Design of Object Systems

C++ Object Oriented Programming

Pei-yih Ting

NTOUCS

Introduction

- **Static model**
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- **The interplay between static and dynamic models:**
  - Novice OO designers often **over-emphasize on static models** – classes, properties, interfaces, inheritance/aggregation relationships
  - **Software design is about behavior, behavior is dynamic**
  - **Object oriented design is a technique used to separate and encapsulate behaviors.**

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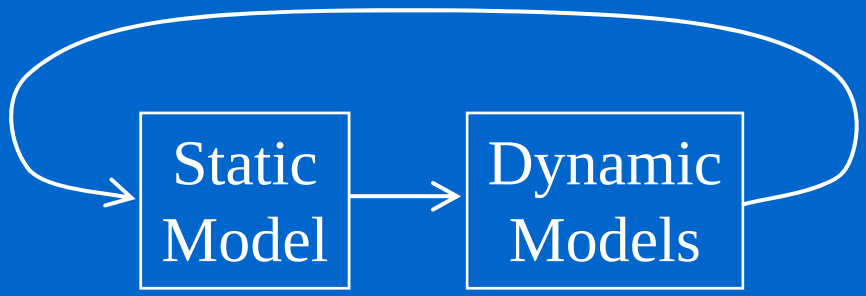

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- Forward class declarations make it possible for classes to have ***circular relationships*** without having *circular dependencies* between header files.

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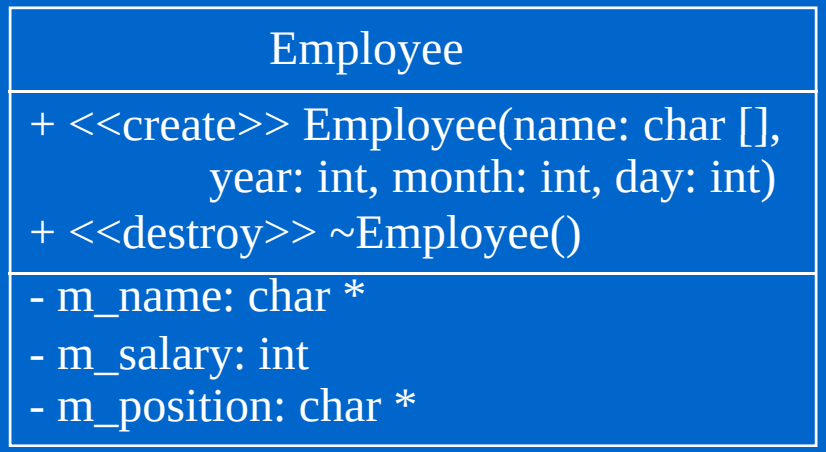

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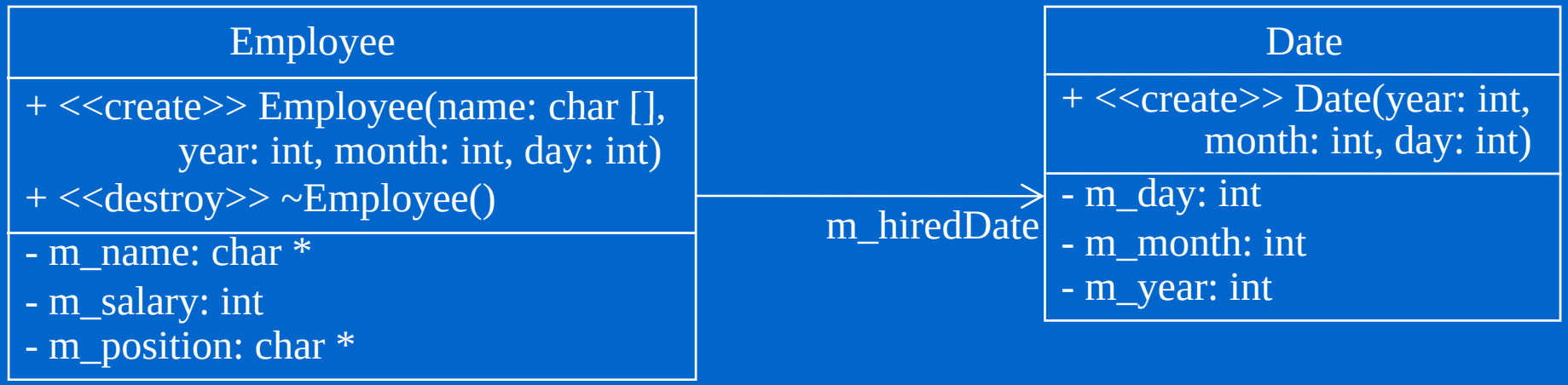

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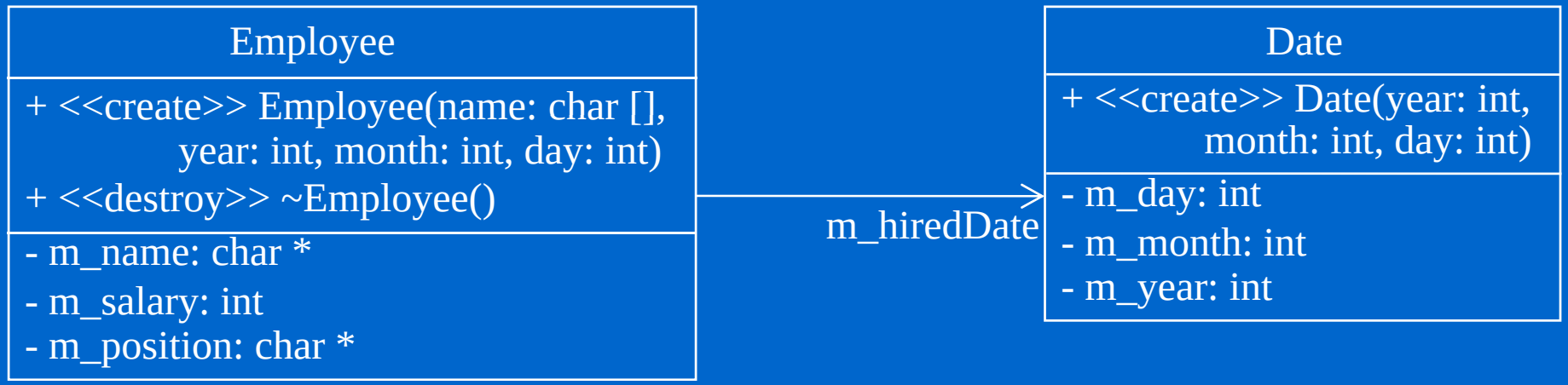

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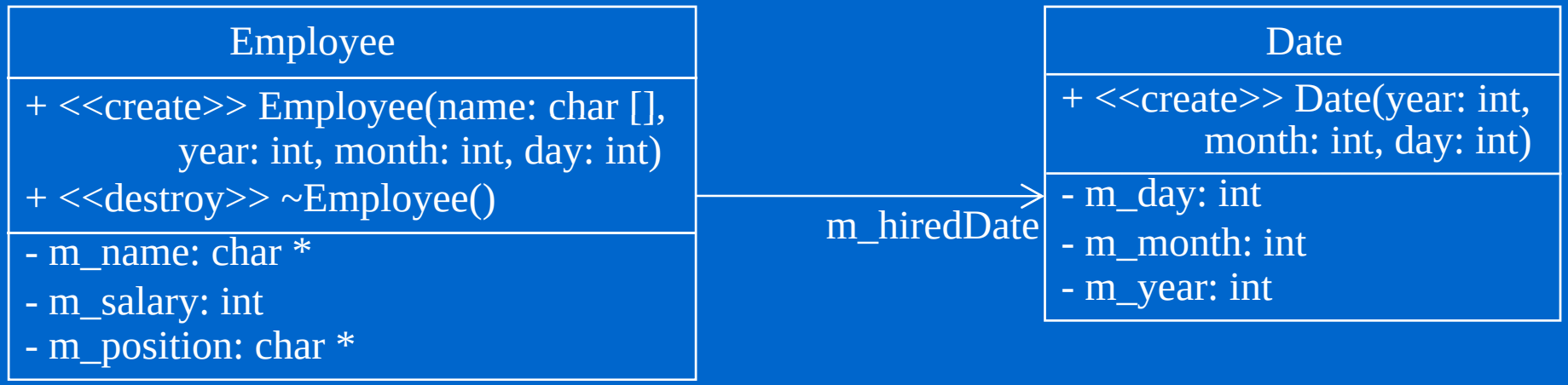

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Note: Sequence and collaboration diagrams describe **the same** information and can be transformed into one another

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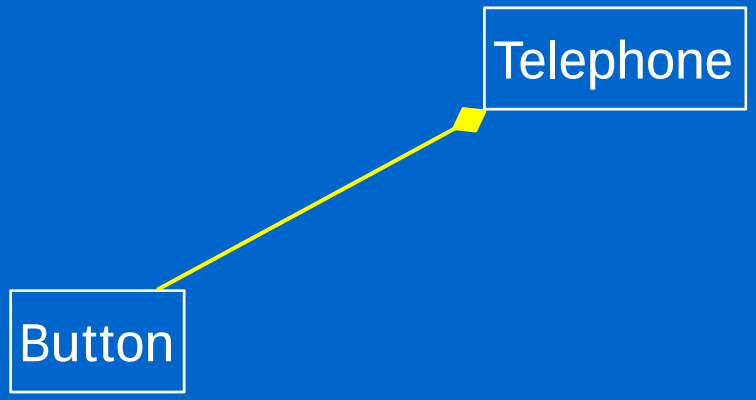

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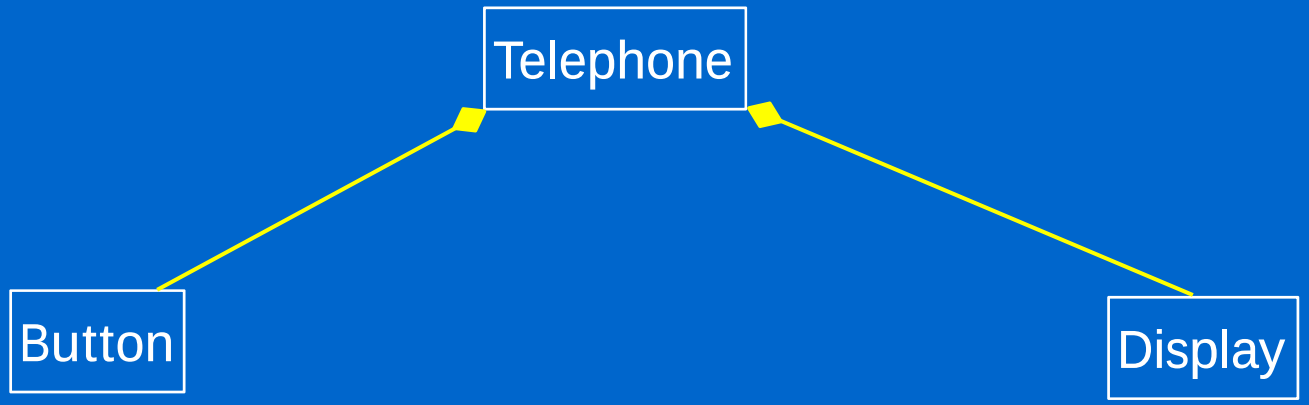

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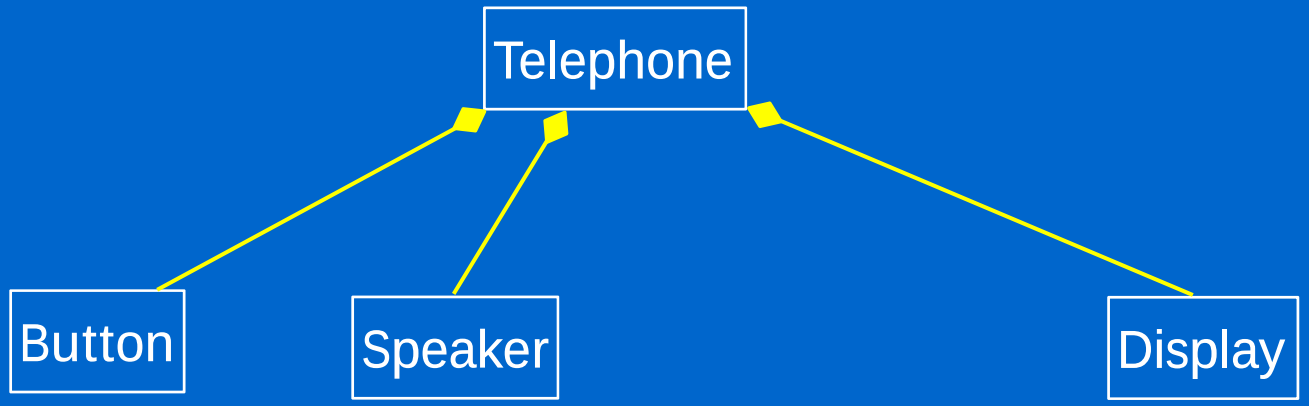

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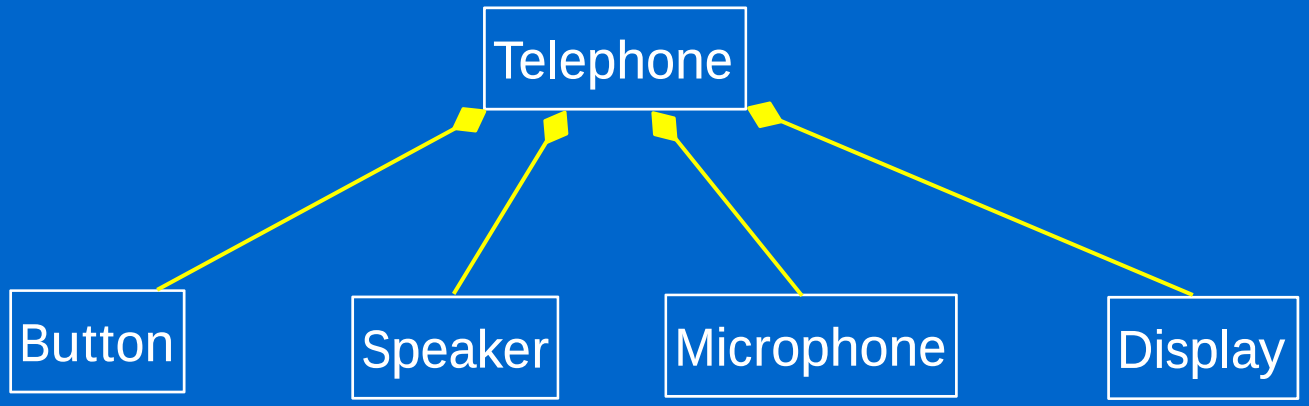

