MIT Wake-up Call System

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Features

- **Security PIN**

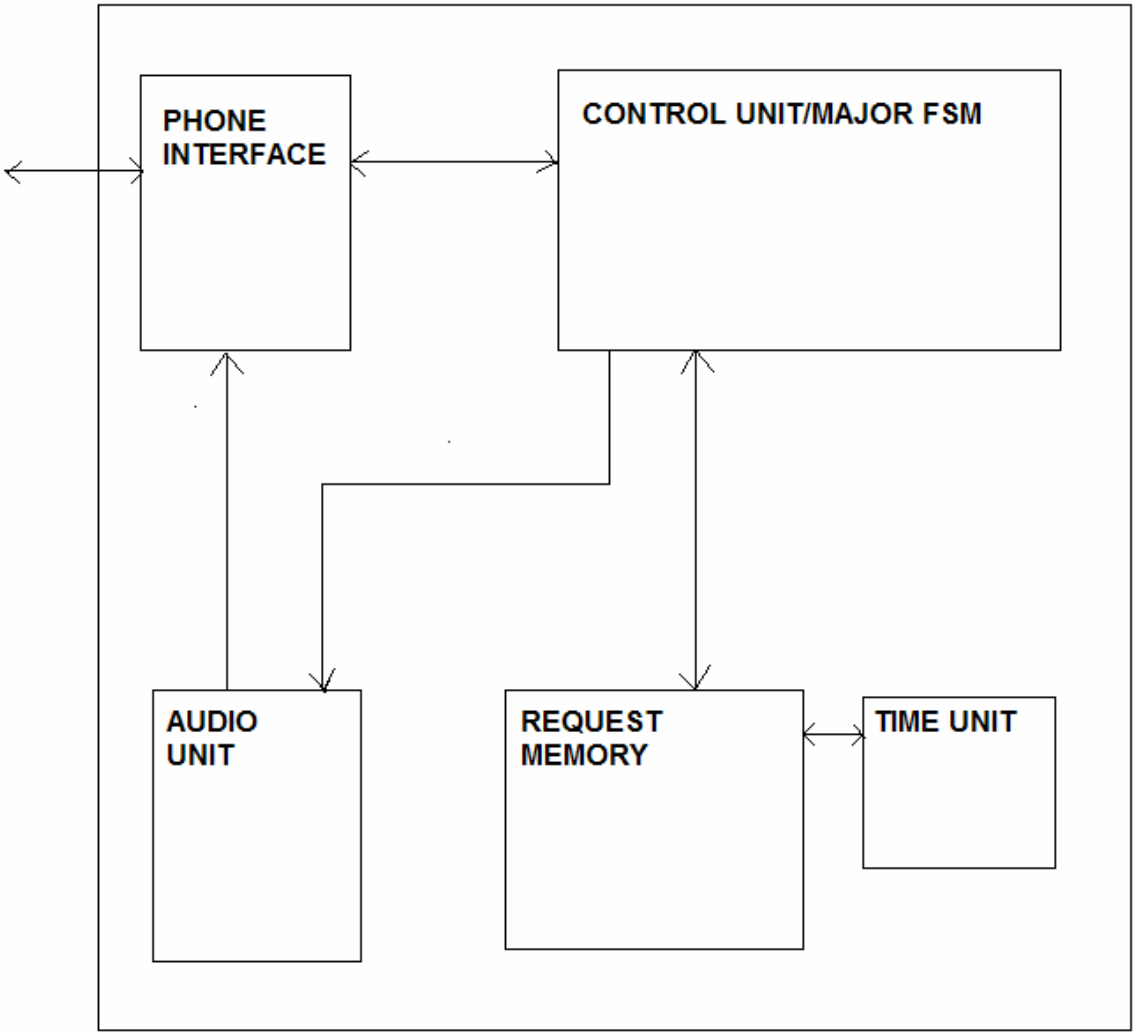
  - Each user is assigned a PIN associated with his telephone number

  - When a user calls in, the system verifies his PIN before allowing the user to proceed to the menu.

