

Broadcast Hub

FrontlineSMS (<http://www.frontlinesms.com>) is a software tool used in developing countries to monitor elections, broadcast weather changes, and connect people who don't have access to the Web but do have phones and mobile connectivity. It is the brainchild of Ken Banks, who has probably done more to help people using mobile technology than any other human alive.

FrontlineSMS runs on a computer with a phone plugged into it. The computer and plugged-in phone serve as a hub for SMS (short message service) text communication within a group. People who don't have Internet access can send in a special code to join the group, after which they receive broadcast messages from the hub. For places with no Internet access, the broadcast hub can serve as a vital connection to the outside world.

With App Inventor, you can create your own SMS-processing app. The cool thing is that the people who use your app don't need to have an Android phone. Your app will run on an Android device, but your app users can interface with it through SMS using any phone, smart or not so smart. Your app will still have a graphical user interface (GUI) as well, but that GUI will be reserved for the administrator who monitors the activity via the Android app you're about to build.



In this chapter, you'll create a hub that works similarly to FrontlineSMS but runs on an Android phone. Having the hub itself on a mobile device means the administrator can be on the move, something that is especially important in controversial situations like election monitoring and healthcare negotiations.

Your broadcast hub will be for the fictitious FlashMob Dance Team (FMDT), a group that uses the hub to organize flash mob dances anywhere, anytime. People will register with the group by texting “joinFMDT” to the hub, and anyone who is registered can broadcast messages to everyone else in the group.

Your app will process received text messages in the following manner:

1. If the text message is sent from someone not yet in the broadcast list, the app responds with a text that invites him to join the broadcast list and lets him know the code.
2. If the text message “joinFMDT” is received, the app adds the sender to the broadcast list.
3. If the text message is sent from a number already in the broadcast list, the message is broadcast to all numbers in the list.

You’ll build this app one piece of functionality at a time, starting with the first autoreponse message that invites people to join. By the time you complete this app, you’ll have a pretty good idea of how to write apps utilizing SMS text as the user interface.

What You’ll Learn

The tutorial covers the following App Inventor concepts, some of which you’re likely familiar with by now:

- The `Texting` component for sending texts and processing received texts.
- List variables—in this case, to keep track of the list of phone numbers.
- The `foreach` block to allow an app to repeat operations on a list of data. In this case, you’ll use `foreach` to broadcast messages to the list of phone numbers.
- The `TinyDB` component to store data persistently. This means that if you close the app and then relaunch it, the list of phone numbers will still be there.

Getting Started

You’ll need a phone that can accept and send SMS texts to test this app, as the emulator that comes with App Inventor isn’t set up for this. You’ll also need to recruit some friends to send you texts in order to fully test the app.

Connect to the App Inventor website and start a new project. Name it “BroadcastHub” and also set the screen’s title to “Broadcast Hub”. Open the Blocks Editor and connect to the phone.

Designing the Components

Broadcast Hub facilitates communication between mobile phones. Those phones do not need to have the app installed, or even be smartphones. So, in this case, you're not building an interface for your app's users, but instead for the group administrator.

The user interface for the administrator is simple: it displays the current *broadcast list*—that is, the list of phone numbers that have registered for the service—and all of the texts it receives and broadcasts.

To build the interface, add the components listed in Table 11-1.

Table 11-1. User interface components for Broadcast Hub

Component type	Palette group	What you'll name it	Purpose
Label	Basic	Label1	This is the header above the list of phone numbers.
Label	Basic	BroadcastListLabel	Display the phone numbers that are registered.
Label	Basic	Label2	This is the header above the log information.
Label	Basic	LogLabel	Display a log of the texts received and broadcast.
Texting	Social	Texting1	Process the texts.
TinyDB	Basic	TinyDB1	Store the list of registered phone numbers.

As you add the components, set the following properties:

1. Set the Width of each label to "Fill parent" so that it spans the phone horizontally.
2. Set the FontSize of the header labels (Label1 and Label2) to 18 and check their FontBold boxes.
3. Set the Height of BroadcastListLabel and LogLabel to 200 pixels. They'll show multiple lines.
4. Set the Text property of BroadcastListLabel to "Broadcast List...".
5. Set the Text property of LogLabel to blank.

Figure 11-1 shows the app layout in the Component Designer.

