 | -------------->>| Point |<<----------- |

 | |Protect | | Consume | |

 | |Content ----------------- Content | |

 | |Request+ Request+ | |

 | |Attributes Attributes| |

 | |(FAE) (FAE) | |

 v | v v

 v | v v

 ----------------- -----------------

 | | | |

 | Content | Distribute | Content |

 | Creation | Content | Consumption |

 | Decision | ---------------------------->>| Decision |

 | Requestor | | Requestor |

 | | | |

 ----------------- -----------------

 Figure 2 General Scheme for Publishing and Consuming Protected Content

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 The Plasma model is applicable to any type data (email, documents,

 databases, IM, VoIP, etc.). This facilitates consistent policy

 enforcement for data across multiple applications. Another objective

 is to not require the data holder to have access to the plain text

 data in order to be able to make decision requests to the PDEP. The

 policy decision is complex so the content creation DR in Plasma just

 uses policy pointers or labels to indicate the set of policies

 applicable to the content. The content consuming DR dynamically discovers

 the PDEPs that are authoritative for the decisions on protected

 content in question. The PDEPs dynamically discover the specifics of

 a policy from a PAP using the policy references. The specifics of

 policy authoring and policy decision logic modules are matters beyond

 the scope of this document. It is important to note that the actors in

 this model are logical entities and as such can be combined physically

 in different configurations.

 o The Plasma model uses references to bind the data and the policy.

 When information is created, it is encrypted and a list of

 policies that must be enforced by the PDEP is bound to the

 protected data.

 O The Plasma model includes policy discovery capability for

 subjects. This enables subjects to interact with one or more PDEPs

 to discover the set of policies policieseach PDEP would

 permit the subject to use to protect new content. ?The PDEP

 issues a role token to subject which contains one or more policy

 collections. Each policy collection is identified by a role name.

 Subjects can pick any combination of policies from a policy

 collection, but cannot mix policies from different policy

 collections. The token issued to subjects containing the policy

 collections is known as a role token.

 o The Plasma model is an Attribute-Based Access Control (ABAC)

 model where the ABAC policy is specified in terms of a set of

 attributes, their values, and their relationships. The policy may

 specify attributes about the subject, their device, or their

 environment, or attributes about a resource.

 o The ABAC policy does not require the subject provide their

 orthonym. Subjects could be anonymous or pseudonymous. What is

 required is the presentation of a set of attributes that

 satisfies the policy.

 o The subject can be required to bind the supplied attributes to

 the channel with the PDEP to a level of assurance as required by

 the PDEP. If the PDEP only requires low assurance, bearer tokens

 over TLS would be suitable. If the PDEP requires higher

 assurance, then the holder of key tokens over TLS would be

 required where the token key is bound to the TLS channel.

 o This model also supports Capability-Based Access Control (CBAC)

 where security tokens represent a capability to meet a policy.

 Once a subject has proven compliance with a policy, they can be

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 issued a capability token. The client can subsequently present

 this capability token in lieu of a token or tokens with the set

 of subject attributes. The net result is that the model can

 transition to a Capability-Based Access Control because the

 capability token is an un-forgeable token of compliance with a

 policy. The token can be used with any resource tagged with the

 same policy.

 o Plasma has a baseline of a secure transport between the DR and

 the PDEP. One of the decisions the PDEP has to make is the level

 of assurance on the release of the CEK to the subject. For

 example, the PDEP can release a clear text CEK over the secure

 transport to the DR. Alternatively, the PDEP could require the

 production of a high-assurance X.509 encryption certificate as a

 subject attribute to generate an encrypted CEK.

 For the purpose of the Plasma work, it is desirable that the DR and

 PDEP be clearly defined as separate services which may be on separate

 systems. This allows for a generalization of the model and makes it

 less dependent on any specific deployment model, policy representation,

 or implementation method. It also allows for a greater degree of

 control of the PDEP by an organization such that it is possible to

 keep all of the PDEP resources directly under its control and

 independent of the data storage location.

 The base set of information for a Plasma client is as follows:

 o The address of one or more IdP(s) able to issue identity attributes

 to the subject

 o A means to authenticate to the IdP(s)and issue attributes to the

 subject

 o The address of zero or more AtP(s) able to issue additional

 attributes to the subject

 o The address of one or more Plasma PDEPs able to issue role tokens

 to the subject to initiate Plasma policy discovery.