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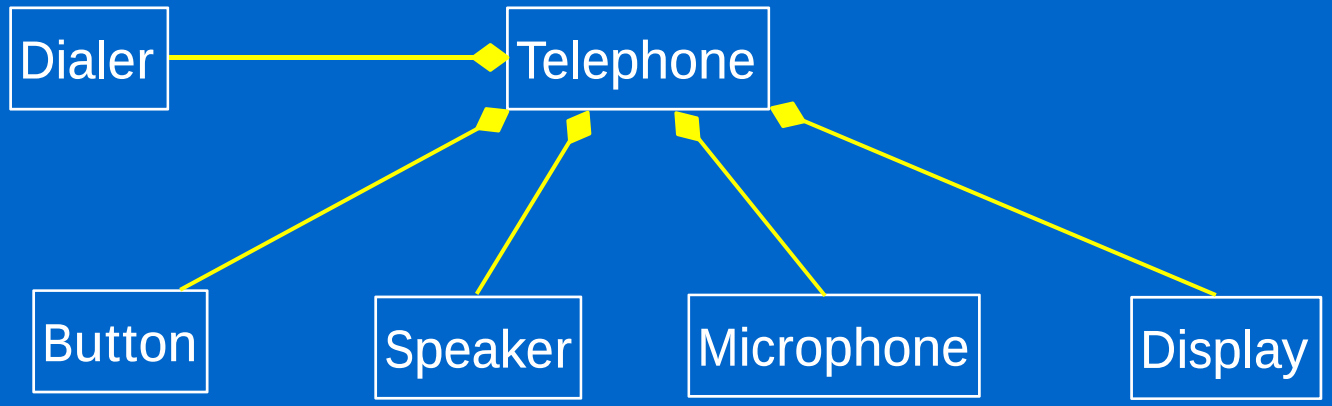

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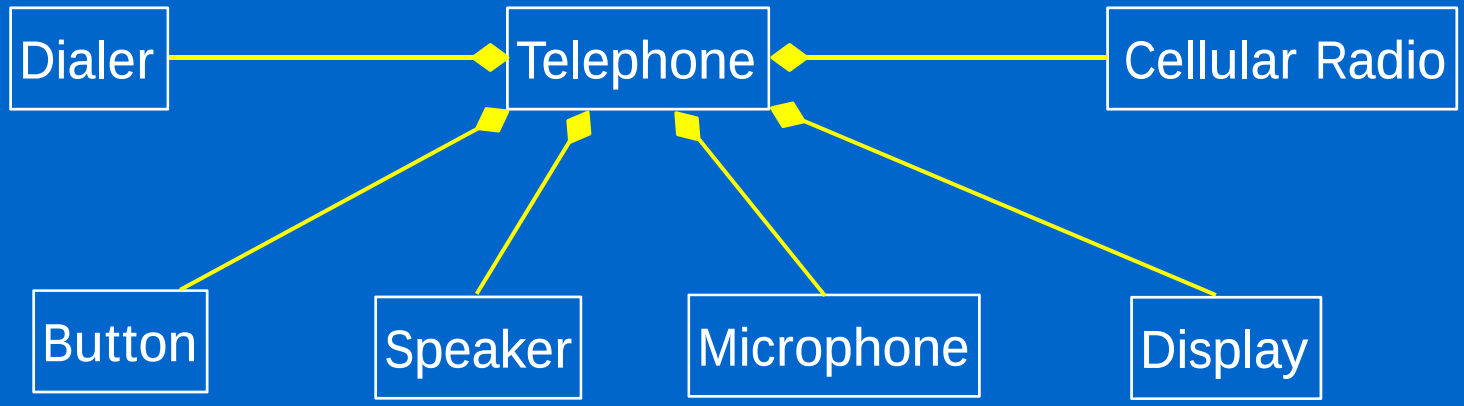

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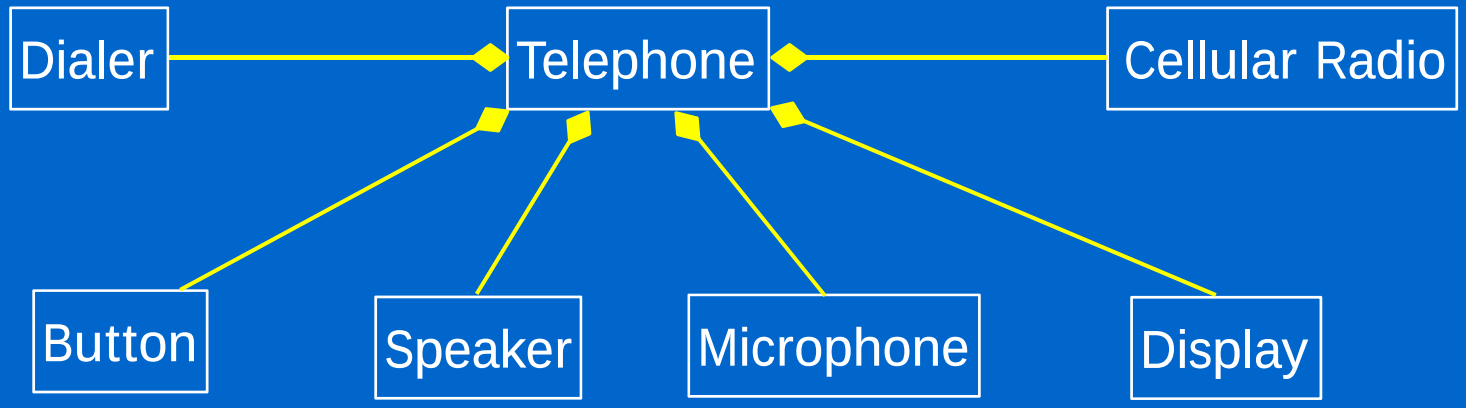

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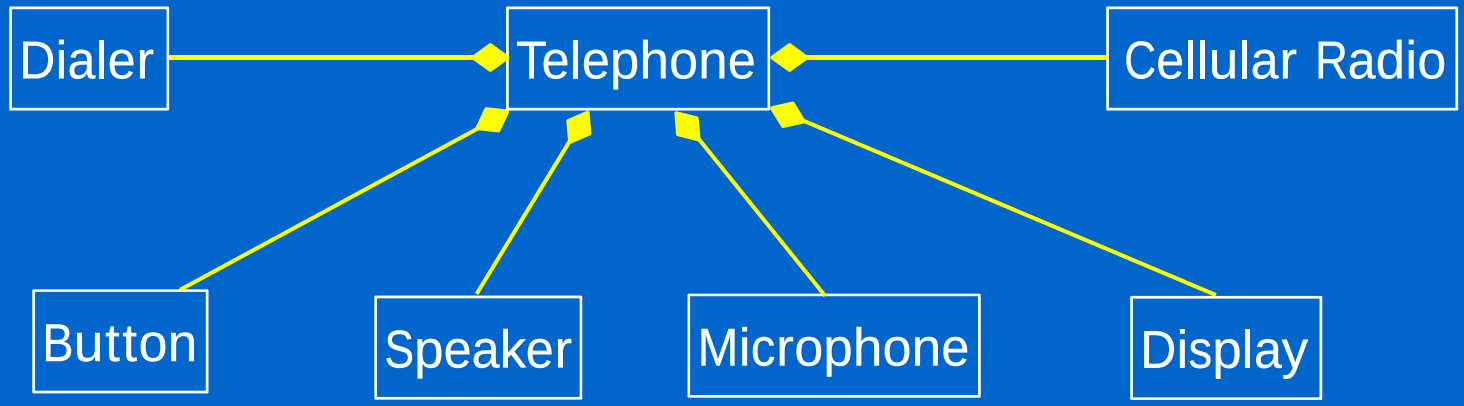

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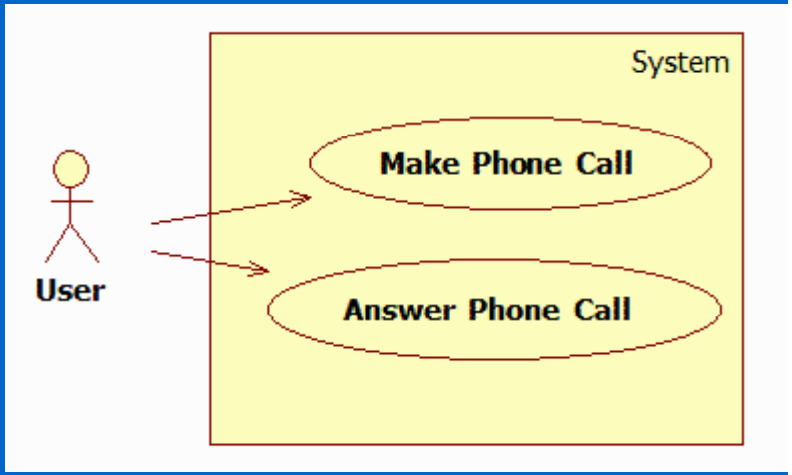

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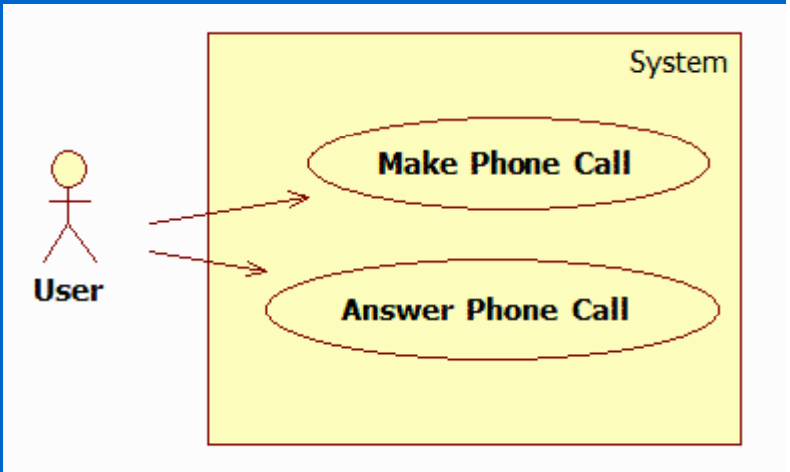

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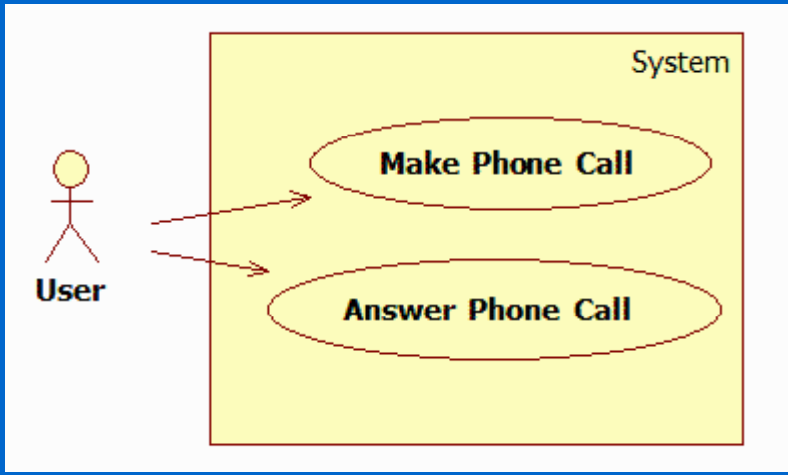

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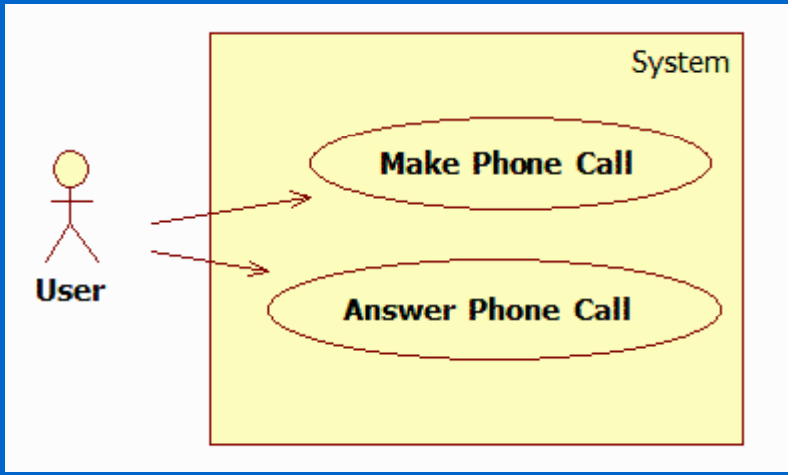

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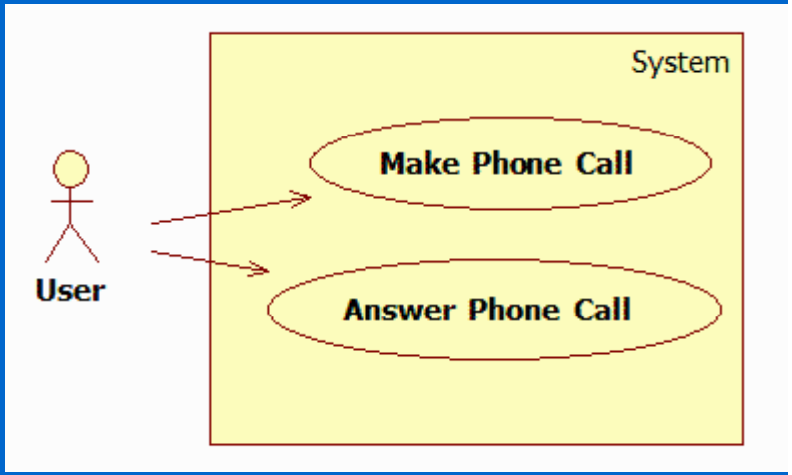

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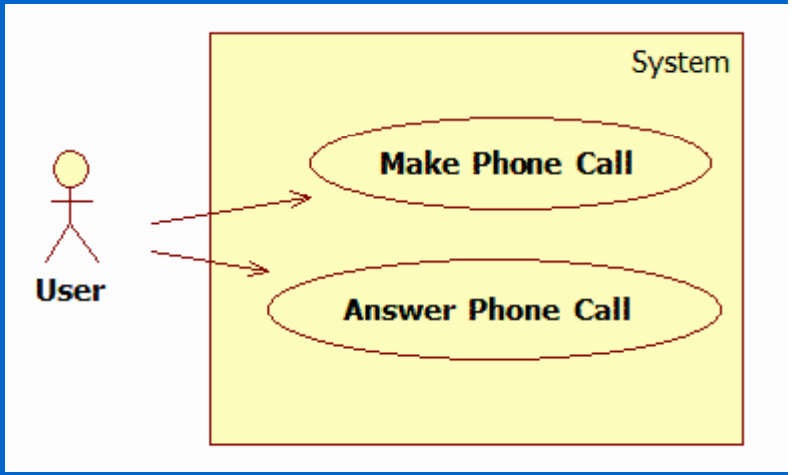