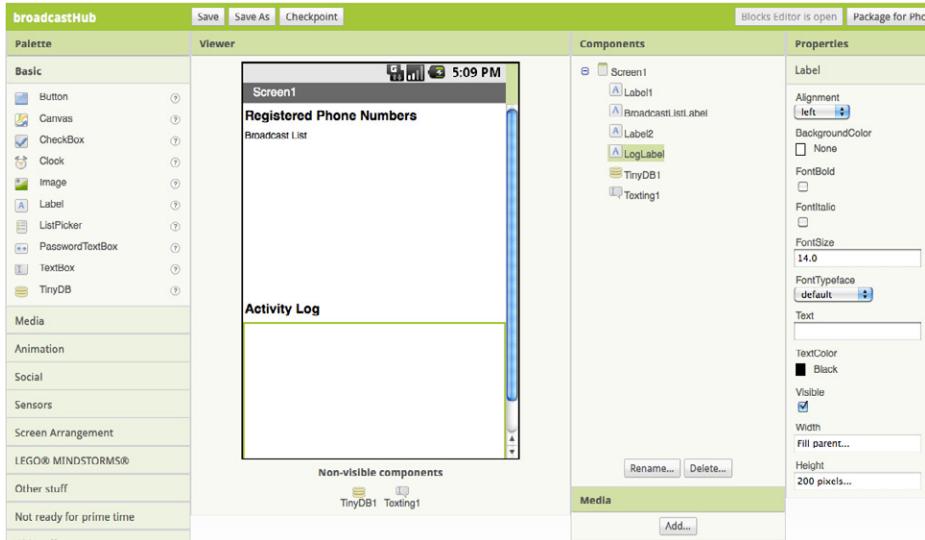


Figure 11-1. Broadcast Hub in the Component Designer

Adding Behaviors to the Components

The activity for Broadcast Hub is not triggered by the user entering information or clicking a button, but rather by texts coming in from other phones. To process these texts and store the phone numbers that sent them in a list, you'll need the following behaviors:

- When the text message is sent from someone not already in the broadcast list, the app responds with a text that invites the sender to join.
- When the text message "joinFMDT" is received, register the sender as part of the broadcast list.
- When the text message is sent from a number already in the broadcast list, the message is broadcast to all numbers in the list.

Let's start by creating the first behavior: when you receive a text, send a message back to the sender inviting her to register by texting "joinFMDT" back to you. You'll need the blocks listed in Table 11-2.

Table 11-2. Blocks for adding the functionality to invite people to the group via text

Block type	Drawer	Purpose
Texting1.Message Received	Texting1	Triggered when the phone receives a text.
set Texting1.Phone Number to	Texting1	Set the number for the return text.
value number	My Definitions	The argument of MessageReceived. This is the phone number of the sender.
set Texting1.Message	Texting1	Set the invite message to send.
text ("To join this broadcast list, text 'joinFMDT' to this number")	Text	The invite message.
Texting1.SendMessage	Texting1	Send it!

How the Blocks Work

Based on the work you did in the No Texting While Driving app in Chapter 4, these blocks should look familiar. **Texting1.MessageReceived** is triggered when the phone receives any text message. As shown in Figure 11-2, the blocks within the event handler set the `PhoneNumber` and `Message` of the `Texting1` component and then send the message.

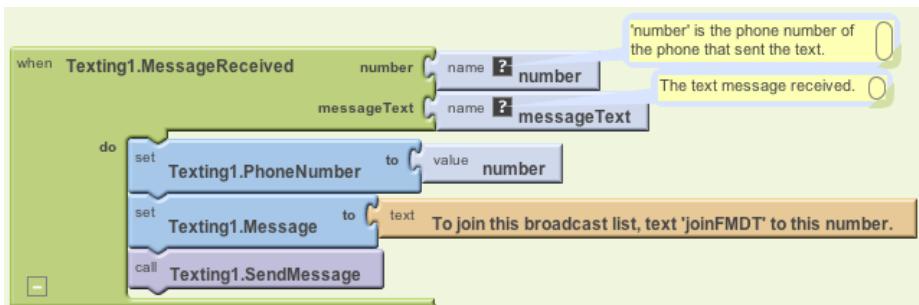


Figure 11-2. Sending the invite message back after receiving a text



Test your app. You'll need a second phone to test this behavior; you don't want to text yourself, as it could loop forever! If you don't have another phone, you can register with Google Voice or a similar service and send SMS texts from that service to your phone. From the second phone, send the text "hello" to the phone running the app. The second phone should then receive a text that invites it to join the group.

Adding Someone to the Broadcast List

Now let's create the blocks for the second behavior: when the text message "joinFMDT" is received, add the sender to the broadcast list. First, you'll need to define a list variable, `BroadcastList`, to store the phone numbers that register. From Definitions, drag out a **def var** block and name it "BroadcastList". Initialize it to an empty list with a **make a list** block from the Lists drawer, as shown in Figure 11-3 (we'll add the functionality to build this list shortly).



Figure 11-3. The `BroadcastList` variable for storing the list of registered numbers

Next, modify the **Texting1.MessageReceived** event handler so that it adds the sender's phone number to the `BroadcastList` if the message received is "joinFMDT". You'll need an **ifelse** block—which you used in `MakeQuiz` in Chapter 10—within your event handler, and an **add item to list** block to add the new number to the list. The full set of blocks you'll need is listed in Table 11-3. After you add the number to the list, display the new list in the `BroadcastListLabel`.