- **Menu Options**

  - Request wakeup call
  - Cancel requested wakeup call
  - Check scheduled requests for his phone number
  - Hear the system time to synchronize with the user's watch

Basic Block Diagram



Phone Interface Functions

- detect incoming call
- pick up/hang up phone
- dial numbers
- detect/interpret dialed numbers
- send prerecorded audio over phone line

Phone Terminology

- **loop**: twisted wire pair connection between phone and central office
- individual wires: **tip** and **ring**

Phone Dialing

- Two types: pulse and tone
- Our system uses tone
  - each digit dialed generates two tones (frequencies)
  - also called dual tone multi frequency (**DTMF**)

Phone Interface: MH88437

- Data Access Arrangement Chip
- provides complete interface between audio/data transmission equipment and phone line
- Tip and Ring connections
- Functions:
  - detect incoming call
  - pick up/hang up phone
  - send prerecorded audio

Phone Interface: MT8889C

- DTMF transceiver
  - convert binary digit to DTMF (outgoing call)
  - convert DTMF to binary digit (incoming data)

Audio Overview

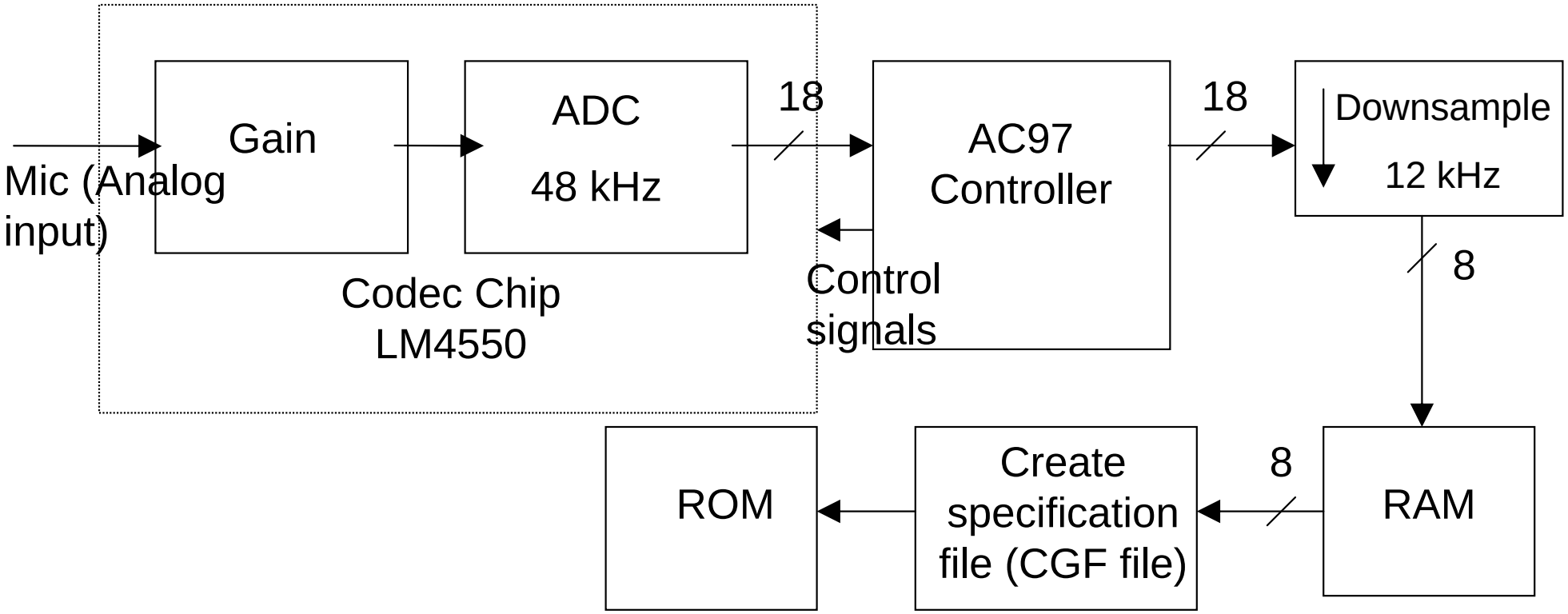
- **Record Mode:**

  - Takes audio input from microphone
  - Samples the analog input
  - Store the samples in RAM
  - Store the samples in ROM by creating specification file from data in RAM

