Android Content Providers: Programming with Content Resolvers

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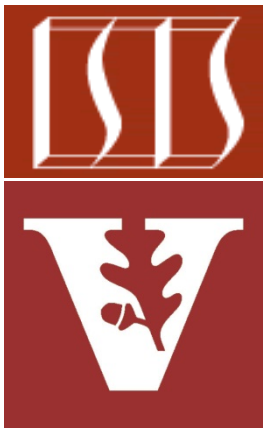

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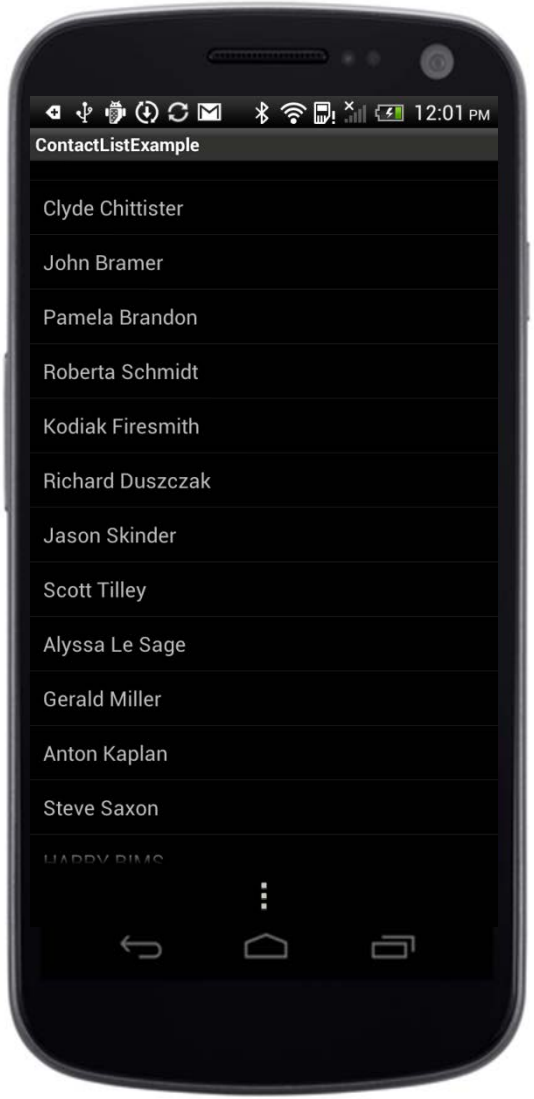
Learning Objectives in this Part of the Module

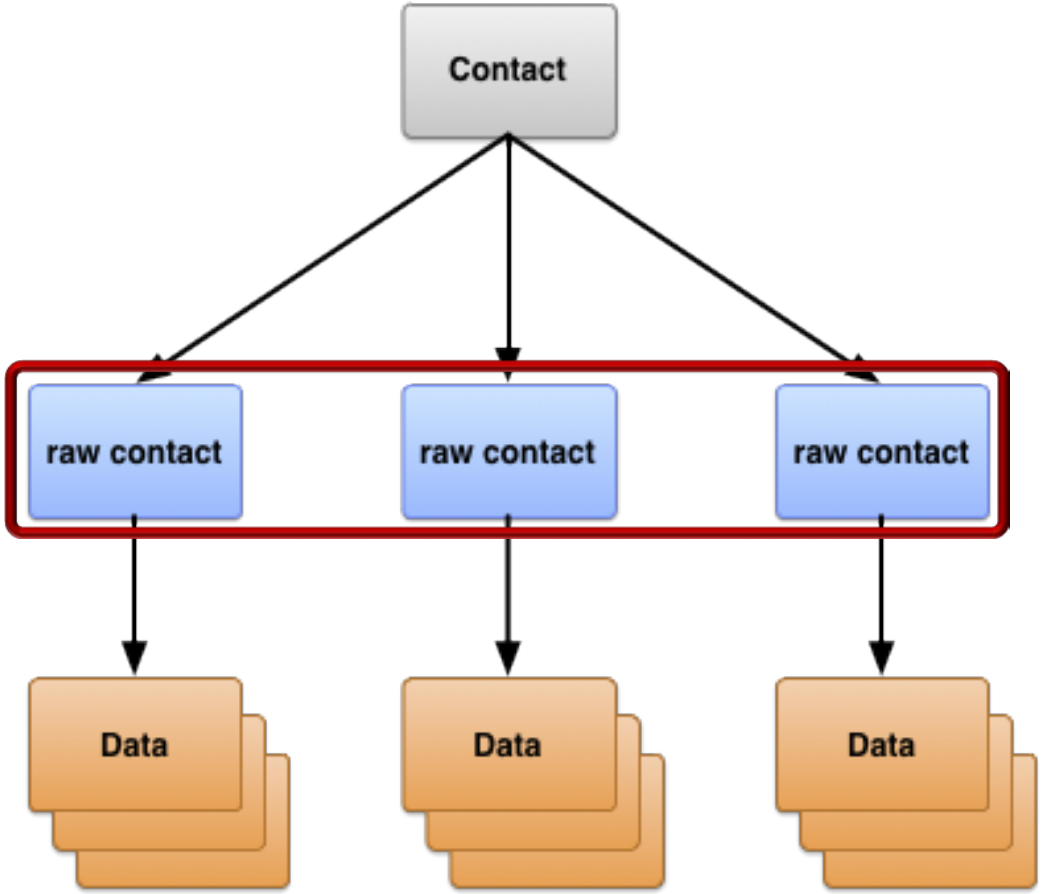
- Understand how to program an App that uses a Content Resolver to retrieve & manipulate names in a phone user's Contacts Content Provider

Contacts Content Provider



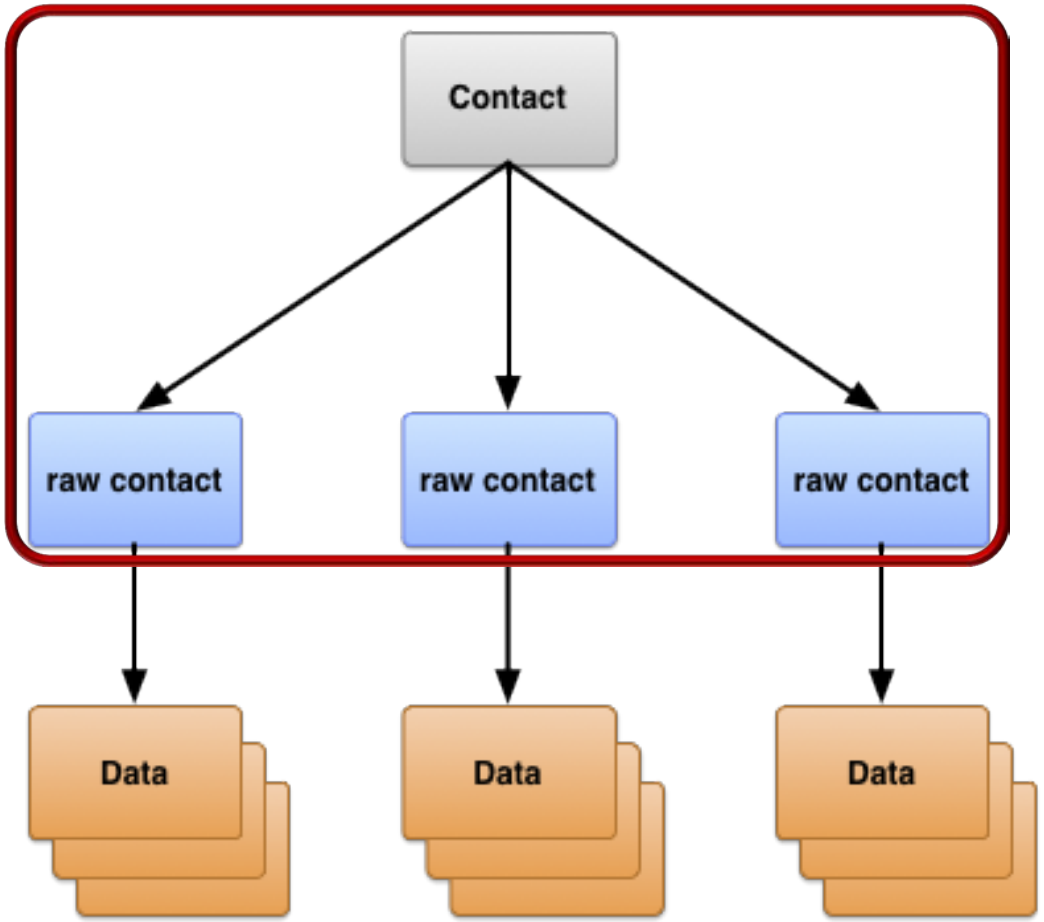
Overview of the Contacts Content Provider

- Contacts Provider is a powerful & flexible component that manages the device's central repository of data about people
  - A raw contact represents a person's data coming from a single account type & account name



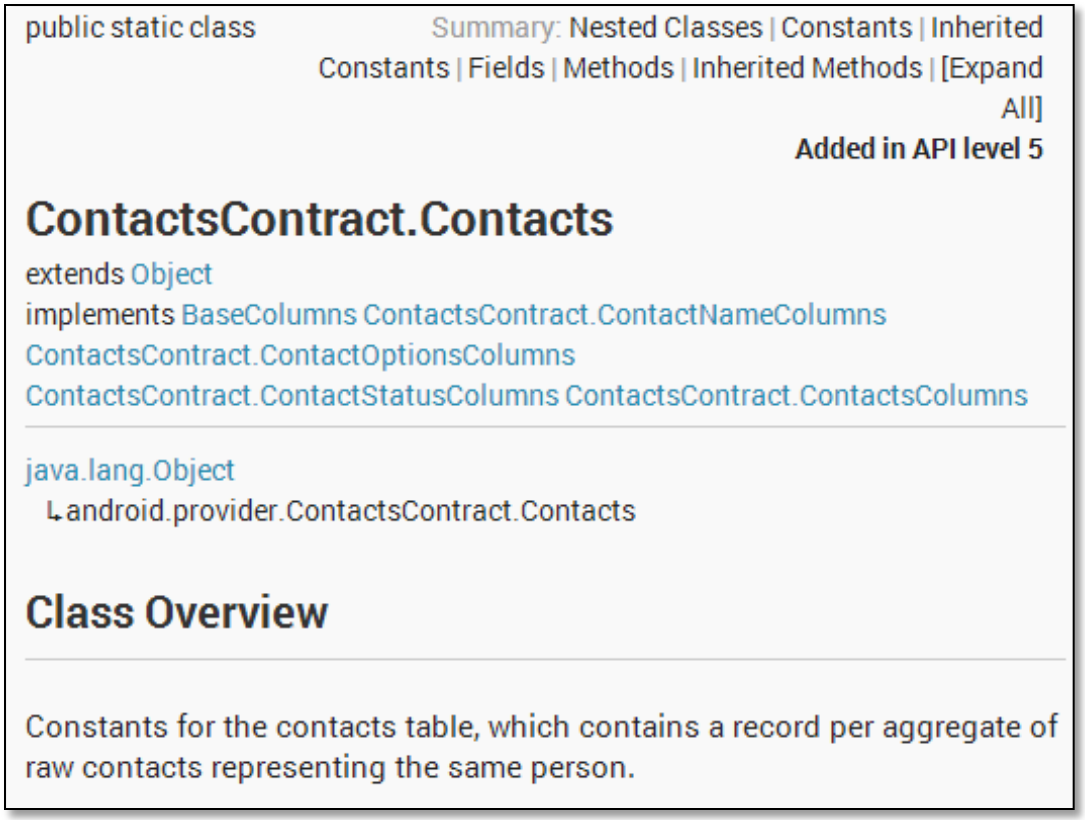
Overview of the Contacts Content Provider

- Contacts Provider is a powerful & flexible component that manages the device's central repository of data about people
  - A raw contact represents a person's data coming from a single account type & account name
  - The Contacts Provider allows multiple raw contacts for the same person



Overview of the Contacts Content Provider

- Contacts Provider is a powerful & flexible component that manages the device's central repository of data about people
- It provides three tables used in a device's “Contacts” App
  - ContactsContract.Contacts – Rows represent different people



public static class

Summary: Nested Classes | Constants | Inherited Constants | Fields | Methods | Inherited Methods | [Expand All]

Added in API level 5

ContactsContract.Contacts

extends Object

implements BaseColumns ContactsContract.ContactNameColumns ContactsContract.ContactOptionsColumns ContactsContract.ContactStatusColumns ContactsContract.ContactsColumns

java.lang.Object

↳android.provider.ContactsContract.Contacts

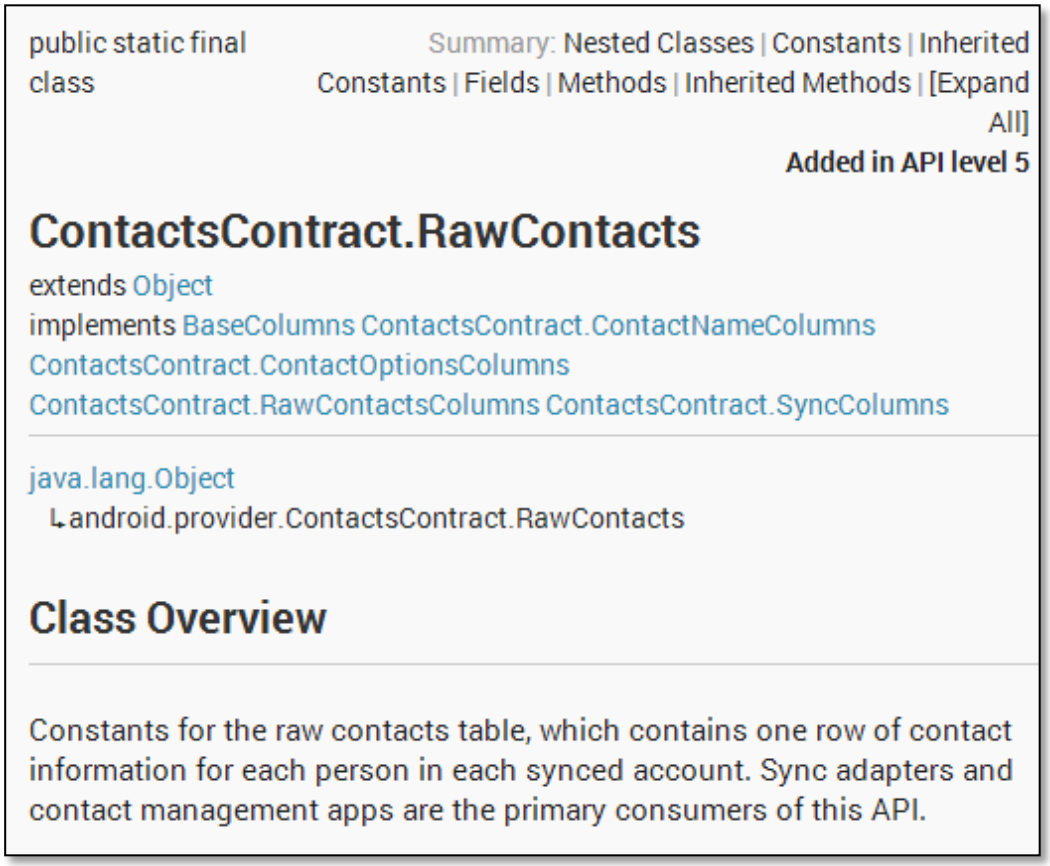
Class Overview

Constants for the contacts table, which contains a record per aggregate of raw contacts representing the same person.

developer.android.com/reference/android/provider/ContactsContract.Contacts.html

Overview of the Contacts Content Provider

- Contacts Provider is a powerful & flexible component that manages the device's central repository of data about people
- It provides three tables used in a device's "Contacts" App
  - ContactsContract.Contacts – Rows represent different people
  - ContactsContract.RawContacts – Rows contain a summary of a person's data
    - e.g., specific to a user account & type



public static final class

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Added in API level 5

ContactsContract.RawContacts

extends Object

implements BaseColumns ContactsContract.ContactNameColumns ContactsContract.ContactOptionsColumns ContactsContract.RawContactsColumns ContactsContract.SyncColumns

java.lang.Object

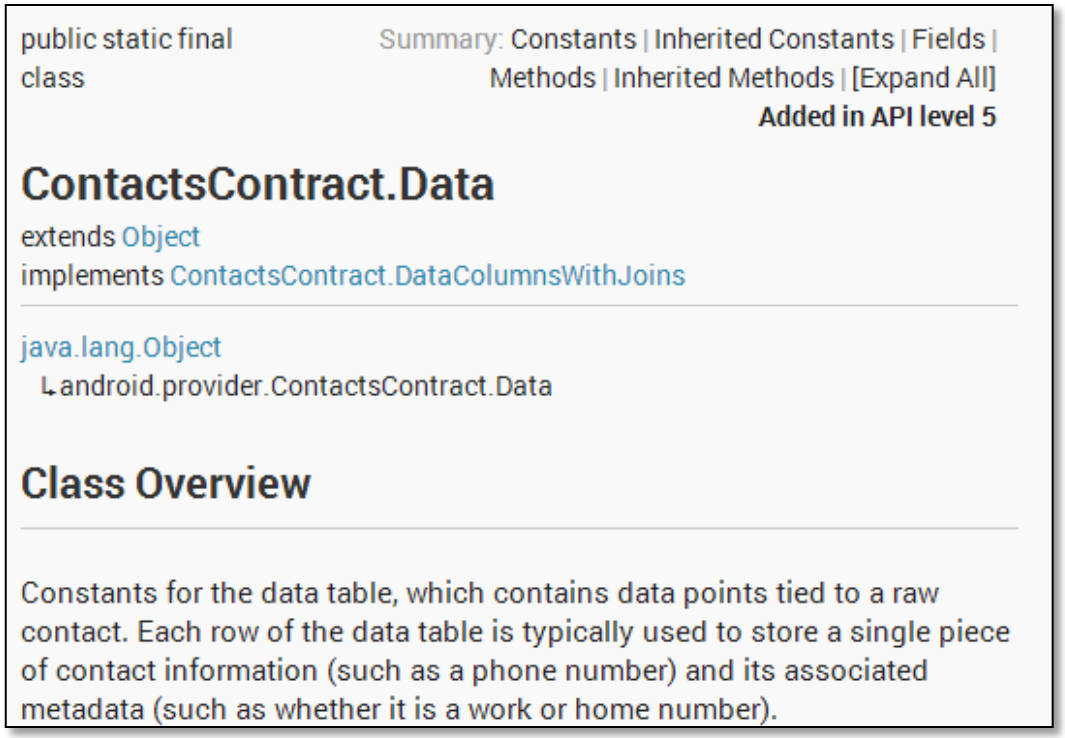
↳android.provider.ContactsContract.RawContacts

Class Overview

Constants for the raw contacts table, which contains one row of contact information for each person in each synced account. Sync adapters and contact management apps are the primary consumers of this API.

