             Mesh of Multiple DAG servers - Results from TISDAG

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Abstract

   The Common Indexing Protocol ([CIP1]) is designed to facilitate the
   creation not only of query referral indexes, but also of meshes of
   (loosely) affiliated referral indexes.  The purpose of such a mesh of
   servers is to implement some kind of distributed sharing of indexing
   and/or searching tasks across different servers.  So far, the TISDAG
   (Technical Infrastructure for Swedish Directory Access Gateways)
   project ([TISDAG], [DAGEXP]) has focused on creating a single
   referral index; the obvious next step is to integrate that into a
   larger set of interoperating services.

1. Introduction

1.1 Overview of mesh possibilities

   Two different possibilities are possible for extending the TISDAG
   service to a mesh model (or some combination of both).  First, it
   should be possible to create a mesh of DAG-based services.  Or, it
   might be interesting to use the mesh architecture to incorporate
   access to other types of services (e.g., the Norwegian Directory of
   Directories).  In either case, the basic principle for establishing a
   mesh is that interoperating services should exchange index objects,
   according to the architecture of the mesh (e.g., hierarchical, or
   graph-like, preferably without loops!).

   As is outlined in the CIP documentation ([CIP1]), many possibilities
   exist for mechanisms for creating indexes over multiple referral
   servers -- for example, WDSP index objects could be passed along

untouched, or a referral index server's contents could be aggregated
into a new index object, generating referrals back to that server.

The proposal is that the mesh should be constructed using index
objects aggregated over participating services' servers.  That is,
referrals will be generated to other recognized services, not their
individual participants.  This can be done as a hierarchy or a level
mesh one-layer deep, but the important reason for not simply passing
forward index objects (unaggregated) is that individual services may
support different ranges of access protocols, have particular
security requirements, etc.  Referrals should be directed to a CAP or
CAPs -- either the standard ones used by the DAG system, or new ones
established to support particular semantics of remote systems (e.g.,
other query types, etc).  Within a given DAG system,  referrals to
these remote servers will look just like any other referral, although
a particular SAP or SAPs may be established to provide query
fulfillment (again, to enable translations between variations of
service, to allow secure access if the relationship between the
services is restricted, etc).

In the following scenarios of mesh traversal, the assumption is that
the primary service in discussion (Country A in Scenario 1, Country B
in Scenario 2) is a DAG-based service.  The scenarios are presented
in the light of interoperating DAG services, but in most cases it
would be equally applicable if the remote service was provided by
some other service architecture.  Again, the key element for
establishing a mesh of any sort is the exchange of the CIP index
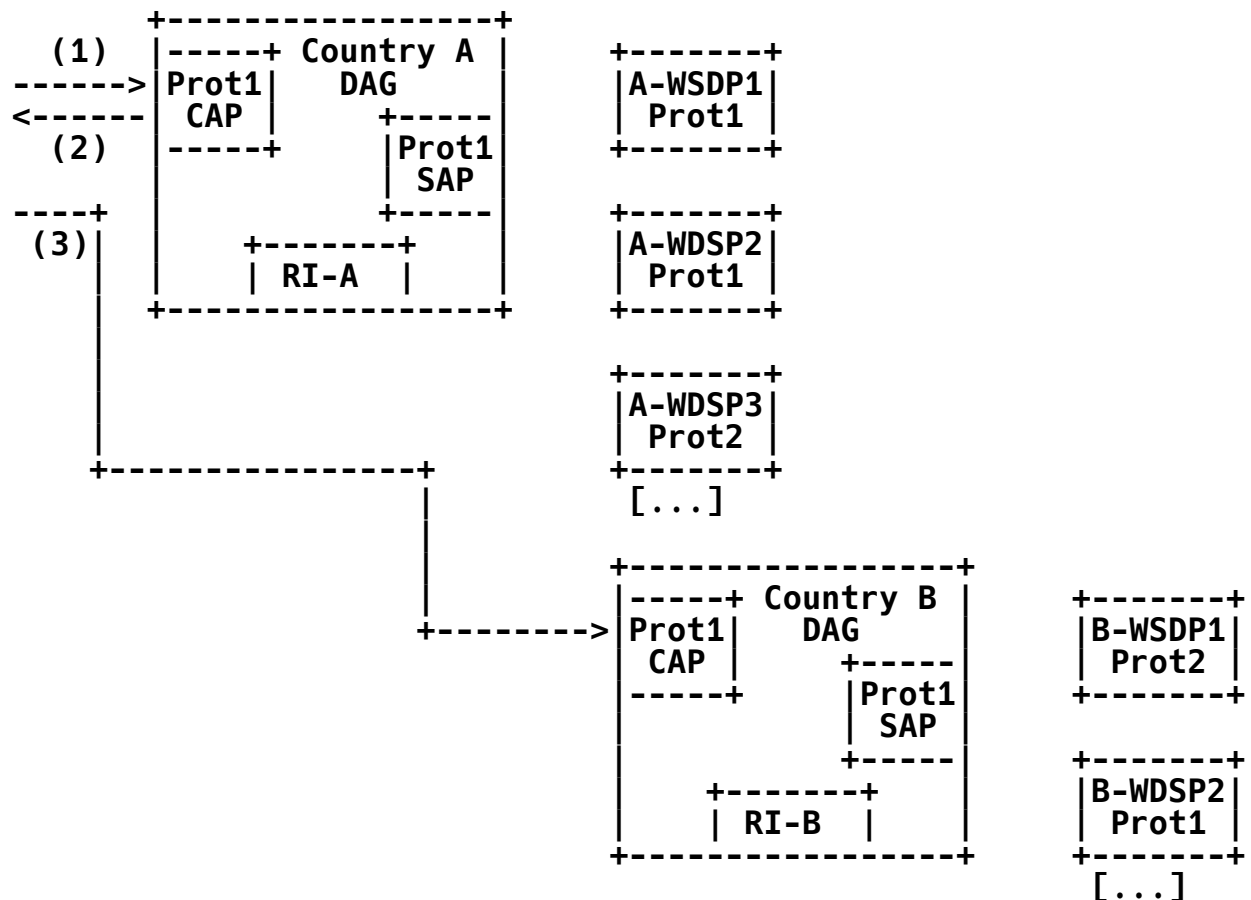object, not internal system architecture.