- **Playback Mode:**

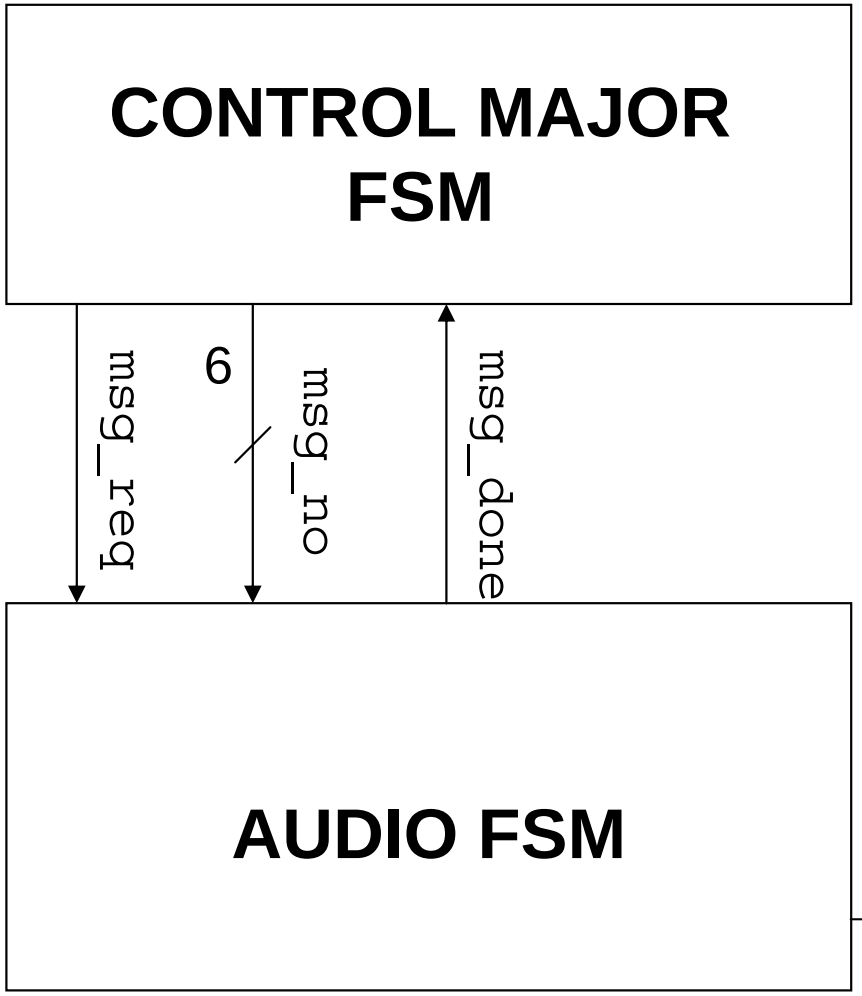
  - Retrieves digitized samples from ROM upon requests from audio major FSM
  - Converts it to analog outputs
  - Amplifies and sends to the speaker

Record Mode – Audio Path



- The AC97 Controller controls the codec chip by supplying frames to the codec at rate 48,000 frames/sec.
- A frame consists of 13 slots (1 tag slot, and 12 data slots).
- One 18-bit digitized sample is received per an incoming frame to the AC97 controller

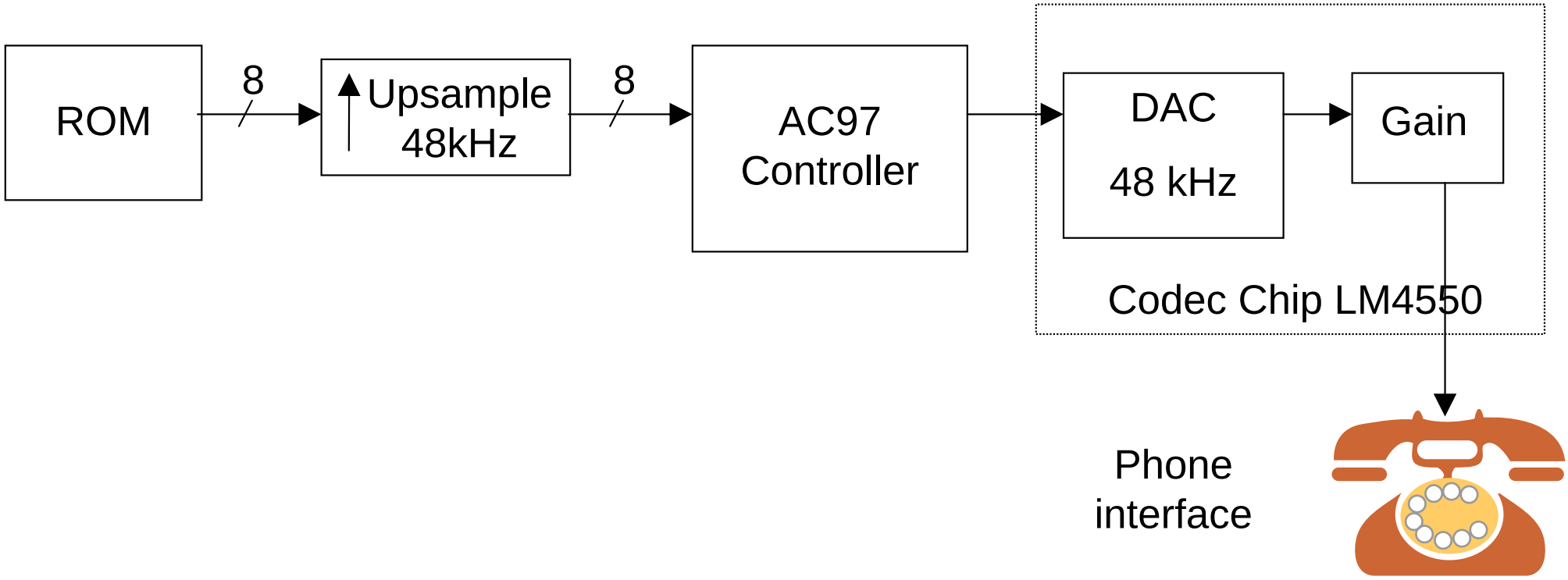
Playback Mode: Interface with Control Unit



