Source Code Analysis

Source Code Analysis

Code & Integration

MT6000

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Calendar

Source Code Analysis

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Document Revision History

Revision	Date	Author	Description
V1.0	2016-11-23	Amit Singh	Initial Release

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1 Introduction

☞

1.1 Purpose

This document provides the high level design description for the Calendar app and associated modules. This manual also elaborates the mechanism required to use the Calendar app . Android Calendar app design , Its feature & related code covered here for having a better understanding about calendar app.

1.2 Scope

This doc covers about what android provide about calendar & what mediatk has added features to enhance calendar app.

The document is about general calendar features & their functions, Calendar feature is independent of chipset.

1.3 Who Should Read This Document

This document is primarily intended for:

- Engineers with technical knowledge of the calendar app & android app developmemt
- Customers who integrate the calendar app.

1.4 How to Use This Manual

Table 1-1 presents an overview of the chapters and appendices in this document.

Table 1-1. Chapters Overview

Sl.No.	Chapter	Contents
1	Overview	Describes the scope and layout of this document.
2	Calendar View	App view in different modes
3.	Provider	Calendar Provider interact with Db to Query
4.	Importer	Calendar importer

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1.4.1 Terms and Conventions

This document uses special terms and typographical conventions to help you easily identify various information types in this document. These cues are designed to simply finding and understanding the information this document contains.

Table 1-2. Conventions

Convention	Usage	Example
Calendar App	Current calendar app features	Calendar App have day, week, month, agenda view
Provider	Calendar Provider (android component)	Database location & different queries to fetch data from database
Vcal	Vcalendar (parser)	Createion of temp vcal file Or Parse the vcal file components
Calendar Importer	Import a calendar to an account	Importing a calendar event to calendar account

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2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

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3 Definitions

For the purposes of the present document, the following terms and definitions apply:

Account: Calendar events are associated with an account. Account can be Email account. Default account for calendar is PC sysc account i.e. without adding any email account you can create Events. MTK has provide this PC Sync account feature. Default calendar (AOSP) does not have PC sync account(Local account).

Instance table: Calendar database has a instance table in which every event instances are created upto a particular range . suppose a event is created for daily upto 1 year, this instance table will keep the instances by default upto 2 months. When view is changed(view more than 2 month calendar) it will expand this instance table called event instance expand mechanism.

Calendar provider: access the calendar db from calendar app will require a provider in android system, this functionality is fulfilled by Calendar provider, It handles different queries from tables of calendar db & provide required result cursor to app/Caller. It follows the template method design pattern for general handling & hook for different handling.

CalendarAlarmManagaer: Calendar alarm manager schedule the next alam that is going to expire. It interact with system Alarm manager.

All Day Event: A event whioch is schedule for full day . for example Birthday.

Date/Time Picker: Calendar have the common Date/time picker for user instead of writing the time manually.

TimeZone Picker : To select a time zone , calendar have a list to pick timezone for a event.

Recurrence Picker: To set the frequency of a event calendar app provide a recurrence picker.

Account color: Calendar assign different color to each account.

Calendar Widget: Calendar app provide a widget to place on home screen that will show a list of upcoming events.

CalendarController: All control events are processed in calendar are processed by this. & responsible for UI change in calendar.

CalendarView: Four types. 1.Day view 2. Week view 3. Moth view 4.Agenda view

Alert: When en event start time is going to begin it will show an notification at UI to alert user.

☞ [Random filler text. Not intended for actual reading.] Must keep the chapter even it have empty content.

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4 Abbreviations

Please note the abbreviations and their explanations provided in Table . They are used in many fundamental definitions and explanations in this document and are specific to the information that this document contains.

Table 1-4. Abbreviations

Abbreviations	Explanation
MTK	MediaTek, Asia's largest fabless IC design company.
AOSP	Android Open Source Project

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5 Overview

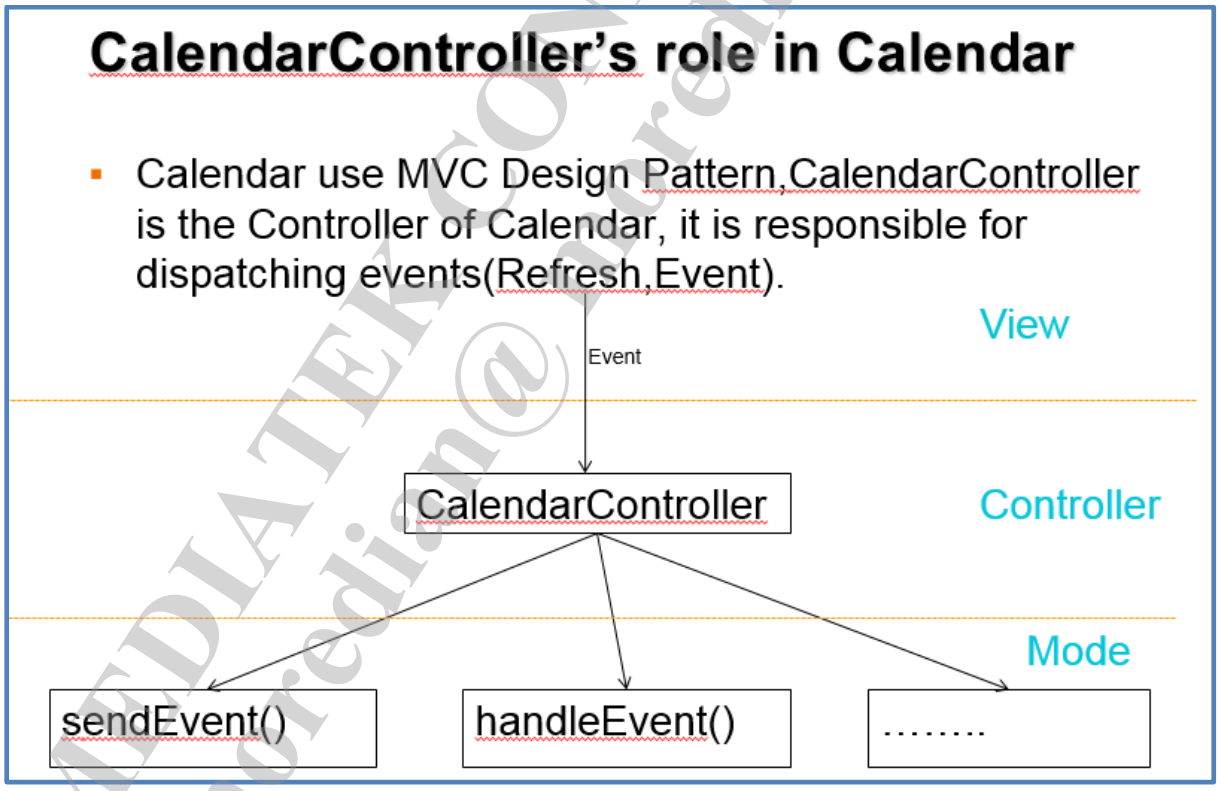
5.1 Architecture Diagrams

[Random filler text. Not intended for actual reading.]

Use UML package diagrams and/or layer diagrams and/or interface diagrams and/or system block diagrams and/or context diagrams to illustrate the top level software components and their interactions/relationships.

5.1.1 Calendar Controller Description

Figure 5-1. CalendarController.



5.1.2 Event view (EventInfoActivity)

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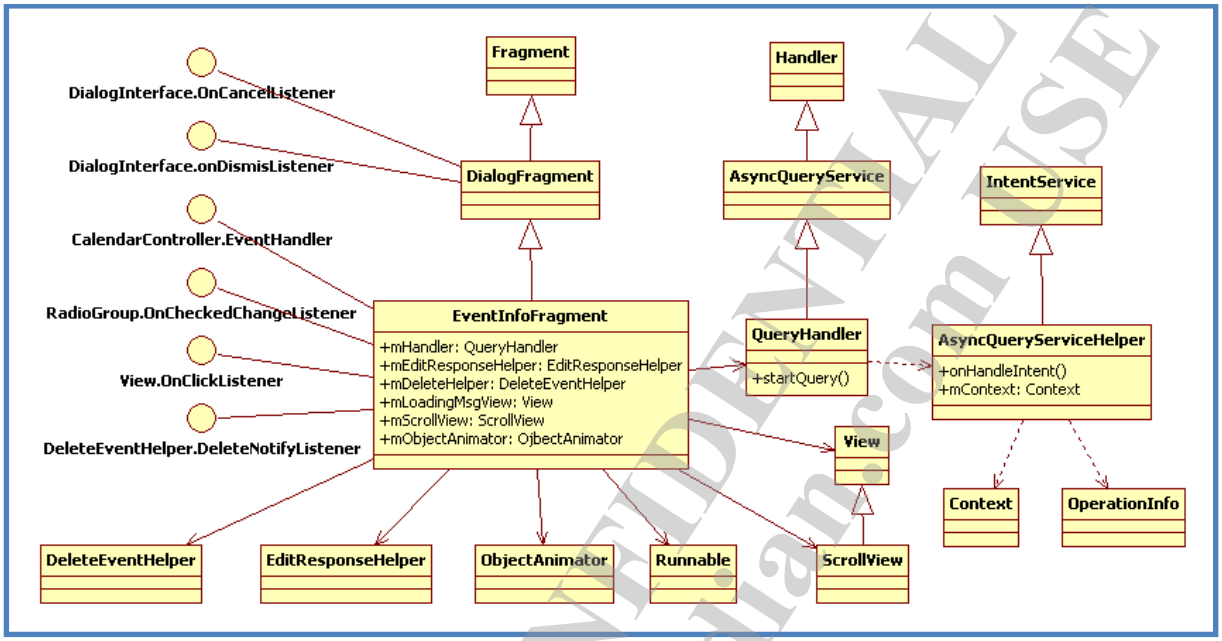
Figure 5-2. EventInfoActivity.