1.1.1  Scenario 1:  Top Down

Suppose 2 countries tie their services together.  A user makes a
query in Country A.  A certain number of hits are made against the
index objects of A's WDSPs.  There is also a hit in the aggregate
index of Country B.  There are 3 possible cases under which this must
be handled:

Case 1:

Country A and Country B are running services that are essentially the
same -- in terms of protocols, queries, and schema that are
supported.  In this case, one referral should be generated per
protocol supported by Country B's service.  The referral can be
passed back as far as the client, if its protocol supports referrals.
Alternatively, the CAP may chain the referral through an appropriate
SAP, in the usual fashion.  In other words, the CAPs of Country B's
service act as WDSPs to Country A's service.

Consider the following illustration (only relevant CAPs, SAPs, etc,
are shown; others suppressed for lack of room):

```
                    +------------------+
         (1)        |-----+ Country A  |       +-------+
      ------>|Prot1|    DAG   |       |A-WSDP1|
      <------|  CAP |          +-----  |       | Prot1 |
         (2)        |-----+          |Prot1   +-------+
                    |              SAP |
    ----+           |          +-----  +-------+
     (3)|           |   +-------+       |A-WDSP2|
        |           |   | RI-A  |       | Prot1 |
        |           +------------------+       +-------+
        |
        |                                      +-------+
        |                                      |A-WDSP3|
        |                                      | Prot2 |
        |                                      +-------+
        +----------------+                      [...]
                         |
                         |
                         |           +------------------+
              +--------->|-----+ Country B  |       +-------+
                         |Prot1|    DAG   |       |B-WSDP1|
                         |  CAP |          +-----  | Prot2 |
                         |-----+          |Prot1   +-------+
                         |              SAP |
                         |          +-----  +-------+
                         |   +-------+       |B-WDSP2|
                         |   | RI-B  |       | Prot1 |
                         +------------------+       +-------+
                                                     [...]
```