- Waits for the enable signal `msg_reg` from Major FSM
- Plays 8-bit voice messages according to the input signal `msg_no`
- Outputs `msg_done` signal to notify Major FSM that the playback has finished

(Phone interface)

Audio Path – Playback Mode



- Digitized samples in ROM are upsampled to match with the sampling rate of the codec by replicating the same sample 4 times

Phone Number/PIN LUT

- Each phone # has a unique PIN #
- PIN # is preassigned

PHONE #	PIN #
56407	3579
58834	0891
52660	4687
38994	1244
87619	8107

Time Unit

- Holds the current system time
  - Extension of the behavioral 1 second timer in Problem Set 2
- Stored as month, day, time

```
04 25 23:40
```

- Sends output to Request Memory Unit

Request Memory Unit

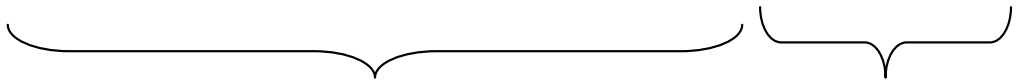
- Combined with the Time Unit, it acts as the timer for every wake-up call
  - Receives wake-up requests such as:

    Wake-up call for: `04 26 07:30`
    PIN #: `9876`
  - Collects requests in memory
  - Sends ‘call’ signals at the appropriate times

Request Memory Unit

- Requests are stored in a RAM, sorted by priority

EVENT {month, day, time}	PIN #
04 26 07:30	9876
04 26 07:50	4385
04 26 08:30	1929
04 26 08:45	1103
04 26 09:45	4385
04 26 10:00	0321
04 26 10:12	8430

