Groupthink Specification Exercise

In this exercise, you will design the control for a simple telephone with integrated answering machine. You will specify the telephone's behavior when the user interacts with it.

PART 1: Specifying Behavior

As a group, read this document and decide upon the behavior of the telephone under all possible user behaviors. Your design may be written down or agreed upon orally. We do not care how you record it.

PART 2: The Groupthink Game

After deciding on the behavior of the telephone, you will be given a variety of scenarios in which a user interacts with the telephone. Each member of your group will *individually* answer questions about the telephone's behavior. Your group is scored not on what your answers are, but whether all of the members' answers are consistent. However, your answers must satisfy the requirements and must be plausible behaviors that a user would find reasonable.

In a real project, consistent answers would lead to components that interoperate correctly, behavior that is consistent with the documentation, etc. Problems due to diverging interpretations are common in software (and other!) development teams where the specification is ambiguous or underconstrained. We encourage you to think hard in part 1!

Here is an example question:

> The user is connected to an outside party. The outside party hangs up. What state is the phoneline in?
>
> A. Lineactive (the user hears dialtone)
>
> B. Lineidle (the user does not hear dialtone)

The group that wins the Groupthink Game will receive a prize. Your group may not give answers based on the form of the game; for instance, you may not agree to answer "A" if you aren't sure what else to do.

Definitions

lineidle The phone is hung up or "on hook." In a traditional phone, this means the handset is lying in the cradle, but your phone uses the **`end`** key instead.

lineactive The phone is picked up or "off hook." In a traditional phone, this means the handset is not in the cradle (it is "off hook"), but your phone uses the **`talk`** key instead.

ring signal A +/- 24 volt AC signal sent over the phone line, which causes a traditional phone to ring. The phone company only sends a ring signal if it detects the lineidle state.

System Specification

TELEPHONE COMPONENTS

- Handset (includes both speaker and microphone)
- 24-character display
- Answering machine
- Keypad with keys labeled **`talk`**, **`redial`**, **`ansmachine`**, and **`end`**.

  *Simplification: The keypad also has 0 through 9, but in this exercise, you can ignore how those keypresses are handled. When the **`talk`** key is pressed, the digits previously entered by the user are delivered to the control software (much like a cellular phone). The **`redial`** key does not deliver any numbers. There is no hook or cradle as with a traditional phone, just the keys.*

FUNCTIONS

- The user places a call by pressing **`talk`** or **`redial`**. The user answers a call by pressing **`talk`**.

  Simplification: Your phone is not required to handle call waiting.

- The user begins using the answering machine by pressing **`ansmachine`** on the handset.

  Simplification: In this exercise, you will not be asked to specify the answering machine's behavior during message review.

- The user presses **`end`** to end a call or to stop using the answering machine.

REQUIREMENTS

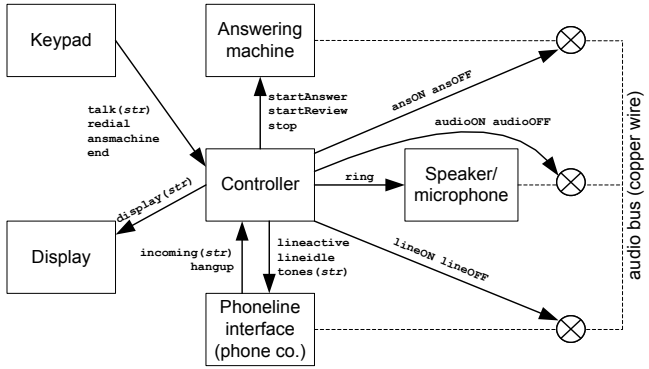
- The display must show the appropriate information at all times.
  - If idle — show "READY"
  - If a ring signal is being sent by the phone company — show the caller ID information of the caller
  - If connected to an incoming call — show the caller ID information of the caller
  - If connected to an outgoing call — show the number being called
  - If using the answering machine — show "ANSWERING MACHINE"
- If a ring signal is delivered, the telephone must ring and show the caller ID of the caller. If the user doesn't answer the call within 2 rings, the answering machine must pick it up.

CHALLENGE

This specification may be incomplete or inconsistent. This is normal in any development effort! Your group should figure out the details needed to handle all possible scenarios that you might be asked about in the Groupthink Game.