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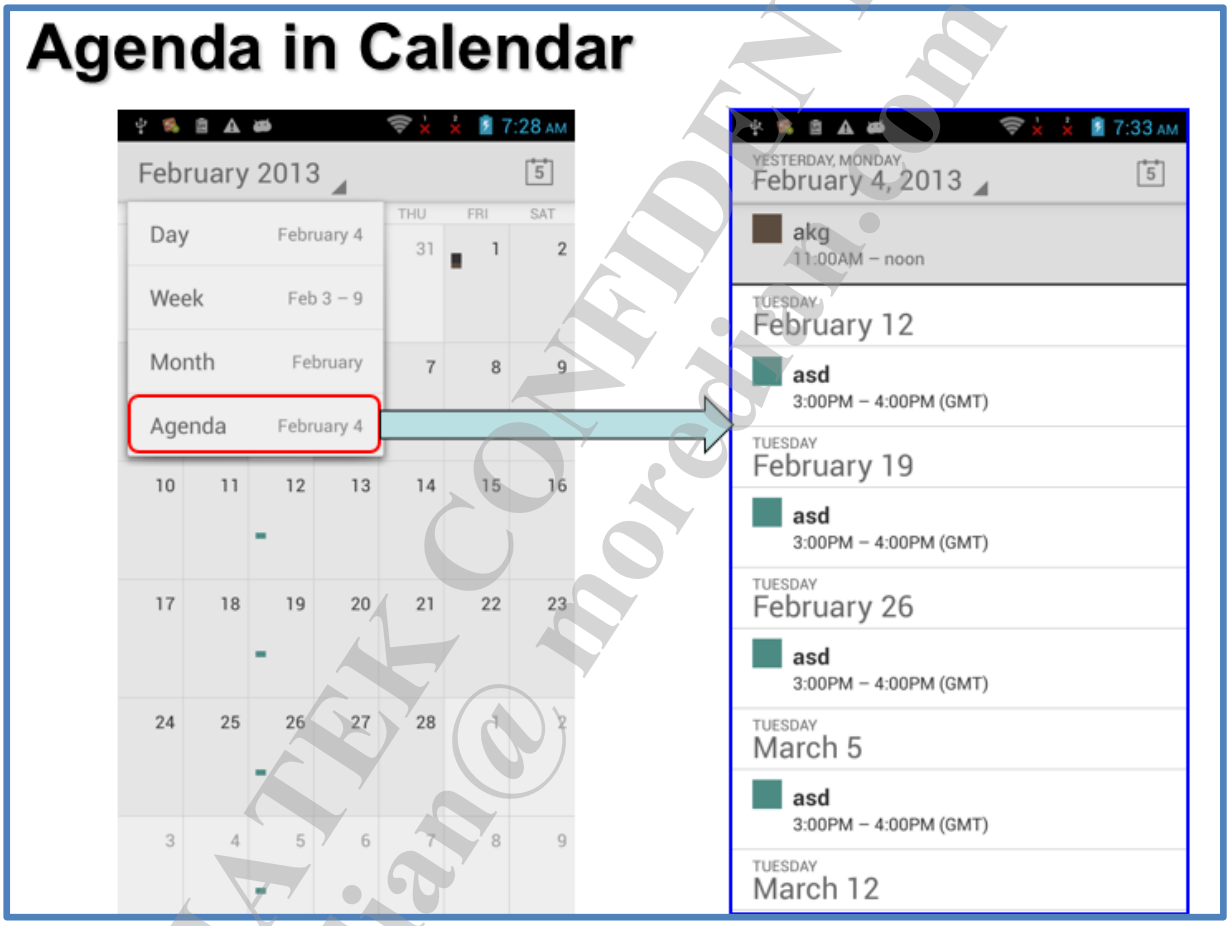
6 Calendar View

6.1 Agenda View

Agenda view display the events that are passed that are upcoming(scheduled) based upon date range selected.

Figure 6-1.1 AgendaView.



6.1.1 Purpose

- Events in a list by time order.
- Events belong to the same day will be put together under one title indicates the date.
- Events before “Today” are background grayed while other events are not. Yesterday is marked as “YESTERDAY”.
- There are header and footer views display “Touch to view events …” at top and bottom.
- Agenda is hosted in AllInOneActivity, as a fragment. It depends on CalendarController to do something, and verse also. The fragment is registered as a event handler of CalendarController, for handling messages.

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-

6.1.2 Classe diagram of Agenda:

Figure 6-1.2. View of AgendaView.

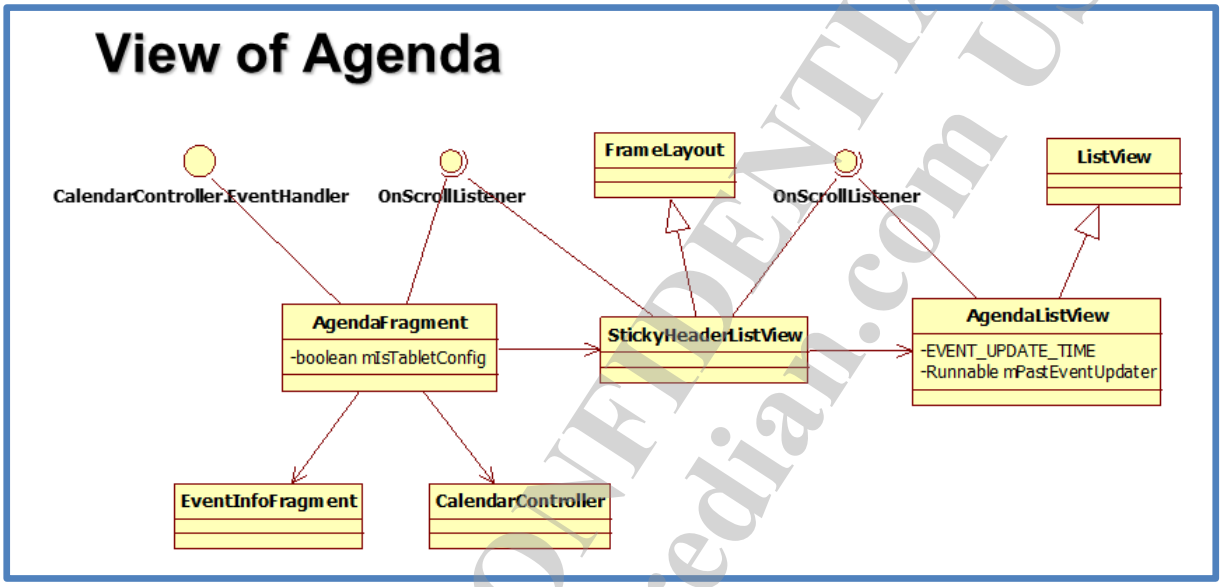

Figure 6-1.3. Data of AgendaView.

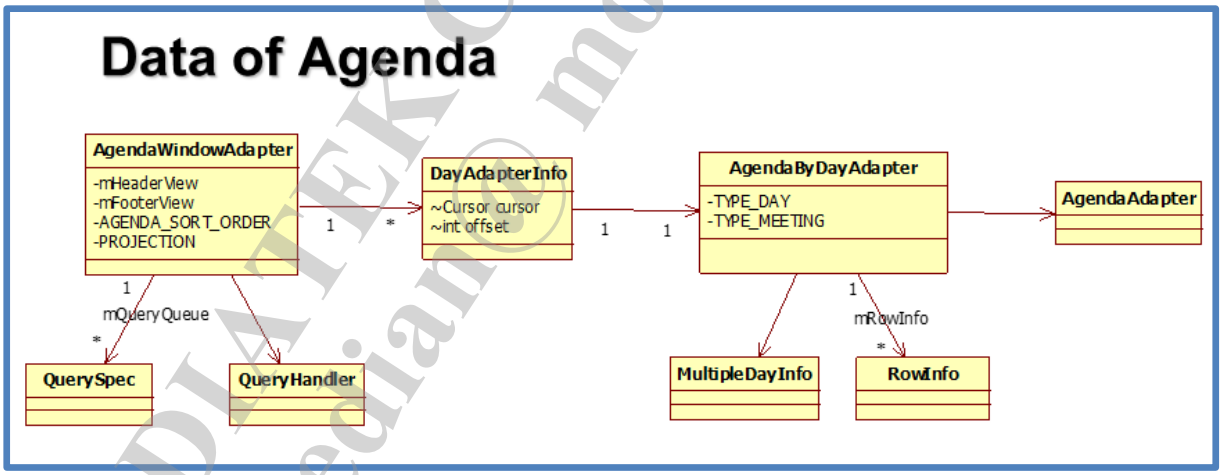

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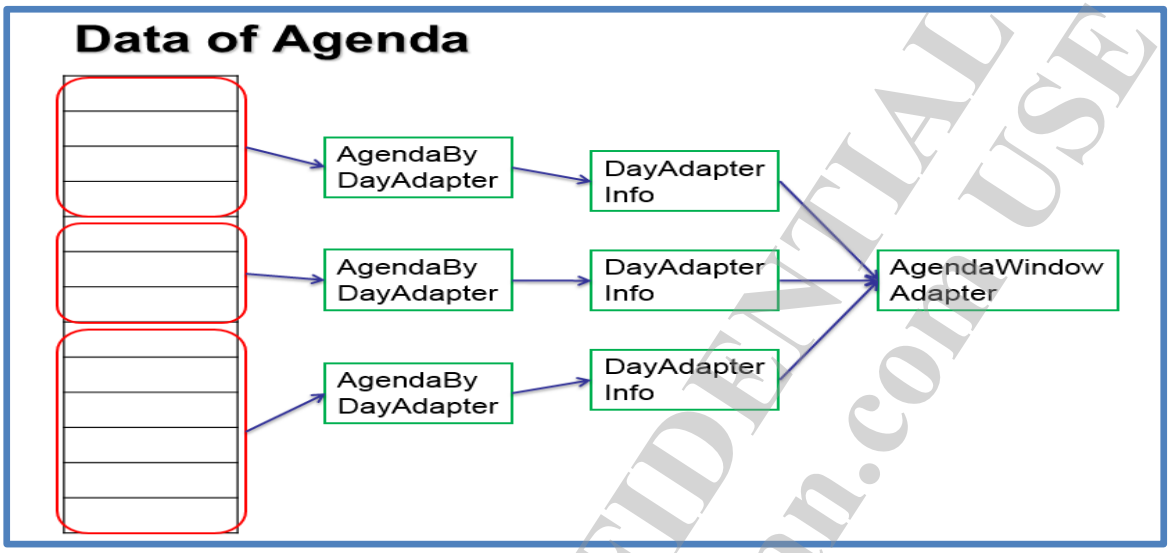
Figure 6-1.4. Summary of AgendaView.



6.1.3 Related classes

- com.android.calendar.agenda
  - AgendaFragment.java(hosted in AllinOneActivity as fragment)
  - AgendaListView.java (is responsible for displaying events, and also update of events)
  - AgendaWindowAdapter.java (provides all the items for the list view)
  - AgendaByDayAdapter.java (provides a bunch of items for the list view)
  - AgendaAdapter.java (single event item for the list view)
- com.android.calendar
  - StickyHeaderListView

6.1.4 Queries & operations performed

QuerySpec and QueryHandler are used to query event from data base.

mQueryQueue (QuerySpec Queue

onQueryComplete(…) notified

- There are three kinds of query:
  - QUERY_TYPE_CLEAN
  - QUERY_TYPE_OLDER
  - QUERY_TYPE_NEWER

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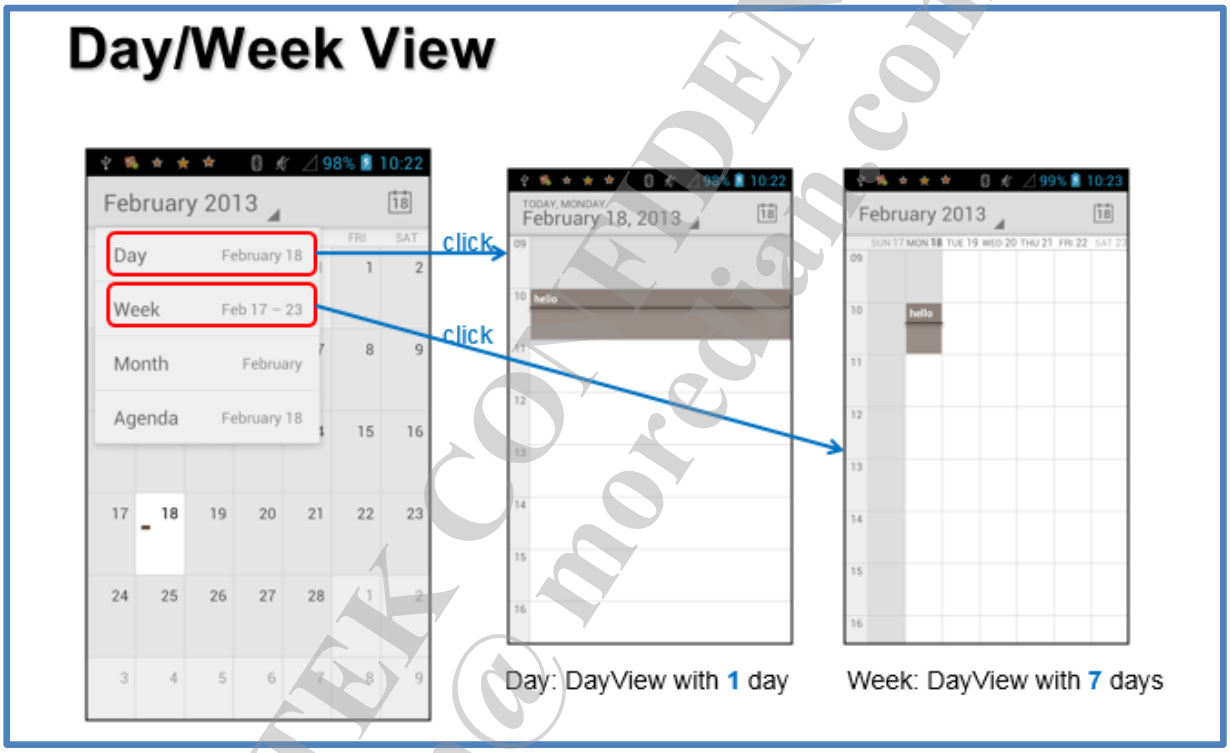
6.2 Day/Week View

Calendar modifies its view into day or week for fine details of event beased upon hours.