 From this base set of data, the subject is able to authenticate to

 each Plasma PDEP in turn using the identity token from the IdP and

 discover the set of assigned roles. Each role has a set of policies

 which can be applied to data. A subject may be assigned to multiple

 roles and therefore has the ability to select the most appropriate

 role for the content being created. Once a role is selected, the

 subject is able to choose one or more policies from the policy

 collection for that role. Role assignment is dynamic so the role

 discovery needs to be done on a regular (but not frequent) basis.

 Policy selection during content creation can be either manual or

 automatic. A DR may have sufficient context to be able to select the

 role and policies for the subject or have some rules that facilitate

 policy selection.

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 The model allows the content creation DR to discover the role

 assignments from multiple PDEPs which would allow the subject to access

 policies based on roles from within their organization and from any

 partner organization due to cross-organizational collaboration. The

 PDEPs that are authoritative for the role assignment for a subject

 may be different from the PDEP that are authoritative for enforcement

 of a policy collection in question. The DR uses the role token to

 authenticate the content creation request. The PDEP will check that

 the requested list of policies for the information is a subset of the

 policies in the role token. If the set of policies is a subset of the

 policies in the role token, then it will issue the policy metadata

 token to be attached to the protected data.

 The policy metadata token is a signed data structure created by the

 PDEP which is bound to the protected data. It contains public policy

 metadata attributes which are used by the DR. An example of a public

 policy metadata attribute is a list of one or more URLs which

 represent the PDEPs that can make policy decisions using the policy

 metadata token. The DR can submit the decision request to any PDEP in

 the list. The policy metadata token also has a confidential payload

 containing private policy metadata attributes used by the PDEP to make

 policy decisions. An example of a confidential policy metadata

 attribute is the list of CEKs for the protected data which would be

 released to the DR if it passes the policy checks.

 Policy rule processing and distribution is complex, so the Plasma

 model does not require policy rules to be distributed to the DR. The

 DR submits the policy metadata token as part of the decision request.

 The confidential portion of the policy metadata token contains a logic

 tree of policy references. The PDEP uses the policy references to

 discover the policy rules to apply to the request. The logic tree

 defines the relationship between the policies. The tree has a series of

 nodes where each node represents a set of policies and the relationship

 for the policies at the node, e.g., are they combined via an AND clause

 or an OR clause. The pinnacle of the tree represents the decision from

 all the policies in the tree. The use of policy references minimizes

 any policy maintenance issues relating to the protected data due to

 policy updates. The policy rules can be updated and the new rules

 discovered on subsequent decision requests.

 The DR and PDEP are required to carry out obligations of the policy

 such as specific encryption requirements, e.g., key size or algorithm,

 data integrity requirements, time-to-live (TTL) of the CEK, or audit record

 creation requirements. It is a matter for the policy on how to

 determine if the DR or PDEP is trusted to carry out the obligations.

 This could be achieved by device type and state attributes.

 The PDEP makes its decisions based on the requested action from the

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 DR, the policy requirements from the PAP(s), and the information from

 the PIP(s) about the subject, the subject's device, and the subject's

 environment. The information about the subject may be exchanged

 directly between the PIP(s) and the PDEP (Back End Attribute Exchange)

 or indirectly via the DR (Front End Attribute Exchange) or both. The

 content creator can also include attributes in the policy metadata.

 There is no guarantee that identity and attribute providers will

 consistently use the same name to identity a specific attribute or

 attribute data. For example they may use different schemas to identify

 an email address or use localized names to describe job functions or

 roles. These kinds of values may be standardized within communities of

 interest, but not globally across all identity and attribute

 providers. Therefore it is necessary to canonicalize the attribute

 names and values before processing by the policy. The attribute name

 and value mapping is part of the policy data set, i.e., it is in

 addition to the policy processing rules.

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 | | | | | |

 | | | Policy | | Policy |

 | Policy | | Decision and | | Decision and |

 | Decision | | Enforcement | | Enforcement |

 | Point | | Point | | Point |

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 | Policy | | Decision | | Decision |

 | Enforcement | | Requestor | | Requestor |

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 | | | | | |

 | End | | End | | End |

 | User | | User | | User |

 | Application | | Application | | Application |

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 (a) (b) (c)

 Figure 3 Options For Trusted Actors with Data.