Overview of the Contacts Content Provider

- Contacts Provider is a powerful & flexible component that manages the device's central repository of data about people
- It provides three tables used in a device's “Contacts” App
  - ContactsContract.Contacts – Rows represent different people
  - ContactsContract.RawContacts – Rows contain a summary of a person's data
  - ContactsContract.Data – Rows contain details for raw contact
    - e.g., email addresses or phone numbers



public static final class

Summary: Constants | Inherited Constants | Fields | Methods | Inherited Methods | [Expand All]

Added in API level 5

ContactsContract.Data

extends Object

implements ContactsContract.DataColumnsWithJoins

java.lang.Object

↳android.provider.ContactsContract.Data

Class Overview

Constants for the data table, which contains data points tied to a raw contact. Each row of the data table is typically used to store a single piece of contact information (such as a phone number) and its associated metadata (such as whether it is a work or home number).

developer.android.com/reference/android/provider/ContactsContract.Data.html

Overview of the Contacts Content Provider

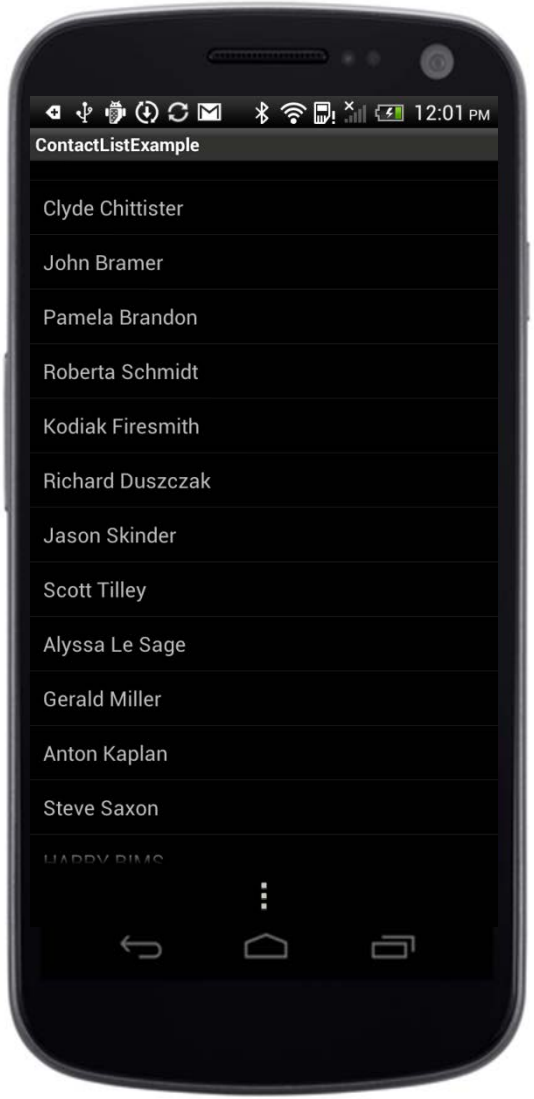
- Contacts Provider is a powerful & flexible component that manages the device's central repository of data about people
- It provides three tables used in a device's "Contacts" App
- Android defines a Content URI for retrieving & modifying an Android Contacts Content Provider database

```
public final class ContactsContract {
  public static final String
    AUTHORITY =
      "com.android.contacts";
  public static final Uri
    AUTHORITY_URI =
      Uri.parse("content://"
                + AUTHORITY);

  public static class Contacts
                      implements ... {
    public static final Uri
     CONTENT_URI =
       Uri.withAppendedPath
         (AUTHORITY_URI,
          "contacts");
```

Simple Example of Listing Contacts

- This simple App lists the names of all the entries in the Contacts Content Provider



Contacts Content Provider

Simple Example of Listing Contacts

```
public class ContactsListExample extends ListActivity {
  public void onCreate(Bundle savedInstanceState) {
    ...
    ContentResolver cr = getContentResolver();
```

Get ContentResolver & perform query

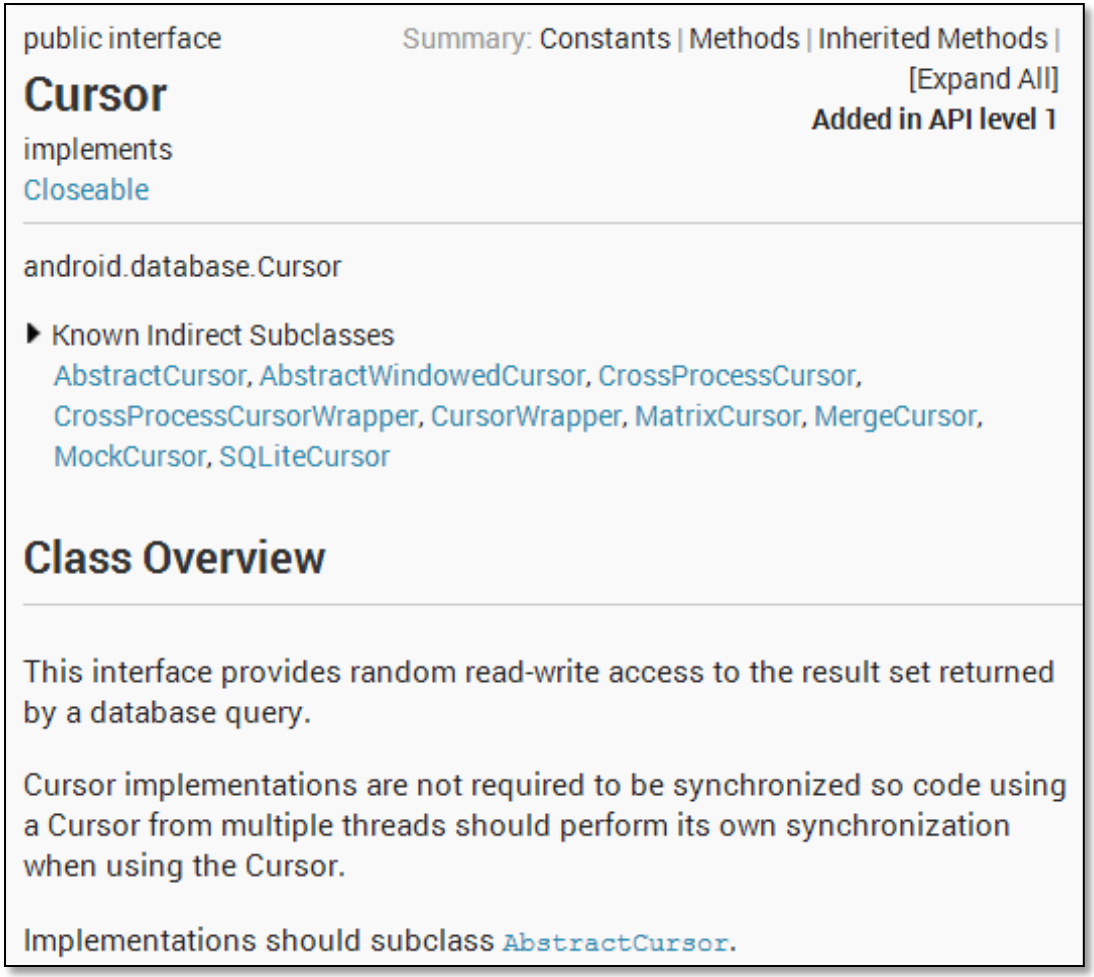
```
    Cursor c = cr.query(ContactsContract.Contacts.CONTENT_URI,
        new String[] { ContactsContract.Contacts.DISPLAY_NAME },
           null, null, null);
      ...
      if (c.moveToFirst()) {
        do {
          ...
        } while (c.moveToNext());
      }
      ...
```

Determine the data to display

Populate list view widget with data to display

Simple Example of Listing Contacts

- The Cursor returned by query() provides an iterator for accessing the retrieved results



public interface

Summary: Constants | Methods | Inherited Methods | [Expand All]

Cursor

Added in API level 1

implements
Closeable

android.database.Cursor

▸ Known Indirect Subclasses
AbstractCursor, AbstractWindowedCursor, CrossProcessCursor, CrossProcessCursorWrapper, CursorWrapper, MatrixCursor, MergeCursor, MockCursor, SQLiteCursor

Class Overview

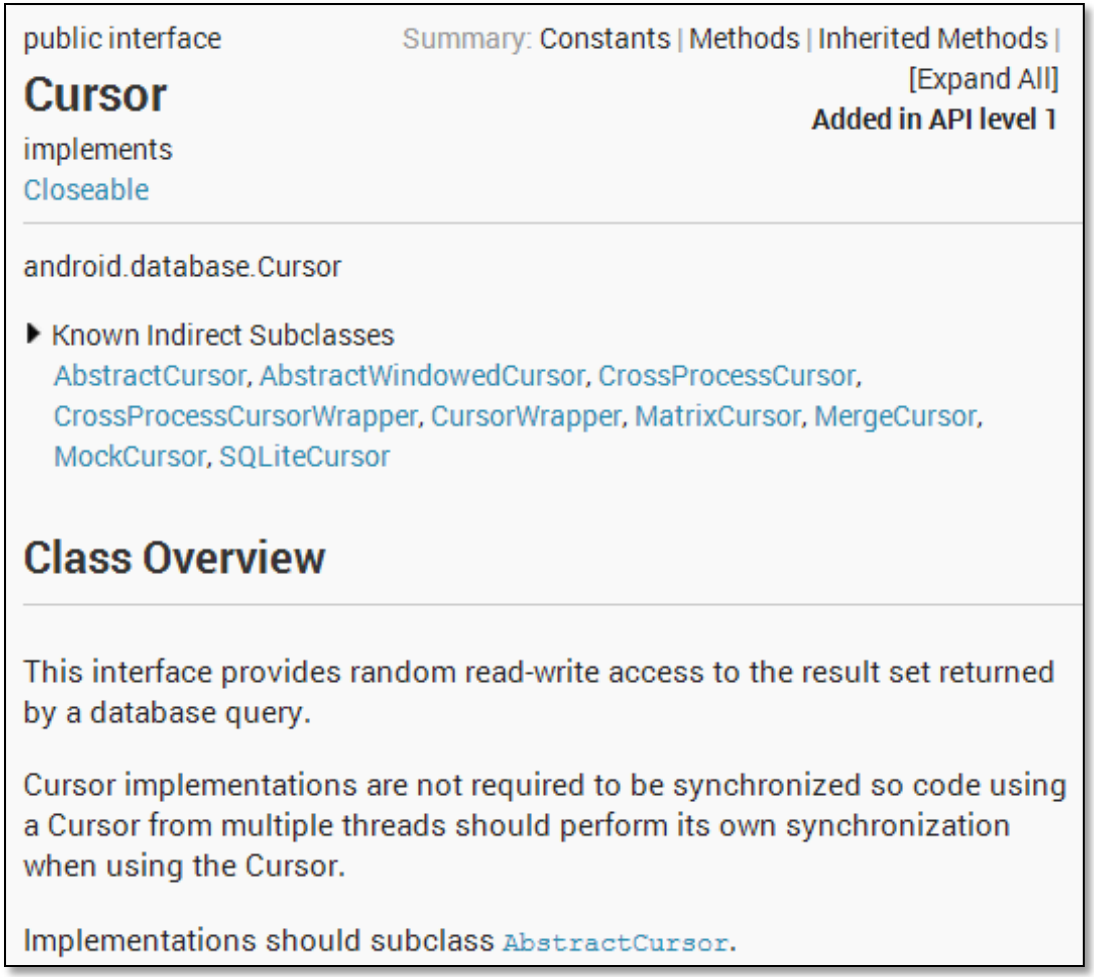
This interface provides random read-write access to the result set returned by a database query.

Cursor implementations are not required to be synchronized so code using a Cursor from multiple threads should perform its own synchronization when using the Cursor.

Implementations should subclass `AbstractCursor`.

Simple Example of Listing Contacts

- The Cursor returned by query() provides an iterator for accessing the retrieved results
- Some useful methods
  - boolean moveToFirst()
  - boolean moveToNext()
  - int getColumnIndex (String columnName)
  - String getString (int columnIndex)



public interface

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Simple Example of Listing Contacts

```
public class ContactsListExample extends ListActivity {
   public void onCreate(Bundle savedInstanceState) {
     Cursor c = ...

     List<String> contacts = new ArrayList<String>();
     if (c.moveToFirst())
       do {
          contacts.add
            (c.getString
                 (c.getColumnIndex(
                      ContactsContract.Contacts.DISPLAY_NAME)));
       } while (c.moveToNext());

       ...
   }
}
```

Store column we're interested in for each contact

Extract a column with contact name from the cursor

Populate & display list view widget

Simple Example of Listing Contacts

```
public class ContactsListExample extends ListActivity {
   public void onCreate(Bundle savedInstanceState) {
     Cursor c = ...


     List<String> contacts = new ArrayList<String>();
     if (c.moveToFirst())
       do {
          ...
       } while (c.moveToNext());


     ArrayAdapter<String> adapter =
       new ArrayAdapter<String>(this, R.layout.list_item,
                                contacts);
     setListAdapter(adapter);
   }
}
```

ArrayAdapter can handle any Java object as input & maps data of this input to a TextView in the layout

ArrayAdapter uses toString() method of data input object to determine String to display

A More Sophisticated Example of Listing Contacts

- This App lists the _id & names of all entries in the Contacts Content Provider

Contacts Content Provider

A More Sophisticated Example of Listing Contacts

```
public class ContactsListExample extends ListActivity {
  public void onCreate(Bundle savedInstanceState) {
    ...
```

Columns to retrieve

```
    String columns[] = new String[] {
                       ContactsContract.Contacts._ID,
            ContactsContract.Contacts.DISPLAY_NAME,
            ContactsContract.Contacts.STARRED };
```

Columns to display

```
       String colsToDisplay[] = new String[]
{"_id", ContactsContract.Contacts.DISPLAY_NAME };
```

Layout for columns to display

```
int[] colResIds = new int[] { R.id.idString, R.id.name };
...
```

A More Sophisticated Example of Listing Contacts

```
public class ContactsListExample extends ListActivity {
  public void onCreate(Bundle savedInstanceState) {
...
      ContentResolver cr = getContentResolver();

Cursor c = cr.query(
     ContactsContract.Contacts.CONTENT_URI, columns,
    ContactsContract.Contacts.STARRED + "= 0”, null, null);

        setListAdapter(new SimpleCursorAdapter
       (this, R.layout.list_layout,
        c, colsToDisplay, colResIds));
   }
}
```

Query for columns

Only select “non-starred” contacts

Map columns from a cursor to TextViews, specifying which columns are wanted & which views to display the columns

developer.android.com/reference/android/widget/SimpleCursorAdapter.html

Example of Deleting an Entry from Contacts

```
public class ContactsListDisplayActivity extends ListActivity {
   ...
                          Delete a particular contact
   private void deleteContact(String name) {
     getContentResolver().delete
      (ContactsContract.RawContacts.CONTENT_URI,
       ContactsContract.Contacts.DISPLAY_NAME + "=?",
       new String[] {name});
   }

          Delete all contacts (be careful!)
   private void deleteAllContacts() {
     getContentResolver().delete
       (ContactsContract.RawContacts.CONTENT_URI, null, null);
   }
   ...
}
```

Example of Inserting an Entry into Contacts

```
public class ContactsListDisplayActivity extends ListActivity {
  ...
  private void insertContact(String name) {
    ArrayList<ContentProviderOperation> ops =
                new  ArrayList<ContentProviderOperation>();

    ...

    try {
      getContentResolver().applyBatch
        (ContactsContract.AUTHORITY, ops);
     }
    ...
}
```

Create new RawContacts (see below)

