The Developer Meeting Agenda
- Advanced Security Features -

NEC OSS Promotion Center

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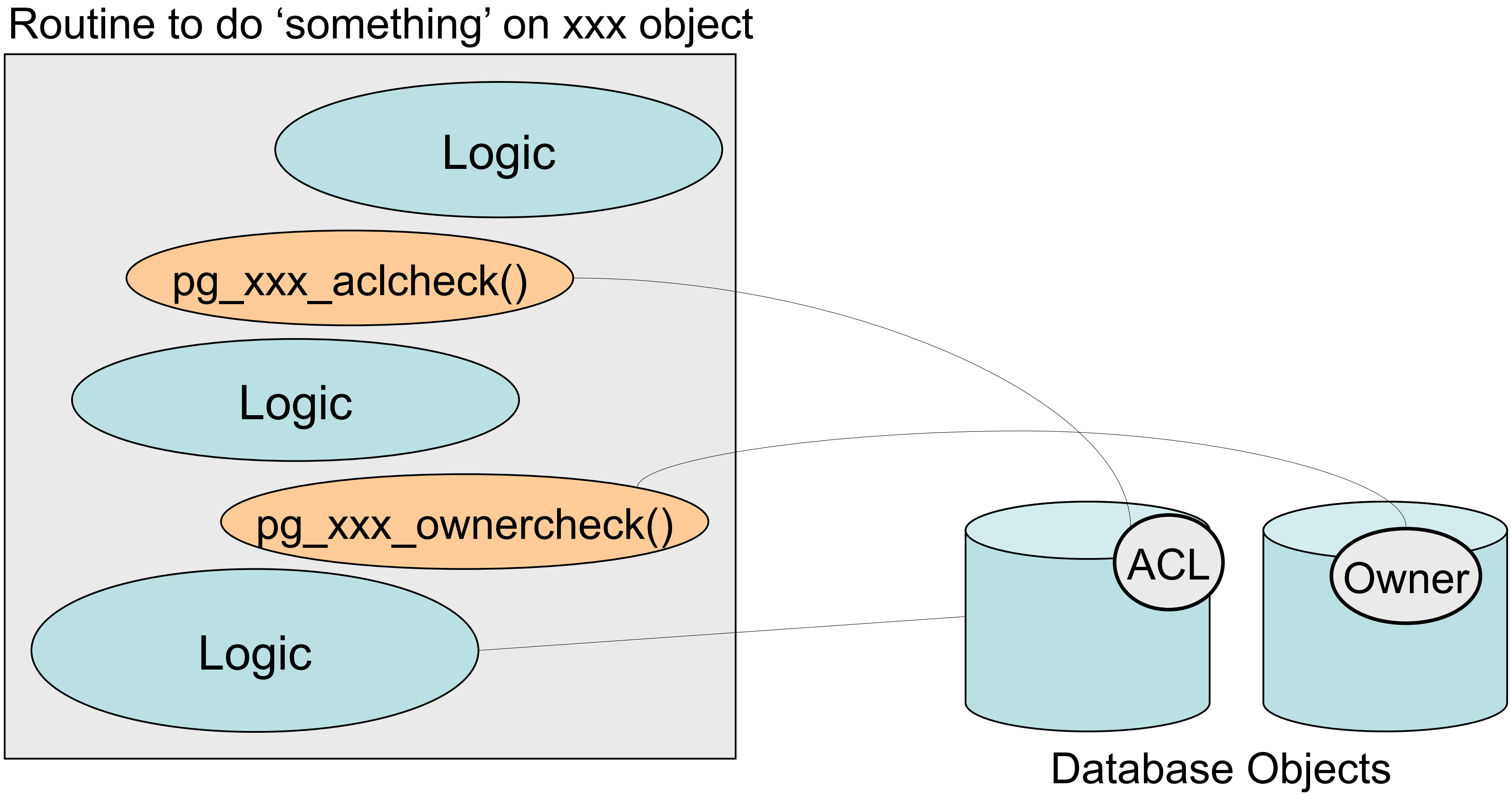
My Topics in v9.1

- External Security Providers
  - Step.1: Reworks existing access controls
  - Step.2: Add security label support
  - Step.3: Add SELinux support
- Row-level Access Controls
  - A few issues to be resolved here
    - using VIEWs for row-level access controls
    - PK/FK constraints with RLS
    - And so on...