 When drawing a line where the actors in the model are full trusted

 with the clear text data there are three possibilities (see figure 2).

 Figure 2a shows the full trust line between the user application and

 the Policy Enforcement Point(PEP). This is the model for current

 standard access control mechanism, e.g., XACML [XACML-core]. In 2a,

 the PEP has full access to the plain text data. It makes decision

 requests to the PDP and if the decision is affirmative, allows the PEP

 to release the data to the application. To use figure 2a for secure

 email would require every MTA and MUA to be fully trusted with plain

 text data which is impossible.

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 Figure 2b shows the full trust line between the PDEP and the DR. In

 2b, the DR only has cipher text data. The data is encrypted with a

 CEK and the PDEP has access to the CEK. The

 PDEP releases the CEK to the end-user application when access is

 granted so the application can recover the plain text. This mode is

 viable for secure email as it does not require the MTA to be trusted

 with the plain text data and either the MTA or MUA can act as a DR.

 In figure 2c, no actor is given full trust. When the data is

 encrypted, the CEK is encrypted for each recipient just as S/MIME does

 today. The encrypted CEKs are given to the PDEP and the PDEP releases

 the encrypted CEK when access is granted. This mode is also viable for

 secure email as the sender can use either conventional public key

 cryptography or Identity-Based Encryption[RFC5408] to protect the CEK

 for each recipient.

5.1 Plasma Client/Server Key Exchange Level of Assurance

 There are a number of mechanisms by which a client and server can

 exchange CEKs. As a baseline, Plasma is establishing a secure

 transport between the client and server via TLS. However the client

 may be a proxy acting on behalf of the subject, therefore transporting

 a clear text CEK over the TLS transport would expose the key to the

 proxy. There also may be a proxy at the server which is terminating

 the TLS transports and forwarding the requests to another server which

 would mean a clear text CEK sent over the transport would be exposed

 to the server proxy. Policies may require a higher level of assurance

 that the CEK is not exposed to unauthorized principals. This requires

 encrypting the CEK for the subject before transport. This would

 further require the client or the server to provide a public key to

 the other party to be used to protect the CEK before sending it over

 the secure transport.

5.2 Policy Data Binding

 There are three ways to bind policy to data:

 o By value. This is where a copy of the machine-readable rule set is

 directly associated with the data, e.g., where a file system has an

 Access Control List for the file or directory, or where a rights

 management agent embeds a copy of the policy expressed in a policy

 expression language in the rights-protected data. When an access

 request is made to the data, the PDEP compares the access request

 to the policy on the data itself.

 o By reference. This is where a reference to the policy is directly

 associated with the data, e.g., a URI or a URN which identifies the

 policy to be enforced or points to where the policy is published.

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 For example with S/MIME, the ESS label identifies the applicable

 policy by an OID. When a decision request is made for access to the data, the

 PDP finds the policy based on the identifier and then compares the

 access request to the referenced policy.

 o By inference. This is where the policy has a target description in

 terms of resource attributes the policy applies to. When a decision

 request is made, a set of attributes describing the resource which

 is the subject of the decision request is included in the request

 by a PEP. The PDP then compares the resource attributes to the set

 of target descriptions of the policies in its policy store to

 determine the set of policies to apply to the request. For example

 when an XACML policy is authored, a target description in terms of

 the attributes of the resource for the policy is also defined. When

 an XACML decision request is made, the PDP finds the policy set to

 apply to the request by matching the set of attributes in the

 request against the target description associated with the policies

 in its store. It then processes the decision request using the

 identified policy set.

 The chief strength of binding policy by value is its simplicity. The

 policy, being local to the data, can easily and quickly be read by the

 PDP. The chief weakness in binding policy by value is maintaining

 policy over time as binding by value results in the policy being

 replicated for every instance of data the policy is applied to. Many

 policies have a multi-year life span and over the course of time,

 there is a very high probability that the policy would need to be

 updated. Given the high number of copies, updating a value-bound

 policy has proven to be a very costly and imperfect process both from

 an enforcement and audit perspective. This process is complicated by

 the fact that because only the result is stored and not an identifier,

 it is hard to identify the policy that has to be updated.