Apply the batch operation to add the new contact

Example of Inserting an Entry into Contacts

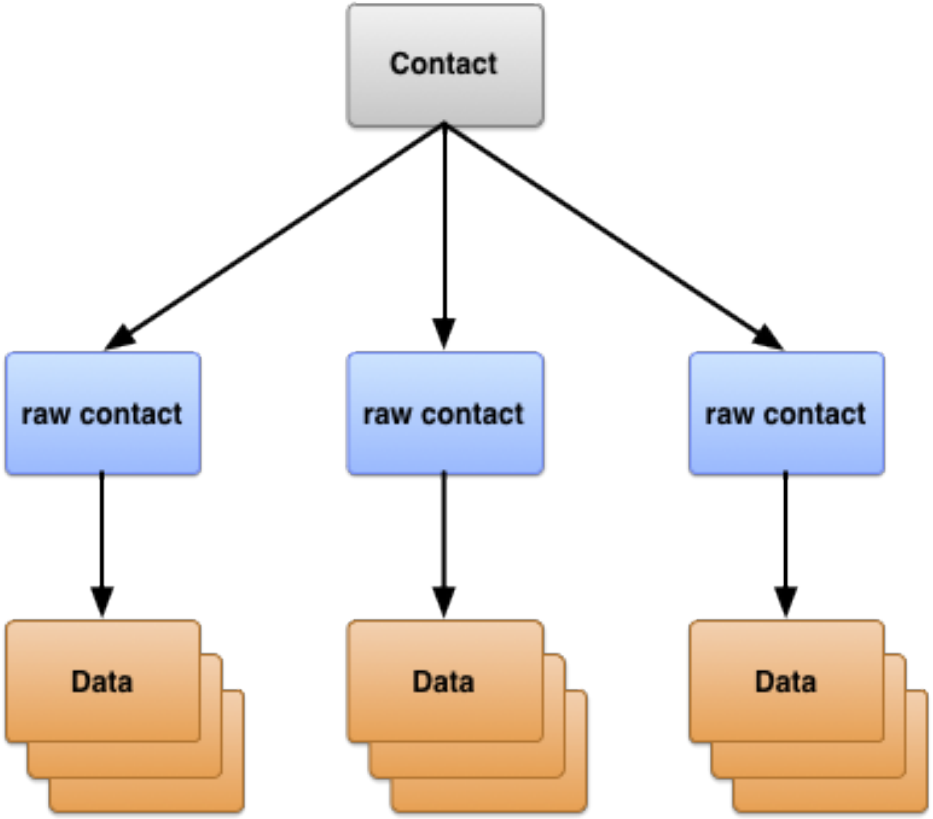
```
public class ContactsListDisplayActivity extends ListActivity {
  ...
  private void insertContact(String name) {
    ...
    ops.add(ContentProviderOperation
            .newInsert(RawContacts.CONTENT_URI)
            .withValue(RawContacts.ACCOUNT_TYPE, "com.google")
            .withValue(RawContacts.ACCOUNT_NAME,
               "douglas.schmidt@gmail.com")
            .build());

    ops.add(ContentProviderOperation.newInsert(Data.CONTENT_URI)
            .withValueBackReference(Data.RAW_CONTACT_ID,0)
            .withValue(Data.MIMETYPE,
                       StructuredName.CONTENT_ITEM_TYPE)
            .withValue(StructuredName.DISPLAY_NAME, name)
            .build());
  ...
```

Create a new RawContact

Add a new RawContact

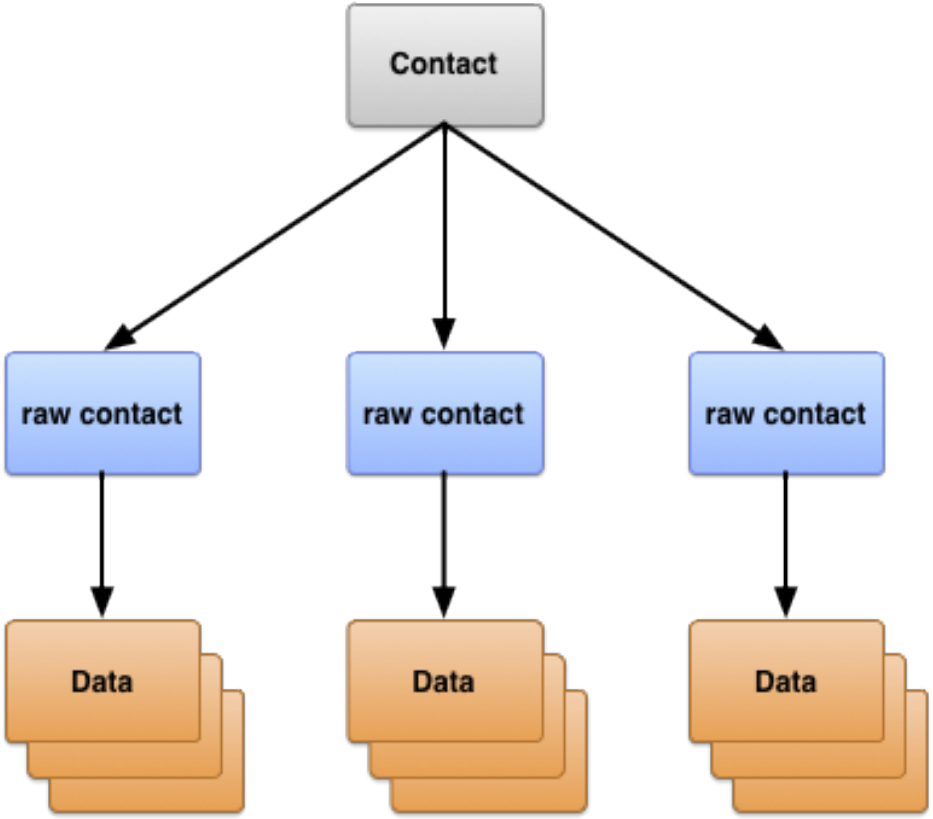
Summary

- The Android Contacts Provider accommodates a wide range of data sources & tries to manage as much data as possible for each person
  - Not surprisingly, the implementation is large & complex!



Summary

- The Android Contacts Provider accommodates a wide range of data sources & tries to manage as much data as possible for each person
- The provider's API includes an extensive set of contract classes & interfaces that facilitate both retrieval & modification of contact data



developer.android.com/guide/topics/providers/contacts-provider.html

Android Content Providers: Designing & Implementing a Content Provider

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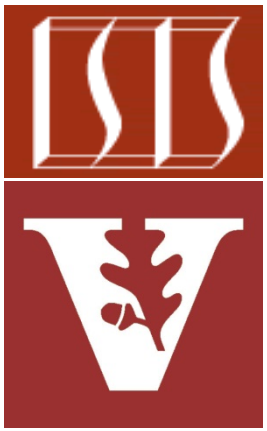

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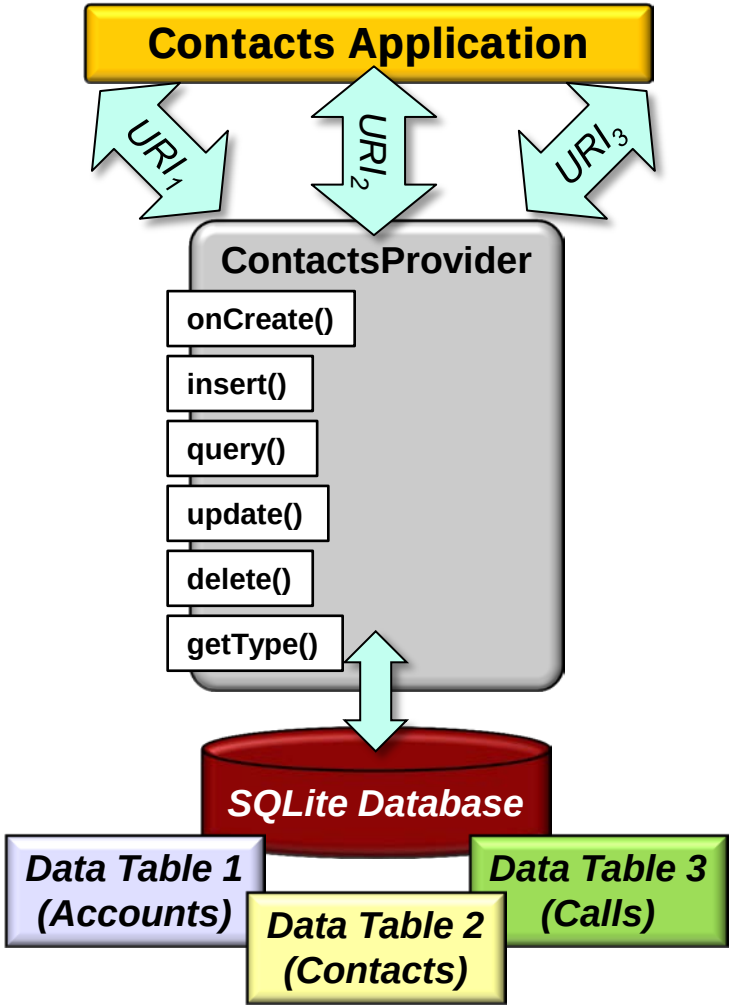
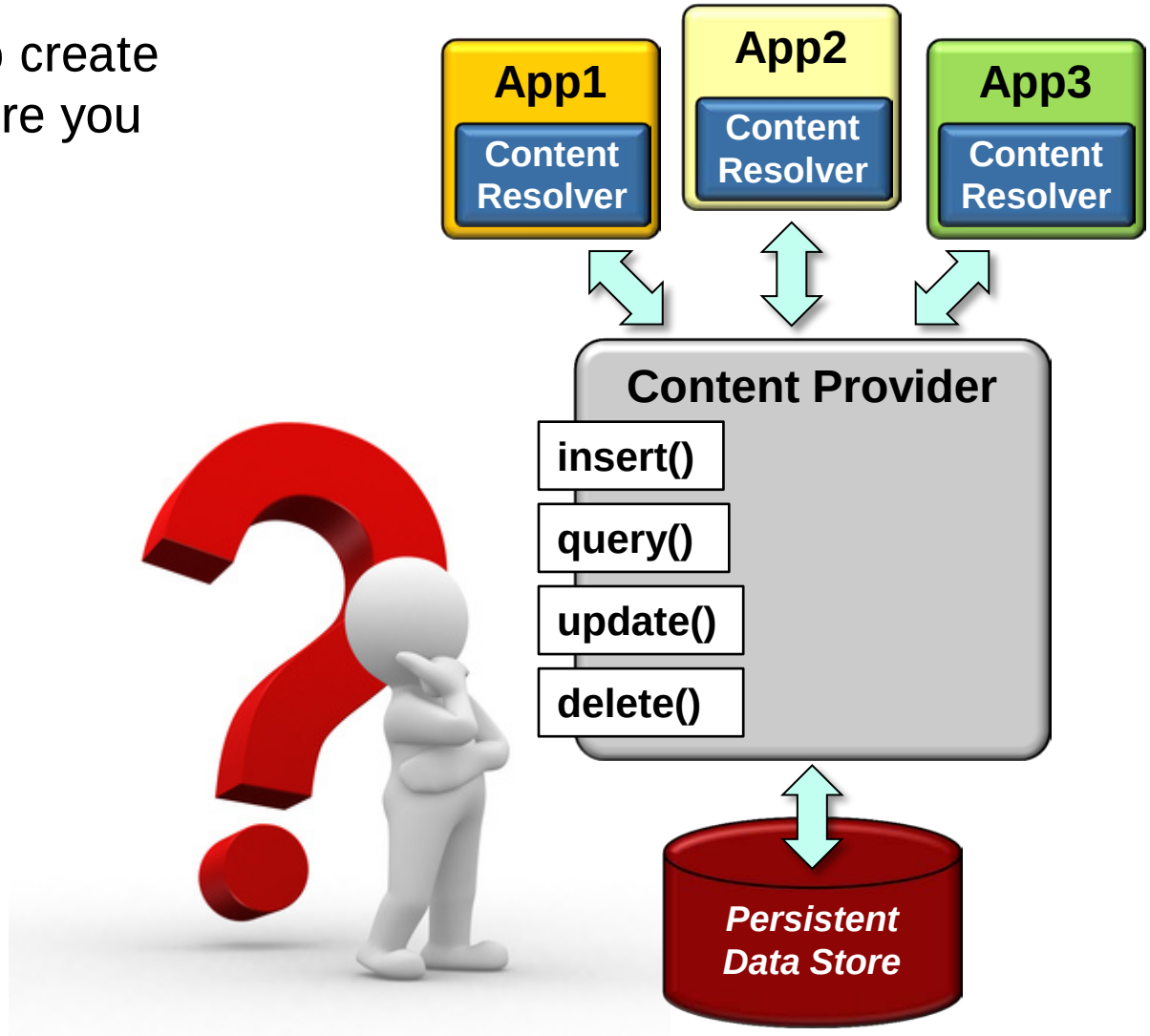
Learning Objectives in this Part of the Module

- Understand the steps involved in designing & implementing a Content Provider



Analyze Your Requirements

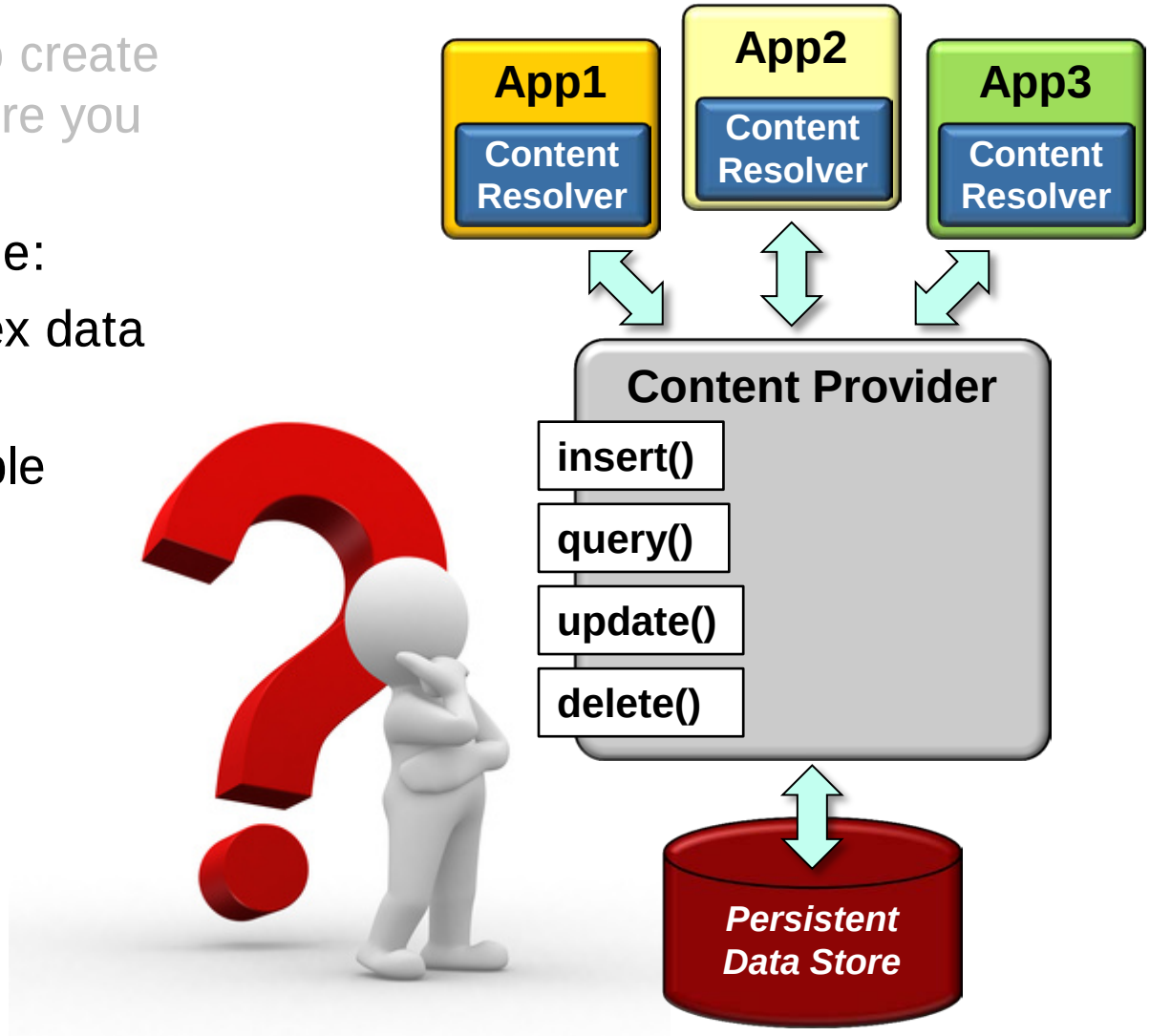
- Before making the effort to create a ContentProvider make sure you really need one!



developer.android.com/guide/topics/providers/content-provider-creating.html

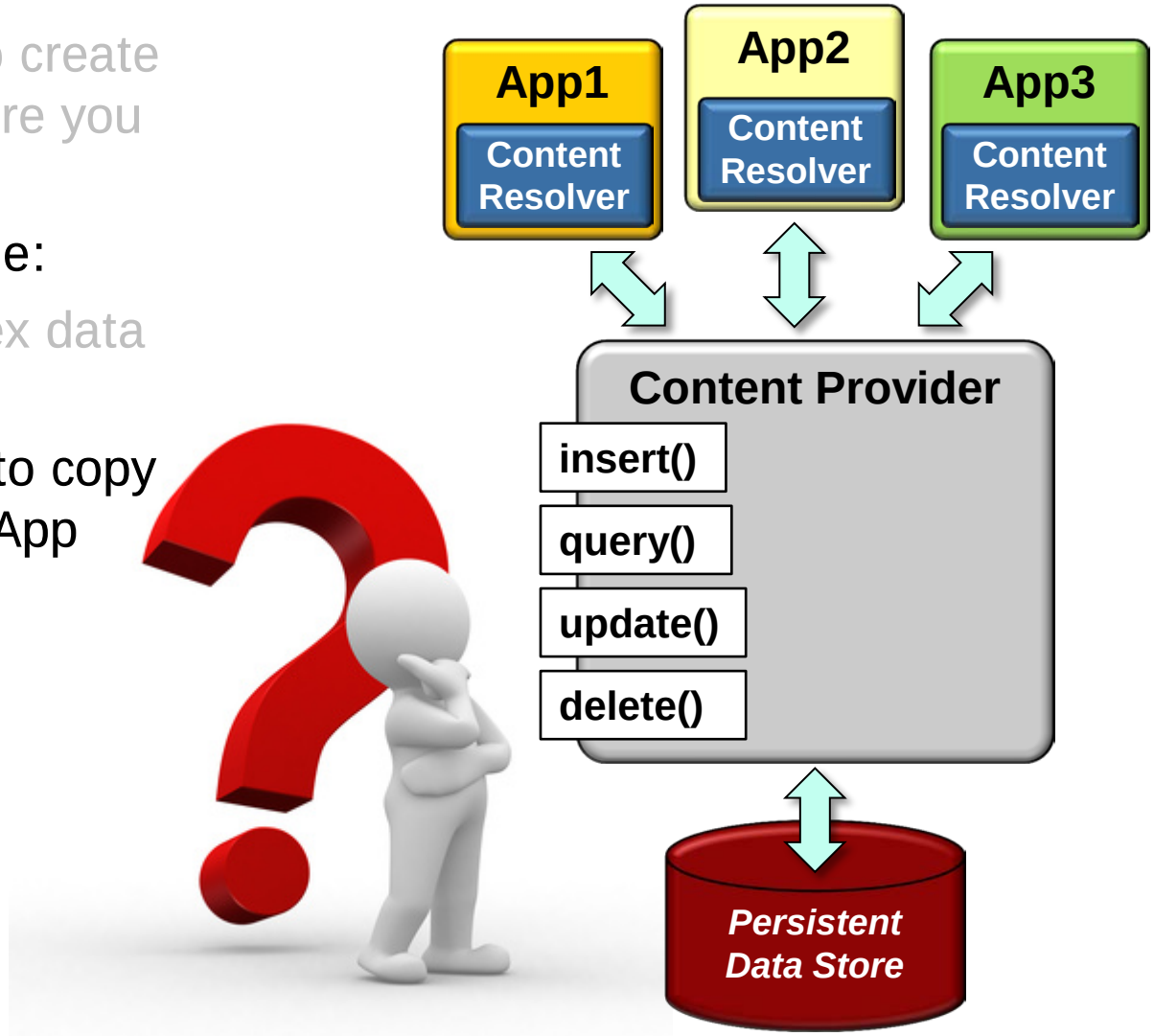
Analyze Your Requirements

- Before making the effort to create a ContentProvider make sure you really need one!
- Some considerations include:
  - You want to offer complex data or files to other Apps
    - e.g., a user-customizable spell checker