To change this view calendar controller send the event to AllInOneActivity to modify the view.

Figure 6-2.1. Day and Week View.



6.2.1 Purpose

Day View can prompt user the schedule by show all the events of the day.

It displays events in one day ordered by time. The event's time information can be seen at a glance.

The view's background is gray when its represent time is before current time.

There is a timeline on the left side of the view.

6.2.2 Class diagram for Day View

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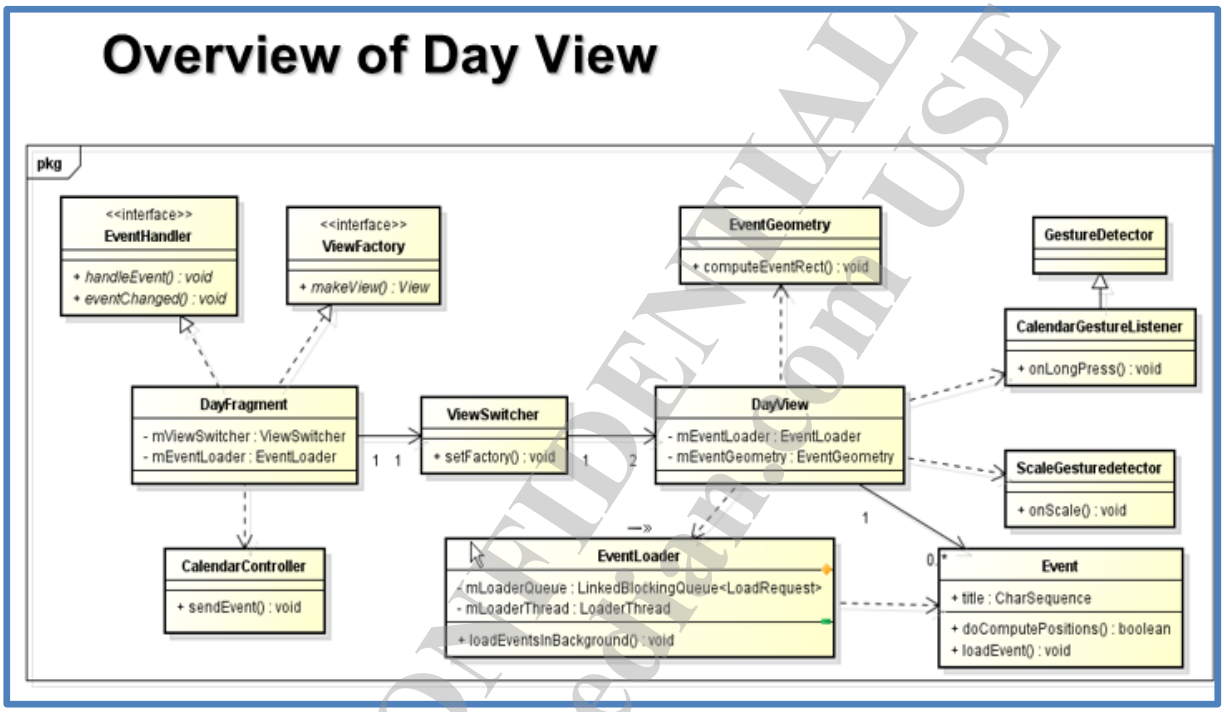
Figure 6-2.2OverView of day view



6.2.3 Related classes

com.android.calendar

- DayFragment(CalendarController.EventHandler implement & EventType.GO_TO, EventType.EVENTS_CHANGED handling)
- DayView (Listen CalendarGestureListener & handle gestures)
- EventLoader(It is used to load event in the background)
  - It only process the most recent request that stored in the loader queue.
  - EventLoader uses the information of loadRequest to loading event in LoaderThread. And DayFragment starts its background thread at onResume() and stops it at onPause().
  - After finish the request, it will post the callback to notify caller to update UI.
- EventGeomety
  - It is used to record the event's detail information and position used to draw on day view
  - It supplies the utility function computePositions() to compute the position for each event. Each event is displayed as a non-overlapping rectangle.
  - It supplies the utility function loadEvent() to do event query synchronously
- Event

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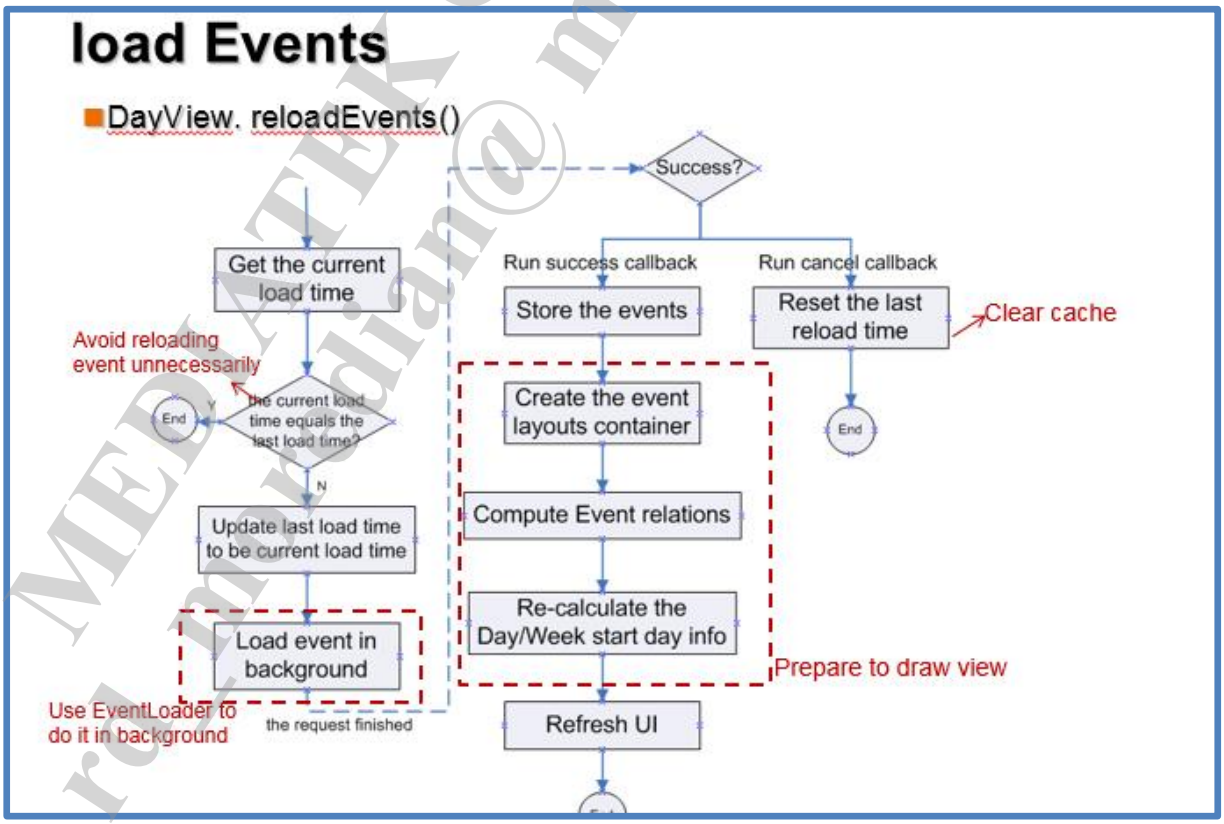
- It is used to do geomety compute for event.
- It supplies the computeEventRect() to compute the rectangle coordinates of the given event on the screen, and pointToEvent() to compute the distance from the point to the given event.

6.2.4 General information

- Day/Week is hosted on AllInOneActivity, as fragment.
- It depends on CalendarController to deliver messages/events.
- It loads events by Eventloader class, and computes event's display info by EventGeometry and Event class.
- It switches the view by a ViewSwitcher that contains 2 DayView.
- The DayView can listen and handle various gestures operation by CalendarGestureListener; and scale the grid in the vertical direction by ScaleGestureDetector.

6.2.5 Mechanism

Figure 6-2.3. Load Events Mechanism.



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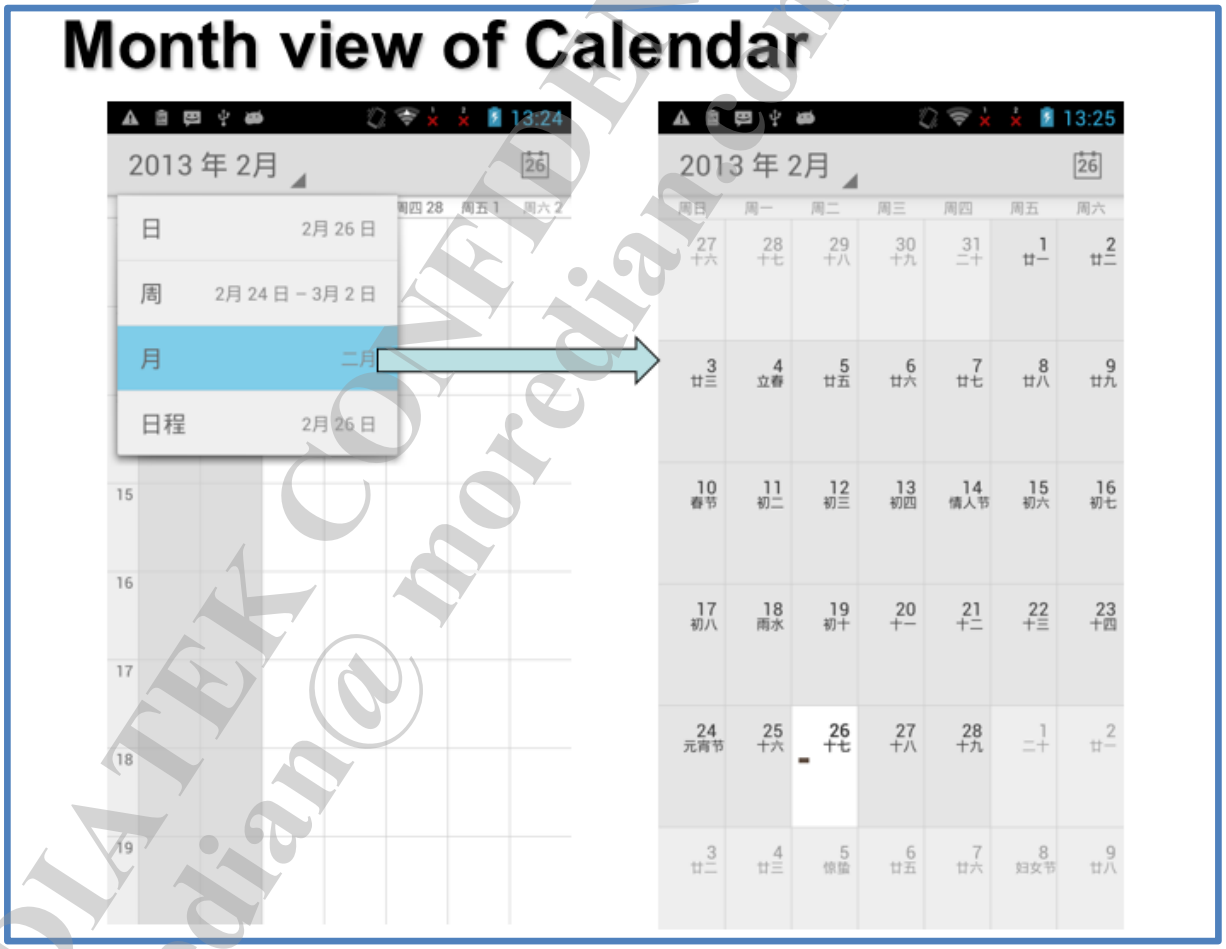
6.3 Month View

Month View hosted from AllInOneActivity as a fragment, it display a full month in UI including the events that are set.