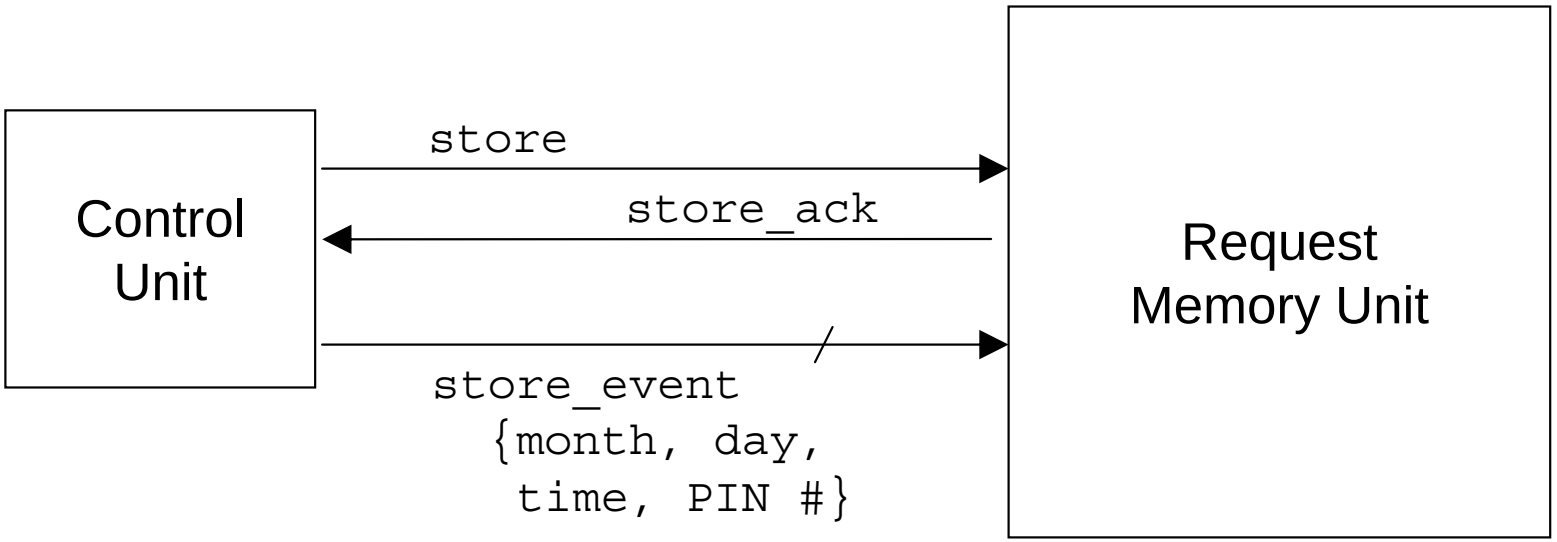


20 bits 14 bits

Request Memory Unit

- 3 basic operations:
  - ***Store*** a new wake-up request
  - As time passes, ***retrieve and send*** the request(s) that are ready for calling
  - ***Cancel*** wake-up requests for a particular person

Storing a Wake-up Request

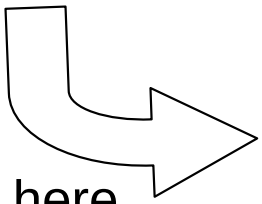


Control Unit sends the new request data & a store signal

Storing a Wake-up Request

04 26 08:00	0004

New request
must be inserted here



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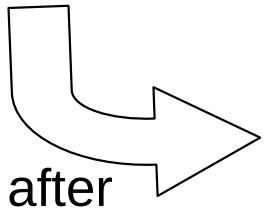
04 26 07:50	4385
04 26 08:30	1929
04 26 08:45	1103
04 26 09:45	4385
04 26 10:00	0321
04 26 10:12	8430

Storing a Wake-up Request

04 26 08:00	0004

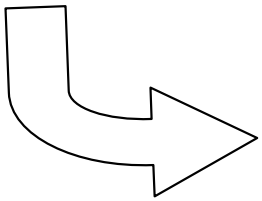


Requests after insertion point get shifted down

EVENT {month, day, time}	PIN #
04 26 07:30	9876
04 26 07:50	4385
04 26 08:30	1929
04 26 08:45	1103
04 26 09:45	4385
04 26 10:00	0321
04 26 10:12	8430