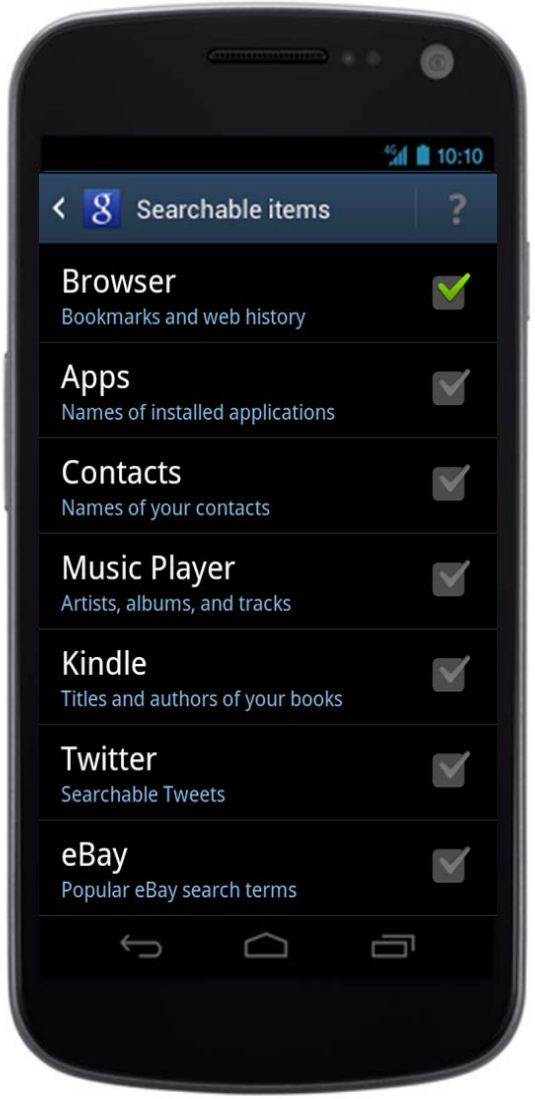
Analyze Your Requirements

- Before making the effort to create a ContentProvider make sure you really need one!
- Some considerations include:
  - You want to offer complex data or files to other Apps
  - You want to allow users to copy complex data from your App into other Apps
    - e.g., contact data



Analyze Your Requirements

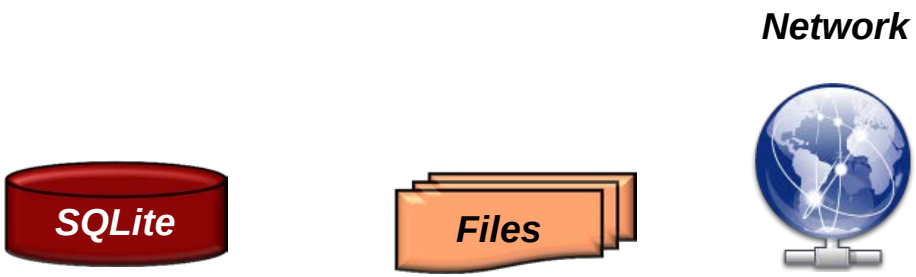
- Before making the effort to create a ContentProvider make sure you really need one!
- Some considerations include:
  - You want to offer complex data or files to other Apps
  - You want to allow users to copy complex data from your App into other Apps
  - You want to provide custom search suggestions using the search framework
    - Many Android Apps provide this capability



developer.android.com/guide/topics/search/adding-custom-suggestions.html

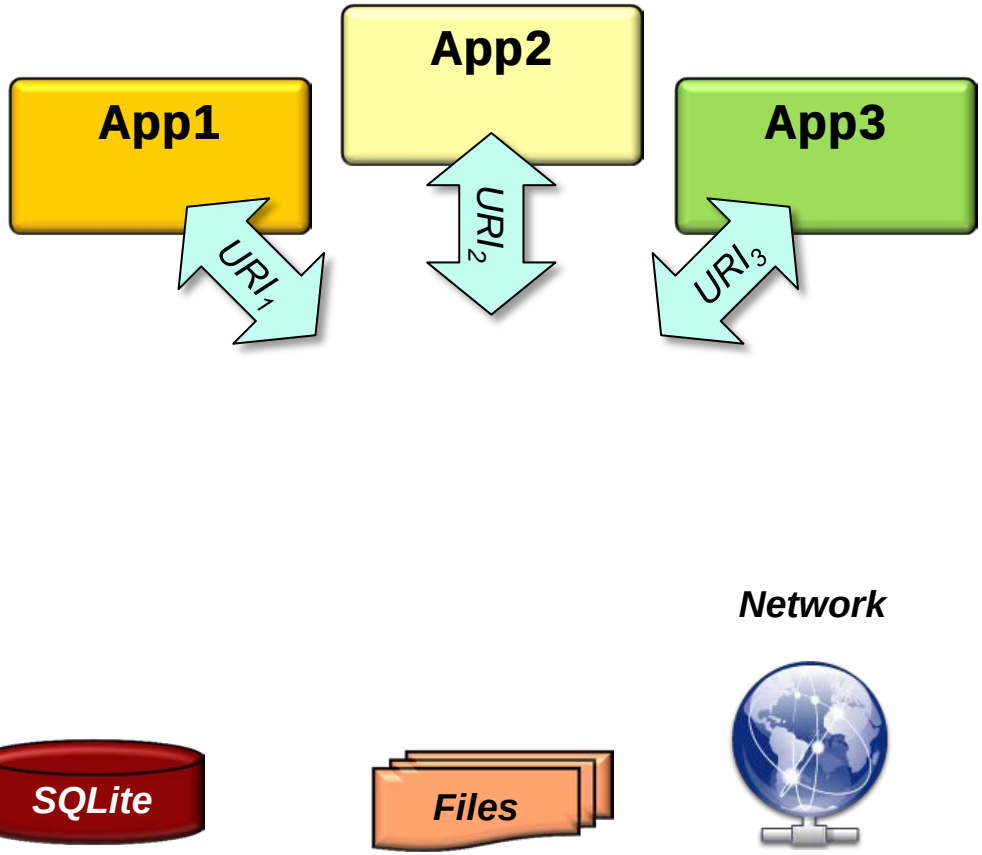
Creating a ContentProvider

- Steps to creating a ContentProvider
  - Implement a storage system for the data
    - e.g., structure data vs. file vs. remotely accessed data, etc.



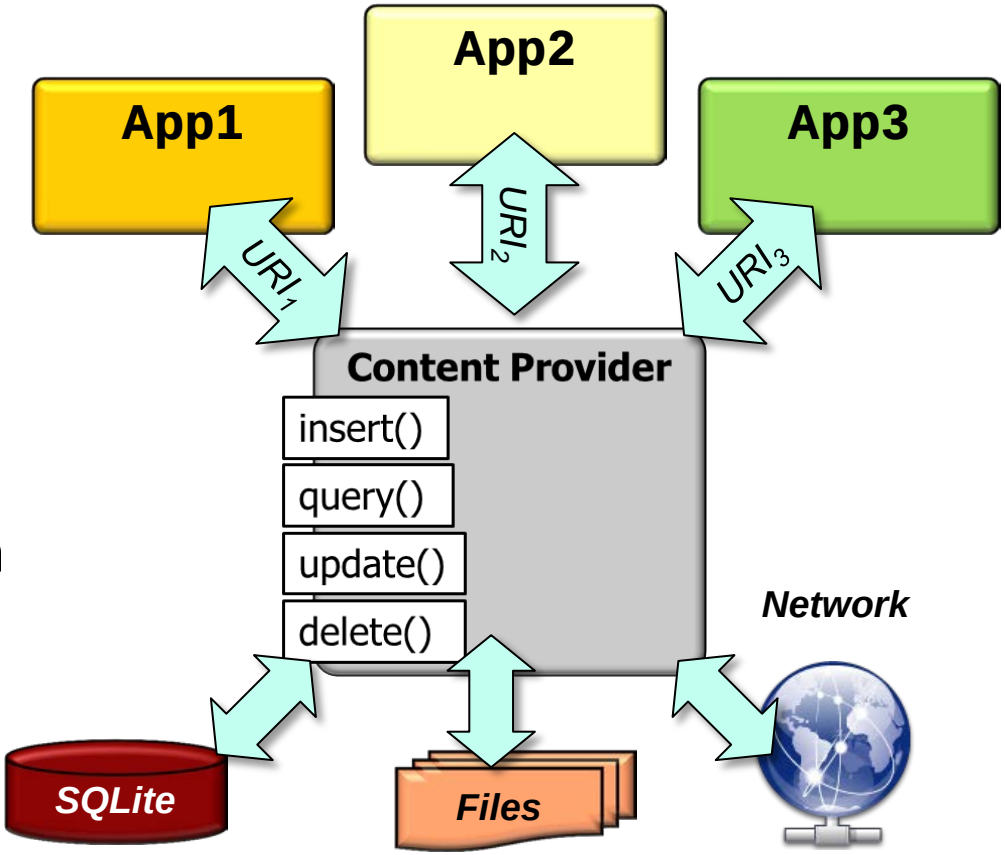
Creating a ContentProvider

- Steps to creating a ContentProvider
  - Implement a storage system for the data
  - Determine the format of the Content URI for accessing the contents of the data managed by the provider



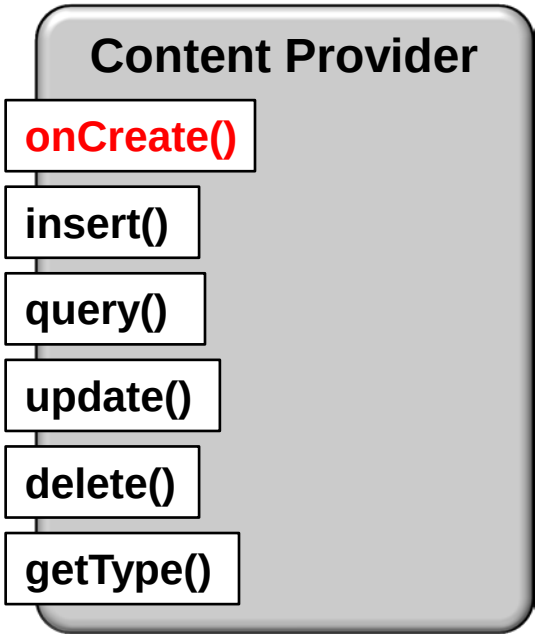
Creating a ContentProvider

- Steps to creating a ContentProvider
  - Implement a storage system for the data
  - Determine the format of the Content URI for accessing the contents of the data managed by the provider
  - Implement a provider as one or more classes in an Android App, along with <provider> element in manifest file
    - Subclass ContentProvider to define the interface between the provider & other Apps



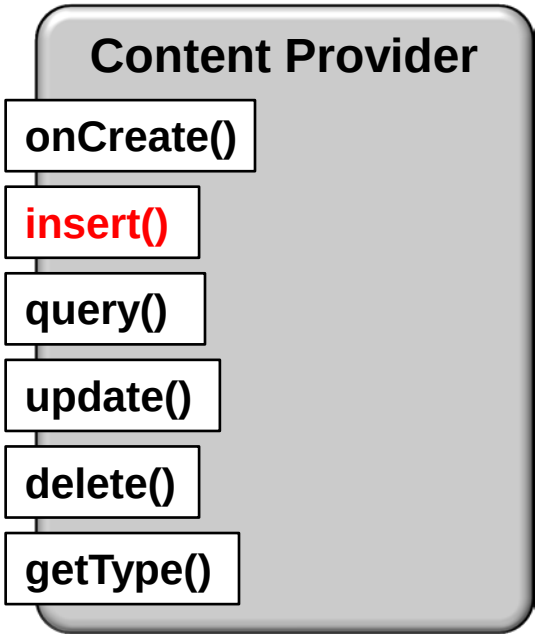
Required ContentProvider Methods

- Abstract methods that subclasses must implement
  - onCreate() initializes a provider (called immediately after creating a provider)



Required ContentProvider Methods

- Abstract methods that subclasses must implement
  - onCreate() initializes a provider (called immediately after creating a provider)
  - insert() selects table & column values to use to insert a new row



Required ContentProvider Methods

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  - insert() selects table & column values to use to insert a new row
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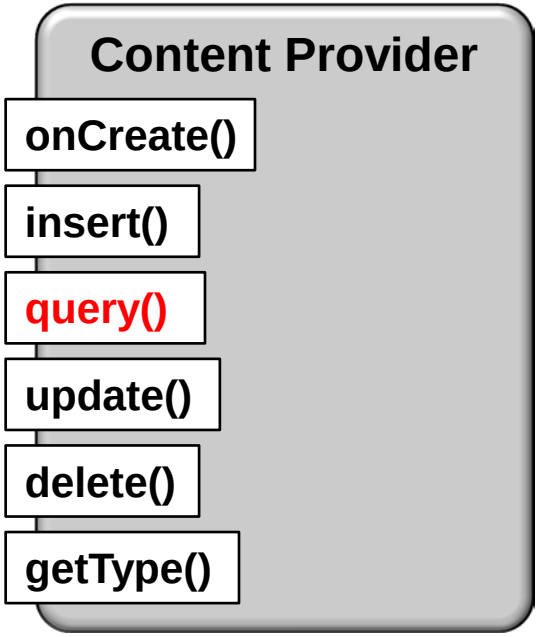

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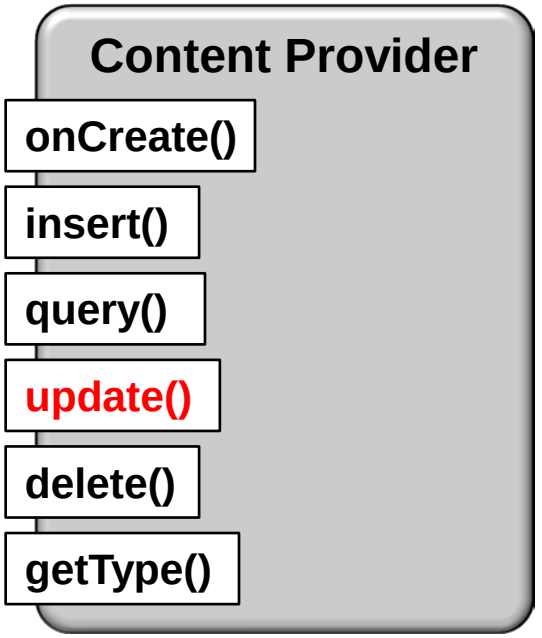

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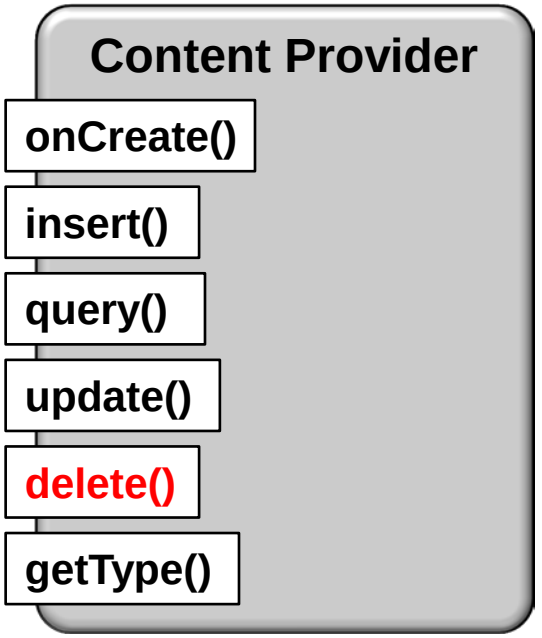

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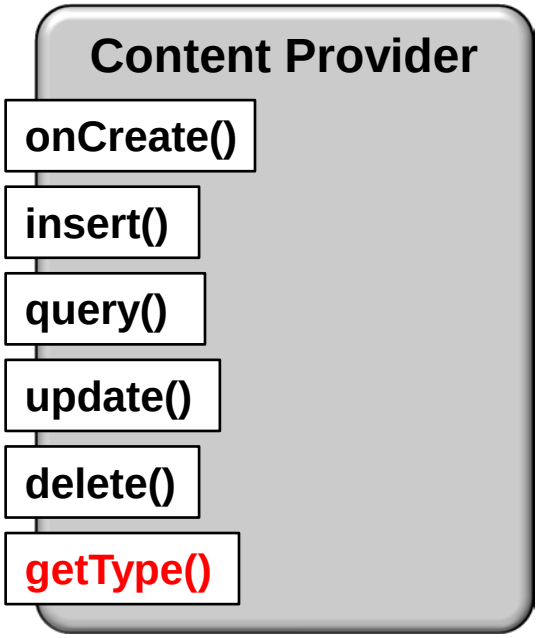
  - query() selects table to query, rows & columns to return via Cursor, & sort order of result
  - update() selects table & rows to update & to get updated column values
  - delete() selects table & rows to delete
  - getType() returns MIME type corresponding to a content URI