where
    Prot[i] is some particular query protocol
    RI-A has an index over all A-WDSP[i] and RI-B
    RI-B has an index over all B-WDSP[i]
    (1) is the query to the Country A DAG system, which
        yields a referral based on the index object from RI-B
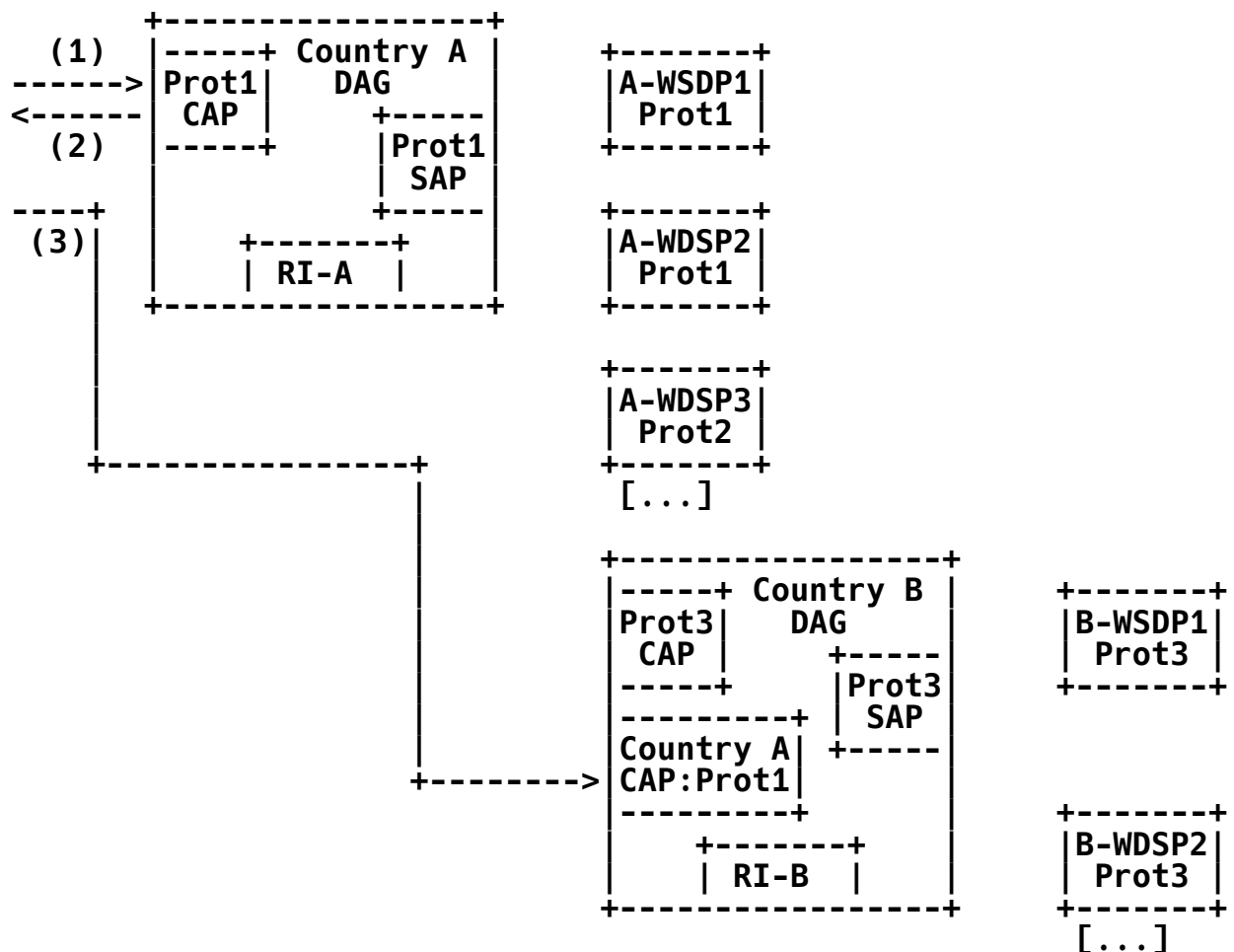    (2) is that referral
    (3) is the resolution of that referral, which the client takes
        to the Country B DAG system directly (to find out which, if
        any, B-WDSP[i] have relevant information)

Case 2:

Country A and Country B are running services that address the same
service type (e.g., whitepages), but are not using an identical
collection of protocols, allowed queries, or schema.  The index
object that Country B sent to Country A's DAG service must be
constructed in terms of Country A's service, in order for appropriate
hits to be generated against the index object (i.e. for referrals to
Country B's service).  However, to resolve the referral, it will be
necessary to do some further protocol/schema/query mapping.  This can
be done by a special SAP established within Country A's service, that
maps Country A's service into the published service of Country B.
Country A may then elect to support only one of Country B's access
protocols, and the designated SAP will always contact one type of CAP
at Country B.

Alternatively, Country B can establish a particular CAP that does the
mapping from Country A's service into something that is most
appropriate against the internal structure of its service.  In this
case, Country A's referral will be to a special CAP in Country B's
service (which, again, will look like a WDSP to the Country A
service); in fact, the referral may be handled directly by the client
software.  The difference between the two possible approaches lies in
the responsibility of managing the relationship between the 2 service
types.  On the one hand, Country A could handle it if it knows its
service as well as the published access to Country B. On the other,
Country B could be responsible for establishing a CAP for every
country that may want to connect to it.  The latter can, in some
cases, be justified by the amount of internal optimization that can
be done, and because it reduces the overhead for Country A's service
(can pass the referral directly back to the client software).