 The chief strength of binding by reference is that once the policies are

 bound to the data, the same policies continue to be applied regardless

 of PDEP configuration or state. These policies may change their rules

 over time, but there is no doubt which policies would be enforced on

 the data. Another strength of binding policy by reference is it has a

 clear result as to the set of policies the PDEP has to apply. IfIt the

 PDP does not have a policy, the reference allows the PDEP to discover

 the missing policy. If the PDEP is unable to access a policy for

 whatever reason, it knows to fail the decision request with a

 different error, i.e., "don't know", which means the DR can reasonably

 try other PDEPs. The chief weakness in binding by reference is adding or

 removing policies requires updating the policy metadata. Adding or

 removing policies has the same difficulties as maintaining policies by

 value.

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 The chief strength of binding by inference is it can often be applied

 to data without impacting the storage format providing the data

 already has a rich and well-defined set of metadata such as the

 structural metadata of an SQL table. It also allows new policies to be

 applied to the data without updating the metadata. Unstructured data

 such as documents have the ability to store metadata but the challenge

 here is what metadata to capture. The nature of the metadata is also

 context specific, e.g., the policy target description required to

 match structural metadata from an SQL query would be different from

 the policy target description for matching content metadata for a

 document. The chief weakness in binding by inference is the

 reliability of the matching of the metadata to the policy target

 description. There are a number of factors which affects the policy

 matching process:

 \* The set of available metadata varies with different data types

 which makes the policy target definition more complex, e.g.,

 structured data such as SQL databases have structural metadata

 whereas unstructured data such as documents have content metadata.

 \* There is a relationship between the metadata that needs to be captured

 and the policies that need to be enforced. It's therefore hard to

 generalize the rules for what metadata is necessary independent of

 knowing what metadata policies require.

 \* The resultant set of policies to enforce for a decision request is

 dependent on the PDP having a complete the set of policies. It is

 impossible, however, to detect missing policies based on the

 request. Likewise, it is also impossible to detect if erroneous

 policies have been selected based on the request. If data moves

 from store to store and thereby uses different PDPs, it's

 impossible to determine the correctness of the result of the

 policy matching process by the new PDP.

 The Plasma model is choosing to use binding by reference for two

 reasons:

 1 The overarching need to consistently enforce the policies selected

 at creation time over the lifetime of the data. The typical use

 case is that the set of policies to be enforced on the data may

 change their rules over time but it is the same set of policies

 that are enforced over the lifetime of the data.

 2 Data in many cases is mobile and travels between users and

 organizations. Any dependency on consistency of the decision-

 making entity would be difficult to enforce or verify.

5.3 Content Creation Workflow

 The content creation DR bootstraps itself via the following

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 sequence of events:

 (1) The content creation DR is configured with the set PIPs and PDEPs

 it trusts.

 (2) The content creation DR submits a request for a role token to all

 the trusted PDEPs. The role token defines the set of roles the

 PDEP allows for the subject. The subject is authenticated to each PDEP and the

 contents of the role token authorized by each PDEP via attributes

 from the PIP(s). The PIP attributes can be obtained by the PDEP

 either via front-end (relayed to the PDEP from the PIP via the

 subject) or back-end (direct exchange between the PDEP and the

 PIP) processing.

 (3) The content creation DR receives zero or more roles tokens from

 each of the PDEPs. Each role token has a one or more policy

 collections defining the set of allowed policies for that role

 when creating new content.

 The DR is now initialized with a list of roles and role tokens. It is

 now ready to create content and request protection of that content

 from PDEPs. This role token request process would typically be

 performed as part of the application initialization process. Role

 tokens can be cached to reduce the number of times the application has

 to invoke the role token request process. When the user wants to

 create new content, they use the following sequence of events:

 (i) The user creates the new content

 (ii) The user selects the appropriate role for the content, then

 selects one or more policies from the policy collection that are

 applicable to the content. When the content creation process is

 complete, the DR:

 (iii) Encrypts the content with one or more locally-generated CEKs

 (iv) Submits a policy metadata token request to the PDEP together

 with the CEK(s), the set of required policies to be applied, the

 role token from the PDEP, and the hash of the encrypted content.

 The CEK(s) in the request can be either raw key(s) or CEK(s)

 encrypted by a KEK if the policy does not allow the PDEP to have

 the ability to access the plain text data.

 (v) The PDEP verifies the set of requested policies is a subset of

 the policy set in the role token. In addition to the role

 token, the PDEP may also require any other attributes from the

 subject as defined by policy to process the creation request.