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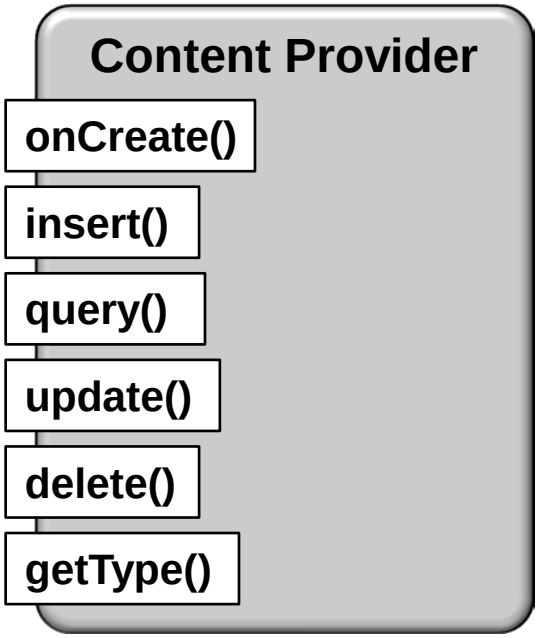


Methods have same signature as identically named ContentResolver methods

Define the Content Provider Data Model

- A content provider typically presents data to external Apps as one or more tables

word	app id	freq	locale	_ID
mapreduce	user1	100	en_US	1
precompiler	user14	200	fr_FR	2
applet	user2	225	fr_CA	3
const	user1	255	pt_BR	4
int	user5	100	en_UK	5

The user dictionary is provider in Android is that stores spellings of non-standard words a user wants to keep

Define the Content Provider Data Model

- A content provider typically presents data to external Apps as one or more tables
  - A row represents an instance of some type of data the provider manages

word	app id	freq	locale	_ID
mapreduce	user1	100	en_US	1
precompiler	user14	200	fr_FR	2
applet	user2	225	fr_CA	3
const	user1	255	pt_BR	4
int	user5	100	en_UK	5

The user dictionary is provider in Android is that stores spellings of non-standard words a user wants to keep

Define the Content Provider Data Model

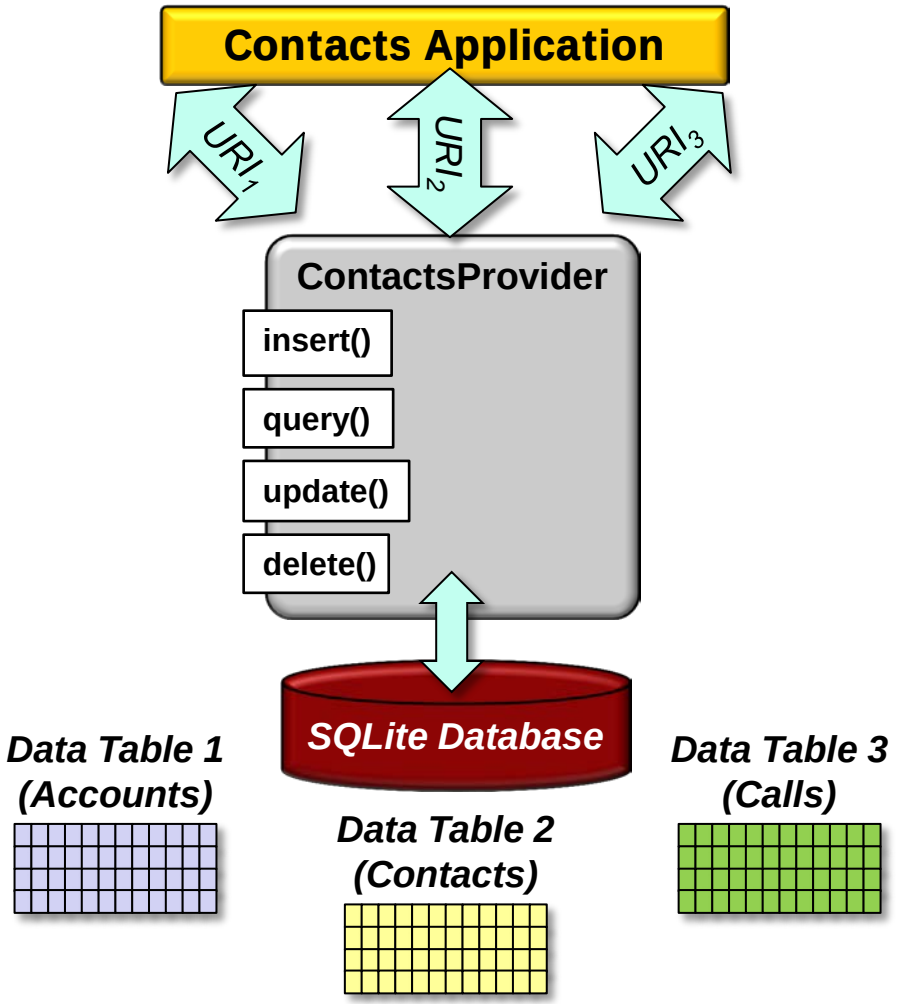
- A content provider typically presents data to external Apps as one or more tables
  - A row represents an instance of some type of data the provider manages
  - Each column in a row represents an individual piece of data collected for an instance

word	app id	freq	locale	_ID
mapreduce	user1	100	en_US	1
precompiler	user14	200	fr_FR	2
applet	user2	225	fr_CA	3
const	user1	255	pt_BR	4
int	user5	100	en_UK	5

The user dictionary is provider in Android is that stores spellings of non-standard words a user wants to keep

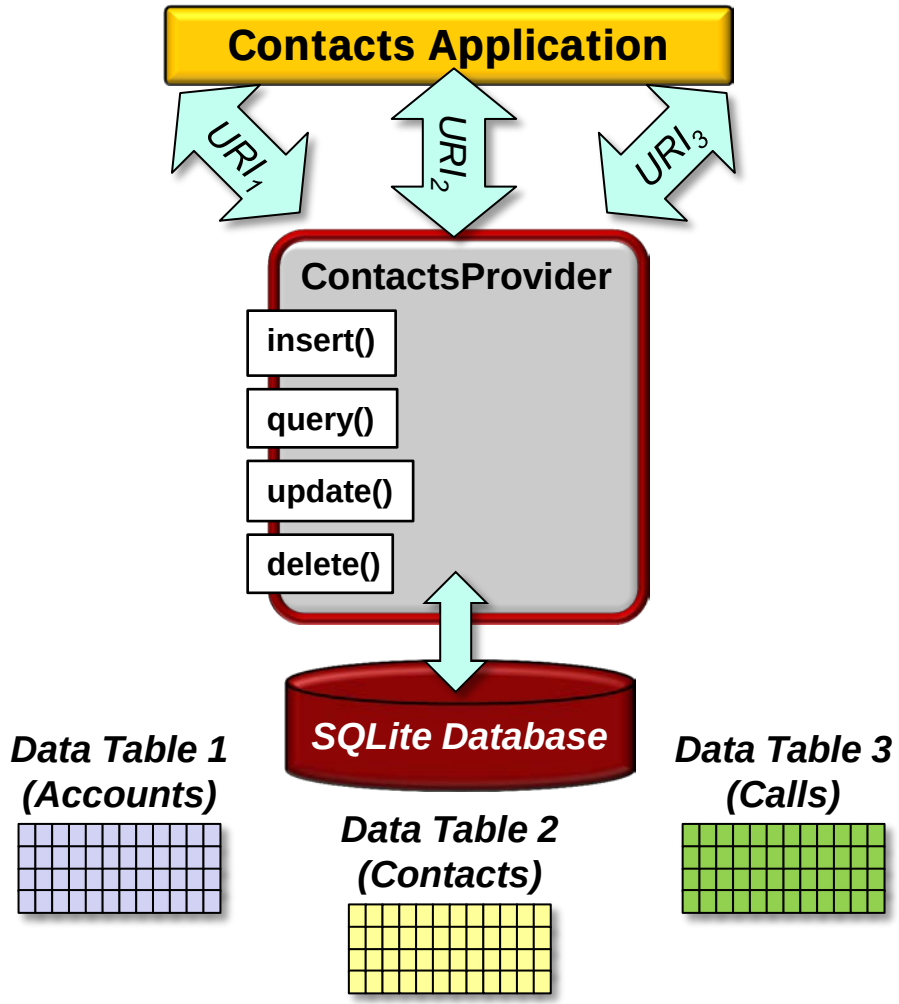
Define the Content URI(s)

- A Content URI identifies data in a provider
  - Each ContentProvider method uses a content URI to determine which table, row, and/or file to access



Define the Content URI(s)

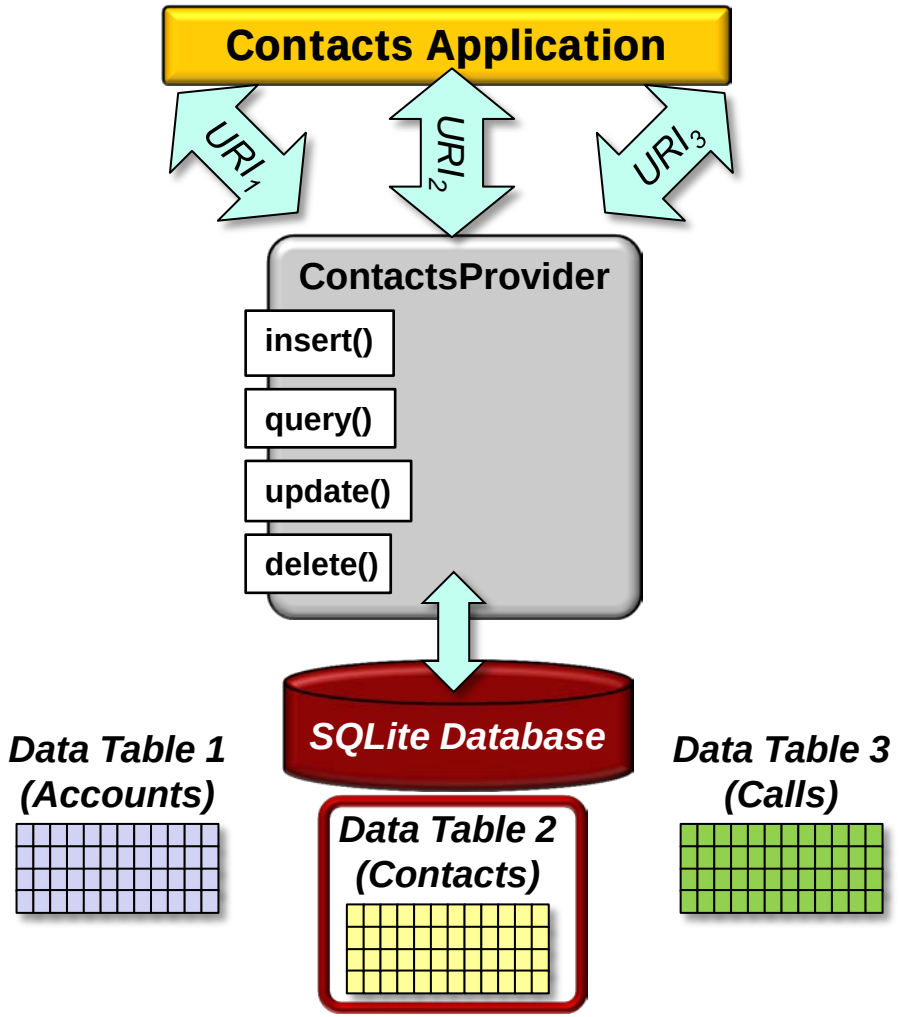
- A Content URI identifies data in a provider
- Content URIs have several parts
  - The symbolic name of the entire provider (its authority)




```
content://com.android.contacts/contacts/directory=0/photo_id
```

Define the Content URI(s)

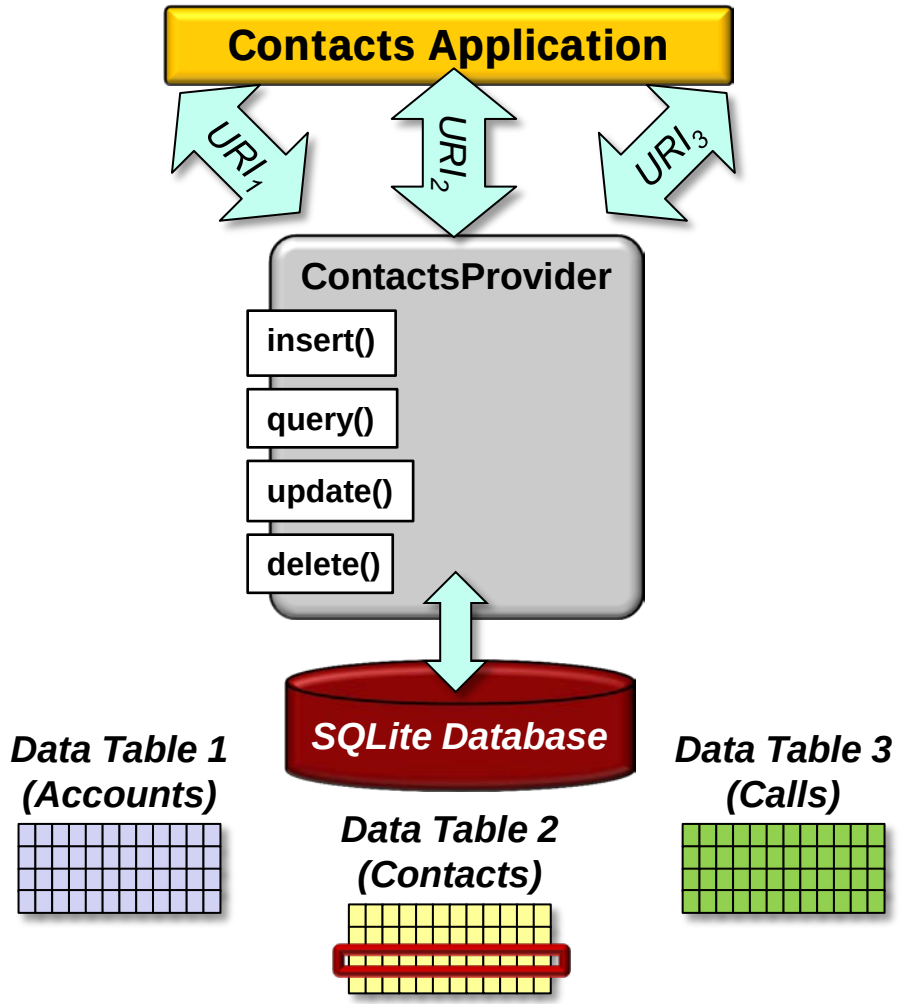
- A Content URI identifies data in a provider
- Content URIs have several parts
  - The symbolic name of the entire provider (its authority)
  - A name that points to a table or file (a path)




```
content://com.android.contacts/contacts/directory=0/photo_id
```

Define the Content URI(s)

- A Content URI identifies data in a provider
- Content URIs have several parts
  - The symbolic name of the entire provider (its authority)
  - A name that points to a table or file (a path)
  - An optional id part that points to an individual row in a table




```
content://com.android.contacts/contacts/directory=0/photo_id
```

Define the Content URI(s)

- A Content URI identifies data in a provider
- Content URIs have several parts
- Define unique data members that represent each Content URI part
  - The AUTHORITY_URI for the provider

```
public final class
ContactsContract {
  public static final String
    AUTHORITY =
      "com.android.contacts";
  public static final Uri
    AUTHORITY_URI =
      Uri.parse("content://"
                + AUTHORITY);
  ...
```

Define the Content URI(s)

- A Content URI identifies data in a provider
- Content URIs have several parts
- Define unique data members that represent each Content URI part
  - The AUTHORITY_URI for the provider
  - The CONTENT_URI for each table
    - If provider has subtables, define CONTENT_URI constants for each one

```
public final class
ContactsContract {
  public static final String
    AUTHORITY =
      "com.android.contacts";
  public static final Uri
    AUTHORITY_URI =
      Uri.parse("content://"
                + AUTHORITY);
  ...
  public static class Contacts
    implements ... {
    ...
    public static final Uri
      CONTENT_URI =
        Uri.withAppendedPath
            (AUTHORITY_URI,
             "contacts");
```

Define the Content URI(s)

- A Content URI identifies data in a provider
- Content URIs have several parts
- Define unique data members that represent each Content URI part
- The UriMatcher class maps content URI "patterns" to integer values using wildcard characters:
  - * Matches a string of any valid characters of any length
  - # Matches a string of numeric characters of any length