Figure 6-3.1. Month View UI.



6.3.1 Purpose

This kind of view is for full month & which days of month have any event or not in a glance.

6.3.2 Class diagram for MonthView

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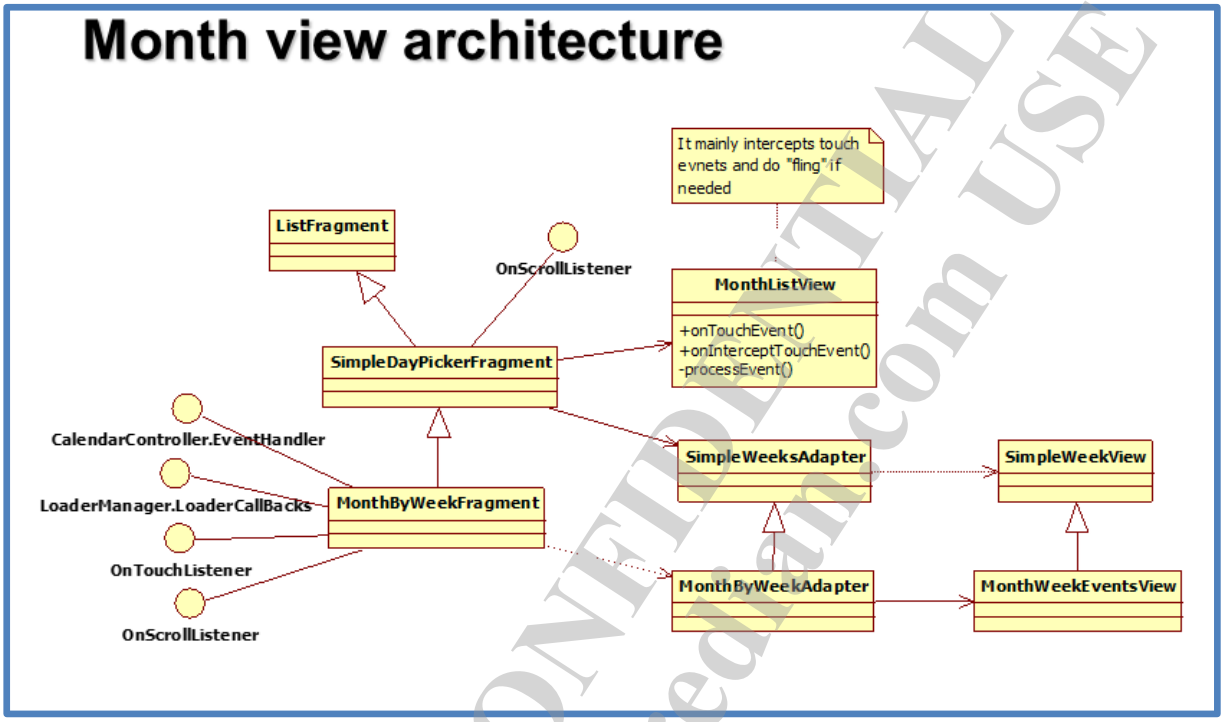
Figure 6-3.2. Month View Architecture.



6.3.3 Related Classes

com.android.calendar

– MonthByWeekAdapter

- MonthByWeekAdapter mainly overrides some methods of SimpleWeeksAdapter to provides views and behavior forMonthListView, e.g. getView and onTouch methods. It is for normal devices without large screens, e.g. phones.
- In MonthByWeekAdapter, mRealSelectedDay and mRealSelectedWeek are used for "Today" icon and "GoTo" functinality, these will be put into a hash map and passed into MonthWeekEventsView in getView method.
-

– MonthByWeekFragment

- They are containers of views for "month name", "month header" and MonthListView.
- MonthByWeekFragment is a customized SimpleDayPickerFragment. It mainly adds CursorLoader (mLoader) related things to query instances from database and build events list.
- MonthByWeekFragment also implements CalendarController.EventHandler interface to handle "GoTo" events in handleEvent method from CalendarController.

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- MonthListView
- MonthWeekEventsView
  - It is a sub-class of SimpleWeekView, responsible for one week drawing in Calendar
  - Drawings are refined in this class, include size, color, padding.
  - It draws a little rectangle to represent a event called DNA.
  - show_details_in_month in config.xml to configure the details show on big screen devices.
  - Handle goto or today actions by controller , drawSelectedDay method will handle this. mSelectedDayAnimator handles the animation.

- SimpleDayPickerFragment
  - SimpleDayPickerFragment is super class of MonthByWeekFragment, it provides the most basic data, also it is the “Mini Month” when running on a x-large device.
  - In SimpleDayPickerFragment, following can be changed to get different appearances or behavior:
    - Number of displayed weeks
    - Number of days per-week
    - Start day of the week
    - Week number
    - Friction of the MonthListView

- SimpleWeeksAdapter
  - SimpleWeekAdapter is super class of MonthByWeekAdapter, both used to provide data for the MonthListView
  - SimpleWeekAdapter holds basic data about the view, so you can inherit from it and customize the data, style of your own, like MonthByWeekAdapter does.
  - SimpleWeekAdapter is used to provide views for devices with large screen, e.g. a tablet. This is controlled by the mIsMiniMonth member, which is passed in by MonthByWeekFragment in its setUpAdapter method. And it is eventually decided by the show_calendar_controls in config.xml.
  -

- SimpleWeekView
  - provides most basic data and style for single week display

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- setWeekParams (set parameters for drawing one week)
- It provides only three methods for drawing one week
  - drawBackground
  - drawDaySeparators
  - drawWeekNums
-

6.4 Calendar Alert

6.4.1 Purpose

The Calendar use Notification to do event alert when it need to remind user that the event is about to begin.

- The events is divided into three priorities that used to do alarm: high, medium and low.
  - High: future events, and concurrent events that started recently.
  - Medium: all-day events of today except high events.
  - Low: other not expired events.
- Calendar can set the notification as a pop-up notification, it can pop up the alert events in one list(in AlertActivity).
  - The low events' alerts can not trigger it to pop up the notification.
- When event reminder(s) coming, user can lookup the event by click notification directly, and also can snooze or dismiss the event, or do a quick response to the event's guests.
  - Snooze: click the "Snooze" button, it will start the SnoozeAlarmService to snooze the reminder and update alert.
  - Email guests : click the "Email guests" button, it will broadcast a EMAIL_ACTION intent, and AlertReceiver will receive it and start QuickResponseActivity to handle it.
  - Clear all: click the clear all button on notification bar, it will start the DismissAlarmsService to dismiss all alarms.
  - Map- it open the location that mentioned in the event.

6.4.2 Related Classes

- AlertReceiver.java
  - Receives EVENT_REMINDER action intents and handles the event reminders. And it can also receive and handle EMAIL_ACTION , and DELETE_ALL_ACTION action intents.

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- AlertService.java
  - Handles the calendar event reminders, do real work.
- AlertActivity.java
  - The alert panel that pops up when there is a calendar event alarm.
- AlertAdapter.java
  - The adapter of AlertActivity, it extends ResourceCursorAdapter.
- AlertUtils.java
  - The utility class.
- DismissAlarmAlarmService.java
  - Service for asynchronously marking a fired alarm as dismissed.
- QuickResponseActivity.java
  - Used to display quick responses list for users to choose one, when they wants to email guests from notifications.
- SoonzeAlarmsService.java
  - Service for asynchronously marking a fired alarm as dismissed and scheduling a new alarm for the event in the future.
- NotificationMgr.java
  - The manager to notify or cancel notification(s).

6.4.3 Event notification flow

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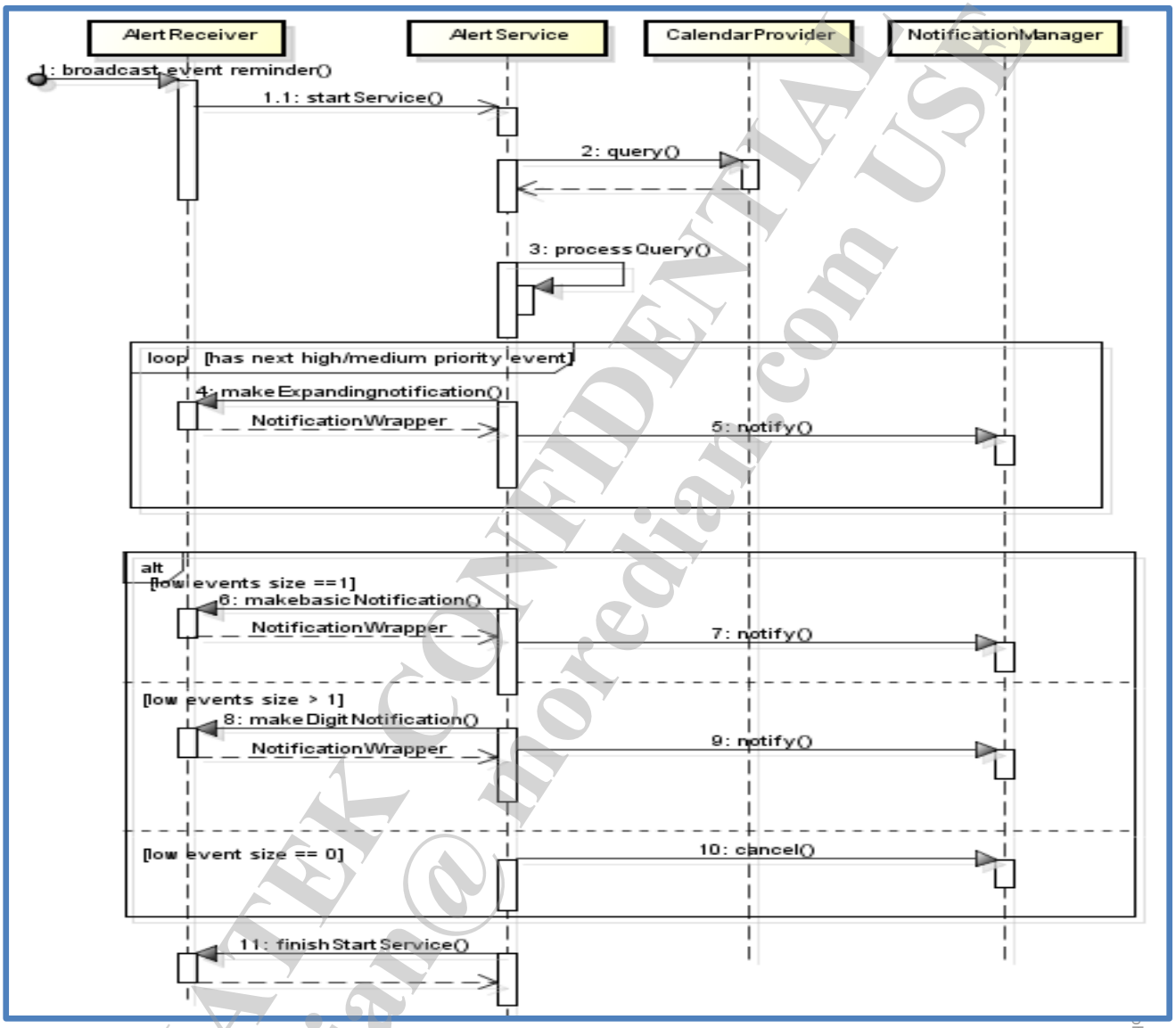
Figure 6-4.1. Calendar Alert diagram.