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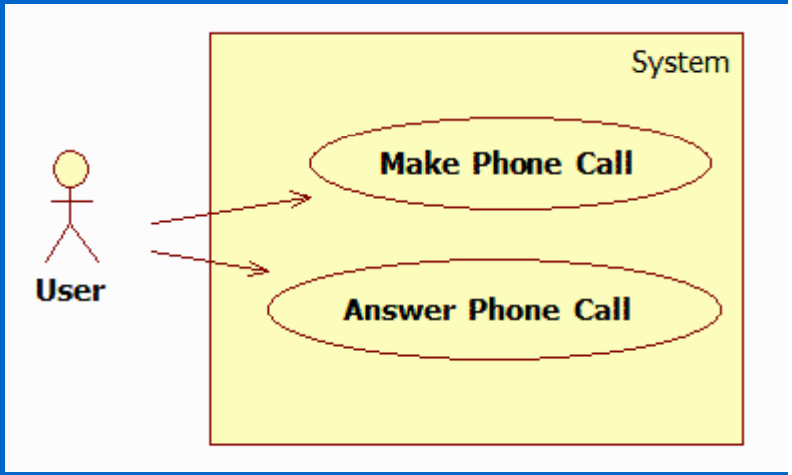

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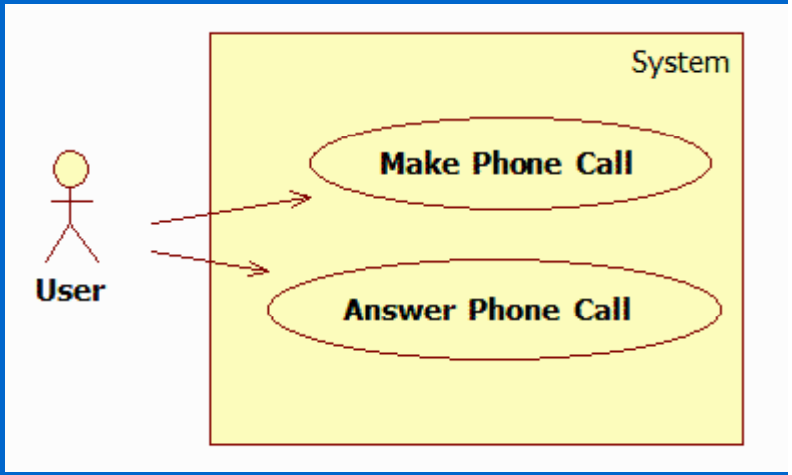

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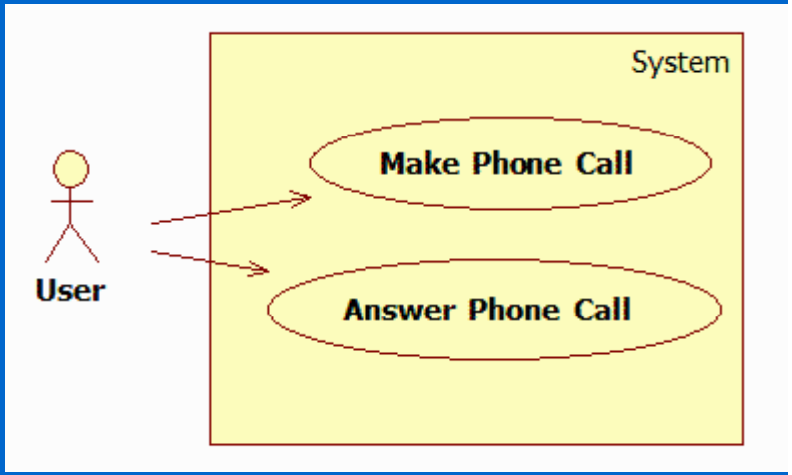

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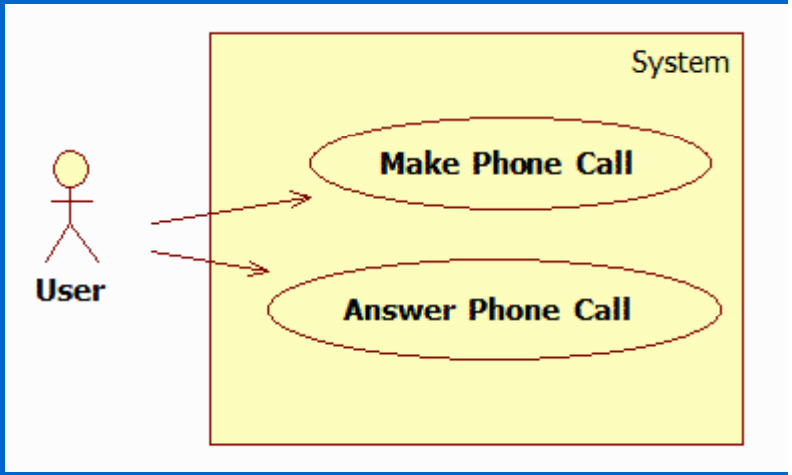

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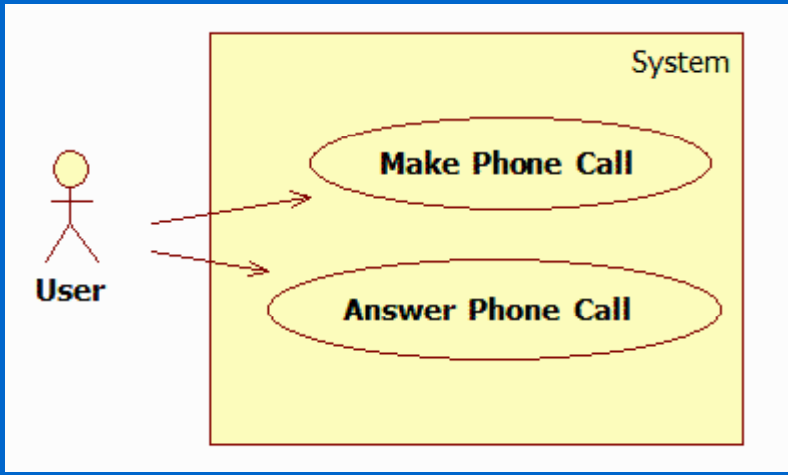
8. The connection is made to the called party.

Specifying Dynamics

- **Use cases**: Make Phone Call



1. User presses the digit buttons to enter the phone number.
2. For each digit, the display is updated to append the digit to the phone number.
3. For each digit, the dialer generates the corresponding tone and emits it from the speaker.
4. User presses “Send”.
5. The “in use” indicator is illuminated on the display.
6. The cellular radio establishes a connection to the network.
7. The accumulated digits are sent to the network.
8. The connection is made to the called party.

- How do the objects in the static model collaborate to execute this procedure?

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  - Digit button object sends a *digit* message to Telephone object.
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- Problem: Is the “Telephone object” necessary?

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  - Dialer object sends *connect* message to CellularRadio object.
  - CellularRadio object sends *inUse* message to Display object to illuminate the “in use” indicator on the display.

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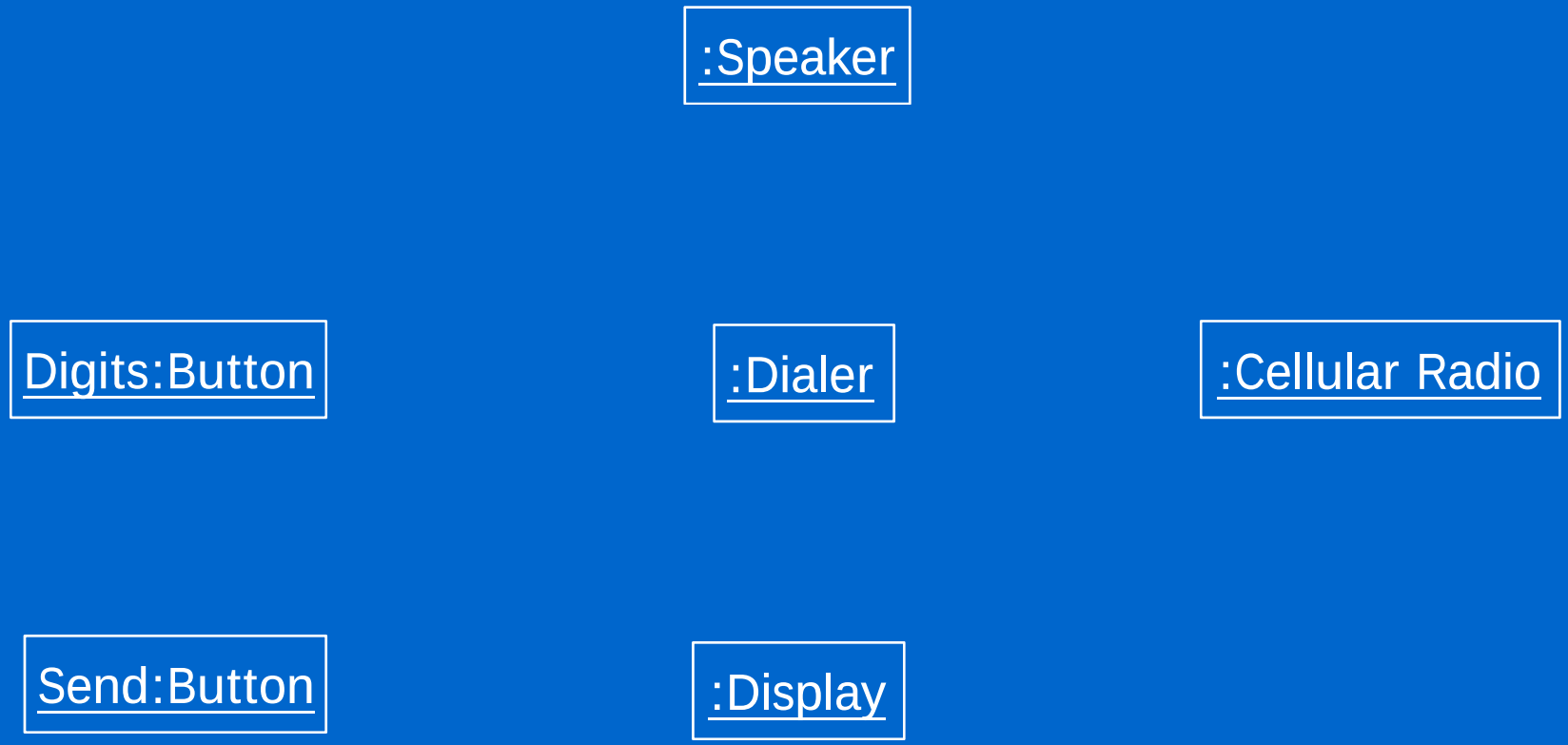

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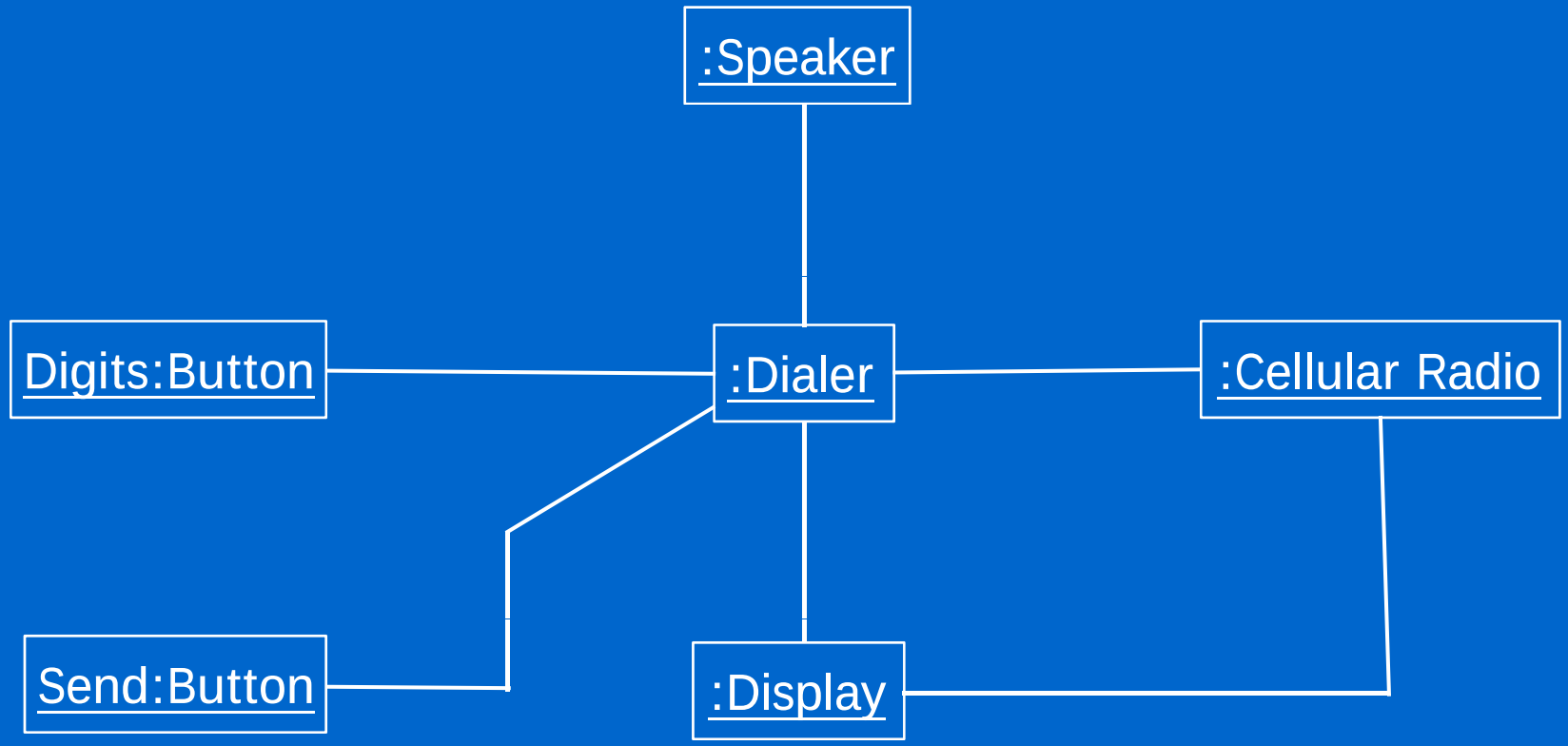