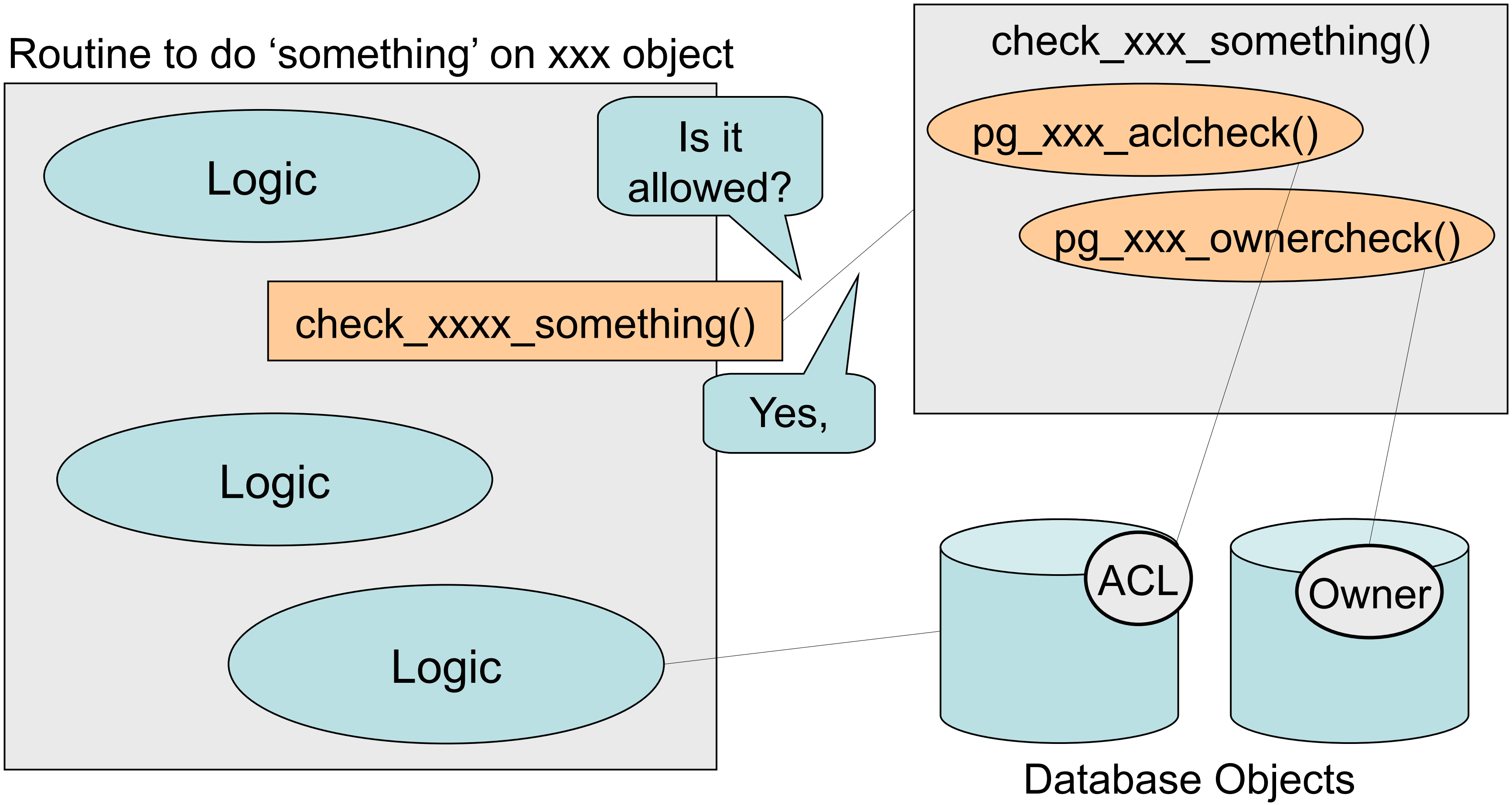
External Security Providers (0/3)

Step.0: Current implementation



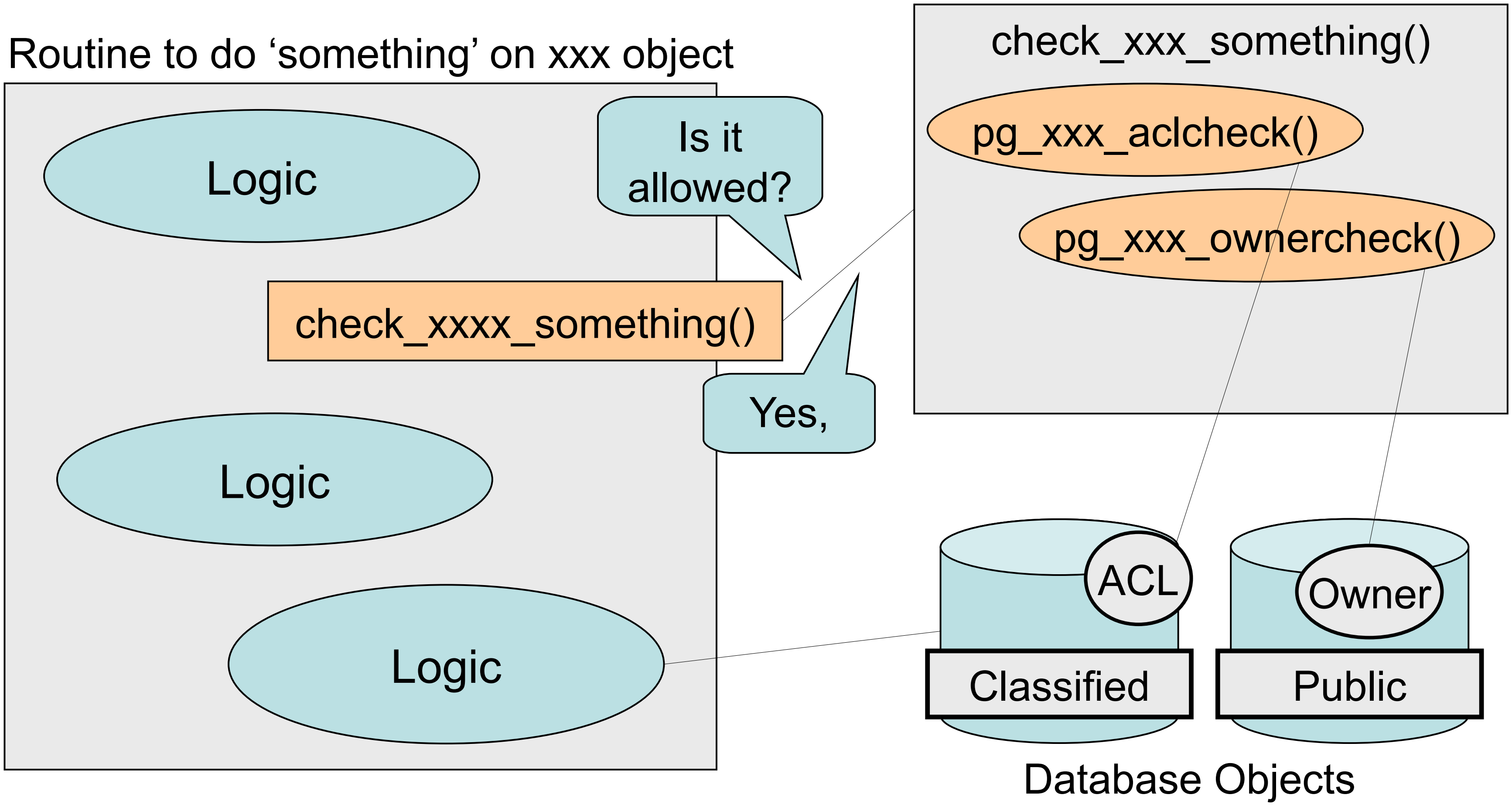
External Security Providers (1/3)