 If the request satisfies the policy requirements, the PDEP generates

 the encrypted policy metadata which contains the list of policies and

 the CEKs. The metadata is encrypted by the PDEP for all the PDEPs

 allowed to service decision requests for the data (the content creation

 PDEP does not have to be in the set of PDEPs allowed to make access

 control decisions). The PDEP includes a list of URLs for all of the

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 PDEPs allowed to process decision requests and the hash of the

 protected content as signed authenticated attributes in the policy

 metadata token, then it signs the encrypted metadata.

 (vi) The PDEP returns the policy metadata token to the DR

 (vii) The DR attaches the policy metadata token to the protected

 content and distributes the content.

5.4 Content Consumption Workflow

 When a user wants to open some protected content they would use the

 following workflow:

 (a) The DR verifies the certificate in the signed policy metadata

 then determines via local policy if it wants to process the

 protected information based on the identity of the PDEP.

 (b) The DR verifies the signature on the policy metadata token and

 the binding to the encrypted data by hashing the encrypted

 information and comparing it to the authenticated attribute in

 the policy metadata.

 (c) The DR creates read token request. The request contains the

 signed metadata from the content together with one or more

 authentication tokens issued by a PIP. The request may also

 contain attributes about the request such as the purpose of the use

 of the data.

 (d) The DR sends the read token request to one of the URLs

 of the PDEPs in the authenticated attributes of the signed

 metadata.

 (e) The PDEP decrypts the policy metadata, de-references the policy

 pointers, and determines the set of rules to apply to the

 request based on the policy published by the PAP. The PDEP then

 determines the set of attributes it needs to evaluate the policy

 rules. The PDEP can use PIPs it has direct relationships with to

 query attributes about the subject. If the PDEP is missing

 attributes it needs to process the policy, it returns a list of

 the missing attributes to the DR.

 (f) If the DR receives a list of missing attributes from the PDEP,

 it obtains the missing attributes requested by the PDEP from a

 PIP and sends them to the PDEP in a new read token request.

 (g) Once the PDEP has a complete set of attributes, and the

 attribute values match those required under the access policy,

 the PDEP releases the CEK to the DR along with a TTL which

 defines how long the DR can use the CEK before it must discard

 the CEK and reapply for access.

 (h) Once the DR has the CEK it decrypts the information. It caches

 the CEK until the TTL expires.

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5.5 Plasma Proxy Servers

 There are two separate use cases for proxy servers in Plasma. The

 forward proxy use case where a DR client needs to connect to a PDEP

 outside of its organization and the reverse proxy use case where a DR

 client outside an organization needs to connect to a PDEP.

 A recipient has no control over senders creating Plasma email (or any

 other type of Plasma protected content) and sending it to them.

 Malicious senders can craft harmful payloads and protect it in a

 Plasma envelope. Therefore, Plasma recipients need a policy to

 determine the set of Plasma PDEP services they are willing to interact

 with. This can be a local policy, i.e., a policy for the allowed set of

 PDEPs a DR client can interact with. This policy would need to be

 distributed to every DR client. An alternate approach is to have a

 forward proxy manage the policy on behalf of the DR client. A forward

 proxy would eliminate the need to distribute policy by mediating the

 connection requests from the DR clients to the PDEP services. The

 forward proxy could be a server belonging to the DR client

 organization or a cloud service.

 In the no-proxy use case the DR client would connect via TLS directly

 to the URL contained in the policy metadata. The DR would thus need

 local policy to determine whether to connect to the PDEP URL. If a

 forward proxy is preset, the DR client would attempt to connect via

 TLS to the forward proxy. The forward proxy would then connect to the

 PDEP if its policy allowed.