Storing a Wake-up Request

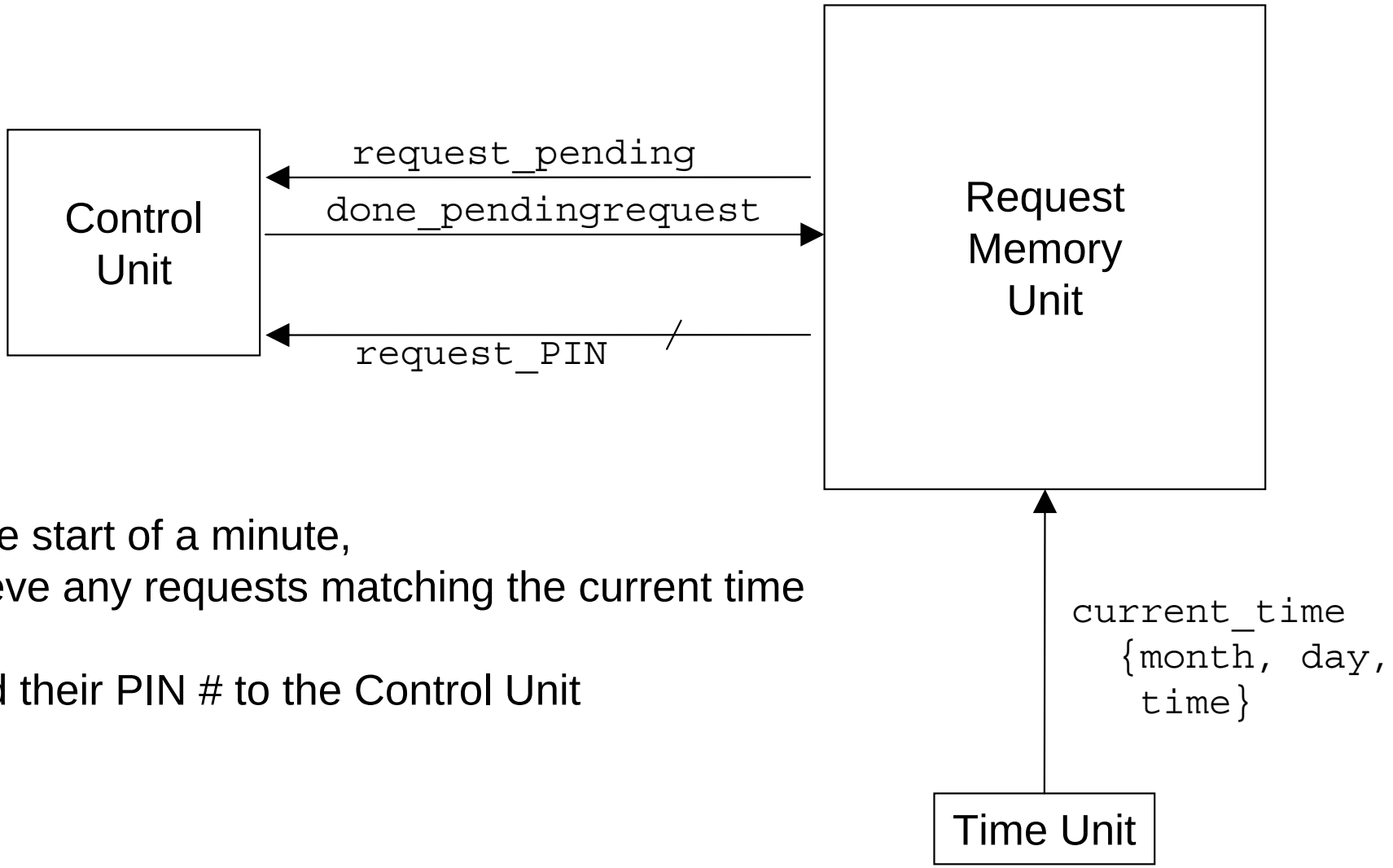
04 26 08:00	0004



New request
has been stored!

EVENT {month, day, time}	PIN #
04 26 07:30	9876
04 26 07:50	4385
04 26 08:00	**0004**
04 26 08:30	1929
04 26 08:45	1103
04 26 09:45	4385
04 26 10:00	0321
04 26 10:12	8430

Retrieving a Wake-up Request



At the start of a minute,
retrieve any requests matching the current time

Send their PIN # to the Control Unit

Retrieving a Wake-up Request

```
Current time: 07:30
```

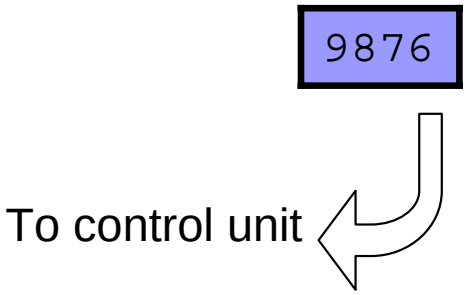
The current time matches the first listing

EVENT {month, day, time}	PIN #
04 26 07:30	9876
04 26 07:50	4385
04 26 08:30	1929
04 26 08:45	1103
04 26 09:45	4385
04 26 10:00	0321
04 26 10:12	8430

Retrieving a Wake-up Request

Current time: 07:30

First listing is deleted;
PIN of first listing is sent
to main control unit



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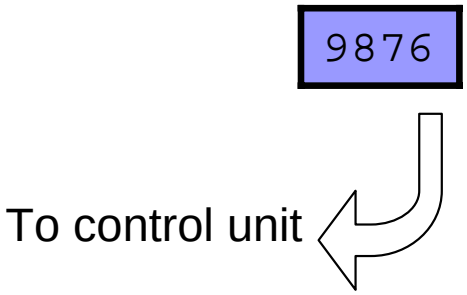
Retrieving a Wake-up Request