Step.1: Reworks existing access control



External Security Providers (2/3)

Step.2: Add security label support

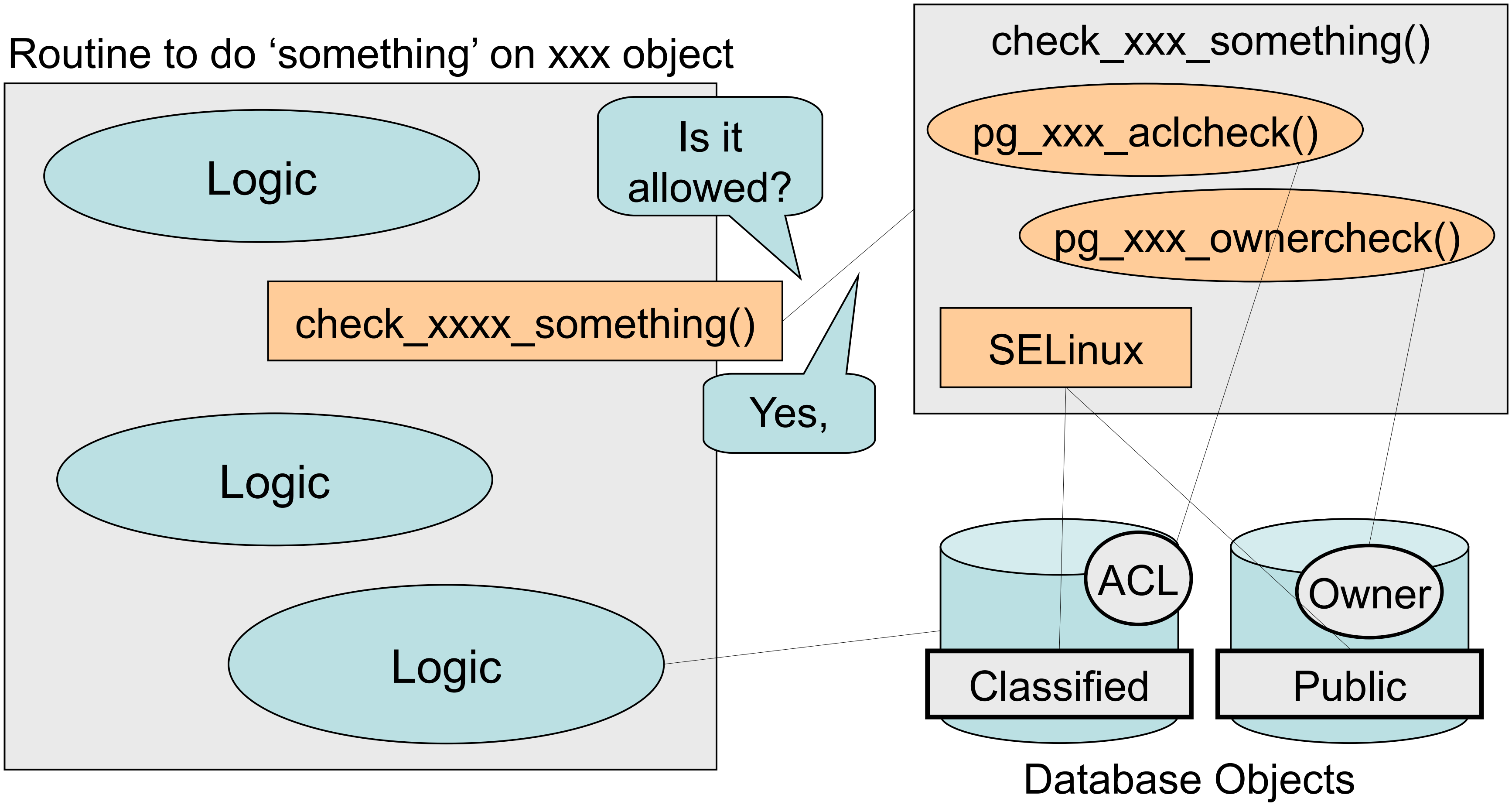


Routine to do 'something' on xxx object

Database Objects

External Security Providers (3/3)