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 Internet | DMZ | Intranet

 | |

 | |

 | | ---------------

 | | | |

 TLS | | TLS | DR |

 ----------|<------------------------|------| Client |

 | | | |

 (a) | | ---------------

 no proxy | |

 | |

 | |

 | --------------- | ---------------

 | | | | | |

 TLS | | Plasma | | TLS | DR |

 ----------|<-----| Forward |<---|------| Client |

 | | Proxy | | | |

 (b) | | | | ---------------

 Forward | --------------- |

 Proxy | |

 Figure 4 Forward Plasma Proxy

 Since the Plasma service has sensitive cryptographic keys used to

 protect the data CEKs, it would be unwise to host those servers

 directly connected to the Internet. However, PDEPs will need to be

 Internet addressable for requests from DR clients outside the

 organization. The simplest possible configuration would be to have a

 passive reverse proxy in front of the Plasma server. Since Plasma is

 using TLS, a passive proxy cannot inspect the data inside the TLS

 session. The passive proxy has therefore a limited function and would

 be only able to filter based on session characteristics, e.g., source

 IP addresses. The Plasma protocol is a series of request-response

 messages, so an active reverse proxy can be implemented like other

 store-and-forward message based services (e.g., SMTP). The Internet-

 facing proxy server would terminate the TLS connections from the

 external DRs. The active proxy can then scan submitted requests to

 ensure they are not malformed and are free from malicious content

 before relaying messages to a full PDEP server further inside the

 network for processing of the request.

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 Internet | DMZ | Intranet

 | |

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 | | | | | |

 TLS | | Passive | | TLS | Full |

 ----------|------|-------------|----|----->| PDEP |

 | | Reverse | | | Server |

 | | Proxy | | | |

 (a) | | | | | |

 | --------------- | | TLS Keys, |

 | | | Content |

 | | | Encryption |

 | | | Keys |

 | | | |

 | | ---------------

 | |

 | --------------- | ---------------

 | | | | | |

 TLS | | Active | | TLS | Full |

 ----------|----->| Reverse |----|----->| PDEP |

 | | Proxy | | | Server |

 (b) | | | | | |

 | | TLS keys | | | TLS Keys, |

 | | | | | Content |

 | --------------- | | Encryption |

 | | | Keys |

 | | | |

 | | ---------------

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 | |

 Figure 5 Reverse Plasma Proxy

5.6 Policy Types

 Policies range from very simple to very complex. Policies have

 dependencies not only on the technical implementation of the software

 but on the range of attributes a PIP would issue to subjects. This is

 likely constrained by the physical procedures a PIP could support to

 capture and verify the information about the subject. To manage this

 range of requirements, this model uses two type types of policy.

5.6.1 Basic Policies

 Basic policies are intended to be universally usable by employing a

 small, fixed set of attributes that are available from all PIPs. For

 example, basic policies are intended to be equivalent to sending

 encrypted email with S/MIME today, i.e., authenticated recipients of

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 the email get access to the message. Basic policies target scenarios

 involving consumers and small businesses who are using public PIPs

 which issue a limited set of attributes. It is expected that all

 Plasma clients and commercial IdPs would be capable of supporting

 basic policies due to the finite set of attributes required which

 will simplify development, testing, and deployment. Later standards

 may expand the set of attributes supported by basic policies and hence

 define richer basic policies.

5.6.2 Advanced Policies

 Advanced policies are intended to be used where one or more policies

 are required on the content that require an expanded set of attributes

 from an IdP. They are intended to target more complex policy

 requirements such as content with regulated information or content

 subject to organizational and contractual policies. The input set of

 attributes are defined by the policies. These attributes are, in

 theory, unbounded and can be either primordial such as date of birth,

 or derived attributes such as age, or both. In practice, advanced

 policies are constrained by the set of attributes available under the

 IdP Trust Framework for the subjects. A data object may require

 multiple policies and any instance of multiple policies requires a

 logical relationships between the policies, e.g., they can be AND-ed

 or OR-ed together. It is not expected that all Plasma clients will

 support the rich set of attributes necessary for advanced policies.

6 Message Protection Requirements

6.1 General Requirements

 Confidentiality policy-protected data MUST be protected from

 unauthorized disclosure, be protected from unauthorized alteration, and

 provide data origin authentication.

 Integrity policy protected data MUST be integrity protected from

 unauthorized alteration and provide data origin authentication.

 Every authentication has a level of identity assurance associated with

 it depending on attributes such as the identity checks made about the

 subject and the authentication technology used by the subject. The

 authentication of content creators and content consumers MUST support

 the multiple levels of identity assurance frameworks. (See sections 3.1,

 3.2, 3.3, and 3.4.)