Consider the following illustration (only relevant CAPs, SAPs, etc,
are shown; others suppressed for lack of room):

```
                 +------------------+
       (1)       |-----+ Country A  |      +-------+
     ------->    |Prot1|   DAG      |      |A-WSDP1|
     <------     | CAP |      +-----       | Prot1 |
       (2)       |-----+      |Prot1|      +-------+
                 |            | SAP |
     ----+       |            +-----       +-------+
       (3)|      |    +-------+   |         |A-WDSP2|
          |      |    | RI-A  |   |         | Prot1 |
          |      +------------------+       +-------+
          |
          |                                 +-------+
          |                                 |A-WDSP3|
          |                                 | Prot2 |
     +---------------+                      +-------+
     |               |                       [...]
                     |
                     |
                   +------------------+
                   |-----+ Country B  |      +-------+
                   |Prot3|   DAG      |      |B-WSDP1|
                   | CAP |     +-----        | Prot3 |
                   |-----+     |Prot3|       +-------+
                   |---------+ | SAP |
                   |Country A| +-----
     +-------->    |CAP:Prot1|
                   |---------+                +-------+
                   |   +-------+   |          |B-WDSP2|
                   |   | RI-B  |   |          | Prot3 |
                   +------------------+       +-------+
                                               [...]
```

    where
       Prot[i] is some particular query protocol
       RI-A has an index over all A-WDSP[i] and RI-B
       RI-B has an index over all B-WDSP[i]
       (1) is the query to the Country A DAG system, which
           yields a referral based on the index object from RI-B
       (2) is that referral
       (3) is the resolution of that referral, which the client takes
           to the Country B DAG system directly, but to a CAP that
           is specifically designed to accommodate protocols from
           Country A's service, and map it (and schema) into Country
           B's service.  Likely, all Country B referrals will be
           chained for the Country A client

   Case 3:

   The third possibility is, in fact, a refinement of the first.  If
   Country A and Country B are running services that are every way
   identical except for the data (WDSPs covered), then it may make sense
   to NOT aggregate Country B's WDSP index objects, but to copy them to
   Country A's server.  Then, Country A's CAPs might be given access to
   the SAPs of Country B in order to carry out chaining directly at the
   remote service (instead of implicating Country A's SAPs and Country
   B's CAPs, as in the first example above).  The answer does not come
   from technology -- it depends entirely on the nature of the
   relationship that can be established between Country A and Country
   B's services.

1.1.2  Scenario 2:  Working Up

   The above scenario implicitly assumes that Country A's server had
   received index objects from Country B's server.  This will be the
   case if Country A's server is higher in the levels of a hierarchy of
   services (established by agreements between the service operators),
   or if the network is comprised of servers that share their index
   objects with all others, for example.  In the latter case, searching
   at any one of the servers in the service yields the full range of
   results -- referrals will be made to any other server that might have
   data that fulfills the user's query.  The sharing of the index
   objects is a mechanism to allow each server to manage local data,
   while enabling distributed load-sharing on the basic query handling.

   However, if a hierarchical, or at least not-completely-connected
   model is used for the server network, queries carried out at a level
   other than the top of the hierarchy, or in one particular branch of
   the hierarchy, will not actually be matched against all index
   objects.  Therefore, there may be other servers to which the query
   should be directed if the full space needs to be searched. Suppose,
   for example, that in the above example Country B is in fact lower in
   the hierarchy than Country A.  A user sending a query to Country B's
   service may be content to limit the scope of the query to that
   country's information (this is true in enough real-life situations
   that this hierarchical relationship becomes an effective mechanism
   for scoping queries and avoiding having to flood the entire network
   with every single query or keep full copies of all data in every
   server).

   Still in theoretical stages, the DAG/IP provides control constructs
   to allow DAG components to act according to the topology of the mesh.
   A CAP might use the "polled-by" system command to establish what
   other servers in the mesh exist in higher levels (and therefore would
   be worth contacting if the scope of the search is to be increased).

In the example above, a CAP in Country B's system could determine
that Country A's service was polling Country B, and therefore make it
a logical target for expanding the scope of the query.  More
experience (primarily with server mesh topologies) is necessary
before it will be clear how to best make use of these capabilities:

- . should the CAP always broaden the scope? only if there are no
  local referrals? under user direction?
- . should the CAP use a local SAP to contact the remote service's
  CAP?
- . is it better to completely connect the mesh of servers, or
  produce some kind of hierarchy?
- . etc

## 2. Other considerations

Depending on the context in which a mesh is established (e.g.,
between national white pages services, or different units of a
corporate organization, etc), it may be useful to allow individual
WDSPs to indicate whether they are willing to have their data
included in a DAG system's aggregated index object (i.e., allowing
the DAG system to receive referrals from other systems in the mesh).

## 3. Security Considerations

This document describes different configurations for sharing
information between information services.  It introduces no security
considerations beyond those attendant in (and addressed by)
particular directory service access protocols.

## 4. Acknowledgements

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going project of Ericsson.  For further information regarding that
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6. References

   Request For Comments (RFC) and Internet Draft documents are available
   from numerous mirror sites.

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             Indexing Protocol (CIP)", RFC 2651, August 1999.

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7. Full Copyright Statement

Acknowledgement