Step.3: Add SELinux support



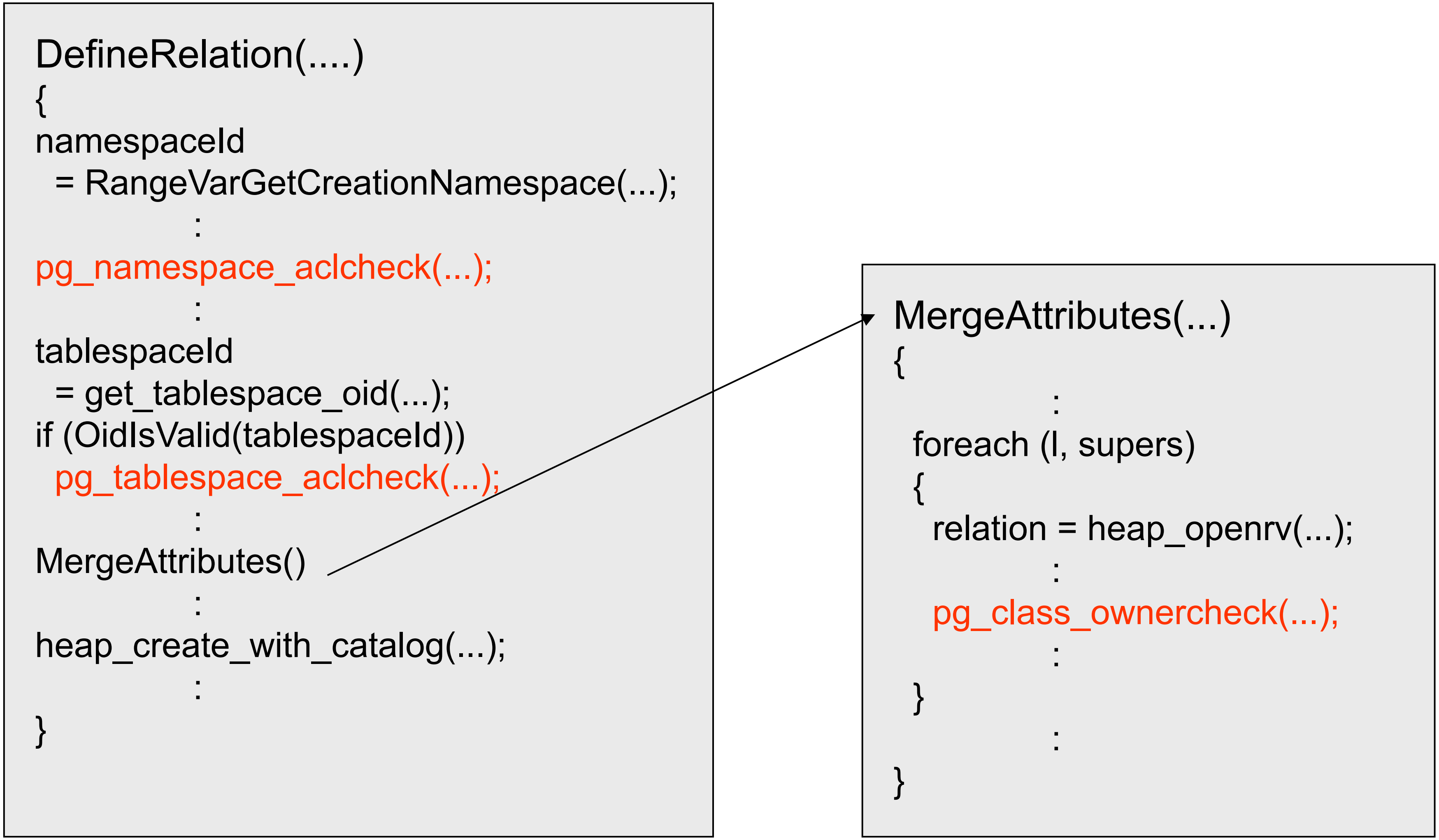
Benefits

- Clear code separation between PostgreSQL and SELinux part
  - Loadable module may be an option?
- Allow to accept various security models
  - Not only SELinux

Step.1: Reworks existing access control

- Policy for reworking
  - At the execution stage
  - All the checks at once
  - Invocation as soon as possible, after all the needed informations are gathered
- Naming convention
  - check_<object class>_<action> (args, ...)
  - E.g) void check_relation_alter(Oid relOid, ...);