 The specifics of every possible authentication mechanism or every

 detail about how the subject's identity was proofed by the IdP cannot

 be known to the DR and PDEP, therefore the specifics of how the sender

 or recipient achieves the required level of identity assurance MUST be

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 abstracted from the PDEP and DR by use of a simple numeric scale,

 e,g., 0-n where n is linked to an identity assurance framework that

 defines the specifics of how to derive the LoA. (See sections 3.1, 3.2,

 3.3, and 3.4.)

 Access policies are complex and subject to change over time. For this

 reason, policies MUST be identified by reference rather than inclusion

 of the actual policy with the data so the policy change can be

 implemented without updating the data. (See section 3.4.1.)

 Access to the plaintext of the content MUST only be provided after the

 recipient has either provided suitable valid attributes to the PDEP or

 the PDEP finds attributes about the recipient directly from a PIP, thus

 satisfying the policy as defined by the sender. (See sections 3.1 3.2,

 3.3, 3.4.1, and 3.5.)

 The sender MUST be provided with a list of policies applicable to

 content they create and scoped to their current role, i.e., what tasks

 they are currently assigned to deliver. (See sections 3.1, 3.2, and

 3.3.)

 The specifics of the access control policy used by the PDEP MUST be

 abstracted from both the sender's and the recipient's DR, i.e., the DR

 MUST NOT make the access control decision or need specifics of the

 access policy requirements. (See sections 3.1, 3.2, 3.3, and 3.4.)

 A content consumer DR MUST receive authenticated attributes of the

 identity of the creator, the level of identity assurance of the

 creator, and the cryptographic fingerprint of the original content so

 that the DR can confirm who created the content and that the content

 has not been altered. (See sections 3.1, 3.2, 3.3, and 3.4.)

 The key exchange between content creator, content consumer, and the

 PDEP MUST support multiple levels of assurance so an appropriate

 strength of mechanism can be selected based on the level of assurance

 required. For example, for low-assurance situations this could be via

 a plan text CEK over a secure transport such as TLS. For high-

 assurance situations, the recipient MAY be required to provide a

 suitable key exchange key such as an X.509 certificate to encrypt the

 CEK. (See sections 3.3 and 3.4.)

 The level of key exchange assurance required MUST be selected by the

 sender's policy and enforced by the PDEP. (See sections 3.1, 3.2, 3.3,

 and 3.4.)

 If the recipient is unable to initially comply with the sender's

 policy, then if it is subsequently able to get the required

 credentials or attributes it MUST be possible for the recipient to retry access to

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 the content without intervention from the content creator.

 A time-to-live (TTL) MUST be provided to content consumers when access

 is granted by the PDEP to define when the DR MUST discard the message

 CEK and submit a new access request to the PDEP. The TTL value MUST be

 based on the message policy and optional attributes about the content

 consumer and its environment.

 The PDEP MUST be stateless for processing policy requests from content

 creators and consumers with respect to any instance of protected

 content. It MUST be possible to have multiple instances of a PDEP

 service and load balance requests across all instances of the service

 transparently to the client and not require synchronization of state

 about requests between instances of the service.

 A PDEP MUST be capable of generating audit events associated with

 access to protected content using policy defined by the PAP.

6.1.1 Email Specific General Requirements

 It MUST be possible for domains to publish keys and attributes about

 the boundary inspection agents. This allows senders to pre-authorize

 the inspection agents of recipients for access to messages.

 It MUST be possible for MTAs to request access to protected messages

 for which they have not been authorized by the sender. (See section

 3.8)

 It should be possible for an MTA to pre-authorize another MTA to access a

 protected message. (See section 3.8)

6.2 Basic Policy Requirements

 The use of a Basic policy MUST be backwards compatible with existing

 S/MIME.

 A sender's agent MAY discover some recipients' encryption certificates

 and create recipient info structures using the existing S/MIME

 standard (unless specifically forbidden by the selected policy).

 A sender's agent MAY elect to use a Basic Policy mechanism for

 recipients for whom encryption certificates cannot be discovered.

 Four Basic policies are to be defined by this work. These Basic

 policies MUST map to the LoA of NIST 800-63-1. This does not preclude

 other Basic policies to be defined by other groups, trust frameworks,

 or even within the context of the IETF.

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 When using a Basic policy defined by this work, the sending agent MUST

 specify which Basic policy is required and the list of RFC 5322[RFC5322]

 recipients.

 A sender using Basic policy MUST be able to send protected messages

 without discovering a recipient's encryption key.