6.4.4 General info & Alert mechanism

Query alert

- Query table is CalendarAlerts table.
- Query condition:
  - The alert state is STATE_SCHEDULED or STATE_FIRED.
  - The alarm time is earlier than current time.

The alert has 3 states:

STATE_SCHEDULED: An alert begins in this state when it is first created

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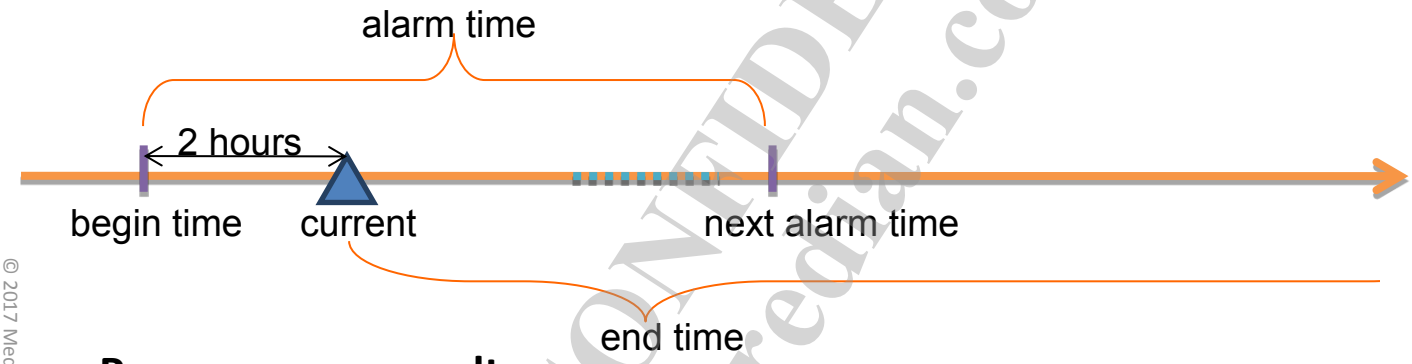
STATE_FIRED: After a notification for an alert has been created it should be updated to fired

STATE_DISMISSED: Once the user has dismissed the notification the alert's state should be set to dismissed so it is not fired again

Which event can be scheduled in CalendarProvider?

1. The alarm time of event is in the range of begin time and next Alarm Time.
2. The event's end time is later than current time.
3. The alarm method is Alert.

The reminders of events that meet the above criteria will be put in CalendarAlerts table.



Process query result

- Before notify the notification for the events, AlertService.processQuery() should process the query results to be 3 priorities.
- After process, if the size of high/medium priority events is more than 20, it will bump some to the low priority digest.
- High priority events need to comply with the following conditions :

current system time is later than event's alarm time;

current system time is earlier than event's begin time plus grace period. alarm time < current time < begin time+ grace period

the grace period is 15 mins for allday events, or Max(15 mins, (endTime- beginTime) /4) for common event

- Medium priority events are the all-day events of today except high events.
- other not expired events in query result are low priority events.

Build notification

- High/Medium priority events: it should make 1 notification for each event, by call makeExpandingNotification().
- Low priority events: it should make 1 notification for it/them, by call makeBasicNotification() or makeDigestNotification() according to the number of events.

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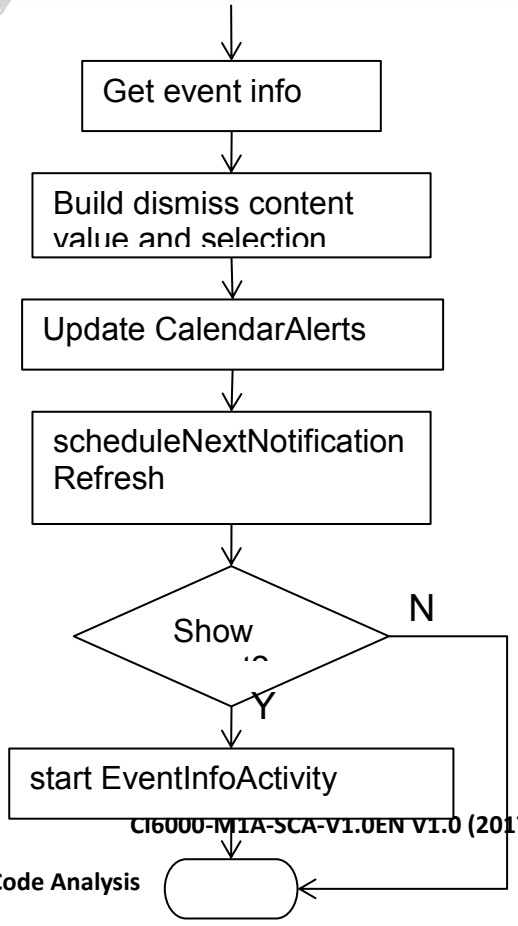
- If there is no low-priority event, just cancel its notification to update UI.
- The table is the notifications' comparison：

Support option	Click intent	Delete intent	Snooze intent	Email intent	Full screen intent
ExpandingNotification	Y	Y	Y	Y	Y
BasicNotification/ DigestNotification	Y	Y	N	N	N

Dismiss

- DismissAlarmsService can be triggered by click the clear all button on notification bar or click on the event's notification.
- If it is triggered by click on notification(except the low-priority events'), it should show event detail after dismiss the alert(s). And the flag is get from the intent that build when make notification for event .
- If the cleared notification is a low-priority events', we'll get a eventIds array to dismiss multi-alarms.

```
boolean showEvent = intent.getBooleanExtra(AlertUtils.SHOW_EVENT_KEY, false);
long[] eventIds = intent.getLongArrayExtra(AlertUtils.EVENT_IDS_KEY);
int notificationId = intent.getIntExtra(AlertUtils.NOTIFICATION_ID_KEY, -1);
```



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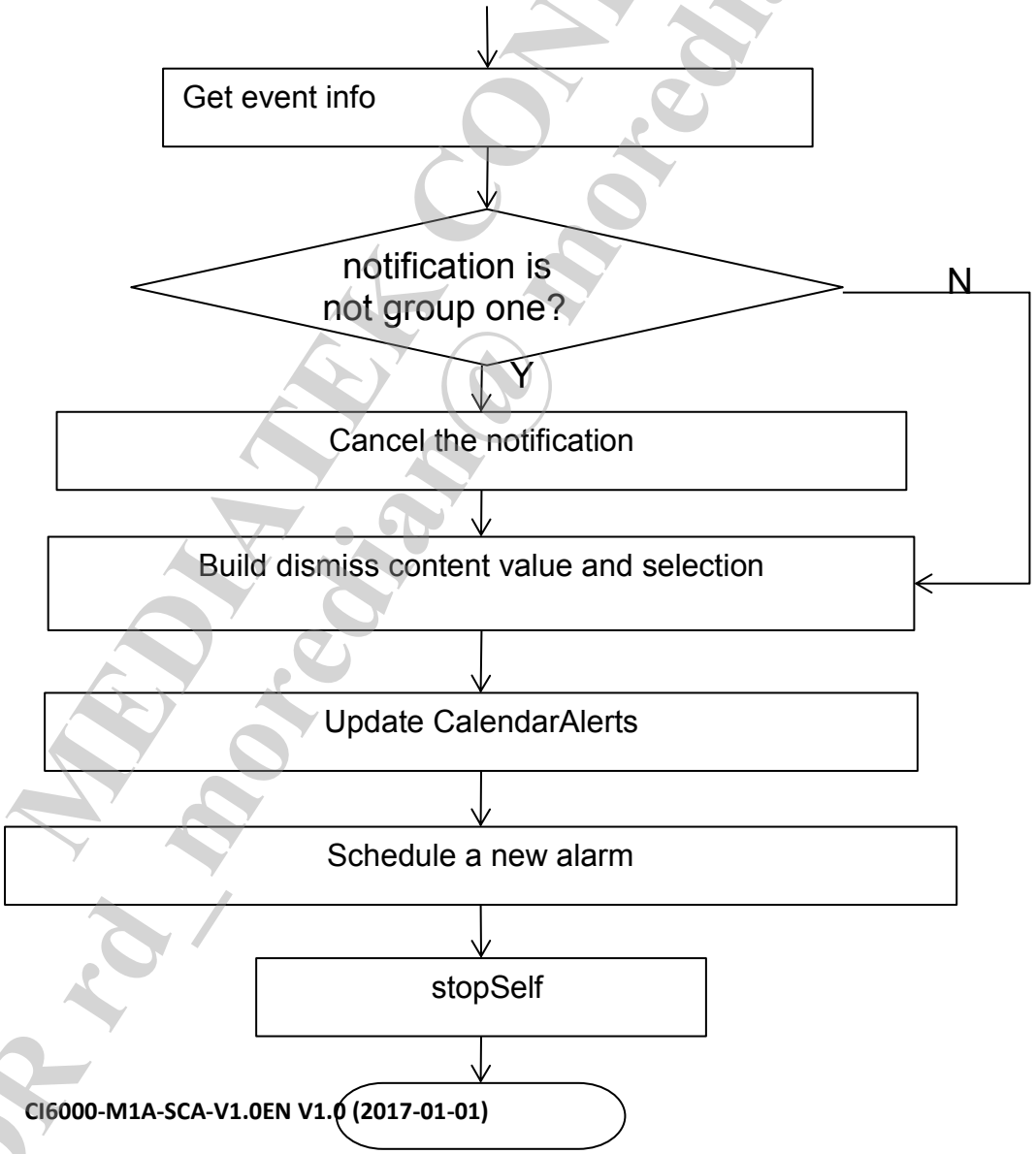
Snooze

- SnoozeAlarmService can be triggered by click the “Snooze” button in the notification.
- After dismiss the old alert, it will schedule a new alarm for this event, and the alarm time is after 5 mins from current system time.

```
// Add a new alarm
long alarmTime = System.currentTimeMillis() + AlertUtils.SNOOZE_DELAY;
ContentValues values = AlertUtils.makeContentValues(eventId, eventStart, eventEnd,
        alarmTime, 0);
resolver.insert(uri, values);
AlertUtils.scheduleAlarm(SnoozeAlarmsService.this, AlertUtils.createAlarmManager(this),
        alarmTime);
```

Figure 6-4.2. Calendar Alert Notification.