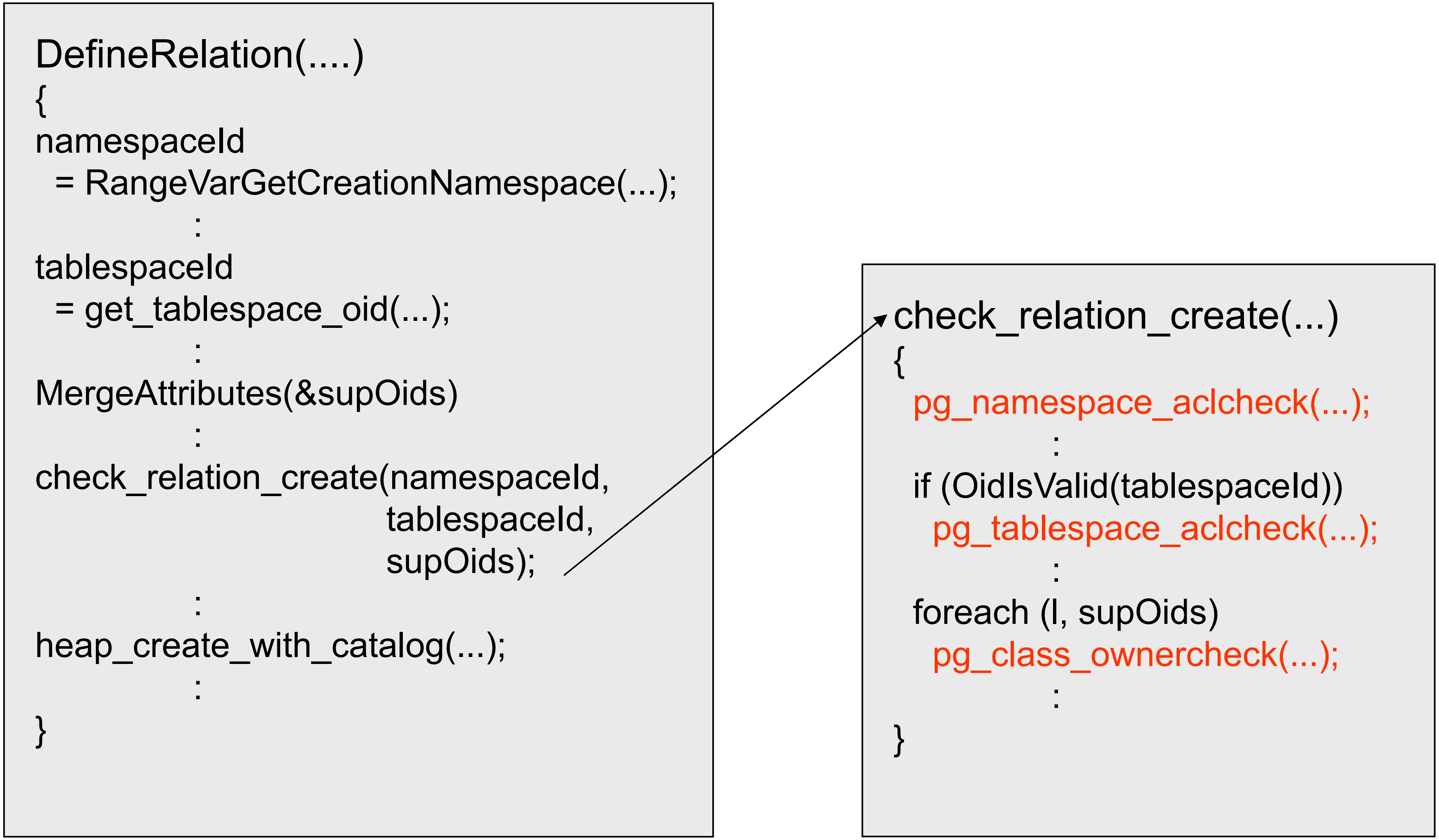
Example: creation of a new table



```
DefineRelation(....)
{
namespaceId
  = RangeVarGetCreationNamespace(...);
                :
pg_namespace_aclcheck(...);
                :
tablespaceId
  = get_tablespace_oid(...);
if (OidIsValid(tablespaceId))
  pg_tablespace_aclcheck(...);
                :
MergeAttributes()
                :
heap_create_with_catalog(...);
                :
}
```

```
MergeAttributes(...)
{
                :
  foreach (l, supers)
  {
    relation = heap_openrv(...);
                :
    pg_class_ownercheck(...);
                :
  }
                :
}
```

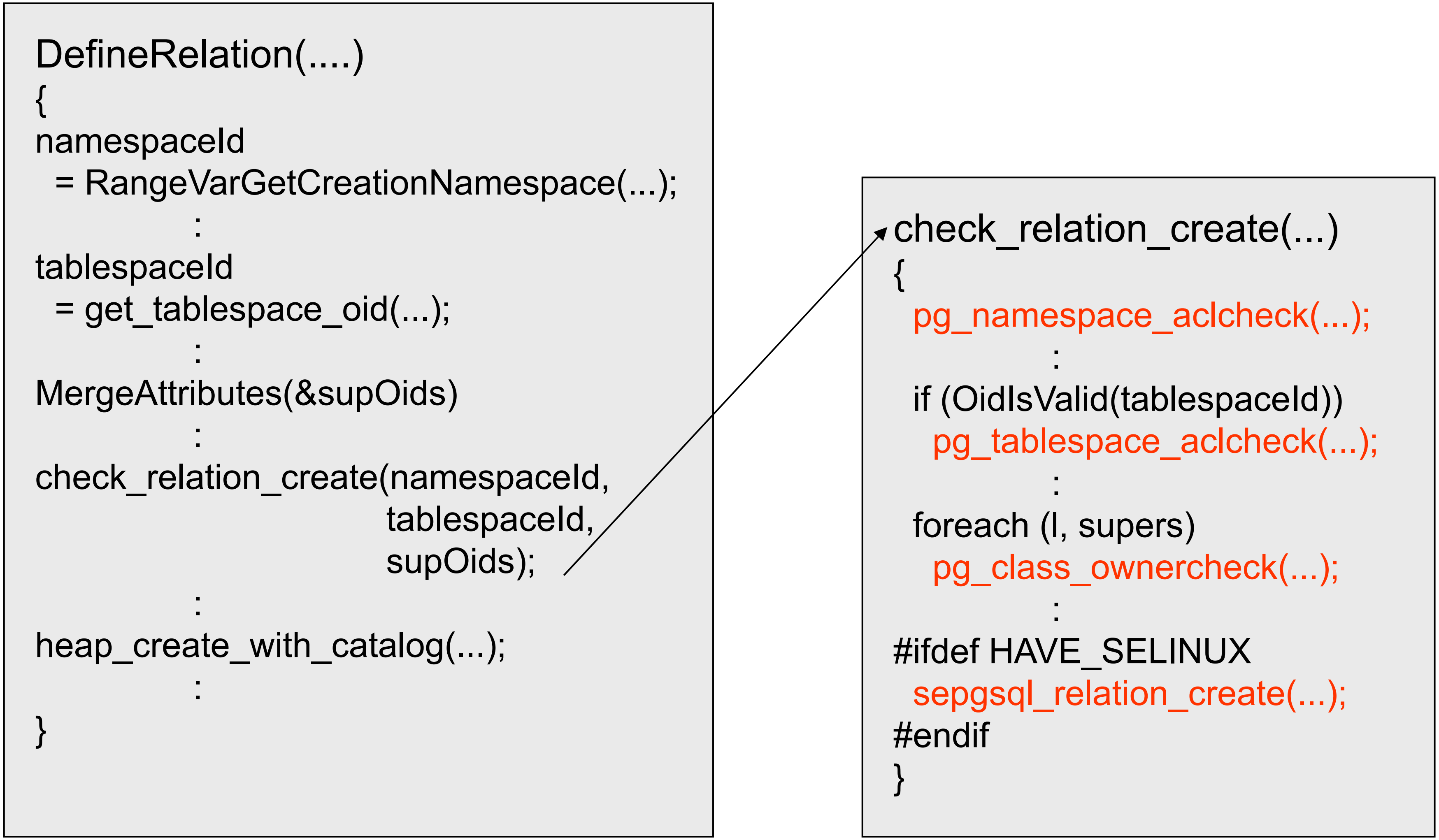
Example: creation of a new table



```
DefineRelation(....)
{
namespaceId
  = RangeVarGetCreationNamespace(...);
                :
tablespaceId
  = get_tablespace_oid(...);
                :
MergeAttributes(&supOids)
                :
check_relation_create(namespaceId,
                                   tablespaceId,
                                   supOids);
                :
heap_create_with_catalog(...);
                :
}
```

```
check_relation_create(...)
{
  pg_namespace_aclcheck(...);
                :
  if (OidIsValid(tablespaceId))
    pg_tablespace_aclcheck(...);
                :
  foreach (l, supOids)
    pg_class_ownercheck(...);
                :
}
```