Current time: 07:30

First listing is deleted;
PIN of first listing is sent
to main control unit



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04 26 07:50	4385
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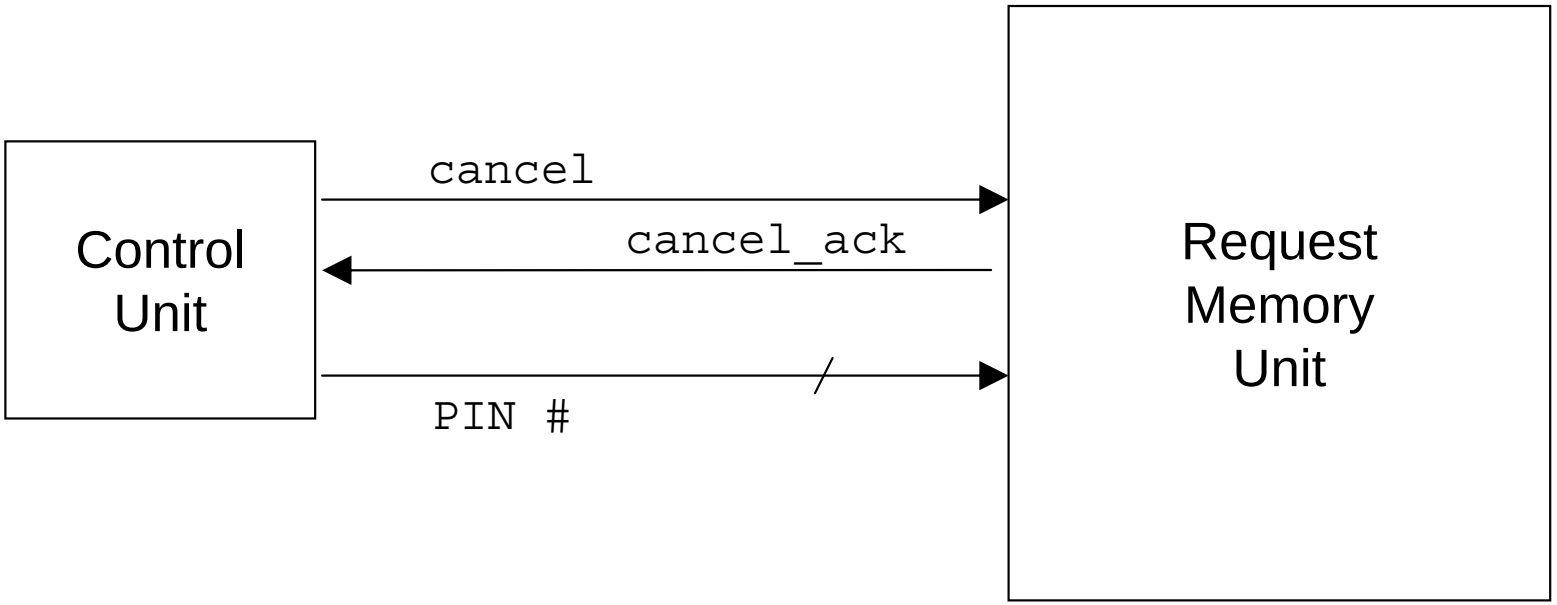
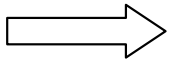
Canceling Requests for a Given PIN

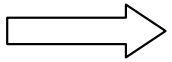


Canceling Requests for a Given PIN

4385

Cancel all requests for PIN # 4385





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04 26 08:45	1103
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04 26 10:00	0321
04 26 10:12	8430

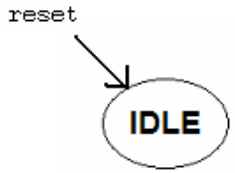
Canceling Requests for a Given PIN

4385

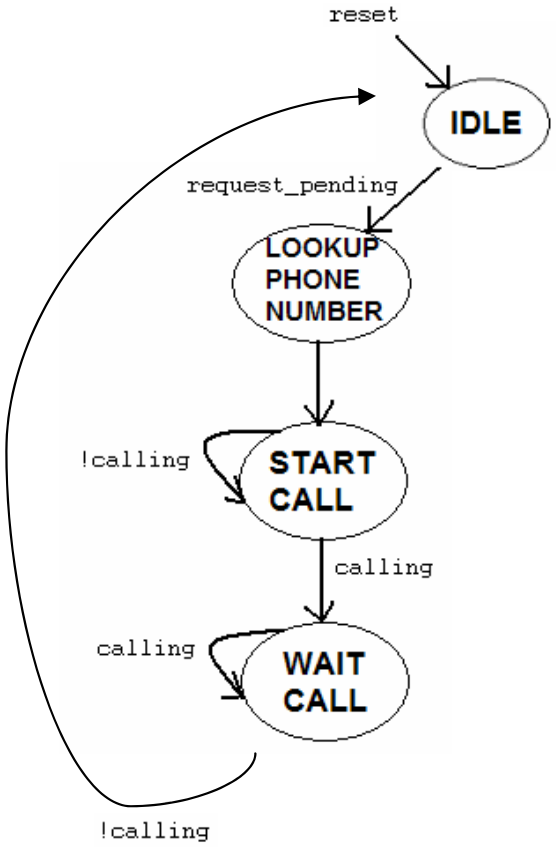
Done!