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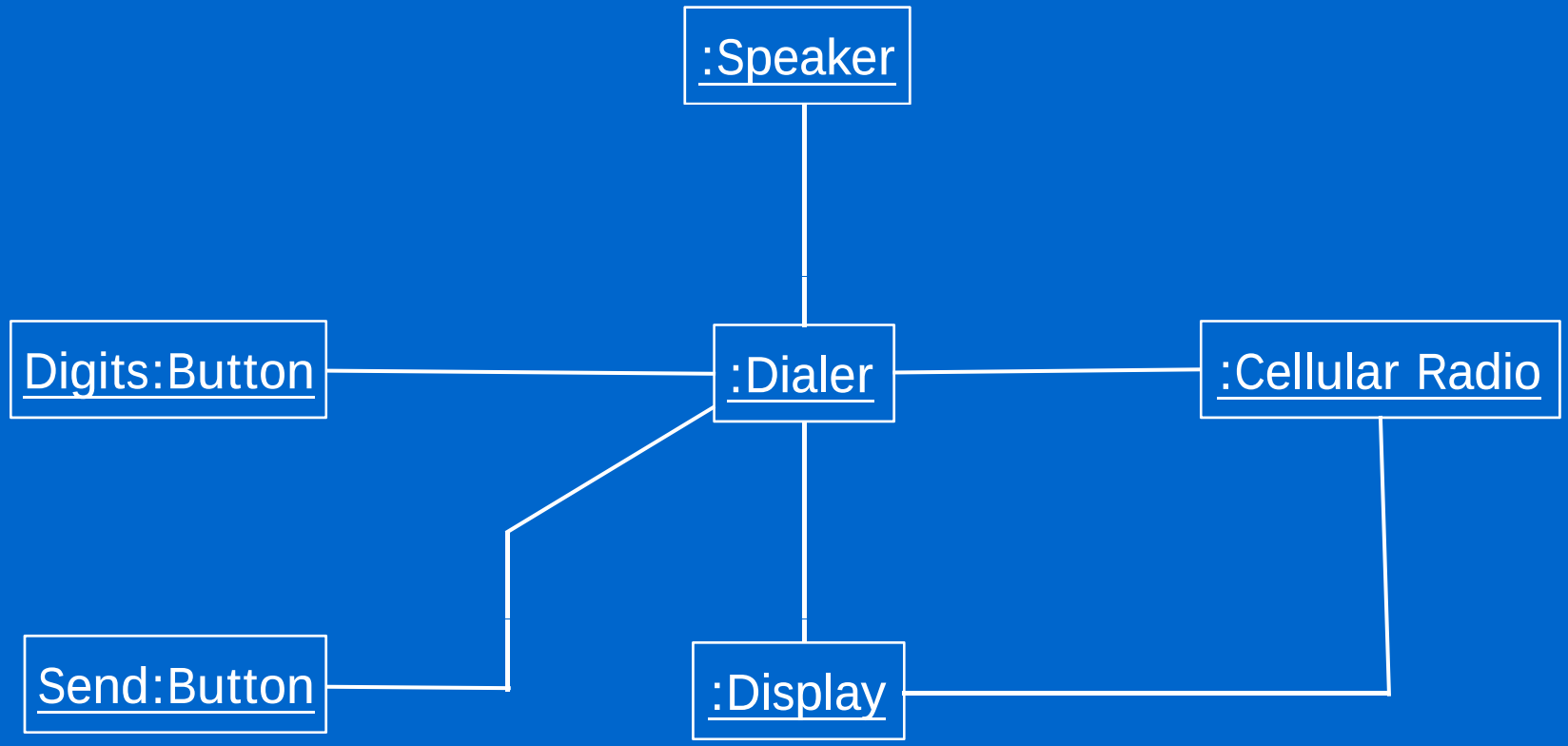

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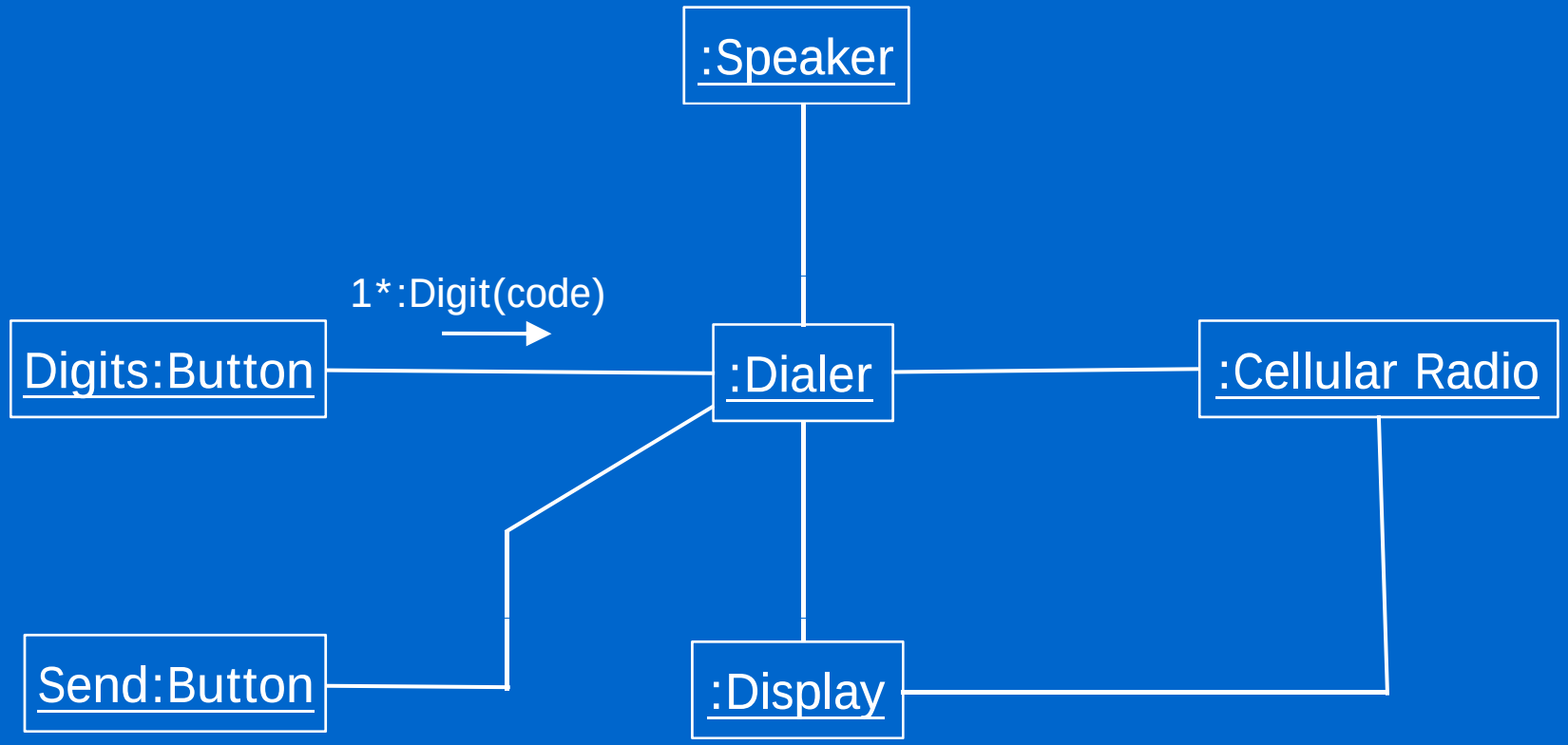

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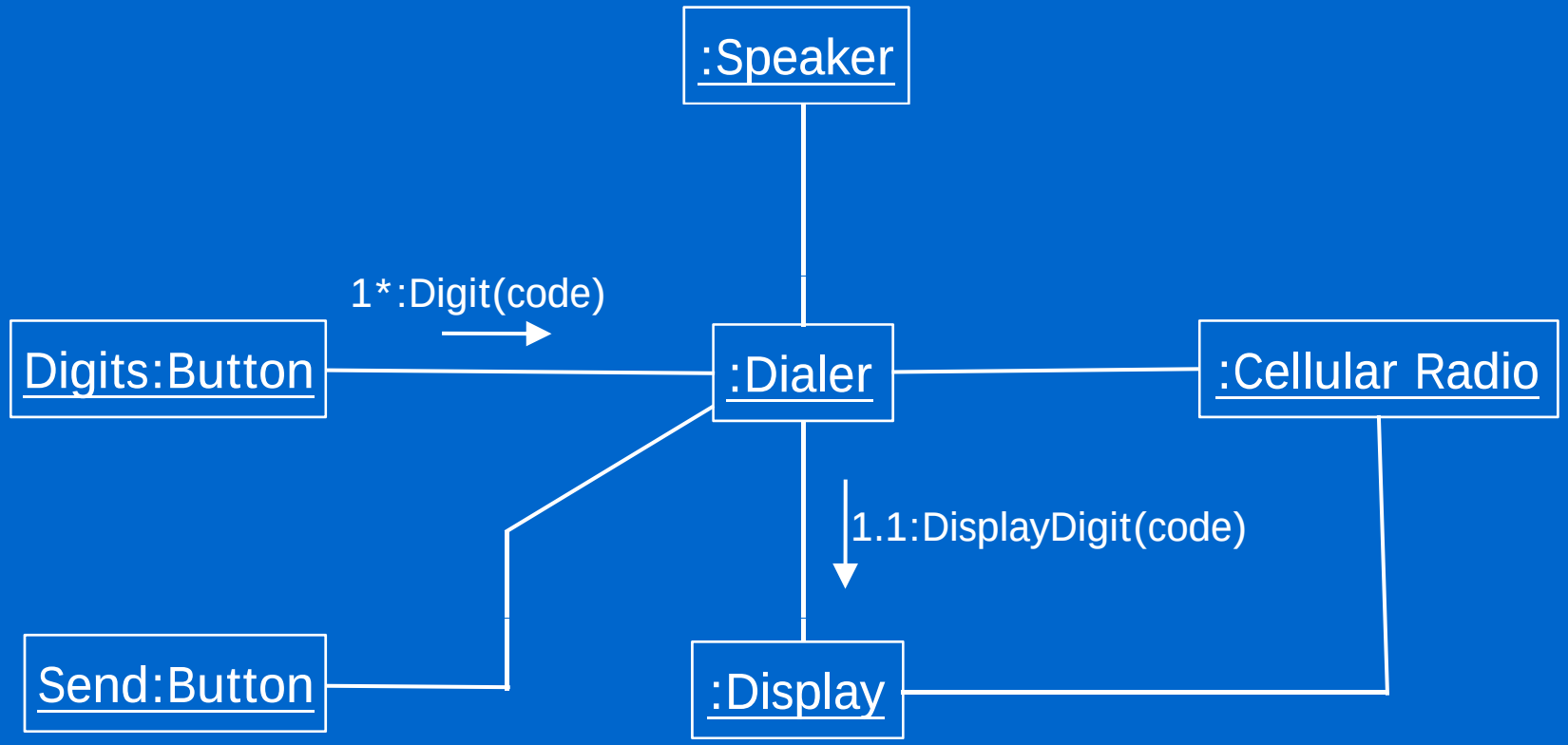

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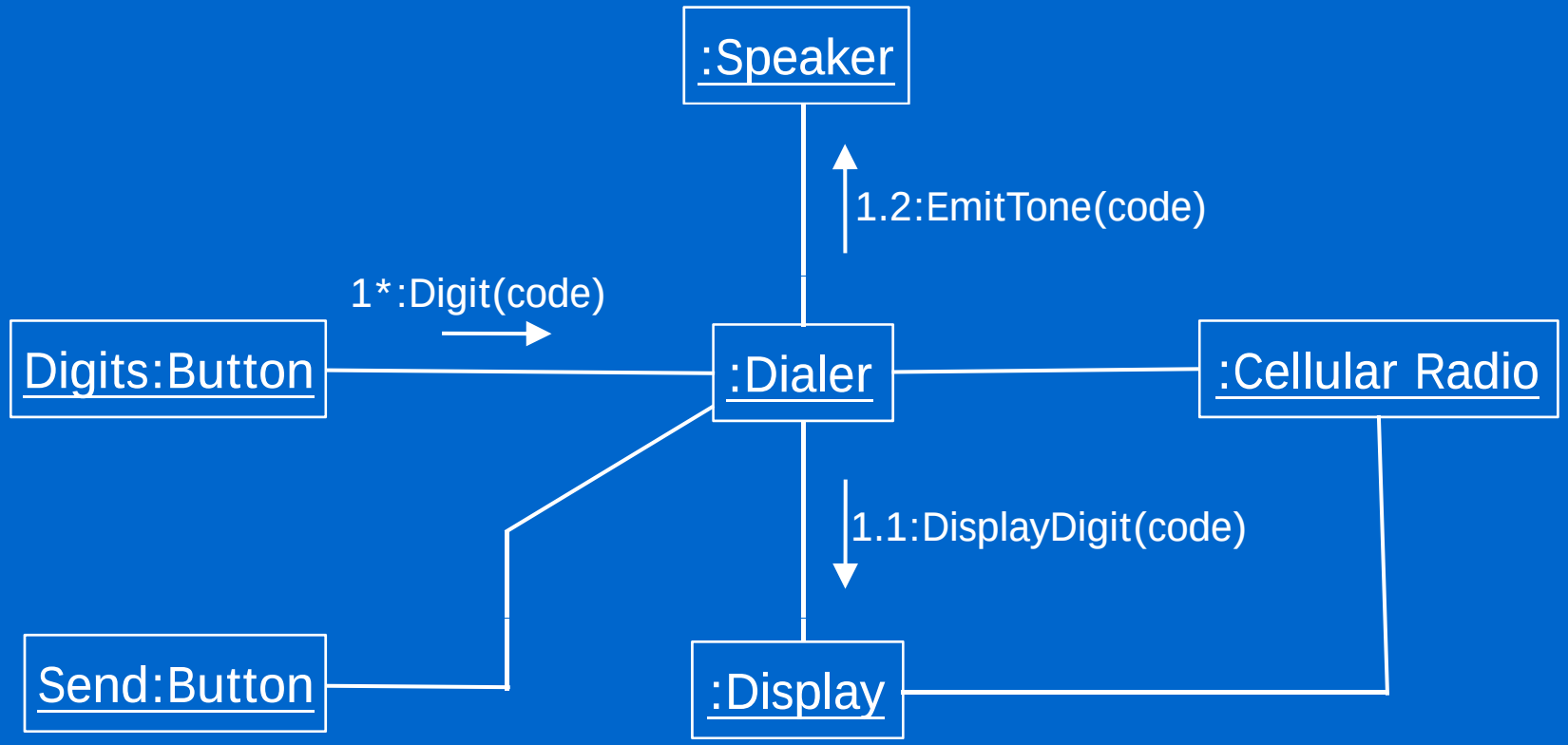