Example: creation of a new table



```
DefineRelation(....)
{
namespaceId
  = RangeVarGetCreationNamespace(...);
                :
tablespaceId
  = get_tablespace_oid(...);
                :
MergeAttributes(&supOids)
                :
check_relation_create(namespaceId,
                                  tablespaceId,
                                  supOids);
                :
heap_create_with_catalog(...);
                :
}
```

```
check_relation_create(...)
{
  pg_namespace_aclcheck(...);
                :
  if (OidIsValid(tablespaceId))
    pg_tablespace_aclcheck(...);
                :
  foreach (l, supers)
    pg_class_ownercheck(...);
                :
#ifdef HAVE_SELINUX
  sepgsql_relation_create(...);
#endif
}
```

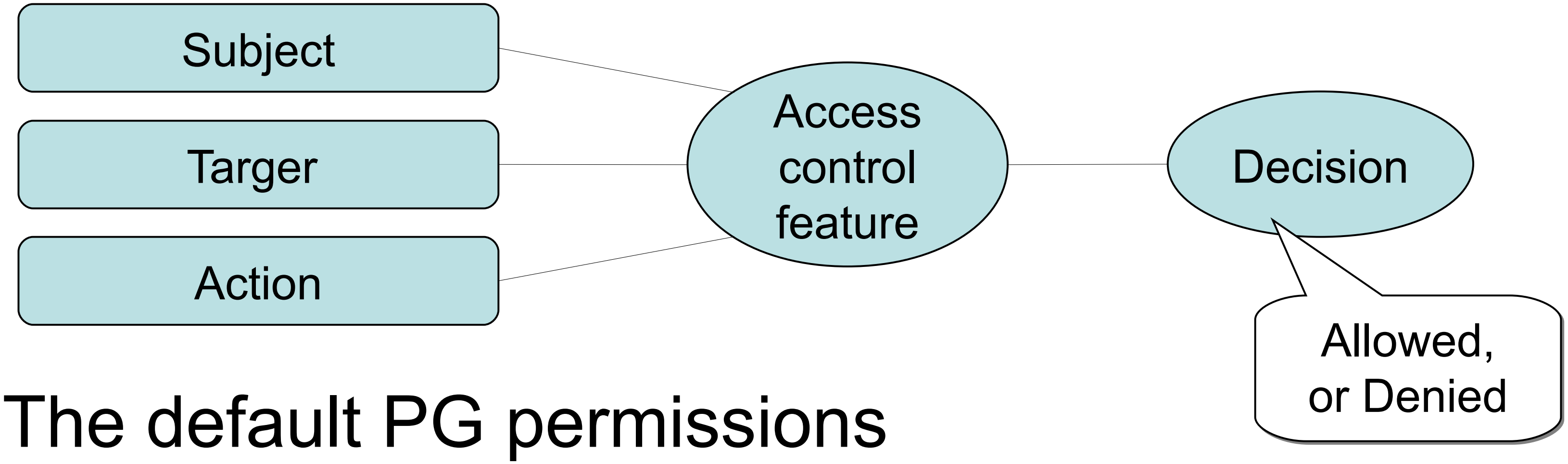
Issue: scale of reworks

- If we try to rework anything at once, the patch will too large to commit.
- The patch should be divided into per object class basis.
  - About 200-500Line/Patch in most cases

Step.2: Security label support

- Security label
  - A text identifier used to MAC security
    - In DAC, similar to owner-id and ACLs
  - E.g) “system_u:object_r:postgresql_db_t:s0”
- Requirement
  - Capability to assign a text label on an object
    - Note: massive number of objects tends to share small number of security labels.