Table 11-3. Blocks for checking a text message and adding the sender to the broadcast list

Block type	Drawer	Purpose
ifelse	Control	Depending on the message received, do different things.
=	Math	Determine whether <code>messageText</code> is equal to "joinFMDT".
value messageText	My Definitions	Plug this into the = block.
text ("joinFMDT")	Text	Plug this into the = block.
add items to list	Lists	Add the sender's number to <code>BroadcastList</code> .
global BroadcastList	My Definitions	The list.
value number	My Definitions	Plug this in as an item of add items to list .
set BroadcastList Label.Text to	<code>BroadcastListLabel</code>	Display the new list.
global BroadcastList	My Definitions	Plug this in to set the BroadcastListLabel.Text to block.
set Texting1.Message to	Texting1	Prepare <code>Texting1</code> to send a message back to the sender.
text ("Congrats, you...")	Text	Congratulate the sender for joining the group.

How the blocks work

The first row of blocks shown in Figure 11-4 sets `Texting1.PhoneNumber` to the phone number of the message that was just received; we know we're going to respond to the sender, so this sets that up. The app then asks if the `messageText` was the special code, "joinFMDT". If so, the sender's phone number is added to the

BroadcastList, and a congratulations message is sent. If the messageText is something other than “joinFMDT,” the reply message repeats the invitation message. After the **ifelse** block, the reply message is sent (bottom row of the blocks).

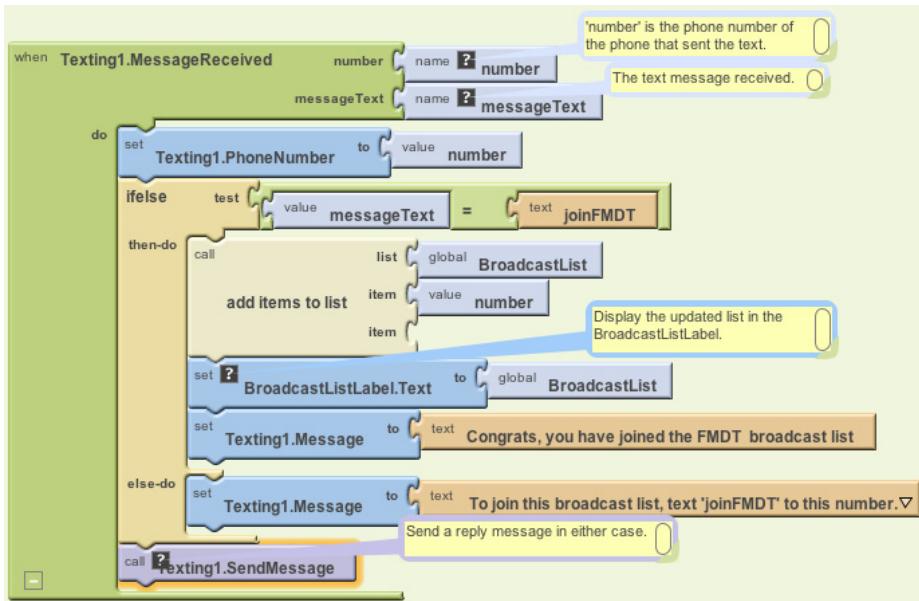


Figure 11-4. If the incoming message is “joinFMDT”, add the sender to BroadcastList



Test your app. From a second phone, send the text message “joinFMDT” to the phone running the app. You should see the phone number listed in the user interface under “Registered Phone Numbers.” The second phone should also receive the Congrats message. Try sending a message other than “joinFMDT” as well to check if the invite message is still sent correctly.

Broadcasting Messages

Next, you’ll add the behavior so that the app broadcasts received messages to the numbers in BroadcastList, but only if the message arrives from a number already stored in that list. This additional complexity will require more control blocks, including another **ifelse** and a **foreach**. You’ll need an additional **ifelse** block to check if the number is in the list, and a **foreach** block to broadcast the message to each number

in the list. You'll also need to move the **ifelse** blocks from the previous behavior and slot them into the "else" part of the new **ifelse**. All the additional blocks you'll need are listed in Table 11-4.

Table 11-4. Blocks for checking if the sender is in the group already

Block type	Drawer	Purpose
ifelse	Control	Depending on whether the sender is already in the list, do different things.
is in list?	Lists	Check to see if something is in a list.
global BroadcastList	My Definitions	Plug this into the "list" slot of is in list? .
value number	My Definitions	Plug this into the "thing" slot of is in list? .
foreach	Control	Repeatedly send out a message to all members in the list.
global BroadcastList	My Definitions	Plug this into the "list" slot of foreach .
set Texting1.Message to	Texting1	Set the message.
value messageText	My Definitions	The message that was received and will be broadcast.
set Texting1.Phone-Number to	Texting1	Set the phone number.
value var	My Definitions	Hold the current item of the BroadcastList; it's a (phone) number.

How the blocks work

The app has become complex enough that it requires a *nested ifelse* block, as shown in Figure 11-5. A nested **ifelse** block is one slotted within the "if" or "else" part of another, outer **ifelse**. In this case, the outer **ifelse** branch checks whether the phone number of the received message is already in the list. If it is, the message is relayed to everyone in the list. If the number is not in the list, then the *nested* test is performed: the blocks check if the `messageText` is equal to "joinFMDT" and branches one of two ways based on the answer.