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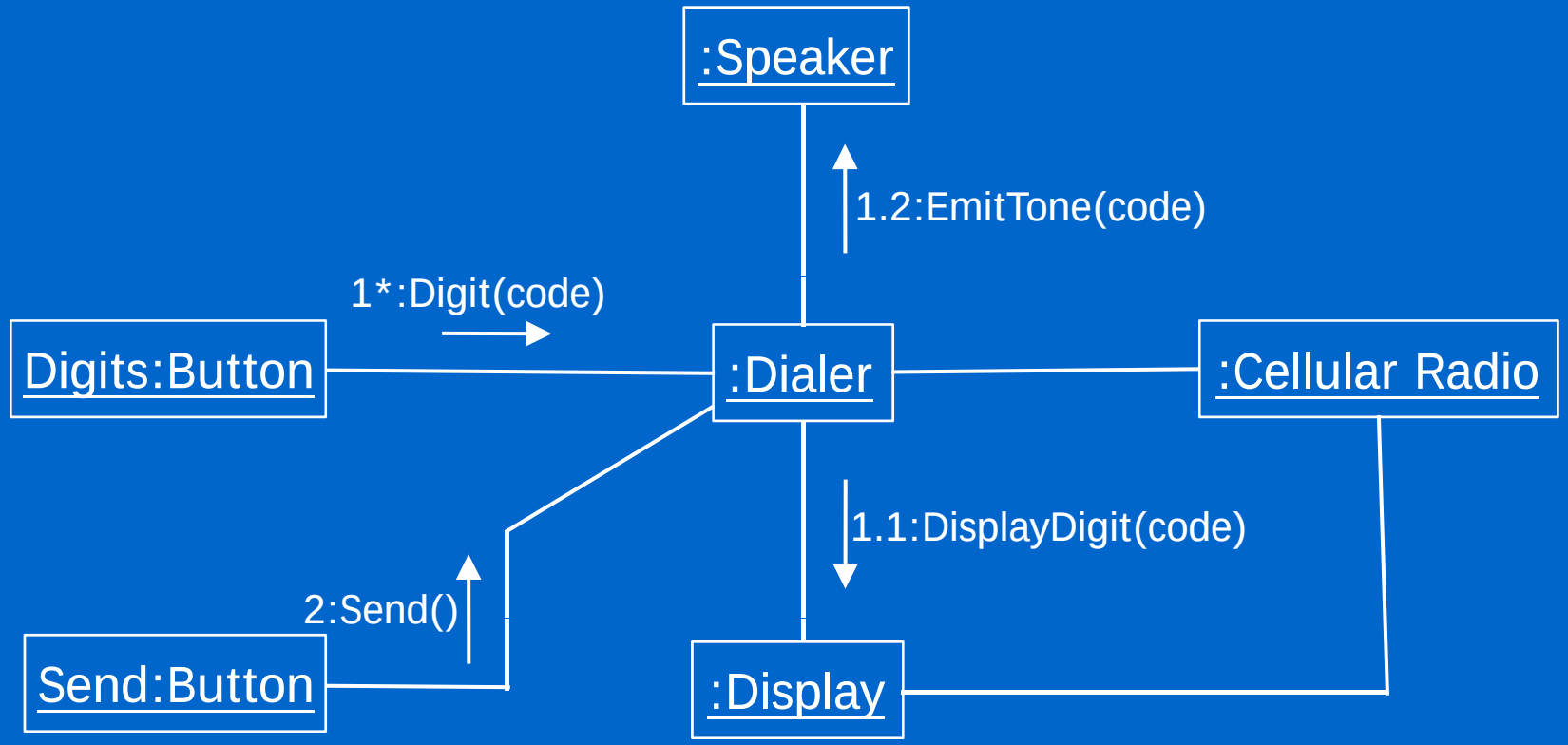

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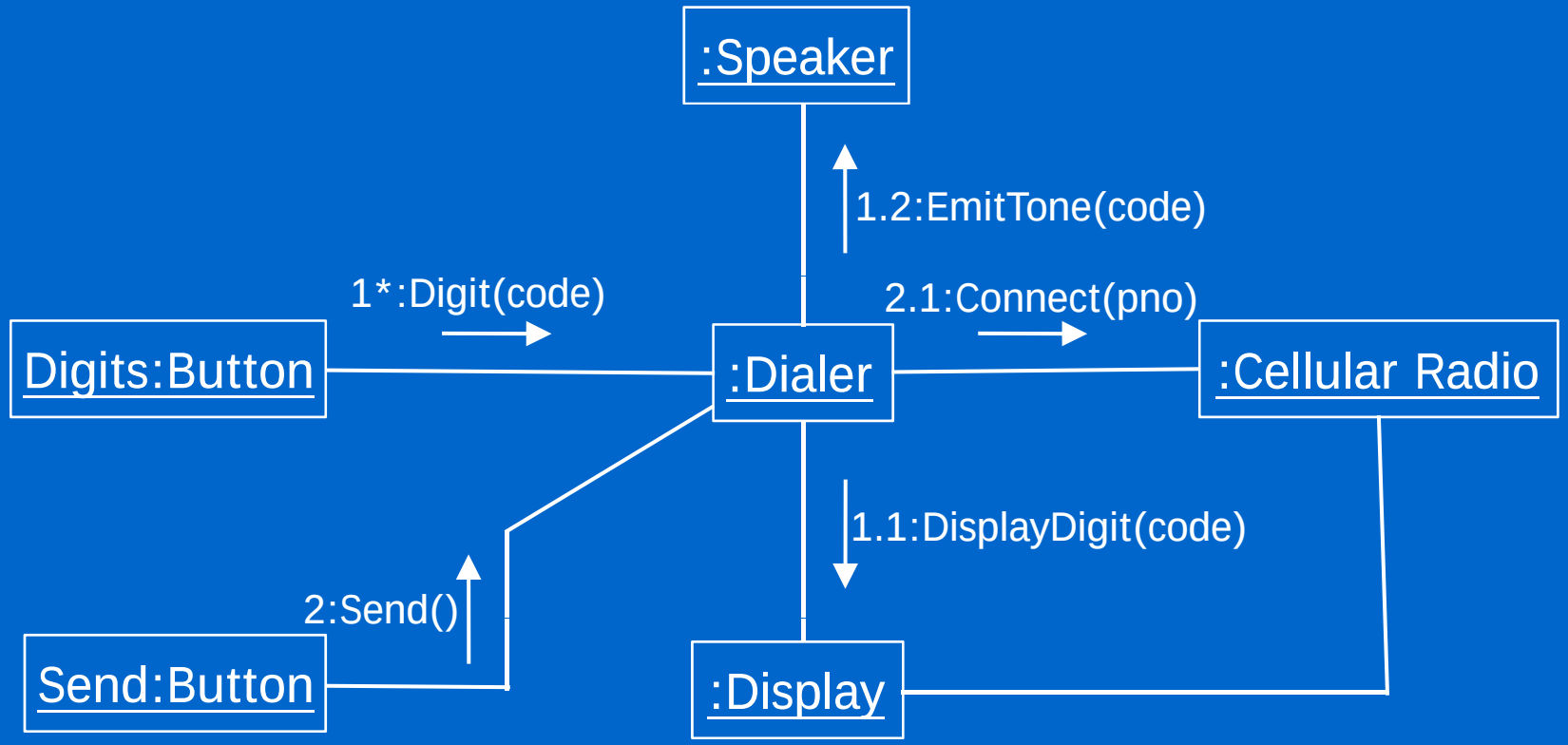

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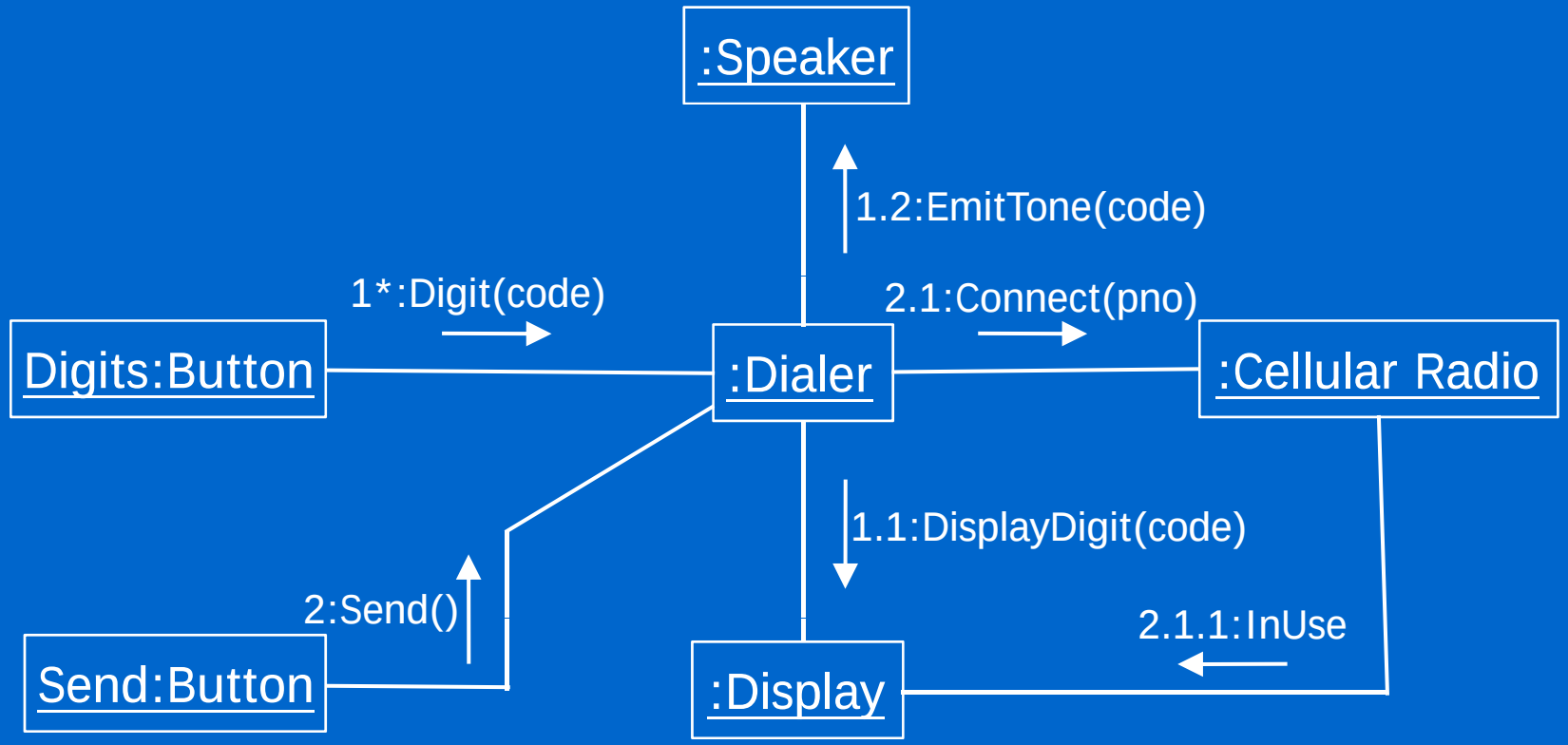

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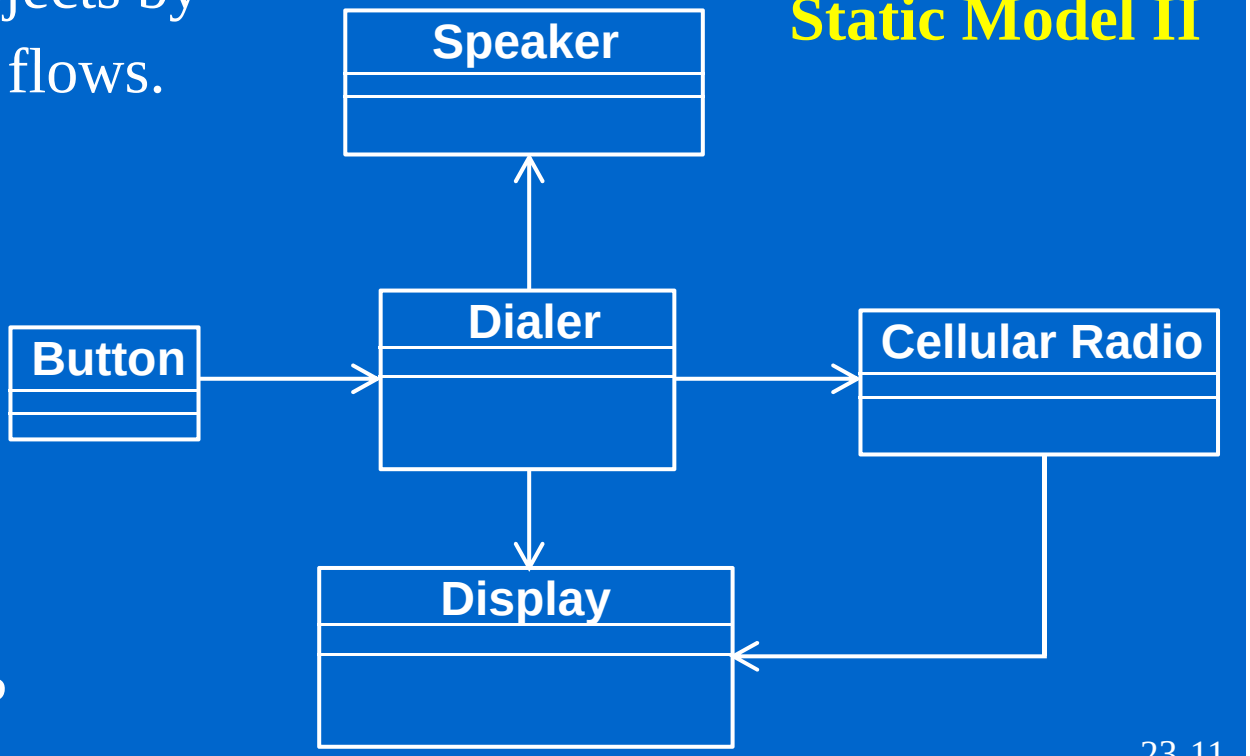