System Architecture

The telephone has the following components. The messages that may be exchanged between the handset controller and the other components are labeled in the diagram. Analog audio links are shown with dashed lines. Switches (represented by ⊗) either make or break audio connections.



talk(*string*)	The user typed the digits in the argument string and then pressed **talk**
redial	The user pressed **redial**
ansmachine	The user pressed **ansmachine**
end	The user pressed **end**
display(*string*)	Makes the LCD display show the characters in ***string***, a 24-character string
startAnswer	Play outgoing message and record the caller's message
startReview	Play back recorded messages and perform other user interactions
stop	Stop answering machine functions, return to idle state
incoming(*string*)	The phone company sent a ring signal with ***string*** as caller ID information. This message is repeatedly sent (every 6 seconds) until the call is answered or the caller hangs up.
hangup	The phone company indicates that the remote party has hung up
lineactive	Put the resistance across the phone line that indicates the phone is active
lineidle	Put the resistance across the phone line that indicates the phone is idle
tones(*string*)	Send the digits in ***string*** out over the phoneline as touch-tones
ring	Causes the speaker to play one ring tone
ansON ansOFF	Connect/disconnect the answering machine to the audio bus
audioON audioOFF	Connect/disconnect the speaker and microphone to the audio bus
lineON lineOFF	Connect/disconnect the phoneline to the audio bus

Simplification: Messages among telephone components are never lost or corrupted.

Specifications

Original design by Michael Ernst & John Chapin

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Specifications tell you what to do (but not how to do it)

- **A perfect implementation is no good if it solves the wrong problem**
- **It's difficult to create a specification that is**
  - complete
  - consistent
  - precise
  - concise

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Bundestag Sound System, 1992

- **No sound from speakers in new building**
  - system requirement: no feedback
  - new all-glass room
- **"This glass does not absorb the sound. The computers, detecting feedback, turn down the volume. A steady state is only achieved when the microphones are turned off."**

  Dr. Debora Weber-Wulff

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Ariane 5 launch vehicle, 1996

- **Went off course during launch**
  - Ariane 4 guidance software reused in Ariane 5
  - Ariane 5 accelerated much faster
  - velocity variable overflowed, computer crashed
- **"The failure of the Ariane 501 was caused by the complete loss of guidance and attitude information... due to specification and design errors in the software."**

  ESA Inquiry Board

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Mars Polar Lander, 1999

- **Crashed while landing on Mars**
  - sensor transient when legs deployed
  - software thought vehicle had landed
  - engine shut down during descent
- **"There was no software requirement to clear spurious signals prior to using the sensor information to determine that landing had occurred."**

  Mars program independent assessment team

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Specifications matter

- **A specification:**
  - connects customer and engineer
  - ensures parts of implementation work together
  - defines correctness of implementation
- **Therefore everyone must understand specs**
  - Designers, implementers, testers, managers, marketing, technical support, ... users!
- **Good specifications are essential**

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Groupthink Specification Exercise

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Groupthink game

- **As a group, specify behavior of a desktop telephone**
- **Individually, answer questions about its behavior**
- **Goal: all group members give same answer**
  - No defaults based on the game (e.g., "always A")
- **The winning group receives a prize**

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Desktop telephone

- **Handset (speaker and microphone)**
- **Keypad**
  - `talk`
  - `redial`
  - `ansmachine`
  - `end`
- **24-character display**
- **Answering machine**
- **Phone jack**

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Requirements

- **Display indicates current functionality**
  - caller ID
  - number being called
  - "Answering machine"
  - "Ready"
- **Answering machine picks up after 2 rings**
- **You decide other aspects of system behavior**

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Definitions

- **Lineidle: phone is on-hook ("hung up")**
  - sent from phone to phoneline
- **Lineactive: phone is off-hook ("picked up")**
  - sent from phone to phoneline
- **Ring signal: causes phone to ring once**
  - sent from phoneline to phone

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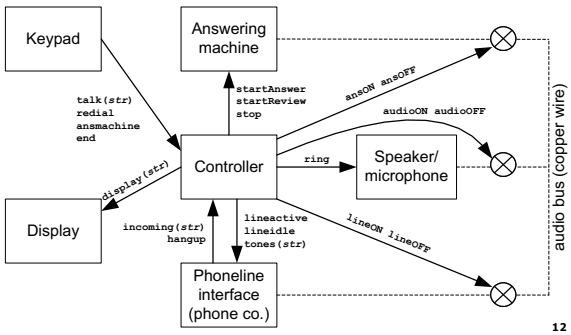
System architecture



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