In general, **if** and **ifelse** blocks can be nested to arbitrary levels, giving you the power to program increasingly complex behaviors (see Chapter 18 for more information on conditional blocks).

The message is broadcast using a **foreach** (within the outer then clause). The **foreach** loops through and sends the message to each item in the `BroadcastList`. As the **foreach** repeats, each succeeding phone number from the `BroadcastList` is stored in `var` (`var` is a variable placeholder for the current item being processed in the **foreach**). The blocks within the **foreach** set `Texting1.PhoneNumber` to the current item `var` and then send the message. For more information on how **foreach** works, see Chapter 20.

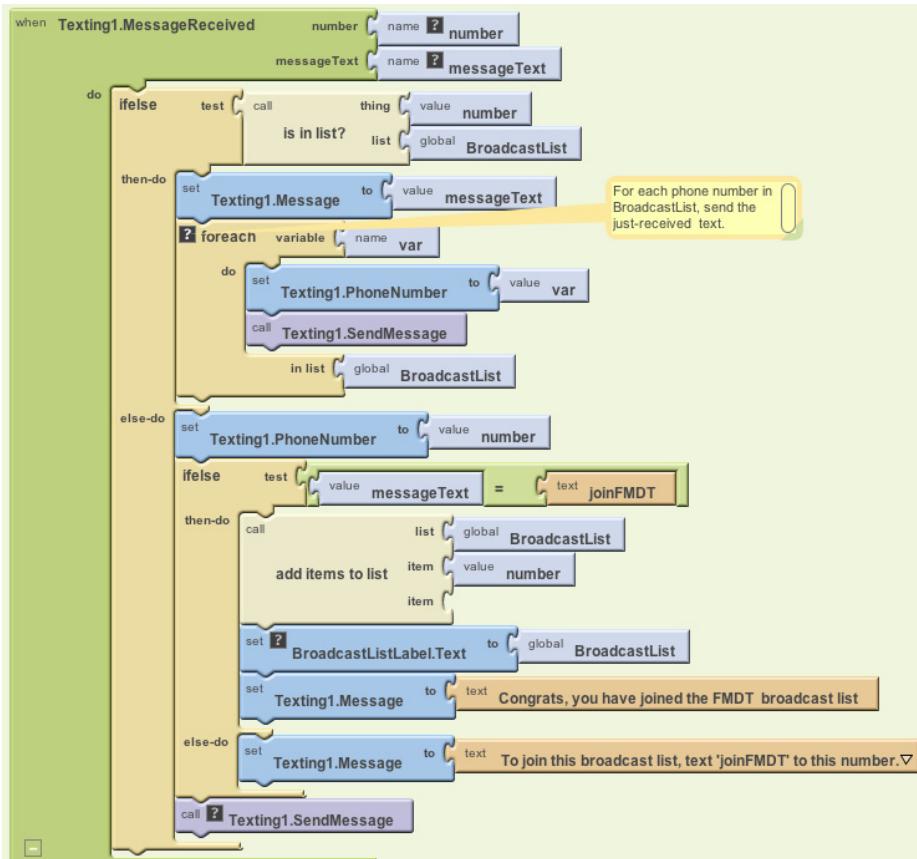


Figure 11-5. Now we check if the sender is already in the group and broadcast the message if so



Test your app. First, have two different phones register by texting “joinFMDT” to the phone running the app. Then, text another message from one of the phones. Both phones should receive the text (including the one that sent it).

Cleaning Up Your List Display

The app can now broadcast messages, but the user interface for the app administrator needs some work. First, the list of phone numbers is displayed in an inelegant way. Specifically, when you place a list variable into a label, it displays the list with spaces between the items, fitting as much as possible on each line. So the `BroadcastListLabel` might show the `BroadcastList` like this:

```
(+1415111-1111 +1415222-2222 +1415333-3333 +1415444-4444)
```

To improve this formatting, create a procedure `displayBroadcastList` using the blocks listed in Table 11-5. This procedure displays the list with each phone number on a separate line. Be sure to call the procedure from below the **add items to list** block so that the updated list is displayed.

Table 11-5. Blocks to clean up the display of phone numbers in your list

Block type	Drawer	Purpose
to procedure ("displayBroadcastList")	Definitions	Create the procedure (do not choose procedure WithResult).
set BroadcastListLabel .Text to	BroadcastListLabel	Display the list here.
text ("")	Text	Click text and then click Delete to create an empty text object.
foreach	Control	Iterate through the numbers.
name pnumber	in the foreach	Name the foreach variable "pnumber". This is the current item as iteration proceeds.
global BroadcastList	My Definitions	Plug this into the "in list" slot of foreach .
set BroadcastListLabel .Text to	BroadcastListLabel	Modify this with each of the numbers.
make text	Text	Build a text object from multiple parts.
BroadcastListLabel.Text	BroadcastListLabel	Add this to the label on each iteration of foreach .
text ("\n")	Text	Add a newline character so that the next number is on the next line.
value pnumber	My Definitions	The current number from the list.