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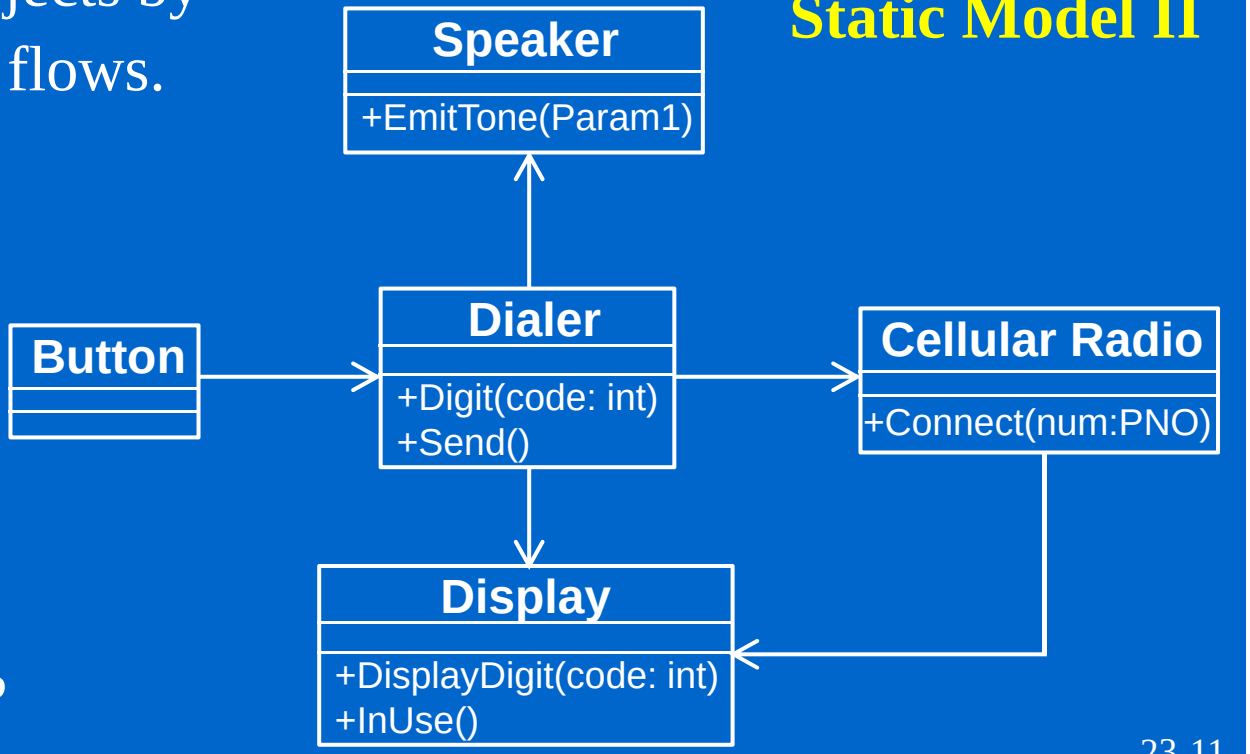

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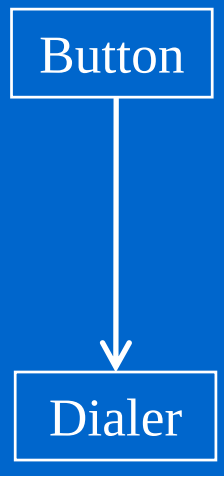

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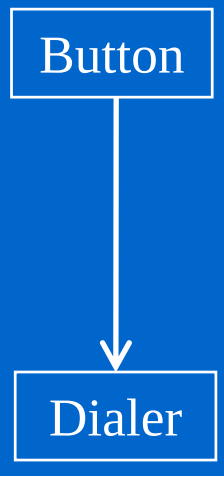

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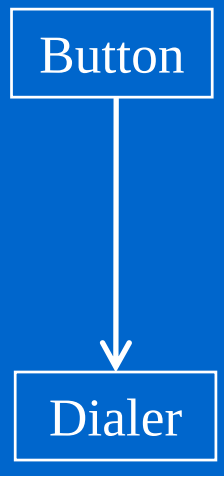

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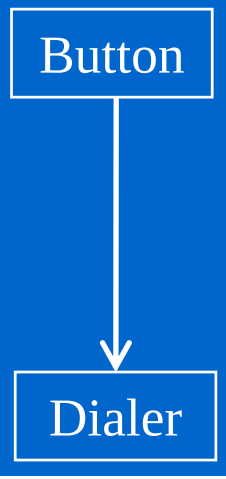

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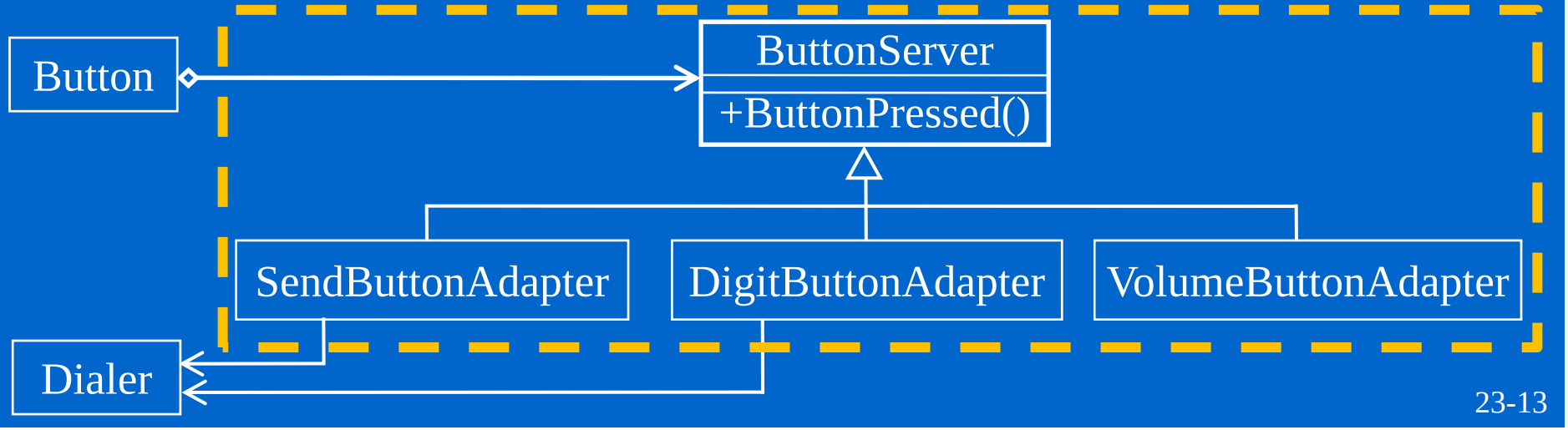

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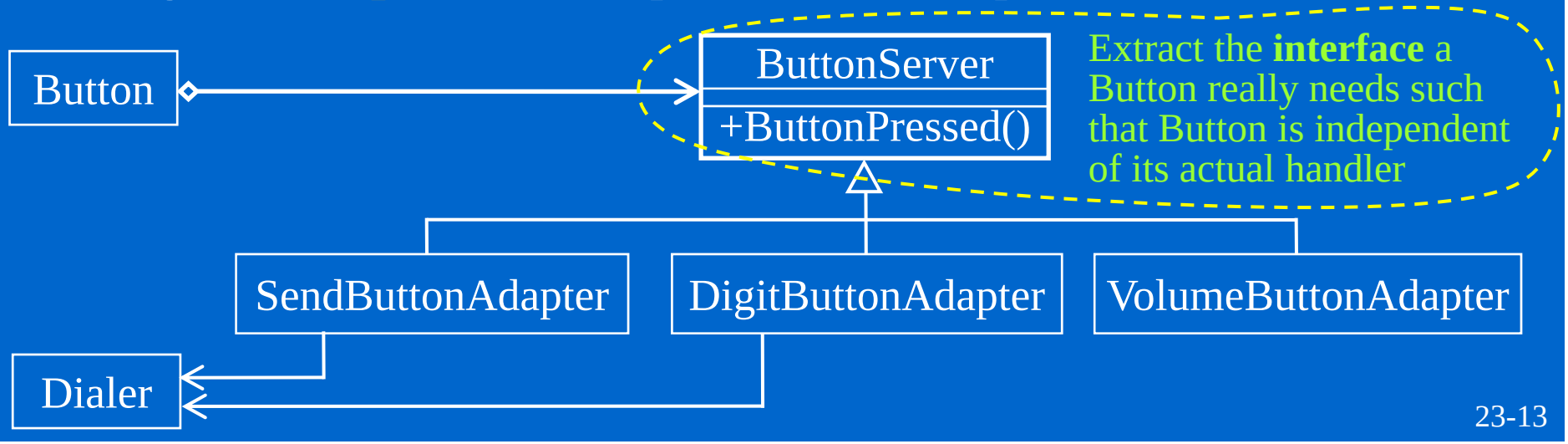

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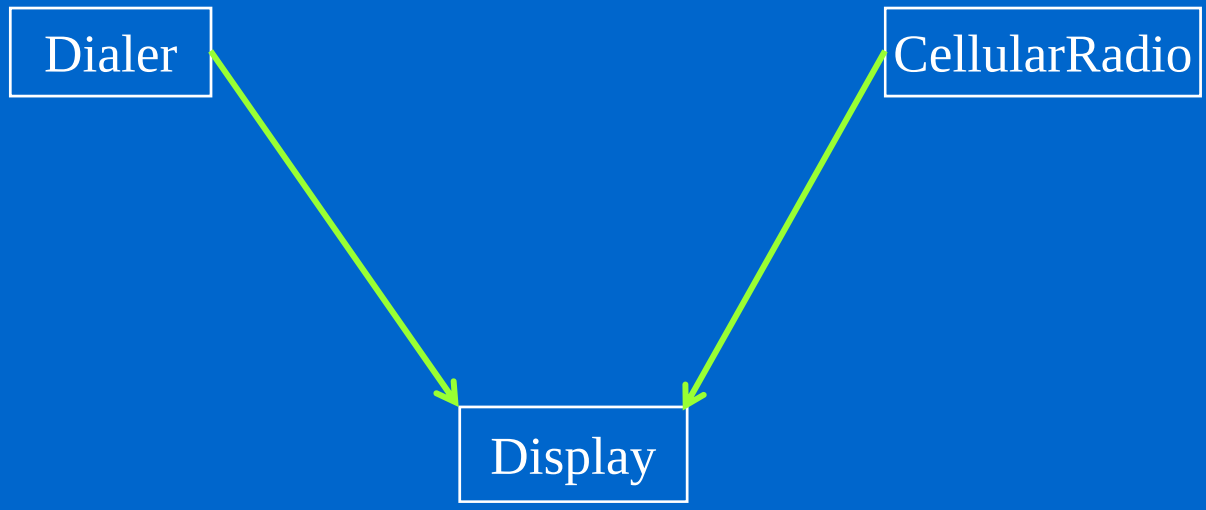

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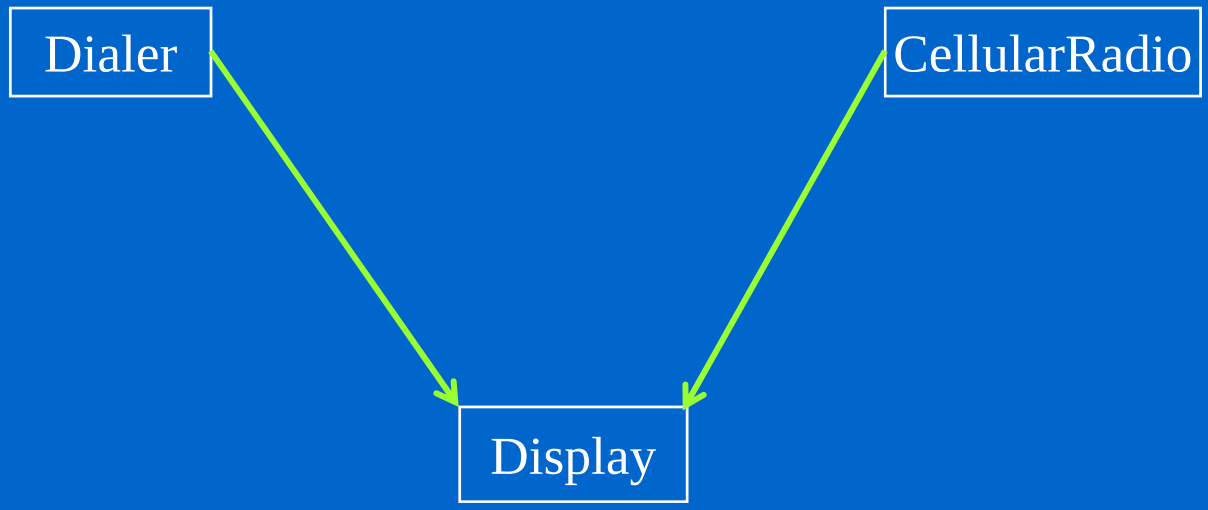

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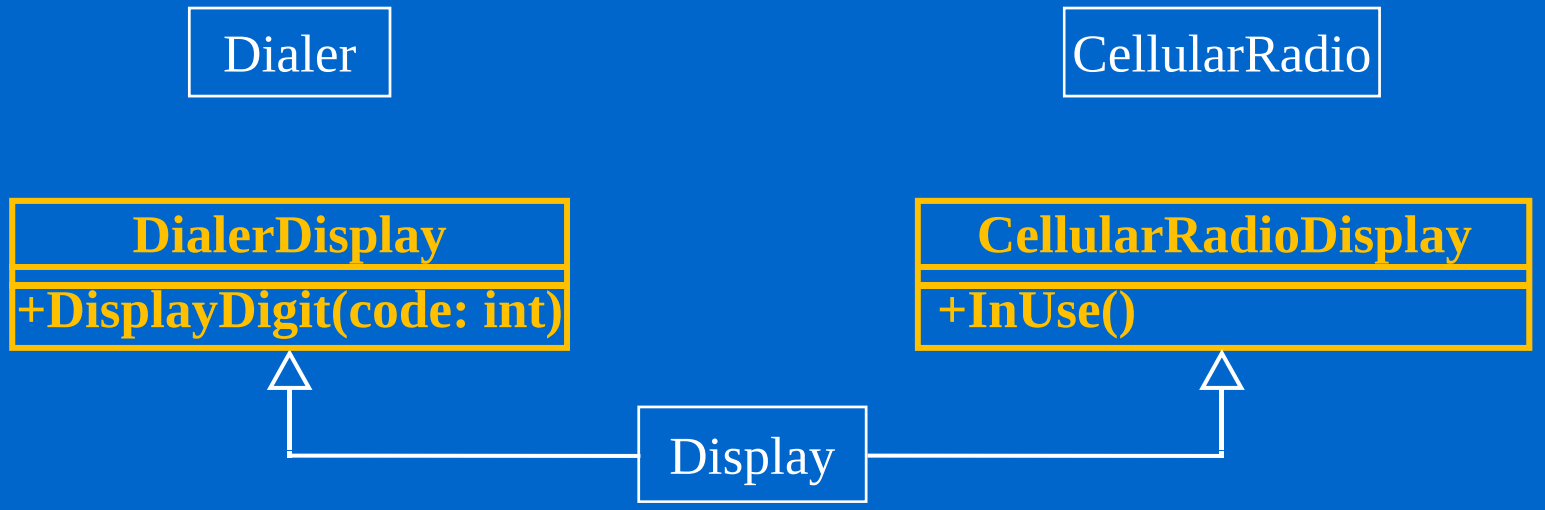