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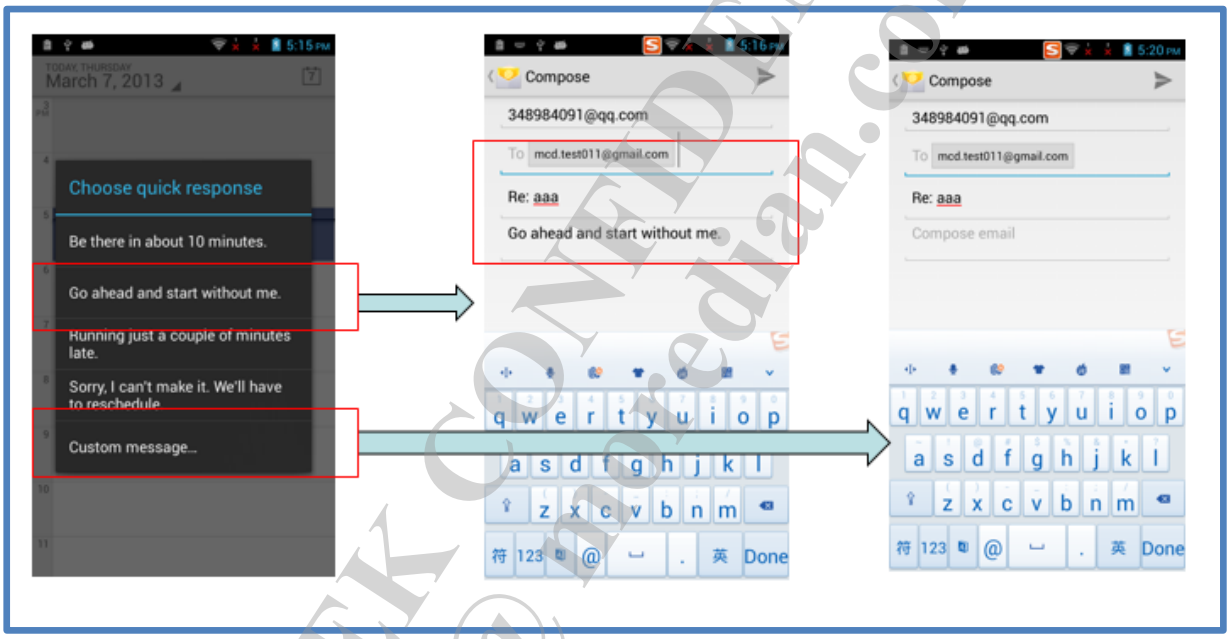
Email Guest

- When users click the “email guests” button, it will broadcast a *MAIL_ACTION* intent to AlertReceiver, and AlertReceiver will start QuickResponseActivity to show quick responses to user.
- When users select one quick response, it will start email with the response text, event title and email address of guest(s) like follow:

Figure 6-4.3. Calendar Alert Email Guest.



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7 Calendar Provider

Figure 7-1. Calendar provider.

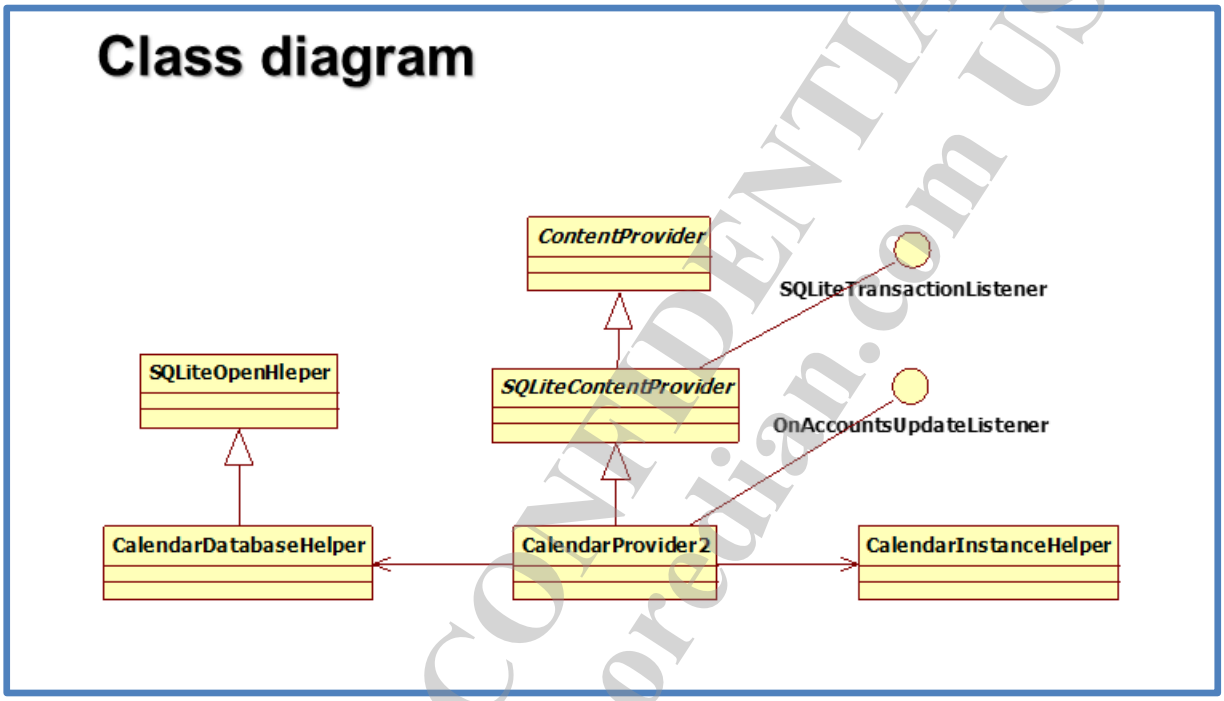

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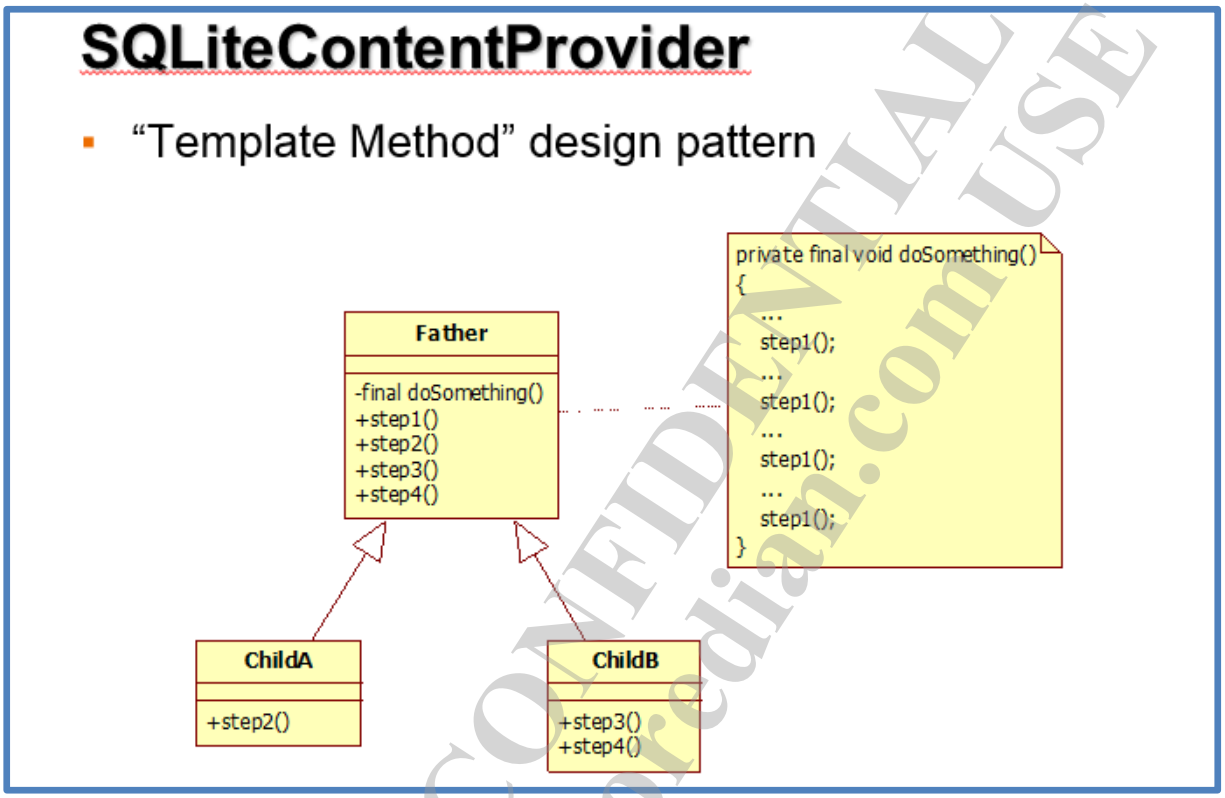
Figure 7-2. Calendar provider design pattern.



7.1 Purpose

Calendar app uses the provider to query from database.

- SQLiteContentProvideris the super class of CalendarProvider2 (It is a singleton, and its instance is created by system and held by mInstance member.). "Template Method" design pattern is applied on them. So, its main responsibilities is define the "Template" methods and the "Hook" methods for its subclasses.
- Its main "Template" methods are:
  - insert
  - update
  - delete
  - bulkInsert
- Its main "Hook" methods are:
  - insertInTransaction
  - updateInTransaction
  - deleteInTransaction

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- All the database manipulations are done in transactions, the “Hook” methods are named like ***InTransaction.
- It has applyBatch method that applys batch database operations hosted in ContentProviderOperation objects. Requests from clients often execute in this way.
- It implements the SQLiteTransactionListener interface to get notified when in progress of one transaction. Methods included:
  - onBegin
  - onCommit
  - onRollback
- **CalendarProvider2.java functions**:
  - MINIMUM_EXPANSION_SPAN ensures at least two month of data are loaded.
  - It registers a BroadcastReceiver named mIntentReceiver to receive broadcast with action as below:
  - android.intent.action.TIMEZONE_CHANGED
  - android.intent.action.DEVICE_STORAGE_OK
  - android.intent.action.TIME_SET
  - CalendarAlarmManagaer is used to schedule alarms when e.g. time zone changed, time changed or events updated, it is held by mCalendarAlarm.
  - SQLiteDatabase, CalendarDatabaseHelper and CalendarInstancesHelper are used to directly or indirectly manipulate database. Members are: mDb (in super class), mDbHelper, mInstanceHelper.
  - SEARCH_COLUMNS holds the columns in which you can search events. There are also some methods help to make search, with “Search” in their names.
  - When time zone is changed, the “Instances” table will be regenerate in CalendarInstancesHelper ‘s performInstanceExpansion method by call CalendarDatabaseHelper’s instancesReplace method. The most obvious method called is regenerateInstancesTable.
  - Query is the most important function, done in query method, provide clients with data. Most querys are done with a SQLiteDatabase object from corresponding tables directly, but instances query, instances search and events query are not so, they query data from joined views, defined in INSTANCE_QUERY_TABLES and INSTANCE_SEARCH_QUERY_TABLES. Involved methods are:
    - handleInstanceQuery
    - handleInstanceSearchQuery
    - handleEventDayQuery

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- Recurrent event is a event repeats itself in some way, e.g. weekly, monthly or yearly. User can create recurrent events in Calendar, a recurrent event is different from a normal event as its “rrule” column is NOT null in the “Events” table. User can also create “exception” events in recurrent events to modify part of the events. ALLOWED_IN_EXCEPTION holds the columns allowed to be modified when creating an exception to a recurrent event. Methods involved in as below:
  - isRecurrenceEvent
  - setRecurrenceEnd
  - handleInsertException
  - backfillExceptionOriginalIds
  - validateRecurrenceRule
-