How the blocks work

The **foreach** in `displayBroadcastList` successively adds a phone number to the end of the label, as shown in Figure 11-6, placing a newline character (`\n`) between each item to place each number on a new line.

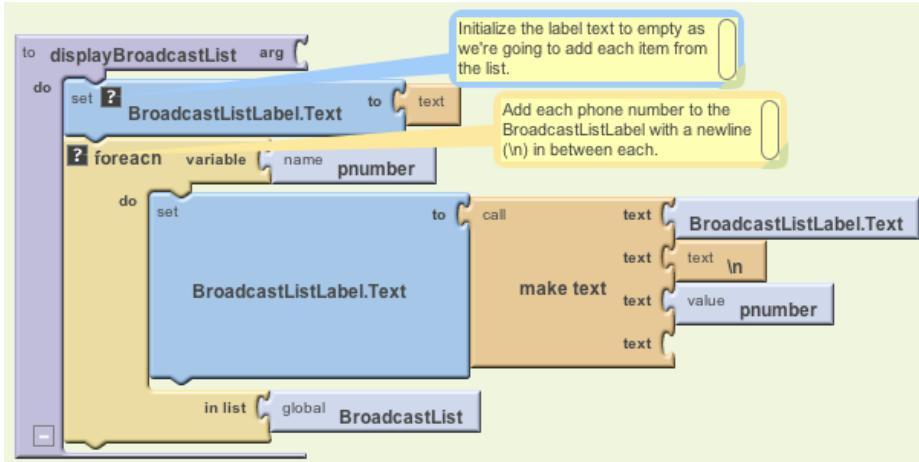


Figure 11-6. Displaying the phone numbers with a newline between each

Of course, this `displayBroadcastList` procedure will not do anything unless you call it. Place a call to it in the **Texting1.MessageReceived** event handler, right below the call to **add item to list**. The call should replace the blocks that simply set the `BroadcastListLabel.Text` to `BroadcastList`. The **call `displayBroadcastList`** block can be found in My Definitions.

Figure 11-7 shows how the relevant blocks within the **Texting1.MessageReceived** event handler should look.

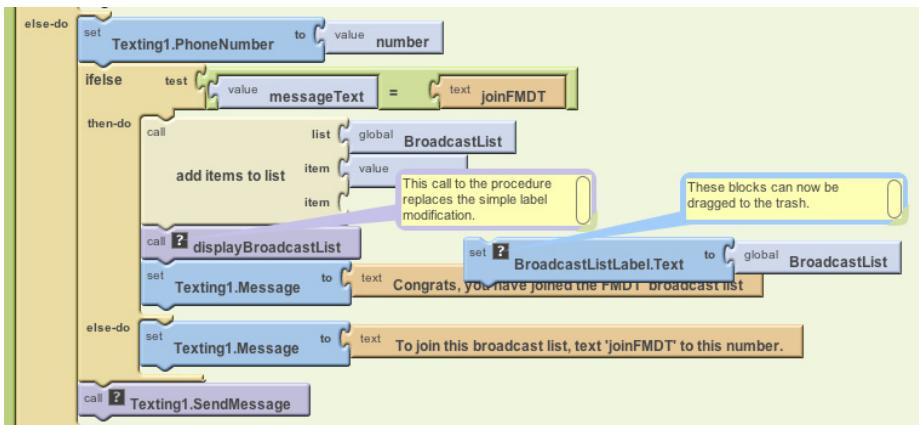


Figure 11-7. Calling the `displayBroadcastList` procedure

For more information on using **foreach** to display a list, see Chapter 20. For more information about creating and calling procedures, see Chapter 21.



Test your app. Restart the app to clear the list and then have at least two different phones register (again). Do the phone numbers appear on separate lines?

Logging the Broadcasted Texts

When a text is received and broadcast to the other phones, the app should log that occurrence so the administrator can monitor the activity. In the Component Designer, you added the label `LogLabel` to the user interface for this purpose. Now, you'll code some blocks that change `LogLabel` each time a new text arrives.

You need to build a text that says something like "message from +1415111-2222 was broadcast." The number +1415111-2222 is not fixed data—instead, it is the value of the argument `number` that comes with the **MessageReceived** event. So, to build the text, you'll concatenate the first part, "message from", with a **value number** block and finally with the last part of the message, the text "broadcast."

As you've done in previous chapters, use **make text** to concatenate the parts using the blocks listed in Table 11-6.

Table 11-6. Blocks to build your log of broadcasted messages

Block type	Drawer	Purpose
set LogLabel .Text to	LogLabel	Display the log here.
make text	Text	Build a text object out of multiple parts.
text ("message from")	Text	This is the report message.
value number	My Definitions	The sender's phone number.
text ("broadcast\n")	Text	Add the last part of "message from 111-2222 broadcast" and include newline.
LogLabel.Text	LogLabel	Add a new log to the previous ones.

How the blocks work

After broadcasting the received message to all of the numbers in `BroadcastList`, the app now modifies the `LogLabel` to add a report of the just-broadcasted text, as shown in Figure 11-8. Note that now we add the message to the beginning of the list instead of the end, so the more recent message sent to the group shows up at the top.