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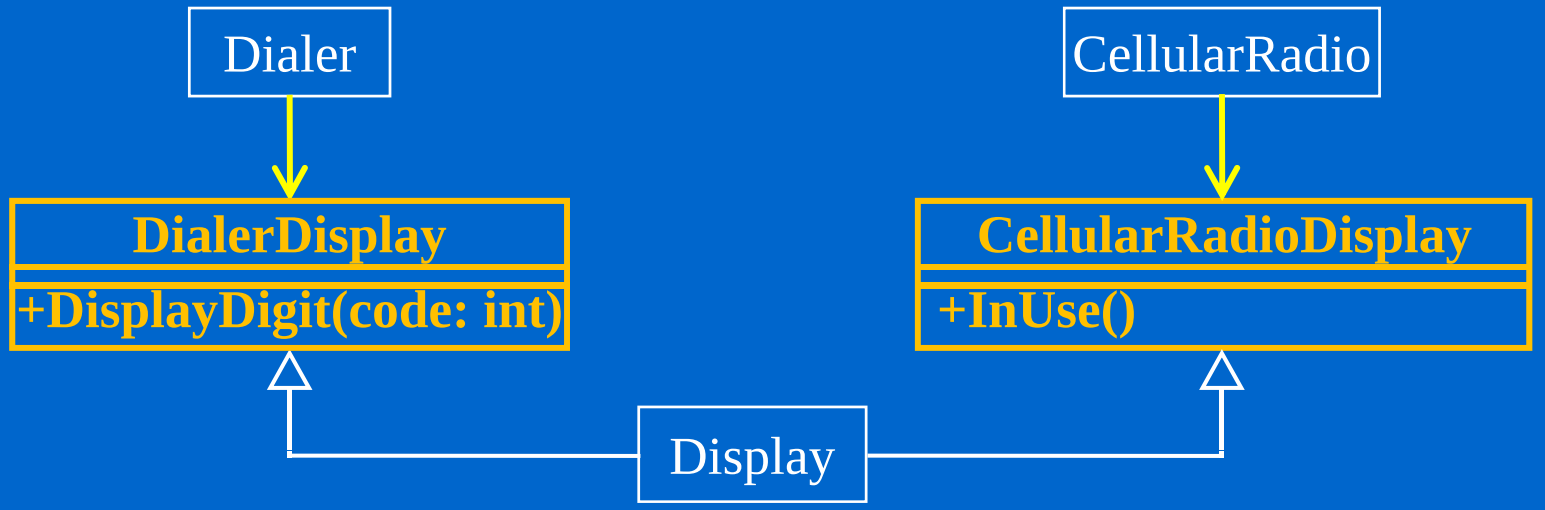

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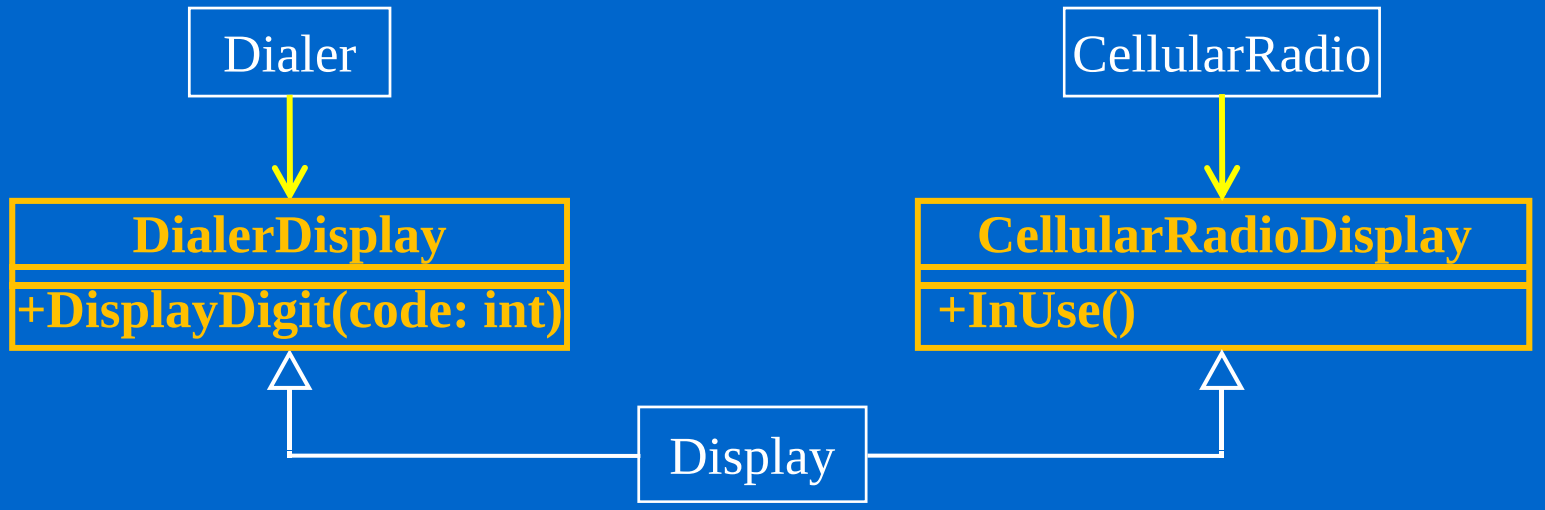

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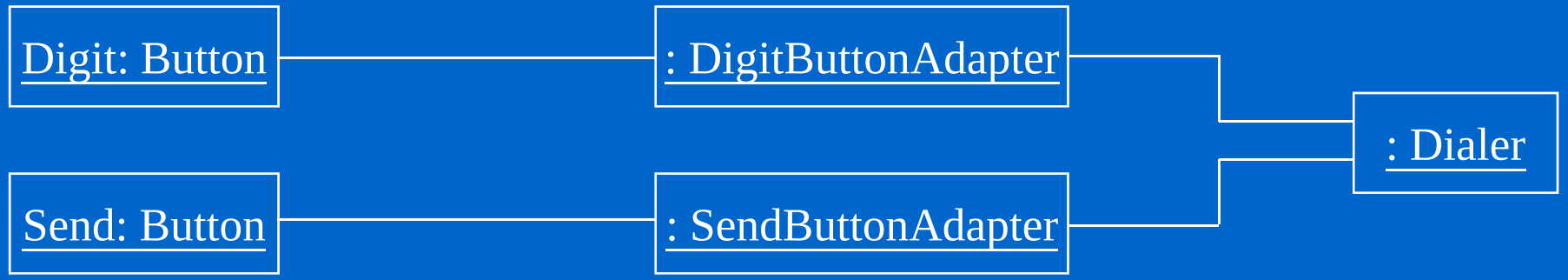

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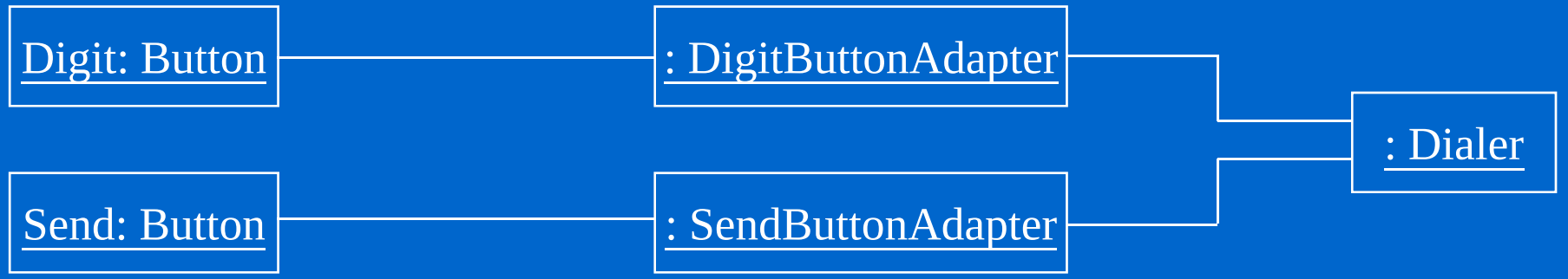

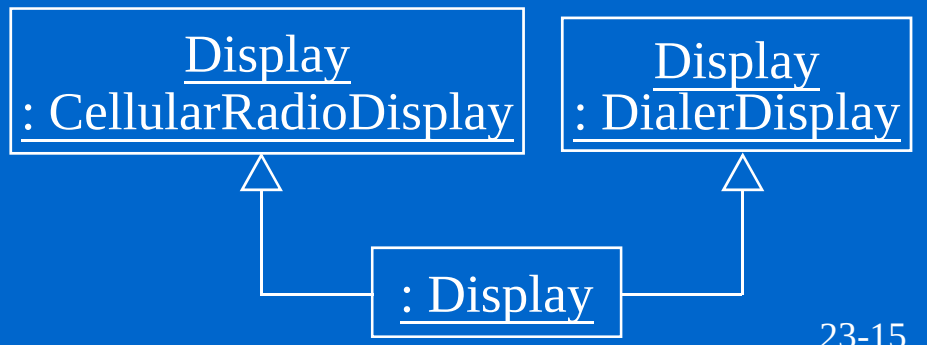

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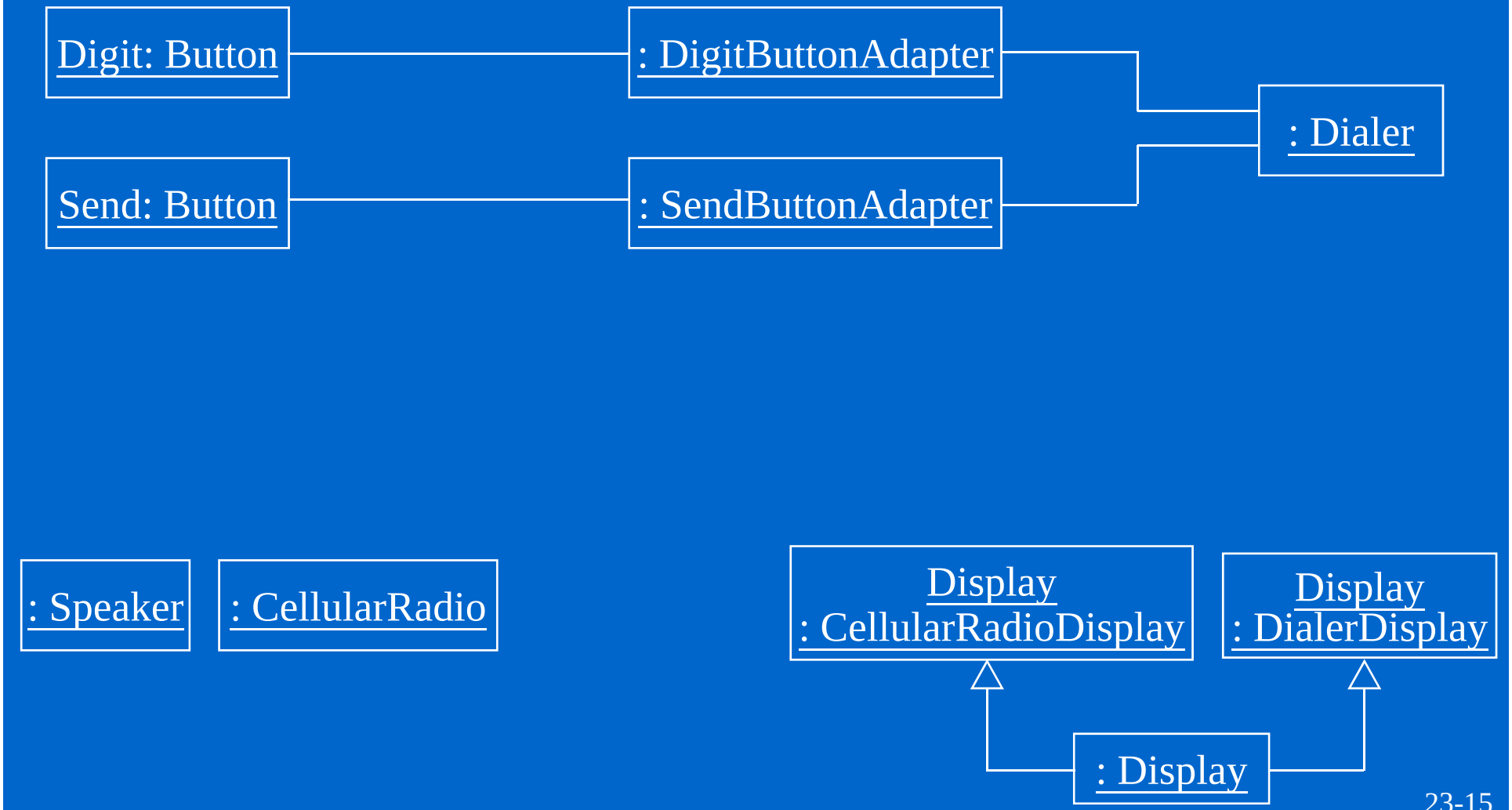