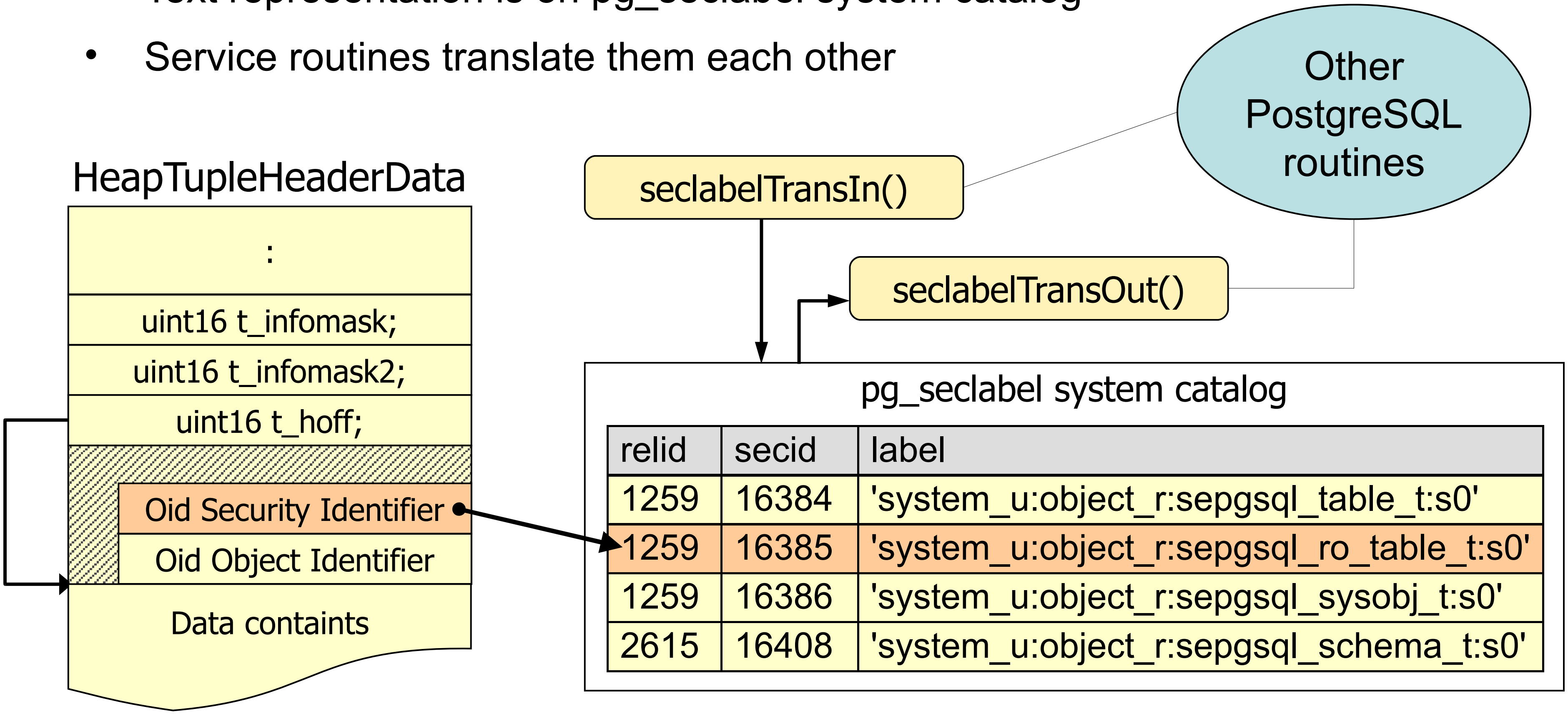
Access control decision



- The default PG permissions
  - S: Database User-Id
  - T: Ownership/ACLs of the object
  - A: defined in the model (ACL_SELECT, ...)
- Labeled based MAC (such as SELinux)
  - S: Label of the client
  - T: Label of the object
  - A: defined in the model (db_table:{select}, ...)

Plan: The way to store labels

- A tuples has a security identifier (4-bytes), if HEAP_HASSECID is set
  - Similar to OID management
- Text representation is on pg_seclabel system catalog
- Service routines translate them each other