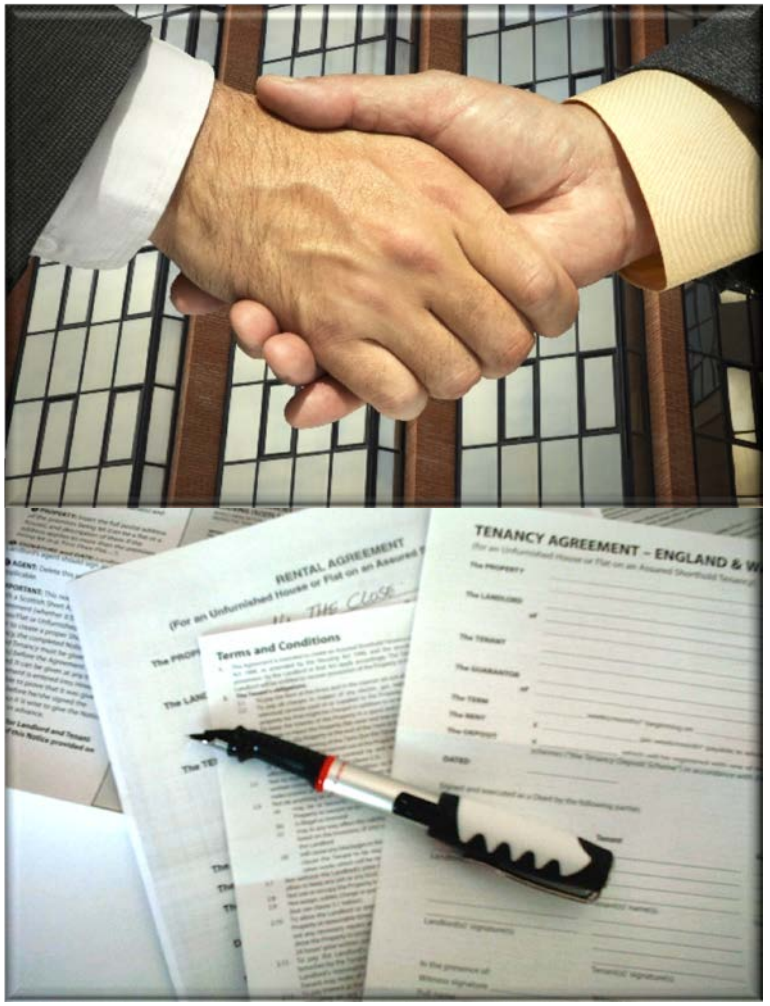
```
private static final
  UriMatcher um;
  um.addURI(
  "com.example.app.provider",
  "table3", 1);
  um.addURI(
  "com.example.app.provider",
  "table3/#", 2);
 ...
public Cursor query(Uri uri, ...){
  ...
  switch (um.match(uri)) {
  // If URI's for all of table3
  case 1: ...; break;

  // If URI's for a single row
  case 2: ...; break;
```

developer.android.com/guide/topics/providers/content-provider-creating.html#ContentURI

Define a Contract Class

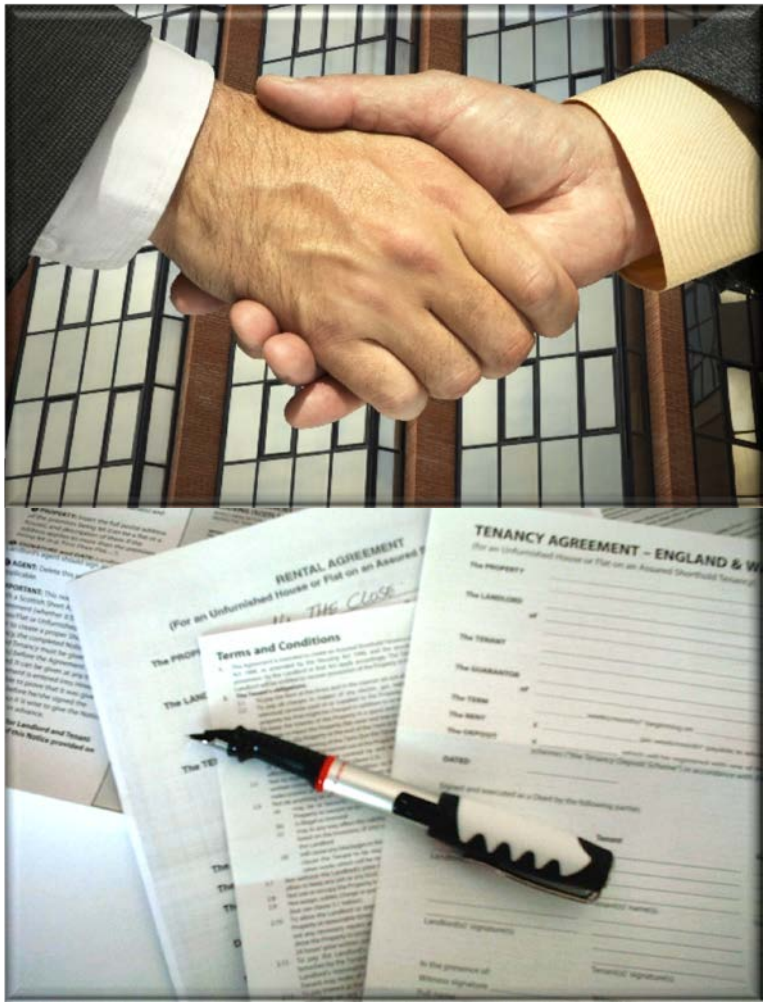
- A contract class is a public final class containing constant definitions for the URIs, column names, MIME types, & other meta-data that pertain to a Content Provider



developer.android.com/guide/topics/providers/content-provider-creating.html#ContractClass

Define a Contract Class

- A contract class is a public final class containing constant definitions for the URIs, column names, MIME types, & other meta-data that pertain to a Content Provider
- The class establishes a contract between the provider & other Apps by ensuring that the provider can be correctly accessed even if there are changes to the actual values of URIs, column names, and so forth



developer.android.com/guide/topics/providers/content-provider-creating.html#ContractClass

Define the Column Names

- Define column names
  - Typically identical to the SQL database column names

```
public static final String
  _ID = "_id", DATA = "data";

private static final String[]
  columns = new String[]
              { _ID, DATA };
```

Define the Column Names

- Define column names
- Also define public static String constants that clients can use to specify the columns
  - Consider implementing a “Contracts class” to document the data type of each column so clients can read the data

```
public static final String
  _ID = "_id", DATA = "data";

private static final String[]
  columns = new String[]
                { _ID, DATA };
```

Define the Column Names

- Define column names
- Also define public static String constants that clients can use to specify the columns
- Be sure to include an integer column named "_id" (with the constant _ID) for the IDs of the records
  - If you use an SQLite database, the _ID field should be of type INTEGER PRIMARY KEY AUTOINCREMENT

```
public static final String
  _ID = "_id", DATA = "data";

private static final String[]
  columns = new String[]
                { _ID, DATA };
```

Document the data type of each column so clients can read the data

Define the Column Names

- Define column names
- Also define public static String constants that clients can use to specify the columns
- Be sure to include an integer column named "_id" (with the constant _ID) for the IDs of the records
- Define the MIME types for items & directories

```
public static final String
  _ID = "_id", DATA = "data";

private static final String[]
  columns = new String[]
              { _ID, DATA };

private static final String
  contentTypeSingle =
    "vnd.android.cursor.item/
     MyCP.data.text";

private static final String
  contentTypeMultiple =
    "vnd.android.cursor.dir/
     MyCP.data.text";
```

Define the MIME Types for Tables

- ContentProvider.getType() returns a String in MIME format
  - This string describes the type of data returned by the content URI argument

public abstract String **getType** (Uri uri) Added in API level 1

Implement this to handle requests for the MIME type of the data at the given URI. The returned MIME type should start with `vnd.android.cursor.item` for a single record, or `vnd.android.cursor.dir/` for multiple items. This method can be called from multiple threads, as described in Processes and Threads.

Note that there are no permissions needed for an application to access this information; if your content provider requires read and/or write permissions, or is not exported, all applications can still call this method regardless of their access permissions. This allows them to retrieve the MIME type for a URI when dispatching intents.

Parameters

uri the URI to query.

Returns

a MIME type string, or `null` if there is no type.

developer.android.com/reference/android/content/ContentProvider.html#getType(android.net.Uri)

Define the MIME Types for Tables

- ContentProvider.getType() returns a String in MIME format
- For content URIs that point to row(s) of table data, getType() should return a MIME type in Android's vendor-specific MIME format

Define the MIME Types for Tables

- ContentProvider.getType() returns a String in MIME format
- For content URIs that point to row(s) of table data, getType() should return a MIME type in Android's vendor-specific MIME format
- e.g., if the content provider authority is com.example.app.provider & it exposes table1, the MIME types will be as follows:
  - multiple rows in table1:

    vnd.android.cursor.dir/vnd.com.example.provider.table1

developer.android.com/guide/topics/providers/content-provider-creating.html#MIMETypes

Define the MIME Types for Tables

- ContentProvider.getType() returns a String in MIME format
- For content URIs that point to row(s) of table data, getType() should return a MIME type in Android's vendor-specific MIME format
- e.g., if the content provider authority is com.example.app.provider & it exposes table1, the MIME types will be as follows:
  - multiple rows in table1:

    vnd.android.cursor.dir/vnd.com.example.provider.table1
  - a single row of table1:

    vnd.android.cursor.item/vnd.com.example.provider.table1

developer.android.com/guide/topics/providers/content-provider-creating.html#MIMETypes

Define the MIME Types for Files

- If a provider offers files, implement getStreamTypes()
  - Returns a String array of MIME types for files your provider can return for a given content URI

public String[] **getStreamTypes** (Uri uri, String mimeTypeFilter)

Added in API level 11

Called by a client to determine the types of data streams that this content provider supports for the given URI. The default implementation returns `null`, meaning no types. If your content provider stores data of a particular type, return that MIME type if it matches the given mimeTypeFilter. If it can perform type conversions, return an array of all supported MIME types that match mimeTypeFilter.

Parameters

uri	The data in the content provider being queried.
mimeTypeFilter	The type of data the client desires. May be a pattern, such as *\/* to retrieve all possible data types.

Returns

Returns `null` if there are no possible data streams for the given mimeTypeFilter. Otherwise returns an array of all available concrete MIME types.

See Also

`getType(Uri)`

`openTypedAssetFile(Uri, String, Bundle)`

`compareMimeTypes(String, String)`

developer.android.com/reference/android/content/ContentProvider.html#getType(android.net.Uri)

Define the MIME Types for Files

- If a provider offers files, implement getStreamTypes()
  - Returns a String array of MIME types for files your provider can return for a given content URI
  - Filter MIME types offered by MIME type filter argument, so return only MIME types that a client wants

public String[] **getStreamTypes** (Uri uri, String mimeTypeFilter)

Added in API level 11

Called by a client to determine the types of data streams that this content provider supports for the given URI. The default implementation returns `null`, meaning no types. If your content provider stores data of a particular type, return that MIME type if it matches the given mimeTypeFilter. If it can perform type conversions, return an array of all supported MIME types that match mimeTypeFilter.

Parameters

uri	The data in the content provider being queried.
mimeTypeFilter	The type of data the client desires. May be a pattern, such as *\/* to retrieve all possible data types.

Returns

Returns `null` if there are no possible data streams for the given mimeTypeFilter. Otherwise returns an array of all available concrete MIME types.

See Also

`getType(Uri)`

`openTypedAssetFile(Uri, String, Bundle)`

`compareMimeTypes(String, String)`

developer.android.com/reference/android/content/ContentProvider.html#getType(android.net.Uri)

Define the MIME Types for Files

- If a provider offers files, implement getStreamTypes()
- e.g., consider a provider that offers photo images as files in .jpg, .png, & .gif format
  - If getStreamTypes() is called by an App with the filter string "image/*" then return array { "image/jpeg", "image/png", "image/gif" }

public String[] **getStreamTypes** (Uri uri, String mimeTypeFilter)

Added in API level 11

Called by a client to determine the types of data streams that this content provider supports for the given URI. The default implementation returns `null`, meaning no types. If your content provider stores data of a particular type, return that MIME type if it matches the given mimeTypeFilter. If it can perform type conversions, return an array of all supported MIME types that match mimeTypeFilter.

Parameters

uri	The data in the content provider being queried.
mimeTypeFilter	The type of data the client desires. May be a pattern, such as *\/* to retrieve all possible data types.

Returns

Returns `null` if there are no possible data streams for the given mimeTypeFilter. Otherwise returns an array of all available concrete MIME types.

See Also

`getType(Uri)`

`openTypedAssetFile(Uri, String, Bundle)`

`compareMimeTypes(String, String)`

developer.android.com/reference/android/content/ContentProvider.html#getType(android.net.Uri)

Define the MIME Types for Files

- If a provider offers files, implement getStreamTypes()
- e.g., consider a provider that offers photo images as files in .jpg, .png, & .gif format
  - If getStreamTypes() is called by an App with the filter string "image/*" then return array { "image/jpeg", "image/png", "image/gif" }
  - If getStreamTypes() is called by an App with filter string "*/jpeg" then just return {"image/jpeg"}

public String[] **getStreamTypes** (Uri uri, String mimeTypeFilter)

Added in API level 11

Called by a client to determine the types of data streams that this content provider supports for the given URI. The default implementation returns `null`, meaning no types. If your content provider stores data of a particular type, return that MIME type if it matches the given mimeTypeFilter. If it can perform type conversions, return an array of all supported MIME types that match mimeTypeFilter.

Parameters

uri	The data in the content provider being queried.
mimeTypeFilter	The type of data the client desires. May be a pattern, such as *\/* to retrieve all possible data types.

Returns

Returns `null` if there are no possible data streams for the given mimeTypeFilter. Otherwise returns an array of all available concrete MIME types.

See Also

`getType(Uri)`

`openTypedAssetFile(Uri, String, Bundle)`

`compareMimeTypes(String, String)`

developer.android.com/reference/android/content/ContentProvider.html#getType(android.net.Uri)

Declaring the Provider in AndroidManifest.xml

- Declare ContentProvider with <provider> in the file AndroidManifest.xml

```
<provider
   android:name=
     "ContactsProvider2"
   android:authorities=
    "contacts;com.android.contacts“
   ...
```

Declaring the Provider in AndroidManifest.xml

- Declare ContentProvider with <provider> in the file AndroidManifest.xml
- The Authorities attribute omits the *path* part of a content:// URI
  - e.g., Tables defined by ContactsProvider2 are not defined in the manifest

    content://com.android.contacts/contacts/

```
<provider
   android:name=
     "ContactsProvider2"
   android:authorities=
    "contacts;com.android.contacts"
   ...
```

Declaring the Provider in AndroidManifest.xml

- Declare ContentProvider with <provider> in the file AndroidManifest.xml
- The Authorities attribute omits the *path* part of a content:// URI
- The authority is what identifies a Content Provider, not the path
  - A Content Provider implementation can interpret the path part of the URI in any way it chooses

```
<provider
   android:name=
     "ContactsProvider2"
   android:authorities=
    "contacts;com.android.contacts“
   ...
```

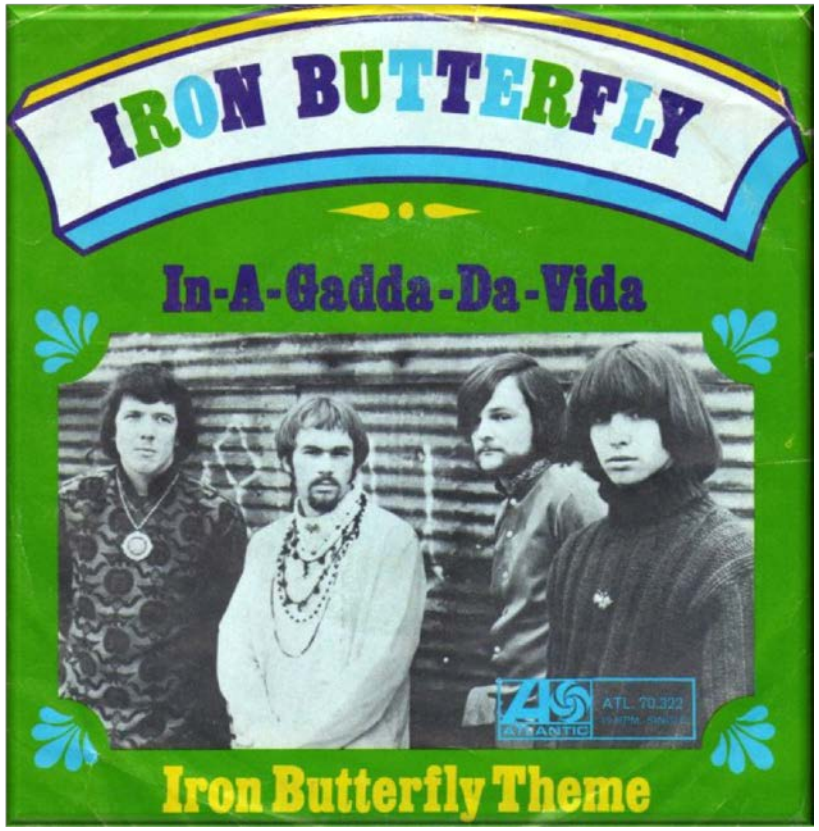
Handling Large Data in Content Providers

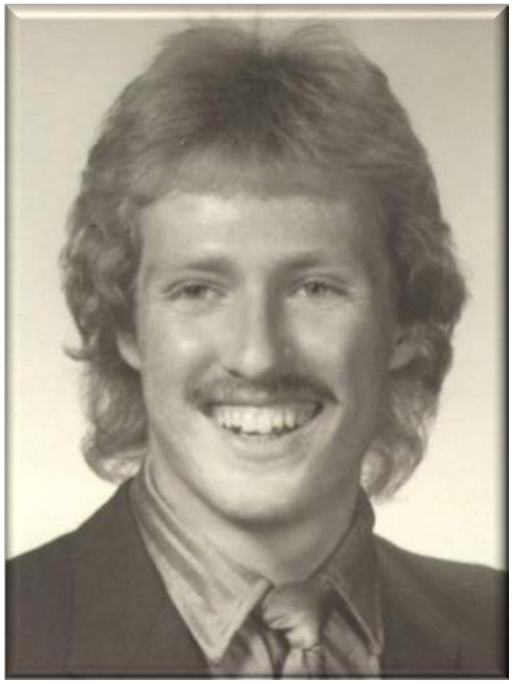
- Although the data model for Content Provider has a blob type, it's only appropriate for "small" binary objects
  - e.g., a small icon or short audio clip

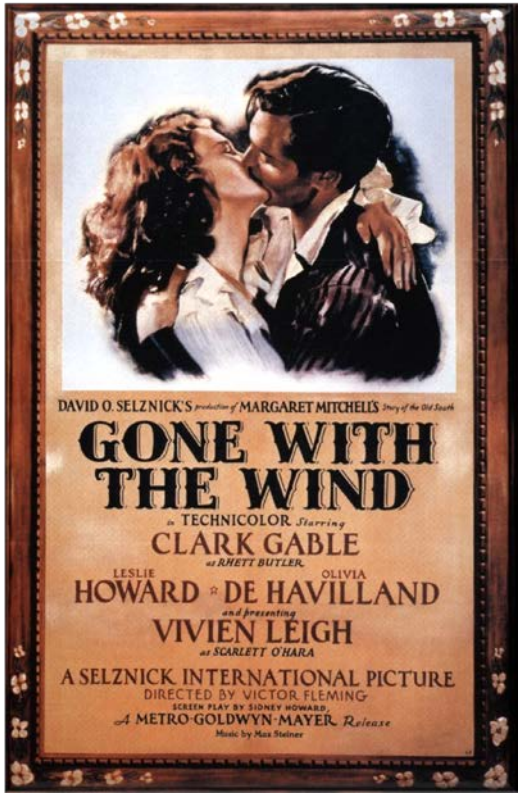
stackoverflow.com/questions/5406429/cursor-size-limit-in-android-sqlitedatabase

Handling Large Data in Content Providers

- Although the data model for Content Provider has a blob type, it's only appropriate for "small" binary objects, rather than "large" binary objects
  - e.g., large photographs or complete songs/videos, etc.







stackoverflow.com/questions/5406429/cursor-size-limit-in-android-sqlitedatabase

Handling Large Data in Content Providers

- Although the data model for Content Provider has a blob type, it's only appropriate for "small" binary objects, rather than "large" binary objects
- If binary data is small then enter it directly into the SQLite table & read from cursor via Cursor.getBlob()
  - getBlob() returns a byte array

public abstract byte[] **getBlob** (int columnIndex) Added in API level 1

Returns the value of the requested column as a byte array.