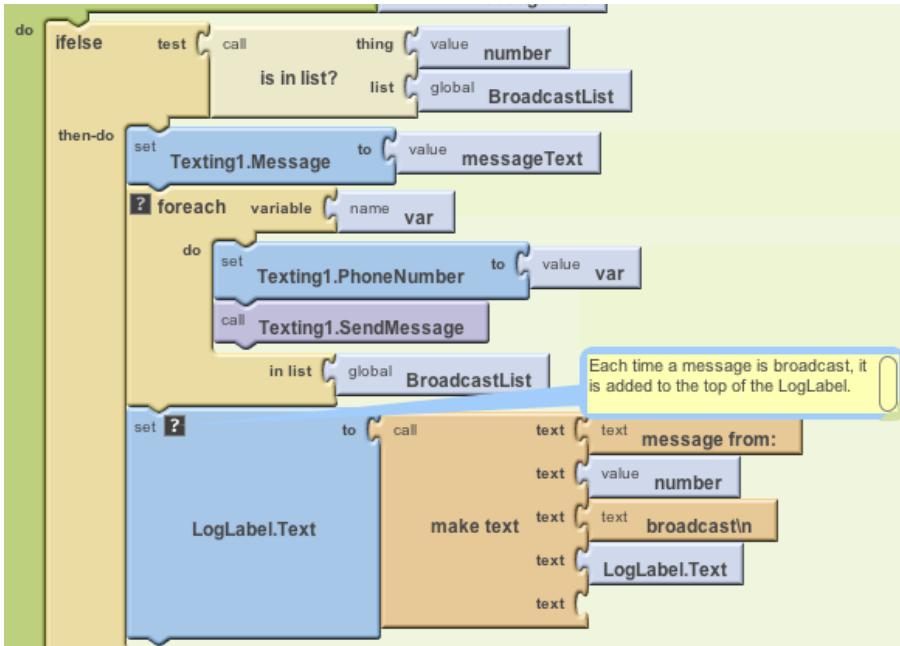


Figure 11-8. Adding a new broadcast message to the log

The **make text** block creates new entries of the form:

```
message from: 111-2222 broadcast
```

Each time a text is broadcast, the log entry is *preended to* (added to the front of) the `LogLabel.Text` so that the most recent entries will appear on top. The way you organize the **make text** block determines the ordering of the entries. In this case, the new message is added with the top three slots of **make text**, and `LogLabel.Text`—which holds the existing entries—is plugged into the last slot.

The “\n” in the text “broadcast\n” is the newline character that displays each log entry on a separate line:

```
message from: 1112222 broadcast
message from: 555-6666 broadcast
```

For more information about using **foreach** to display a list, see Chapter 20.

Storing the BroadcastList in a Database

The app works great so far, but if you’ve completed some of the earlier tutorials, you’ve probably guessed that there’s a problem: if the administrator closes the app and relaunches it, the broadcast list will be lost and everyone will have to reregister. To fix this, you’ll use the `TinyDB` component to store and retrieve the `BroadcastList` to and from a database.

You'll use a similar scheme to the one we used in the MakeQuiz app (Chapter 10):

- Store the list to the database each time a new item is added.
- When the app launches, load the list from the database into a variable.

Start by coding the blocks listed in Table 11-7 to store the list in the database. With the TinyDB component, a tag is used to identify the data and distinguish it from other data stored in the database. In this case, you can tag the data as “broadcastList.” You'll add the blocks in the **Texting1.MessageReceived** event, under the **add items to list** block.

Table 11-7. Blocks to store the list with TinyDB

Block type	Drawer	Purpose
TinyDB1.Store Value	TinyDB1	Store the data in the database.
text ("broadcastList")	Text	Plug this into the “tag” slot of Store Value .
global Broadcast List	My Definitions	Plug this into the “value” slot of Store Value .

How the blocks work

When a “joinFMDT” text comes in and the new member’s phone number is added to the list, **TinyDB1.StoreValue** is called to store the **BroadcastList** to the database. The tag (a text object named “broadcastList”) is used so that you can later retrieve the data. As shown in Figure 11-9, the value that gets called by **StoreValue** is the variable **BroadcastList**.