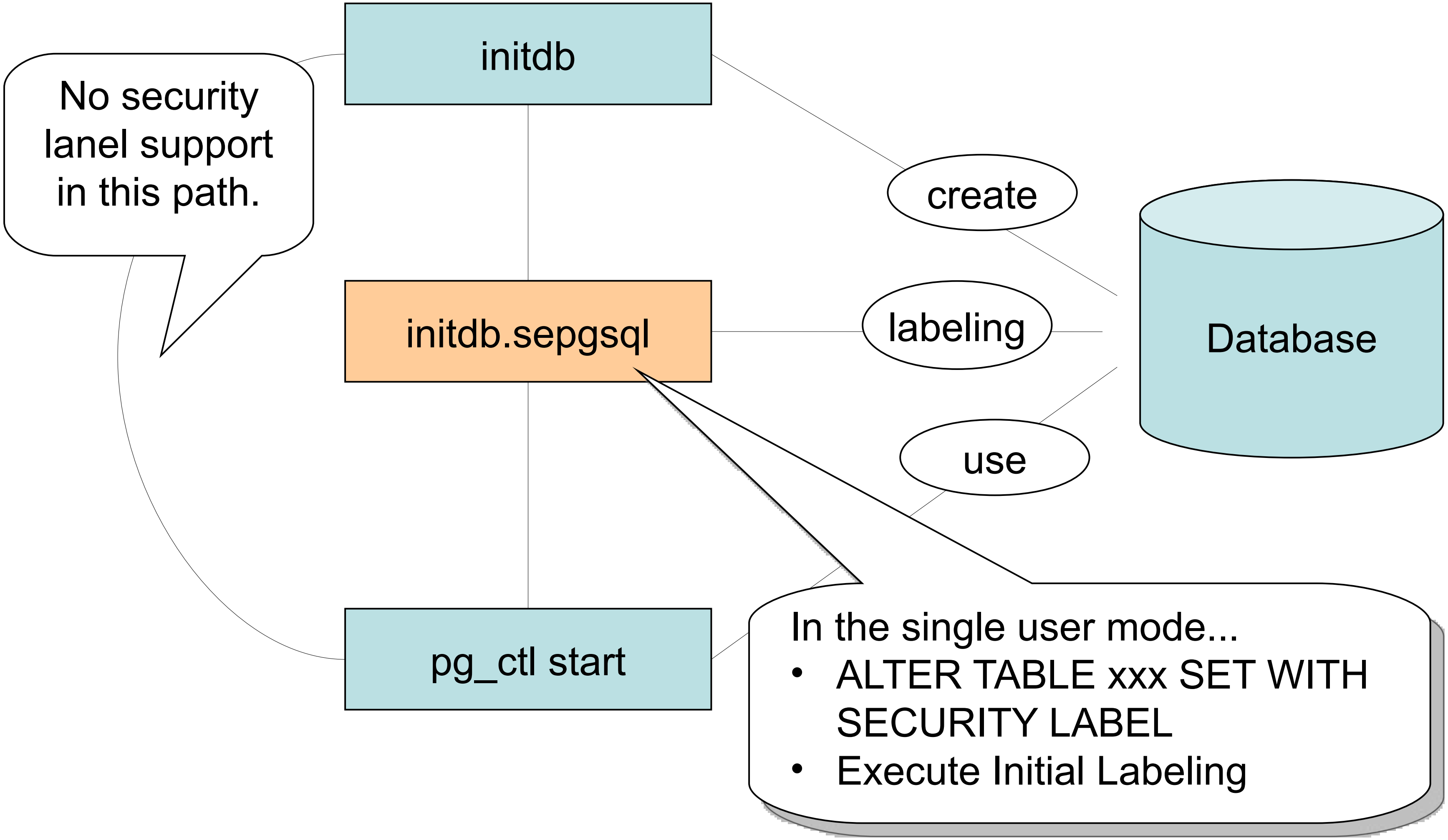


relid	secid	label
1259	16384	'system_u:object_r:sepgsql_table_t:s0'
1259	16385	'system_u:object_r:sepgsql_ro_table_t:s0'
1259	16386	'system_u:object_r:sepgsql_sysobj_t:s0'
2615	16408	'system_u:object_r:sepgsql_schema_t:s0'

Plan: Statement for management

- ALTER TABLE <*name*>
  SET WITH/WITHOUT SECURITY LABEL
  - add/remove ‘security_label’ system column
  - If no MAC, no storage needed for labels
- ALTER xxx <*name*>
  SECURITY LABEL TO *‘<label>’*
  - It changes security label of the object

Plan: Step to label database



No security lanel support in this path.

In the single user mode...

- ALTER TABLE xxx SET WITH SECURITY LABEL
- Execute Initial Labeling

An Alternative (simplified) Idea

- Add “seclabel text[]” for labeled catalogs
  - Similar to reloptions
- Merits
  - Design is simple (suitable for the 1st phase)
- Demerits
  - Needs to redesign when RLS with MAC
  - Waste of storage, and unignorable performance loss
- Issues
  - Multiple security providers should be supported concurrently?

Step.3: Add SELinux support

- We need to do
  - Put SELinux hooks on the new security functions (at step.1)
  - SELinux code makes access control decision using security labels (st step.2)
- Which is more preferable?
  - SELinux code in #ifdef ... #endif block
  - SELinux code in Loadable-module

Row-level access controls

- Issues on the wikipage
  - Covert channel
  - Order to evaluate row-level policy
    Same issue with "using VIEWs for RLS"
    - ➡ Need helps from optimizer experts
  - TRUNCATE, COPY TO statement
  - Table inheritance
  - FK constraints
  - New grammer for RLS setup

Issue: Using VIEW for RLS (1/2)

```
SELECT * FROM v WHERE user_func(v.x);
➡ SELECT * FROM (SELECT * FROM t WHERE policy_func(x)) v
                      WHERE user_func(v.x);
➡ Scan table:  t quals: user_func(v.x) => policy_func(x)
```

- Order to evaluate scan qualifiers
  - x=1 should be earlier than user_func()
  - **order_qual_clauses()** sort the node within quals for the given scan plan
- Idea
  - FuncExpr should remember nestlevel?

Issue: Using VIEW for RLS (2/2)

```
SELECT * FROM v WHERE user_func(v.x);
➡ SELECT * FROM (SELECT * FROM l JOIN r ON l.a=r.x)
                                 WHERE user_func(r.x);
➡ Scan table: l
          table: r  quals: user_func(r.x)
  Join    qual: a=x
```

- User defined function comes into JOINs
  - a=x should be earlier than user_func()
  - **distribute_qual_to_rels()** tries to chain the qual node on the scan node with least dependent
- Idea
  - Also, FuncExpr should remember nestlevel?

Trusted and Untrusted nodes

- Trusted nodes
  - Operator, Index access method,
    Type In/Out methods, Conversion, ...
- Untrusted nodes
  - User defined functions, others?
- Point of idea
  - If we can ensure the node is harmless,
    it can come into more deep nestlevel.
  - Index scan with user given condition,
    instead of SeqScan

RLS and FK Constraints

- Covert channels
  - No major RDBMS handles CC with RLS
- RLS and FK Constraints
  - FK is implement with secondary query
  - Using two modes
    - Filter mode
      - In normal, violated tuples are filtered
      - policy functions should be checked at first.
    - Abort mode
      - In FK checks, violated tuples cause an error
      - policy functions should be checked at last

Thanks for the discussion