The result and whether this method throws an exception when the column value is null or the column type is not a blob type is implementation-defined.

Parameters

columnIndex the zero-based index of the target column.

Returns

the value of that column as a byte array.

developer.android.com/reference/android/database/Cursor.html#getBlob(int)

Handling Large Data in Content Providers

- Although the data model for Content Provider has a blob type, it's only appropriate for "small" binary objects, rather than "large" binary objects
- If binary data is small then enter it directly into the SQLite table & read from cursor via Cursor.getBlob()
- For large binary data put content:// URIs in a table
  - The content:// URI specifies a file that should not be read directly by the client via the Cursor object
  - Instead, call ContentResolver openInputStream() to get an InputStream object to read the data

public final InputStream **openInputStream** (Uri uri) Added in API level 1

Open a stream on to the content associated with a content URI. If there is no data associated with the URI, FileNotFoundException is thrown.

Accepts the following URI schemes:

- content (`SCHEME_CONTENT`)
- android.resource (`SCHEME_ANDROID_RESOURCE`)
- file (`SCHEME_FILE`)

See `openAssetFileDescriptor(Uri, String)` for more information on these schemes.

Parameters

uri The desired URI.

Returns

InputStream

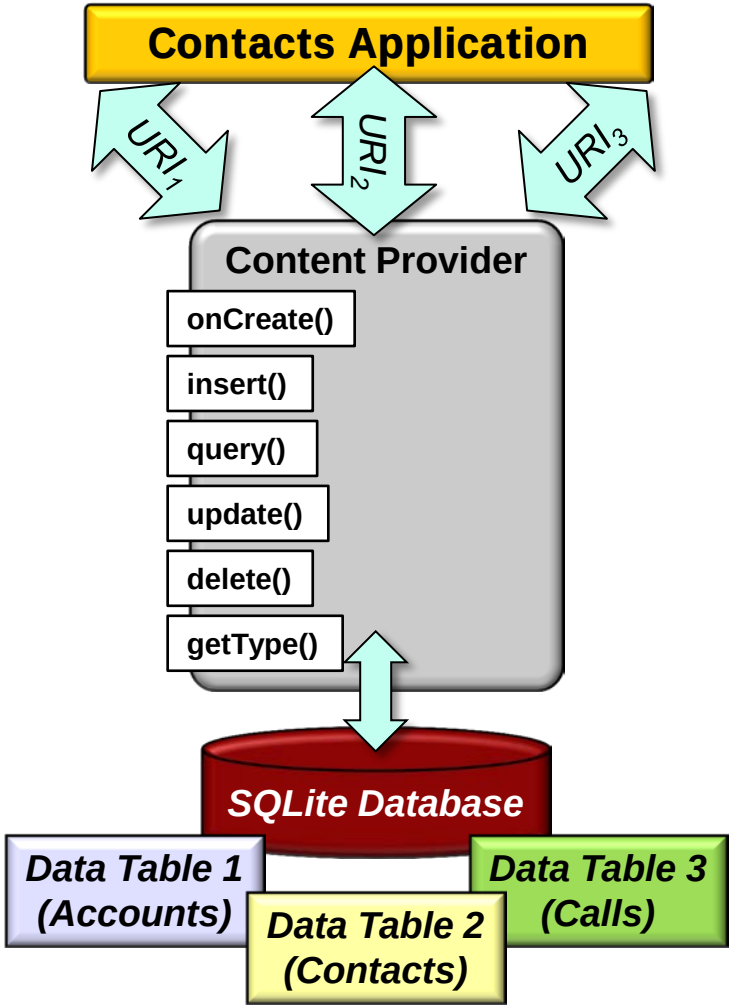
Throws

FileNotFoundException if the provided URI could not be opened.

developer.android.com/reference/android/content/ContentResolver.html#openInputStream(android.net.Uri)

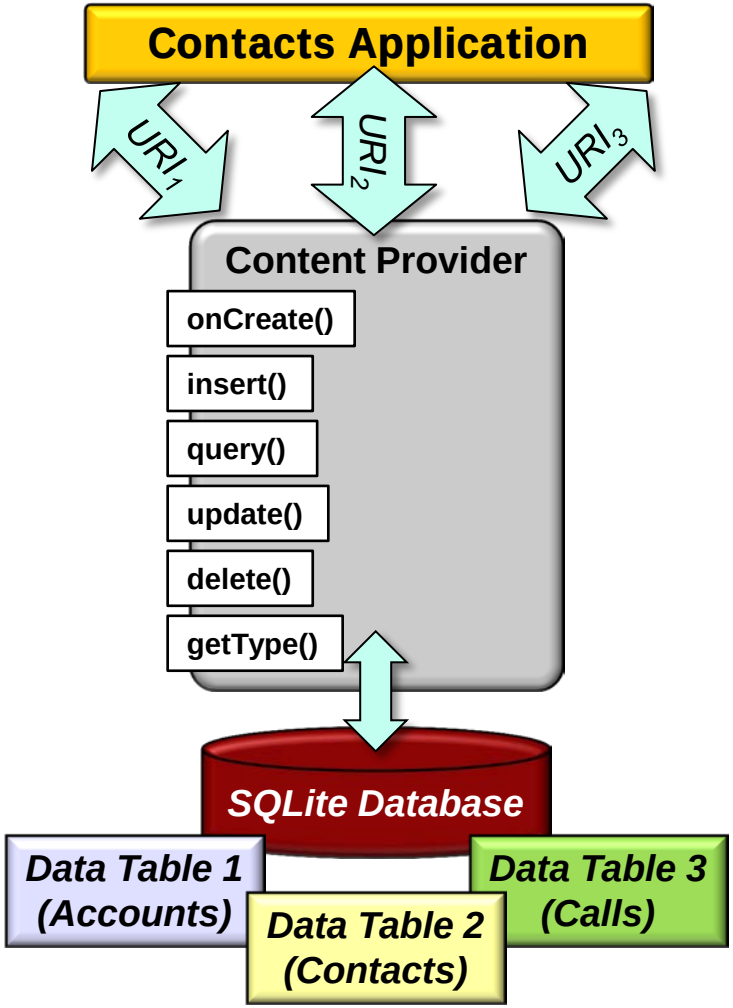
Summary

- A ContentProvider instance manages access to a structured set of data by handling requests from other applications



Summary

- A ContentProvider instance manages access to a structured set of data by handling requests from other applications
- All forms of access eventually call ContentResolver, which then calls a concrete method of ContentProvider to get access



Android Content Providers: Programming a Content Provider

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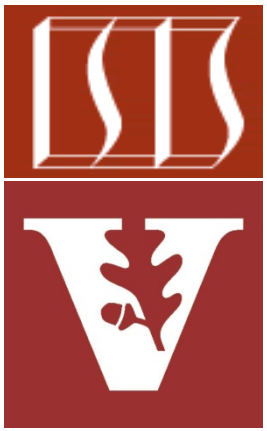

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Learning Objectives in this Part of the Module

- Understand how to program a synchronous Content Provider

Synchronous Content Provider Example

- Show how to implement a simple ContentProvider

Synchronous Content Provider Example

- Show how to implement a simple ContentProvider
- Stores the DataRecord objects in a HashMap
  - "Real" solutions typically use an SQLite database

Synchronous Content Provider Example

- Show how to implement a simple ContentProvider
- Stores the DataRecord objects in a HashMap
- Supports all the ContentProvider "CRUD" operations
  - All of which are implemented as synchronized Java methods

Synchronous Content Provider Example

- Show how to implement a simple ContentProvider
- Stores the DataRecord objects in a HashMap
- Supports all the ContentProvider "CRUD" operations
- Client Activity accesses the ContentProvider using synchronous two-way calls made via a ContentResolver

Synchronous Content Provider

```
public class MyCP extends ContentProvider {
  public static final Uri CONTENT_URI =
   Uri.parse("content://course.examples.ContentProviders.myCP/");

  public static final String _ID = "_id", DATA= "data";

  private static final String[] columns =
     new String[] { _ID, DATA};

  private static final Map<Integer, DataRecord> db =
                              new HashMap<Integer, DataRecord>();
  ...
```

Define the Content URI

Define column names

Define the HashMap that associates numbers with records

Synchronous Content Provider

```
public class MyCP extends ContentProvider {
  ...

  private static final String contentTypeSingle =
       "vnd.android.cursor.item/MyCP.data.text";

  private static final String contentTypeMultiple =
       "vnd.android.cursor.dir/MyCP.data.text";

  ...
```

Define MIME type info for individual items & groups of items

Synchronous Content Provider

```
public class MyCP extends ContentProvider {
  ...
  public synchronized Uri insert(Uri uri,
                                 ContentValues values) {
    if (values.containsKey(Data)) {
      DataRecord tmp =
        new DataRecord(values.getAsString(Data));

      db.put(tmp.get_id(), tmp);

      return Uri.parse(CONTENT_URI +
                       String.valueOf(tmp.get_id()));
    }
    return null;
  }
  ...
```

Insert a new record & return the new URI

Synchronous Content Provider

```
public class MyCP extends ContentProvider {
  ...
  public synchronized int delete(Uri uri, String selection,
                                 String[] selectionArgs) {
    String requestIdString = uri.getLastPathSegment();
    if (null == requestIdString) {
      for (DataRecord dr : db.values())
        db.remove(dr.get_id());
    }
    else {
      Integer requestId = Integer.parseInt(requestIdString);
      if (db.containsKey(requestId))
       db.remove(requestId);
    }
    return // # of records deleted;
  }
  ...
```

Delete all the records

Delete an individual records

Synchronous Content Provider

```
public class MyCP extends ContentProvider {
  ...
  public synchronized Cursor query(Uri uri, String[] projection,
        String selection, String[] selectionArgs, String order) {
    String requestIdString = uri.getLastPathSegment();

    MatrixCursor cursor = new MatrixCursor(columns);

    if (null == requestIdString)
      for (DataRecord dr : db.values())
        cursor.addRow(new Object[]
          { dr.get_id(),
            dr.get_data();
          });
    ...
```

Create a two-dimensional Cursor

Add all the records to the Cursor

Synchronous Content Provider

```
public class MyCP extends ContentProvider {
  ...
  public synchronized Cursor query(Uri uri, String[] projection,
        String selection, String[] selectionArgs, String order) {
    ...
    else {
      Integer requestId = Integer.parseInt(requestIdString);

      if (db.containsKey(requestId)) {
        DataRecord dr = db.get(requestId);
        cursor.addRow(new Object[] {
                        dr.get_id(),
                        dr.get_data();
                      });
      }
    }
    return cursor;
 }
```

Add a single record to the Cursor

Synchronous Contact Provider Activity

```
public class ContactProviderActivity extends ListActivity {
  public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    ContentResolver cr = getContentResolver();

    ContentValues values = new ContentValues();

    values.put("data", "Record1");
    cr.insert(MyCP.CONTENT_URI, values);

    values.clear(); values.put("data", "Record2");
    cr.insert(MyCP.CONTENT_URI, values);

    values.clear(); values.put("data", "Record3");
    cr.insert(MyCP.CONTENT_URI, values);
    ...
```

Insert various records into the Content Provider

Synchronous Contact Provider Activity

```
public class ContactProviderActivity extends ListActivity {
  public void onCreate(Bundle savedInstanceState) {
    ...
    cr.delete(Uri.parse(MyCP.CONTENT_URI + "/1"),
                                (String) null, (String[]) null);

    values.clear(); values.put("data", "Record4");

    cr.update(Uri.parse(MyCP.CONTENT_URI +
              "/2"), values,  (String) null, (String[]) null);

    ...
```

Delete & update various records into the Content Provider

Synchronous Contact Provider Activity

```
public class ContactProviderActivity extends ListActivity {
  public void onCreate(Bundle savedInstanceState) {
    ...

    Cursor c = cr.query
      (MyCP.CONTENT_URI, null, null, null, null);

    setListAdapter(new SimpleCursorAdapter(this,
        R.layout.list_layout, c, new String[] { "_id", "data" },
        new int[] { R.id.idString, R.id.data }));

  }
```

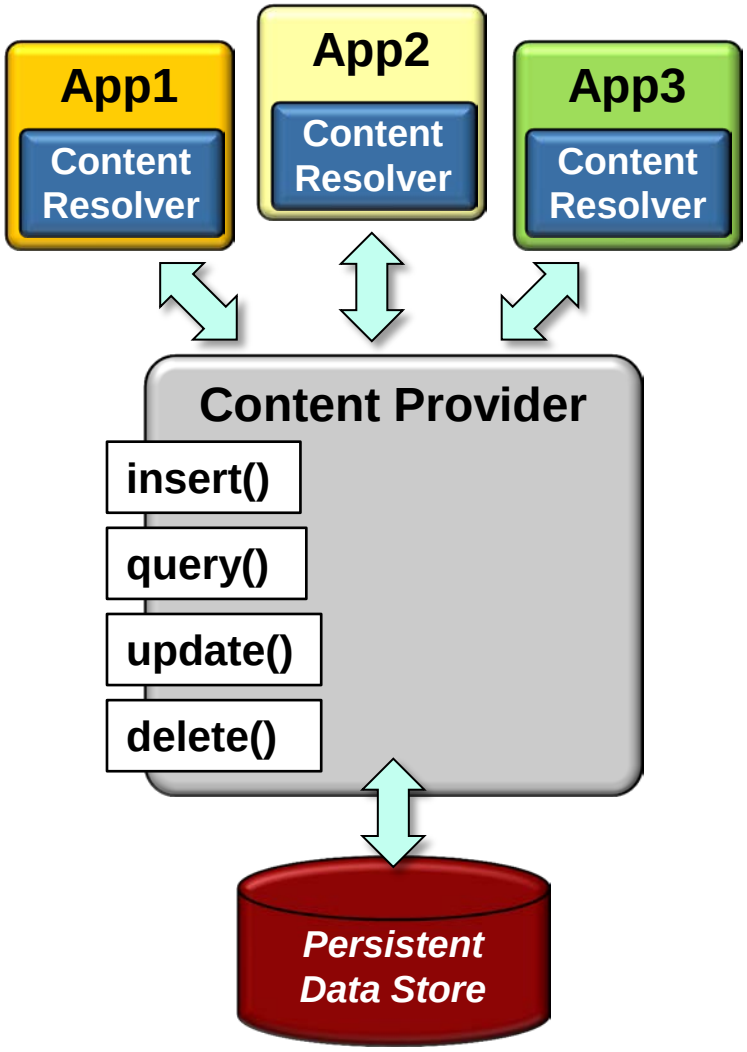
Query the Content Provider
& display the results

AndroidManifest.xml File

```
<manifest …
  package="course.examples.ContentProviders.myCP"  …”>
    <application… >
        <activity android:name=".CustomContactProviderDemo" …>
            …
        </activity>
        <provider android:name=".MyCP”
                  android:authorities=
                   "course.examples.contentproviders.mycp“
                  android:process=":remote">
        </provider>
    </application>
</manifest>
```