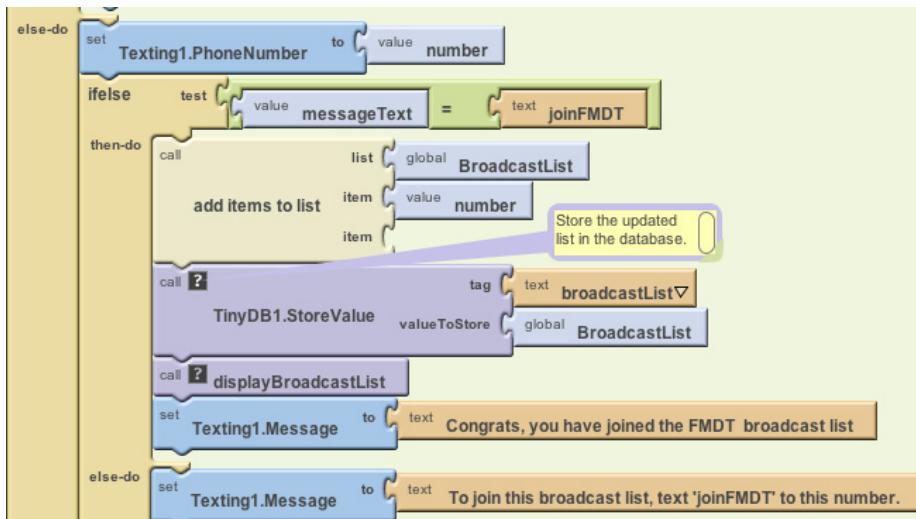


Figure 11-9. Calling TinyDB to store the BroadcastList

Loading the BroadcastList from a Database

Now add the blocks listed in Table 11-8 for loading the list back in each time the app launches. When the app begins, the **Screen1.Initialize** event is triggered, so your blocks will go in that event handler. You'll call **TinyDB.GetValue**, using the same tag you used to store the list ("broadcastList"). At this point, as we've done in previous chapters that work with databases, we have to check if there is actually any data being returned. In this case, we'll check if the returned value is a list, because it won't be if there isn't any data in the list yet.

How the blocks work

When the app begins, the **Screen1.Initialize** event is triggered. The blocks shown in Figure 11-10 first request the data from the database with **TinyDB1.GetValue**. The returned data is placed in the variable `valueFromDB`, a variable defined to temporarily hold it.

Table 11-8. Blocks to load the broadcast list back into the app when it launches

Block type	Drawer	Purpose
def variable ("value-FromDB")	Definition	A temporary variable for holding database data and checking it.
text ("text")	Text	An initial value for <code>valueFromDB</code> .
Screen1.Initialize	Screen1	Triggered when the app launches.
set global valueFromDB to	My Definitions	Put the returned value here temporarily.
TinyDB1.GetValue	TinyDB1	Request the data from the database.
text ("broadcastList")	Text	Plug this into the "tag" slot of GetValue .
if	Control	Check if the database had the data.
is a list?	List	If the data returned is a list, we know it wasn't empty.
global valueFromDB	My Definitions	Plug this into is a list? .
set global Broadcast List to	My Definitions	Set this to the value returned from the database.
call displayBroadcast List	My Definitions	After loading data, display it.

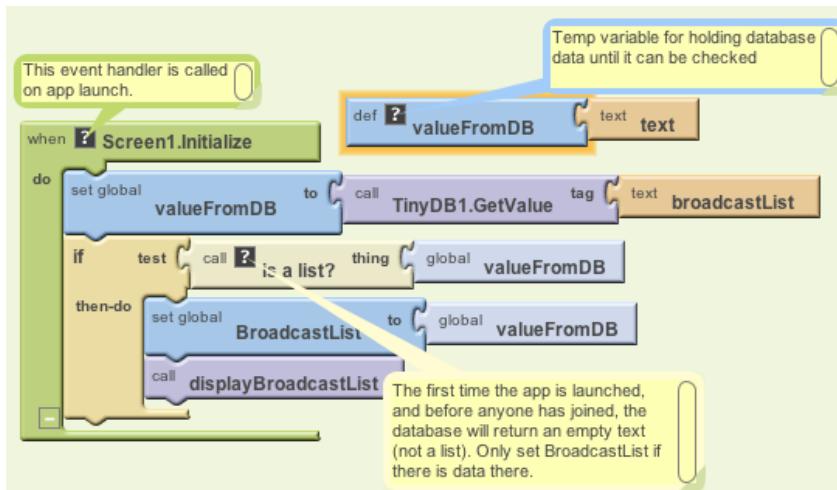


Figure 11-10. Loading the BroadcastList from the database

We need the **if** block in the event handler because the database will return an empty text ("") if it's the first time the app has been used and there isn't yet a broadcast list. By asking if the `valueFromDB` is a list, you're making sure there is some data actually returned. If there isn't, you'll bypass the blocks that transfer the returned data (`valueFromDB`) into the variable `BroadcastList` and the blocks to display that data.



Test your app. You can't use live testing for apps that modify the database because each time you click "Connect to Device," the database starts out empty. So, to test the database storage and the **Screen.Initialize** event handler, you'll need to package and download the app to a phone (you can download an app by choosing "Package for Phone" → "Download to Connected Phone" in the Component Designer). Once you've downloaded your app, use your second and third test phones to send a text to join the group and then close the app on your original phone. If the numbers are still listed when you relaunch the app, then the database part is working.

The Complete App: Broadcast Hub

Figure 11-11 illustrates the blocks in the completed Broadcast Hub app.