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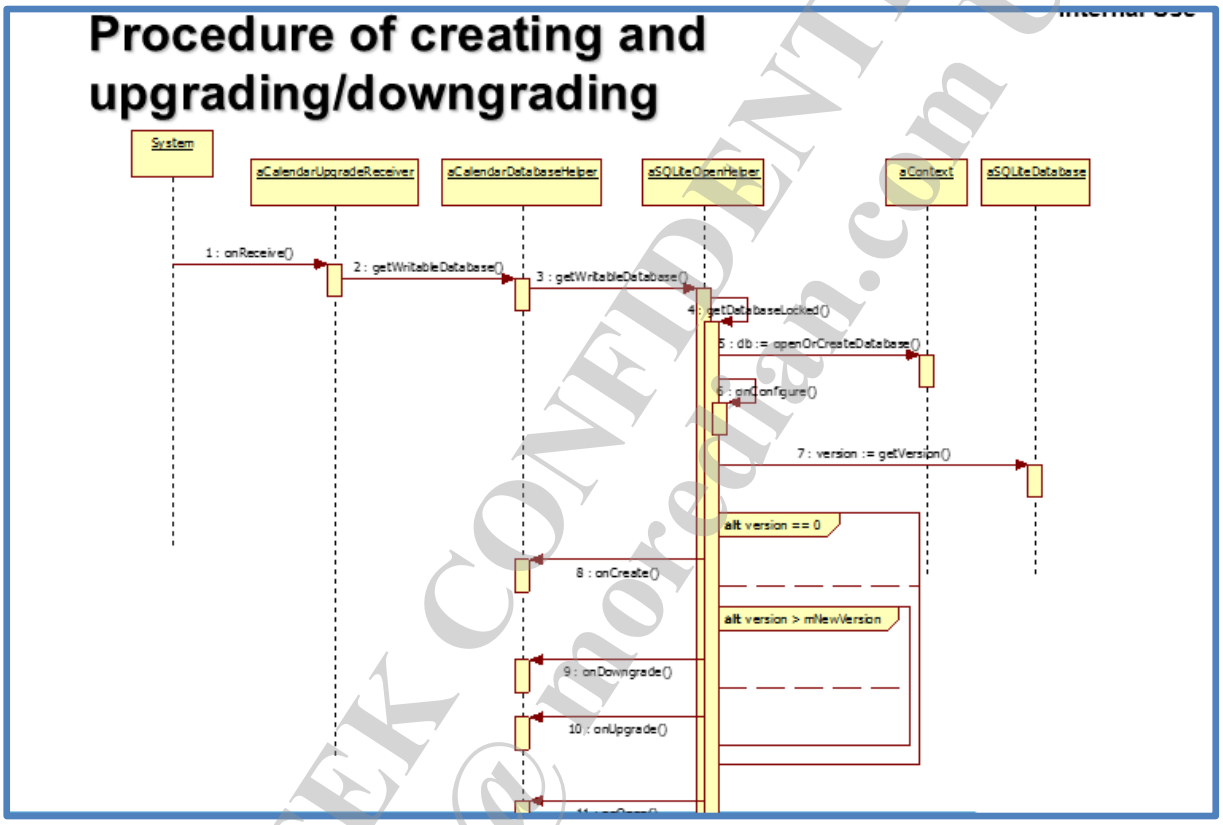
8 Calendar database

8.1 Creating database

Figure 8-1. Calendar database create upgrade and downgrade.



8.2 Class diagram

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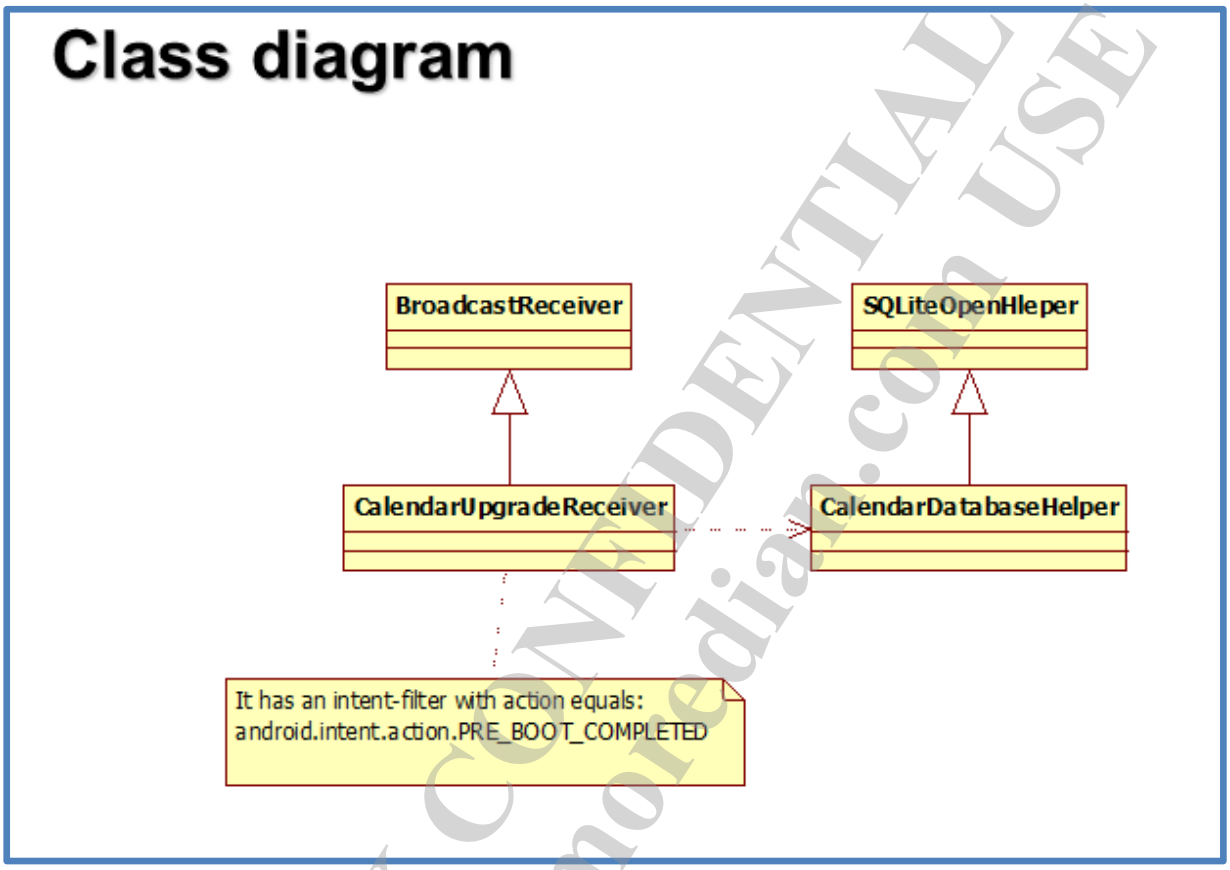
Figure 8-2. Calendar database Class diagram.



8.3 CalendarUpgradeReceiver

- It is used to create Calendar database (if it does not exist) or update Calendar database (if it exists but need update).
- It registers an intent-filter with a “android.intent.action.PRE_BOOT_COMPLETED” action, this intent is sent between after the core system has finished booting and before the intent “android.intent.action.BOOT_COMPLETED” is sent.
- CalendarDatabaseHelper.DATABASE_VERSION holds the version of Calendar’s database.

8.4 CalendarDatabaseHelper

- It is a singleton, with the static method getInstance providing its single instance.
- Name of Calendar’s database is “calendar.db”, held by DATABASE_NAME member.
- DATABASE_VERSION holds the latest (current) version of Calendar’s database, so any change of it should add related methods or make changes to update the database.

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- Some methods are overridden to provide behavior specific to CalendarProvider, they are hooks called in super(SQLiteOpenHelper) class' getDatabaseLocked method
  - onCreate: create all the tables and triggers for the database when it is created for the first time, bootstrapDB is called to do it
  - onOpen: called when the database is opened
  - onDowngrade: called when current version is newer than requested
  - onUpgrade: called when current version is older than requested, there are many upgradeToVersion*** methods to do upgrade work, one by one called with newer version number if needed
- There are some DatabaseUtils.InsertHelper members used to insert rows into some tables, they are used in ***Insert or ***Replace methods to achieve that
- Method scheduleSync is used to synchronize events of exchange accounts, it is called when the database is created the first time, in some upgrade of database, or a new exchange account is created.
- Method createEventsView creates a view from "Events" and "Calendars" table, it is used to query event details in CalendarInstanceHelper and CalendarProvider2. This method is called in bootstrapDB and onUpgrade, when the database is created the first time and every time the database is upgraded.

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9 Calendar Alarm Manager

9.1 Role

This class help to schedule the alarms to Alarma manger side and handling of expired event notify to upper layer.

9.2 Functions

- Alarm Manager is used to create CalendarAlerts table data to DB, according to Reminders, Instances, Events and Calendars table.
- CalendarAlerts table is used to make alert notification.
  - calendars can visible
  - instances, use the fit instances.
  - reminders, which time is fit.
  - events, must ensure the event is available.
- Find the earliest alarm time in current CalendarAlerts table, reset it when insert one alert.
- Joining instances, reminders, events tables to find the real Alerts.
- AlarmManager will use CalendarConract$CalendarAlerts to send ACTION_EVENT_PEMINDER pending intent at the alert time, then Calendar/AlertService will update notification.

9.3 General Flow

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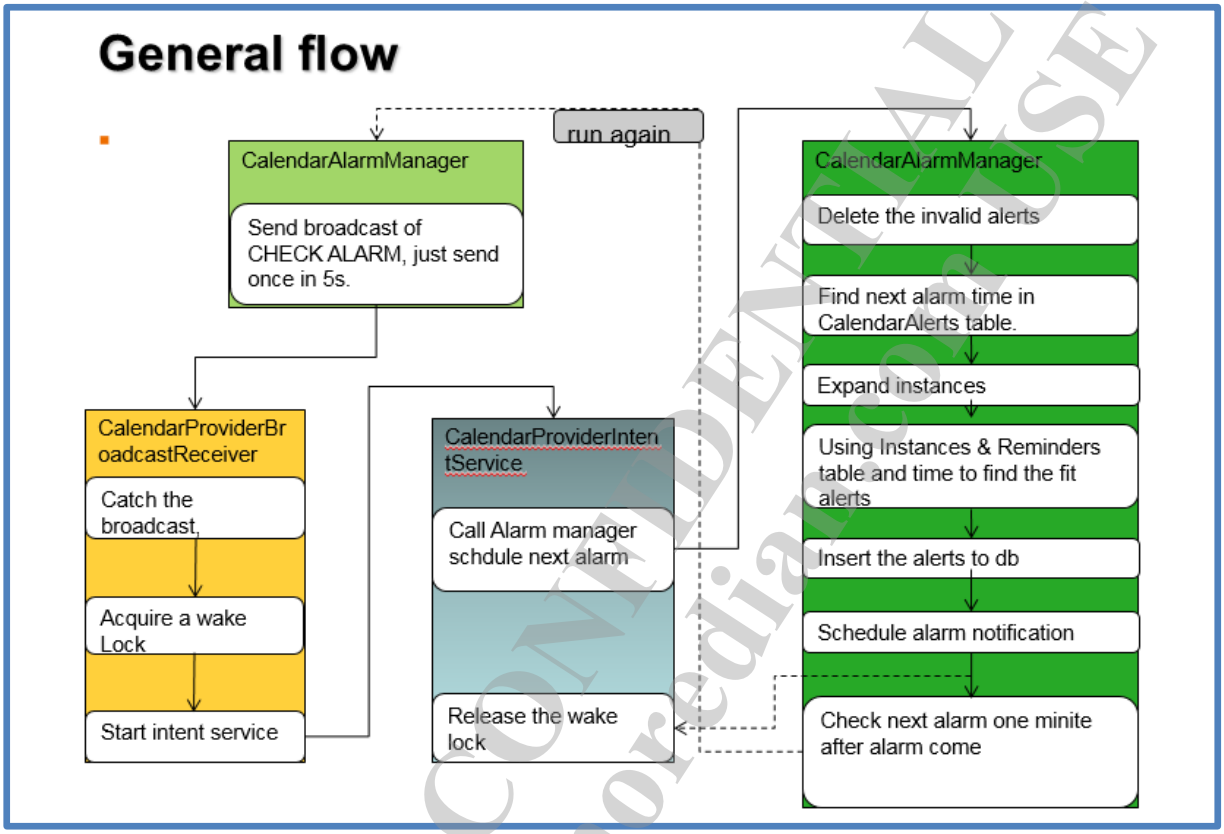
Figure 9-1. Calendar Alarm Manager.