Motivating ContentProviderClient

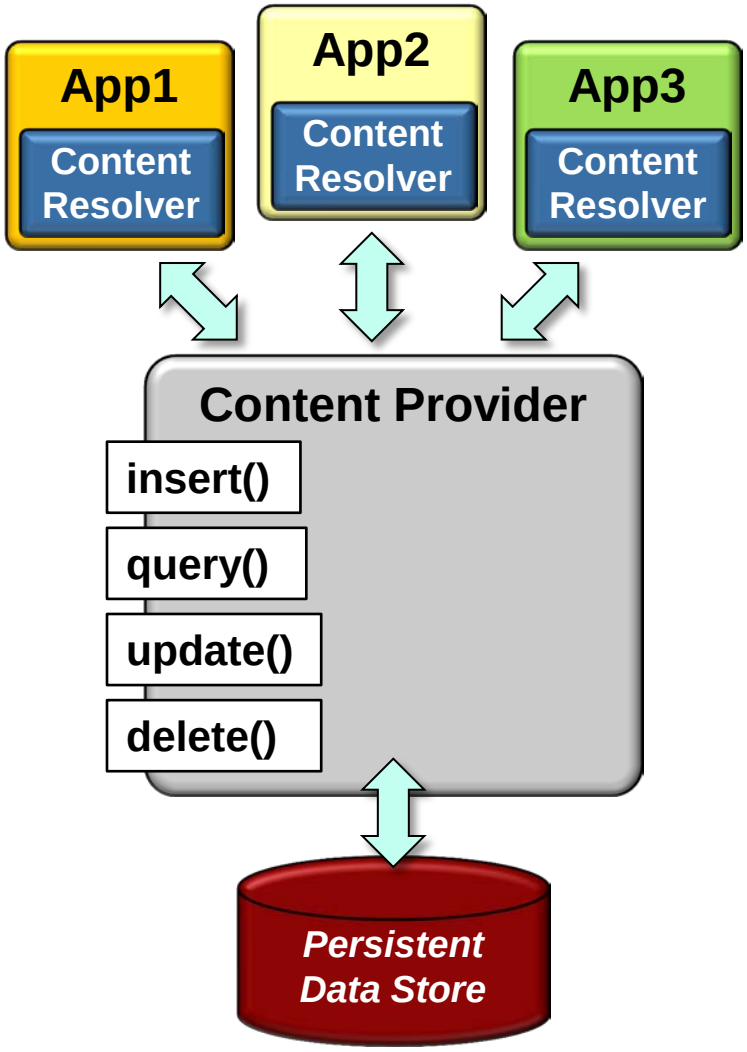
- A ContentResolver provides a mapping from String contentAuthority to ContentProvider



stackoverflow.com/questions/5084896/using-contentproviderclient-vs-contentresolver-to-access-content-provider

Motivating ContentProviderClient

- A ContentResolver provides a mapping from String contentAuthority to ContentProvider
- This mapping is expensive
  - e.g., when you call ContentResolver query(), update(), etc., the URI is parsed apart into its components, the contentAuthority string is identified, & contentResolver must search that map for a matching string, & direct the query to the right provider



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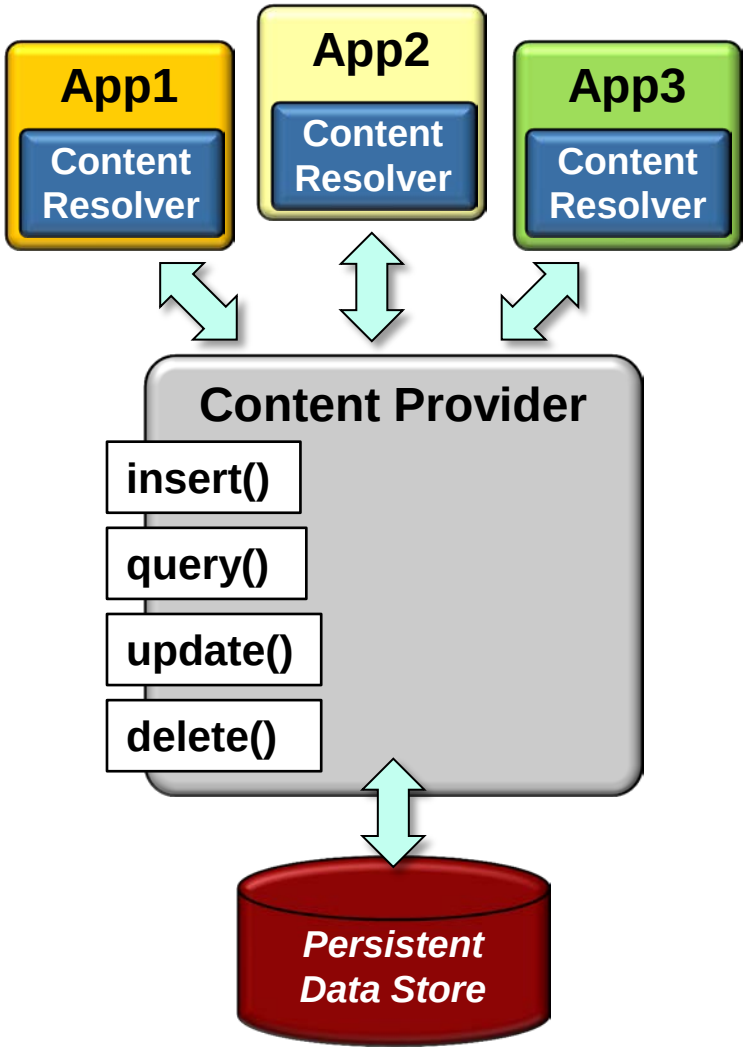
Motivating ContentProviderClient

- A ContentResolver provides a mapping from String contentAuthority to ContentProvider
- This mapping is expensive
- Moreover, this expensive search occurs during every method call since the URI might differ from call to call, with a different contentAuthority



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Querying via ContentProviderClient

- The acquireContentProviderClient() factory method on ContentResolver returns a ContentProviderClient
  - This object is associated with the ContentProvider that services the content at the designated URI

public class Summary: Methods | Protected Methods | Inherited Methods | [Expand All]
Added in API level 5

ContentProviderClient

extends Object

java.lang.Object
↳ android.content.ContentProviderClient

Class Overview

The public interface object used to interact with a `ContentProvider`. This is obtained by calling `acquireContentProviderClient(Uri)`. This object must be released using `release()` in order to indicate to the system that the `ContentProvider` is no longer needed and can be killed to free up resources.

Note that you should generally create a new ContentProviderClient instance for each thread that will be performing operations. Unlike `ContentResolver`, the methods here such as `query(Uri, String[], String, String[], String)` and `openFile(Uri, String)` are not thread safe – you must not call `release()` on the ContentProviderClient those calls are made from until you are finished with the data they have returned.

developer.android.com/reference/android/content/ContentProviderClient.html

Querying via ContentProviderClient

- The acquireContentProviderClient() factory method on ContentResolver returns a ContentProviderClient
  - This object is associated with the ContentProvider that services the content at the designated URI
  - The identified Content Provider is started if necessary

public class Summary: Methods | Protected Methods | Inherited Methods | [Expand All]
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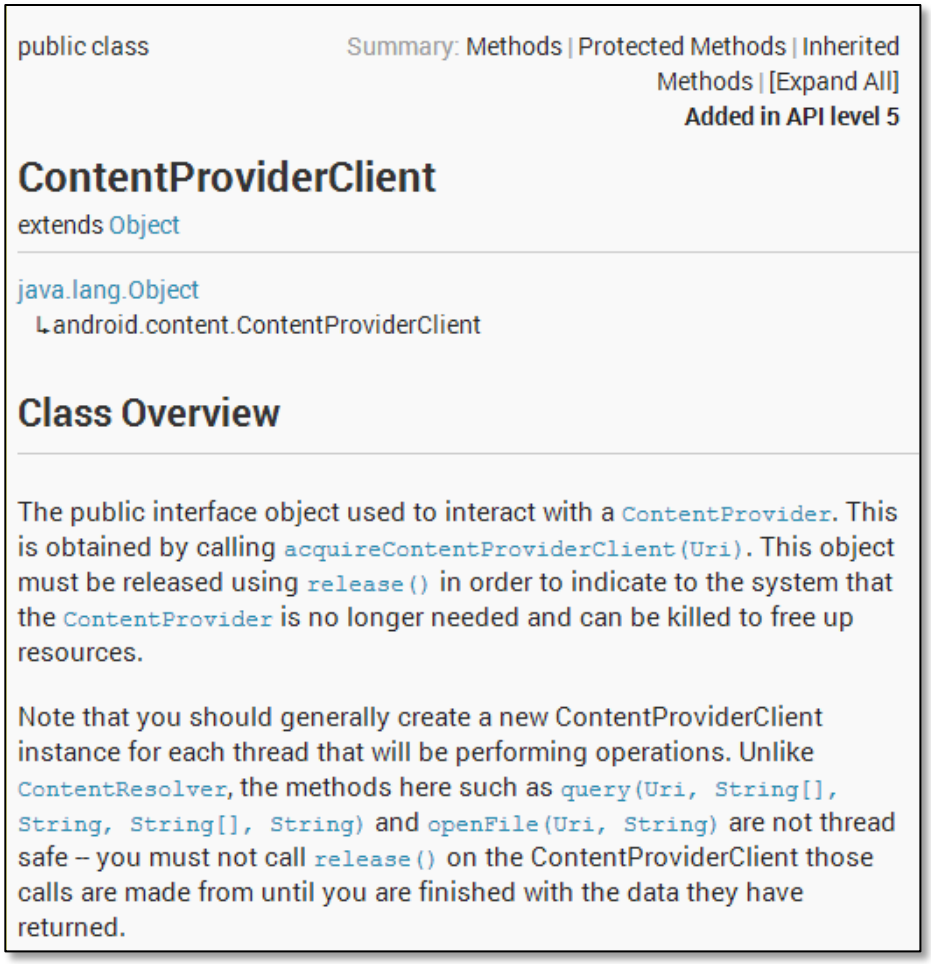
Querying via ContentProviderClient

- The acquireContentProviderClient() factory method on ContentResolver returns a ContentProviderClient
- ContentProviderClient is a direct link to the ContentProvider
  - Needn't constantly re-compute "which provider do I want?"



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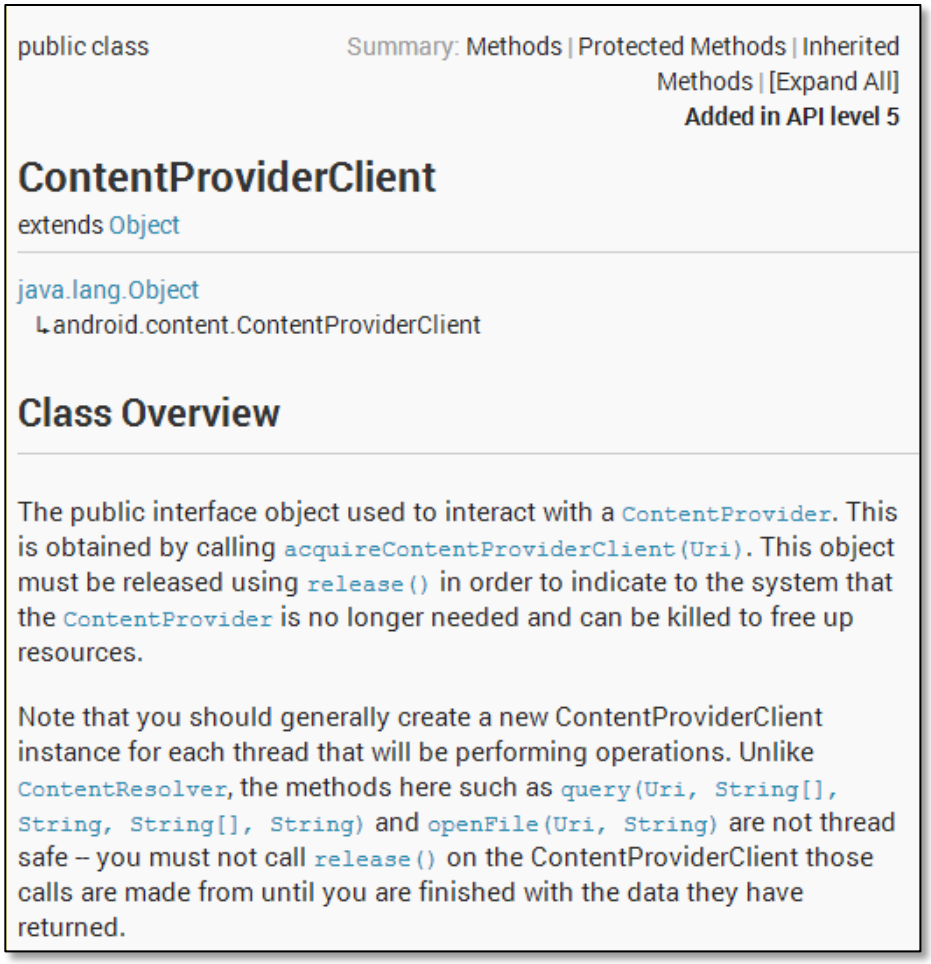
Querying via ContentProviderClient

- The acquireContentProviderClient() factory method on ContentResolver returns a ContentProviderClient
- ContentProviderClient is a direct link to the ContentProvider
- The ContentProviderClient has essentially the same interface as ContentProvider
  - Don't forget to call release() when you're done



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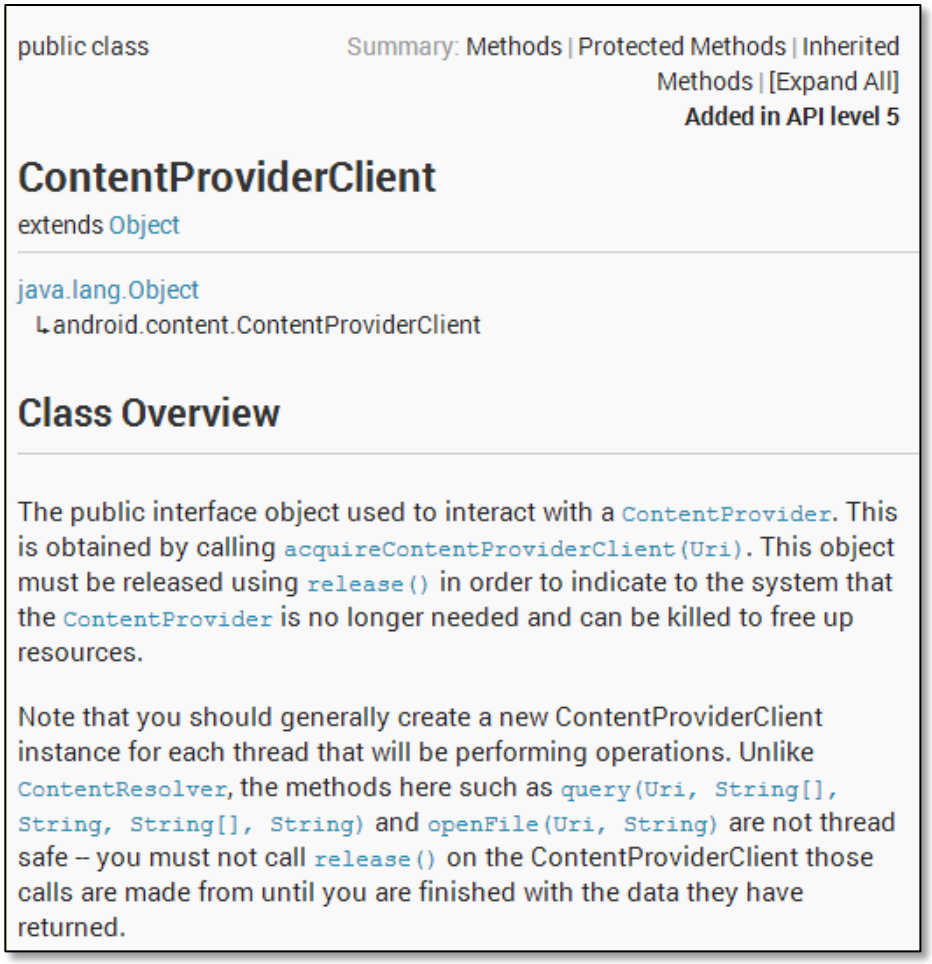
developer.android.com/reference/android/content/ContentProviderClient.html

Querying via ContentProviderClient

- The acquireContentProviderClient() factory method on ContentResolver returns a ContentProviderClient
- ContentProviderClient is a direct link to the ContentProvider
- The ContentProviderClient has essentially the same interface as ContentProvider
  - Don't forget to call release() when you're done
  - Also, the methods aren't thread-safe



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developer.android.com/reference/android/content/ContentProviderClient.html

ContactProviderClientActivity Example

```
public class ContactProviderClientActivity
             extends ListActivity {
  public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    ContentResolver cr = getContentResolver();

    ContentProviderClient cpc =
      cr.acquireContentProviderClient(MyCP.CONTENT_URI);
```

Factory method that obtains a ContentProviderClient

ContactProviderClientActivity Example

```
public class ContactProviderClientActivity
             extends ListActivity {
  public void onCreate(Bundle savedInstanceState) {
    ...
    try {
      ContentValues values = new ContentValues();

      values.put("data", "Record1");
      cpc.insert(MyCP.CONTENT_URI, values);

      values.clear(); values.put("data", "Record2");
      cpc.insert(MyCP.CONTENT_URI, values);

      values.clear(); values.put("data", "Record3");
      cpc.insert(MyCP.CONTENT_URI, values);
      ...
```

Essentially the same code as before, just using a ContentProviderClient

ContactProviderClientActivity Example

```
public class ContactProviderClientActivity
             extends ListActivity {
  public void onCreate(Bundle savedInstanceState) {
    ...
      cpc.delete(Uri.parse(MyCP.CONTENT_URI +
                 "/1"), (String) null, (String[]) null);
      values.clear(); values.put("data", "Record4");
      cpc.update(Uri.parse(MyCP.CONTENT_URI +
                 "/2"), values, (String) null, (String[]) null);
      ...
```

Essentially the same code as before, just using a ContentProviderClient

ContactProviderClientActivity Example

```
public class ContactProviderClientActivity
             extends ListActivity {
  public void onCreate(Bundle savedInstanceState) {
    ...

      Cursor c = cpc.query(MyCP.CONTENT_URI, null,
                           null, null, null);

      setListAdapter(new SimpleCursorAdapter(this,
         R.layout.list_layout, c, new String[] {"_id", "data"},
         new int[] { R.id.idString, R.id.data }));
    } catch (RemoteException e) { /* ... */ }
    finally { cpc.release(); }
  }
```

Essentially the same code as before, just using a ContentProviderClient

Summary

- Implementing synchronous Content Providers is relatively straightforward
  - However, there are issues associated with two-way blocking method calls on the main UI thread

Summary

- Implementing synchronous Content Providers is straightforward
- ContentProviderClients optimize performance
  - However, they need to be released & are not thread-safe