EVENT {month, day, time}	PIN #
04 26 07:30	9876
04 26 08:30	1929
04 26 08:45	1103
04 26 10:00	0321
04 26 10:12	8430

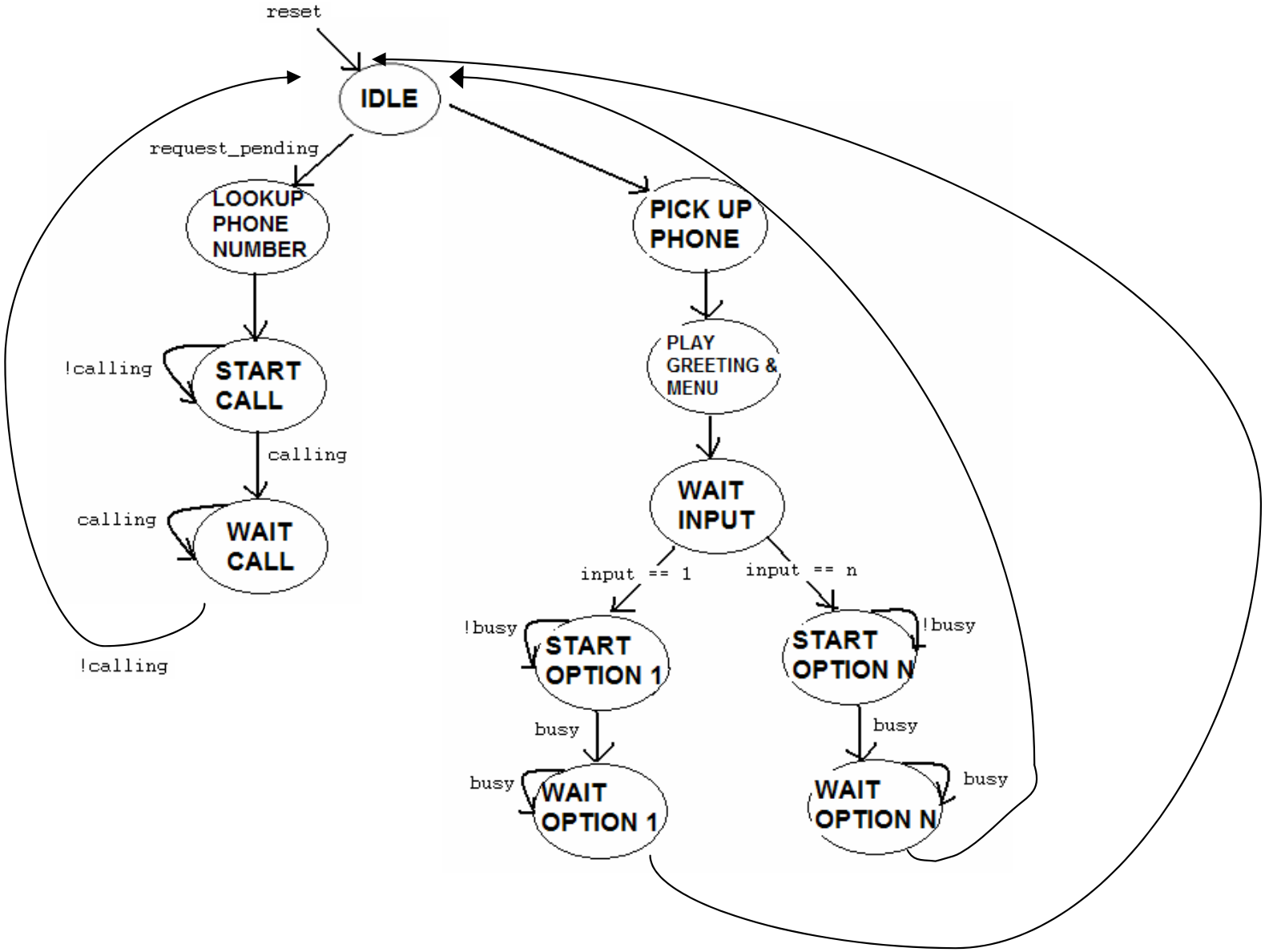
Control Unit/Major FSM



Control Unit/Major FSM



Control Unit/Major FSM



Thank You

- Any questions?