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10 Instance Range

10.1 General information

- One instance refer to an disposable event. It contains the information of start and end time, duration, event ID and so on. Instance is used to create alarms, build agenda list and drawn calendar.
- Normal event has only one instance.
- Repeatedly event contains more than one instance. If one weekly event last for 3 weeks, so has 3 instances.
-

10.2 Expand instance mechanism

- 1. Agenda/Month view is using AgendaFragment , when it 'onResume' , 'eventChanged' or 'goto' will call db query action, so expand the instance.
- 2. Day/Week view is using DayFragment , when it ' onResume' or 'goto' will call db query action, so expand the instance.

  - According to the given time and event table to find the events that happening between start and end time.
  - If the event is not a repeatedly event, just create one instance data into DB.
  - If the event is a repeatedly event, calculate the every start time of one occurrence of that event and insert to DB.
  - The main classes: CalendarProvider2 CalendarInstancesHelper RecurrenceProcessor MetaData

- **Detail flow**
  - 1. get the query start and end time
  - 2. set the end day +1
  - 3. expand the min start and end time duration to 62 days.. .
  - 4. get the current min and max time in instance table.
  - 5. use the actual need extended time expand the instances and insert instances to db if the instance table not contains the instances we want.
  - 6 update the min and max time in instance table and do one query action and return the result.

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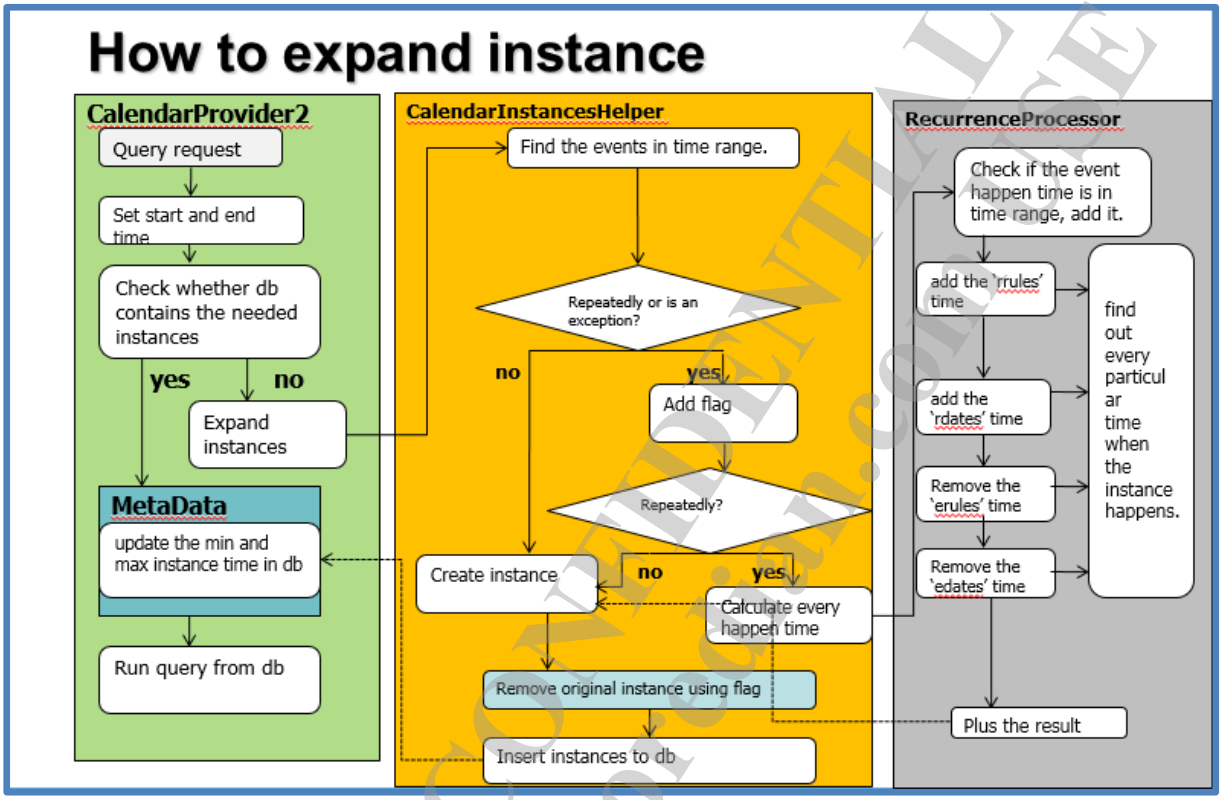
Figure 10-1. Instance Expand mechanism.



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11 CalendarImporter

11.1 General information

Personal Data Interchange (**PDI**), The iCalendar format is suitable as an exchange format between applications or systems. The format is defined in terms of a MIME content type.

Figure 11-1. Calendar Importer Class diagram.

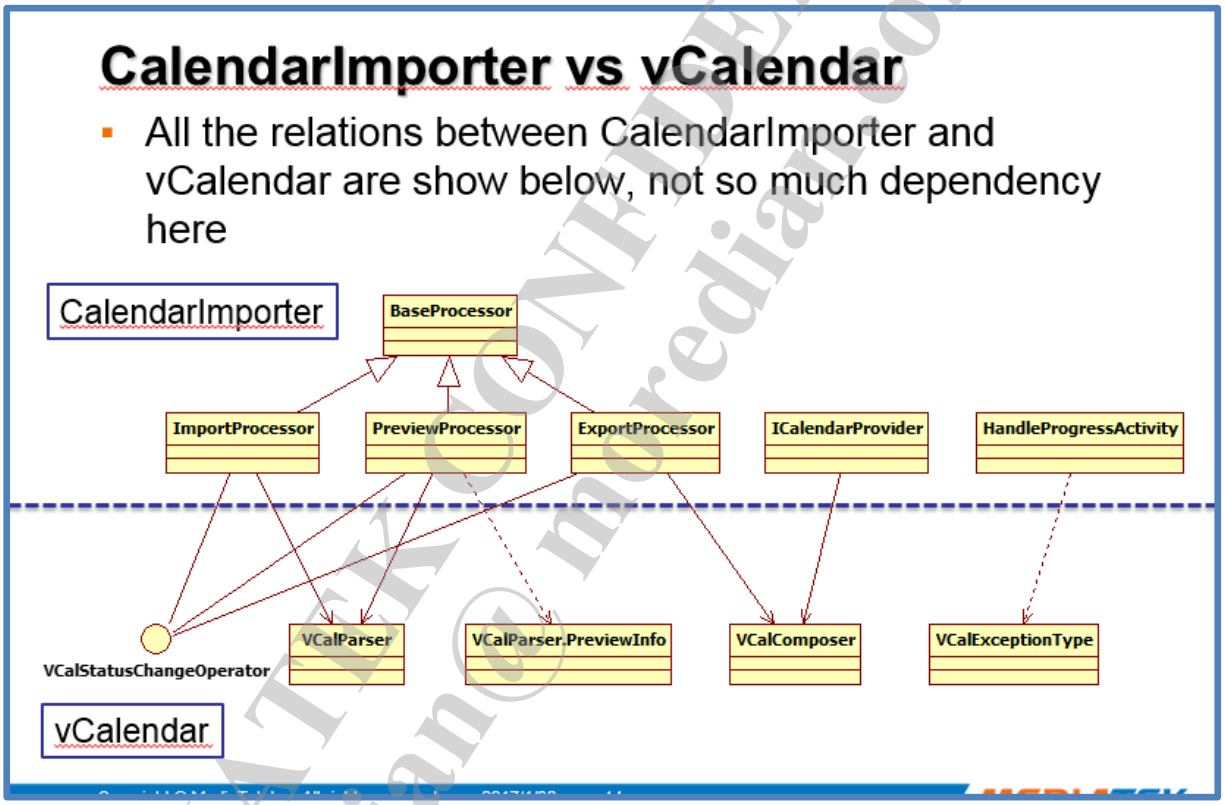

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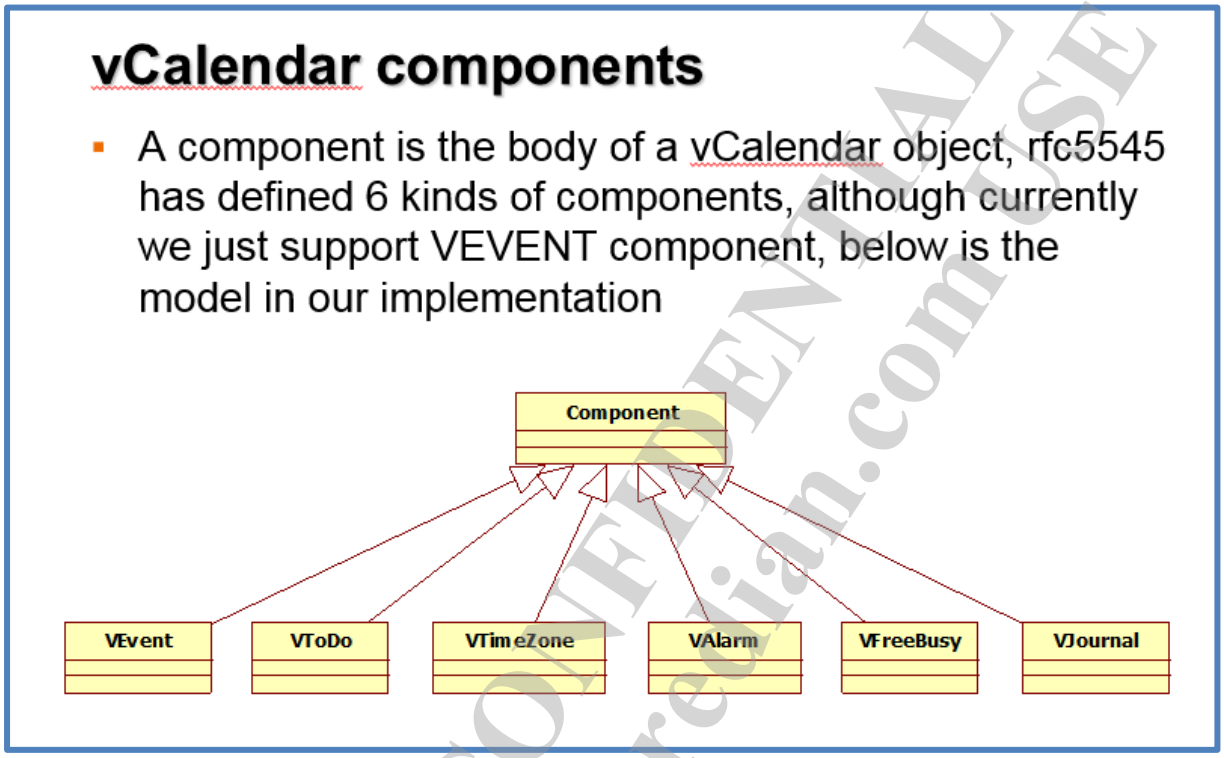
Figure 11-2. Calendar Importer Vcal Components.



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