 A sender using Basic policy MUST NOT require a bilateral agreement

 between sender and recipients as a prerequisite to sending the

 message.

6.2.1 Email Specific Basic Policy Requirements

 The use of Basic Policy MUST be backwards compatible with existing

 S/MIME encryption.

 A sender's agent MAY discover some recipient's certificates and create

 recipient info structures as per the existing S/MIME standard and

 elect to use the new mechanism for recipients it cannot discover keys

 for rather than remove the recipient's without certificates.

6.3 Advanced Policy Requirements

 A Basic policy MAY be combined with Advanced policies.

 It MUST be possible to apply one or more Advanced policies to content.

 Where two or more policies are applied to content, the logical

 relationship between the policies MUST also be expressed, e.g., are the

 policies a logical AND or a logical OR. (See section 3.3)

 An advanced policy MAY require attributes about:

 o The content consumer

 o The device the content consumer is using

 o The environment of the device that is attempting to access the

 protected content

 o The content being accessed

 Advanced policy MUST support an extensible list of obligations on the

 DR or PDEP such as use of the policy requires some specific action on

 the part of the content creator, e.g., signing content with a two-factor

 smart card and/or that the signature complies with the legal

 requirements for the transaction, or the signature needs to be able to

 be verified for an extended period. (See sections 3.3 and 3.4.)

 Advanced policies MUST support the ability to verify the content for

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 an extended period as required by policy. For example policy may

 require signatures to be verifiable for a period of 10 years.

 Advanced policies MUST support the ability to re-sign the data to

 support the verification over the extended period.

7 IANA Considerations

 This document describes the requirements for message access control.

 As such, no action by IANA is necessary for this document

8 Security Considerations

 Authentication by itself is not a good trust indicator. Authentication

 raises the level of assurance that the identity is correct but does not

 address whether the identity is trustworthy or noteworthy to the

 recipient. Authentication should be coupled with some form of

 reputation, e.g., the domain is on a white list or is not on a black

 list. Malicious actors may attempt to "legitimize" a message if an

 indication of authentication is not coupled with some form of

 reputation.

 Malicious actors could attempt to use encrypted email as a way to

 bypass existing message pipeline controls or to mine information from

 a domain. Domains should have sufficient granularity of policy to

 handle situations where their email pipeline agents are not able to

 inspect the contents.

 It must be possible for a third party to, upon correctly presenting a

 legitimate legal justification, to recover the content of a message.

 This includes the sender's and recipient's companies for business

 continuity purposes, as well as law enforcement. If the entity

 requesting the information and the entity controlling the access are

 in different jurisdictions, then the process would be subject to some

 form of rendition.

 The use of a security label type that requires the recipient of a

 message to query a PDEP in order to obtain the contents of a message

 opens an additional method for adversaries to confirm that an email

 address does or does not exist.

 Additionally, it allows for a new channel for materials to be delivered

 to the recipient's mail processor that is not checked for malware or

 viruses by the standard mail scanning methods in place.

 Email is frequently used as part of a password reset ceremony by an

 identity provider. This is problematic when combined with access to

 sensitive email. This could be part of an escalation attack, e.g.,

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 compromise low value email account password, initiate password reset

 via email for higher value account. This would then give access to any

 email protected using the higher value identity.

 Providing differential access to different parts of a message based on

 different policies should only be done via use of different encryption

 keys. All data protected by the same key is under the same access control

 policy.

 It would be desirable to be able to indicate the times and other data

 like request location when a user has asked for access (successful or

 otherwise) to some content as a means to show malicious activity to

 the user.

 Part of the policy is obligations on how to protect the data, e.g.,

 algorithms and parameters required. This can change over time,

 therefore a client may become obligated to re-encrypt or re-digest the

 data if it encounters data which does not meet the current mandate.

 The act of requesting access to messages is a potential privacy issue

 as it allows the sender to gather data about the recipient. For

 business-to-business transactions, disclosure of employee information is

 handled by the organization. For consumers, there is a need to be able

 to consent to the privacy obligations associated with disclosure of

 information. This would include information the consumer releases to

 the PDEP as well as information the PDEP is able to gather such as

 time and location of access requests.

 The fact the PDEP is able to grant access to the data could be used by

 law enforcement to access information. One of the parameters the

 sender needs to be aware of is the jurisdiction the PDEP is under so

 they can make an informed choice.

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