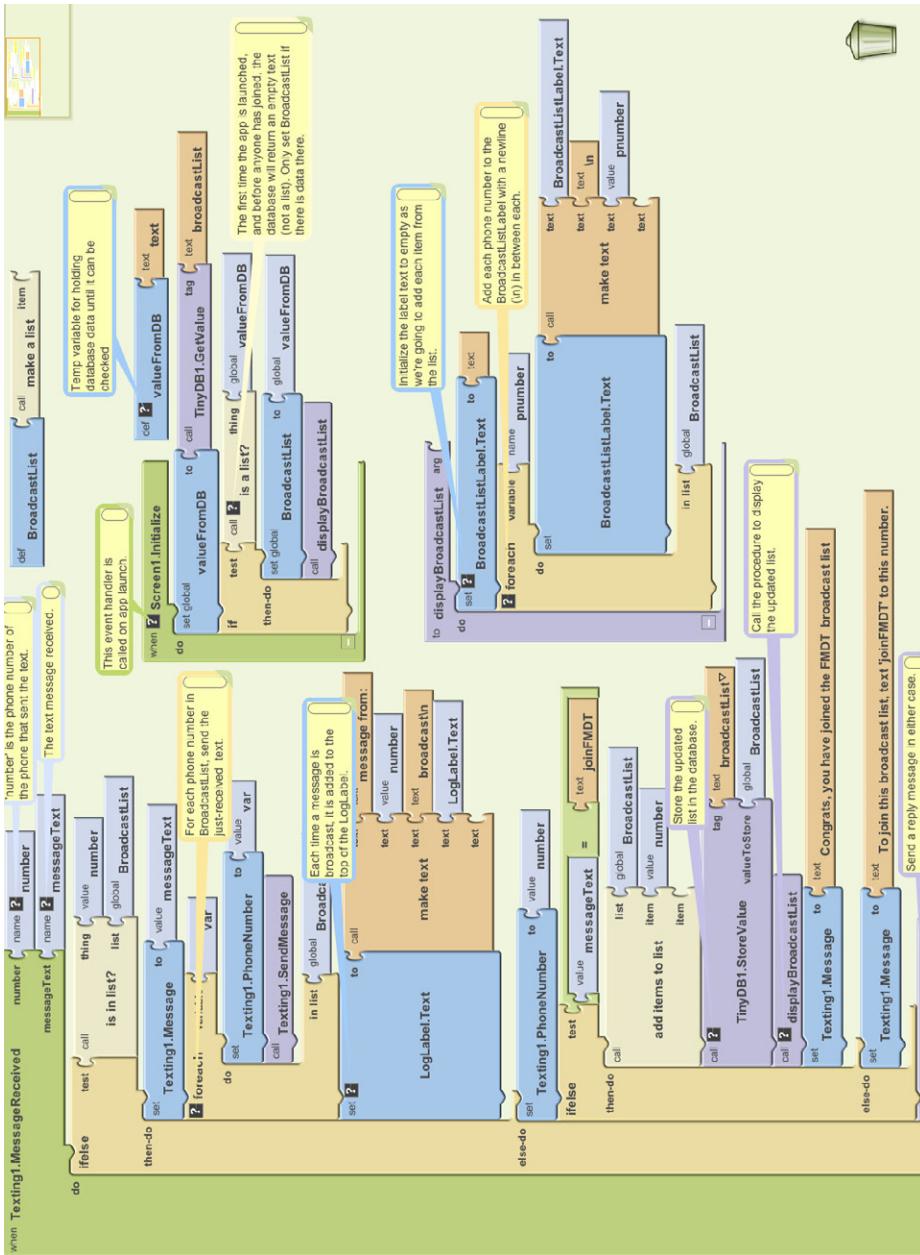


Figure 11-11. The complete app

Variations

After you've celebrated building such a complex app, you might want to explore some variations. For example:

- The app broadcasts each message to everyone, including the phone that sent the message. Modify this so that the message is broadcast to everyone but the sender.
- Allow client phones to remove themselves from the list by texting "quitabc" to the app. You'll need a **remove from list** block.
- Let the hub administrator add and remove numbers from the broadcast list through the user interface.
- Let the hub administrator specify numbers that should not be allowed into the list.
- Customize the app so that anyone can join to receive messages, but only the administrator can broadcast messages.
- Customize the app so that anyone can join to receive messages, but only a fixed list of phone numbers can broadcast messages to the group (this is how the Helsinki event app worked; see <http://appinventorblog.com/2010/08/25/success-story-from-helsinki/>).
- The app stores the broadcast list persistently, but not the log. Each time you close the app and reopen it, the log starts over. Change this so that the log is persistent.

Summary

Here are some of the concepts we've covered in this tutorial:

- Apps can react to events that are not initiated by the app user, like a text being received. That means you can build apps in which your users are on a different phone.
- Nested **ifelse** and **foreach** blocks can be used to code complex behaviors. For more information on conditionals and **foreach** iteration, see Chapters 18 and 20, respectively.
- The **make text** block can be used to build a text object out of multiple parts.
- TinyDB can be used to store and retrieve data from a database. A general scheme is to call **StoreValue** to update the database whenever the data changes and call **GetValue** to retrieve the database data when the app begins.