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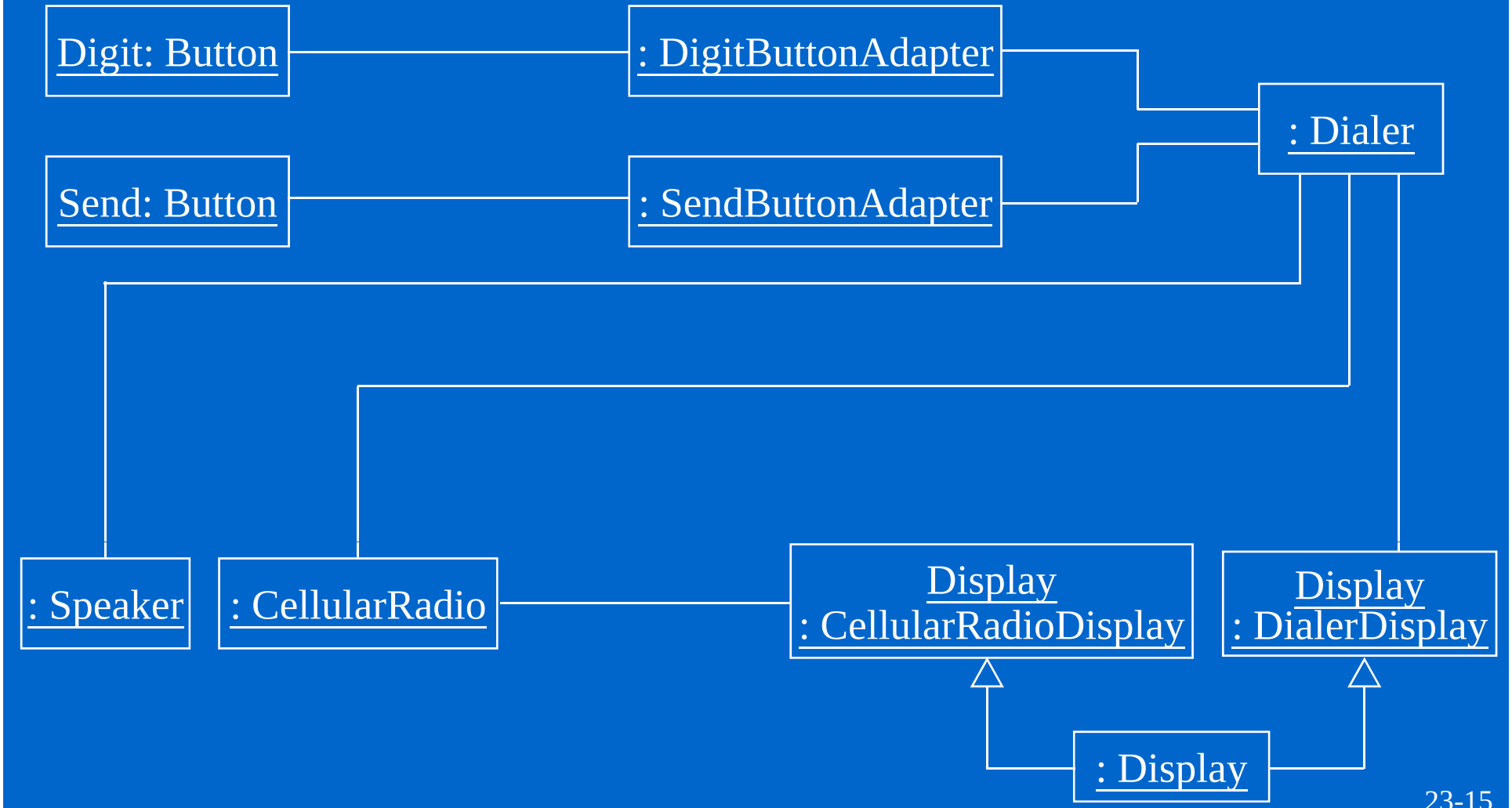

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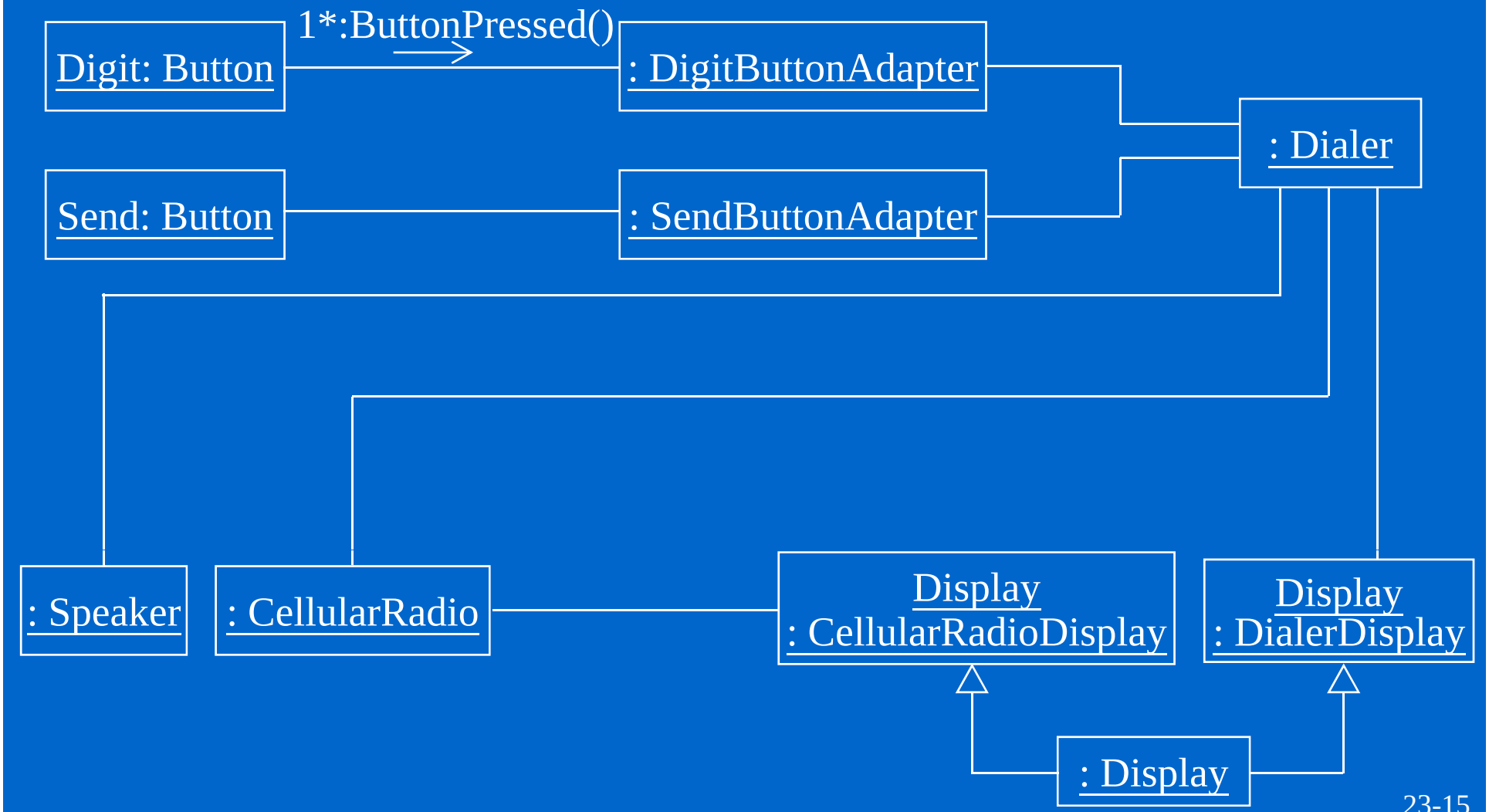

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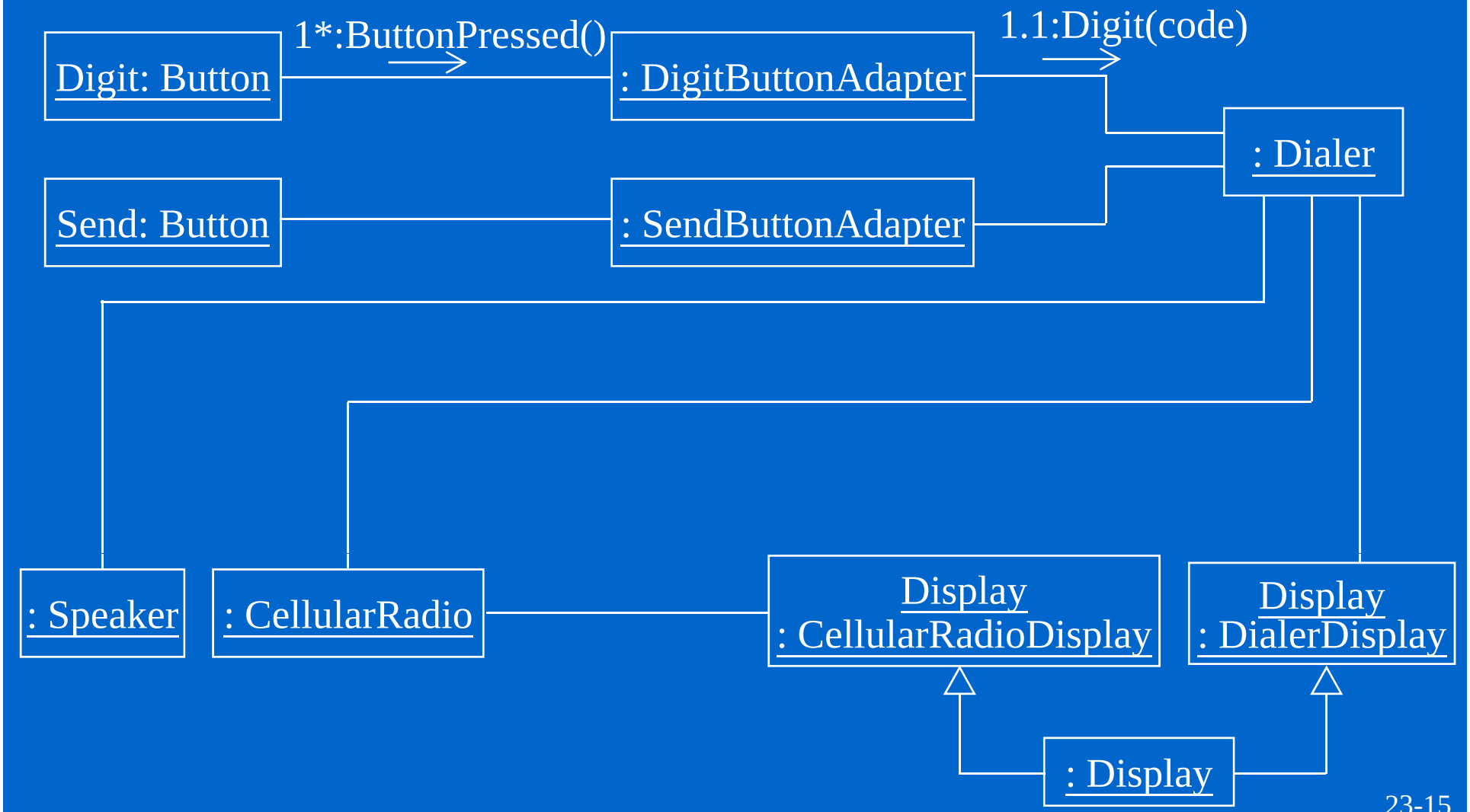

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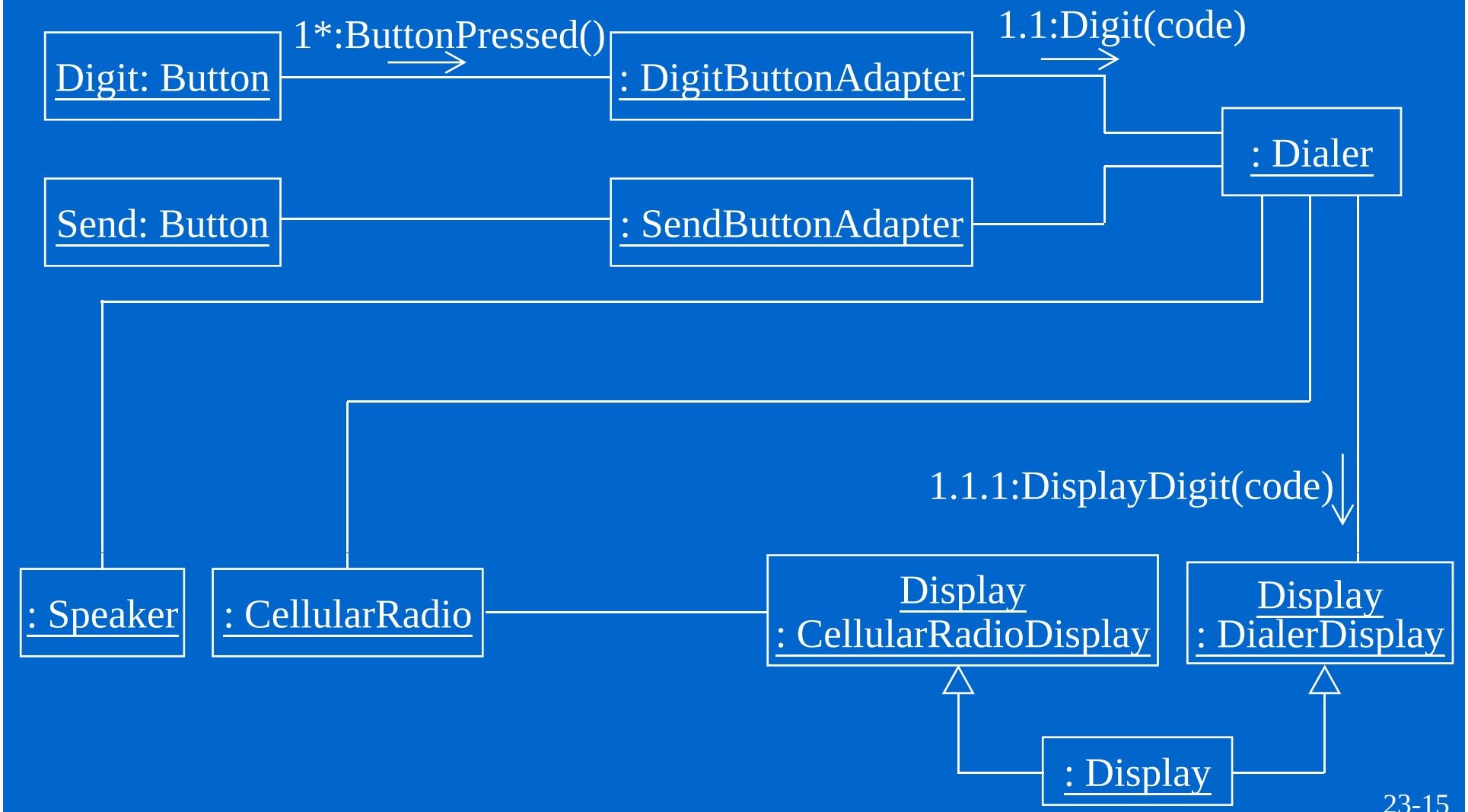

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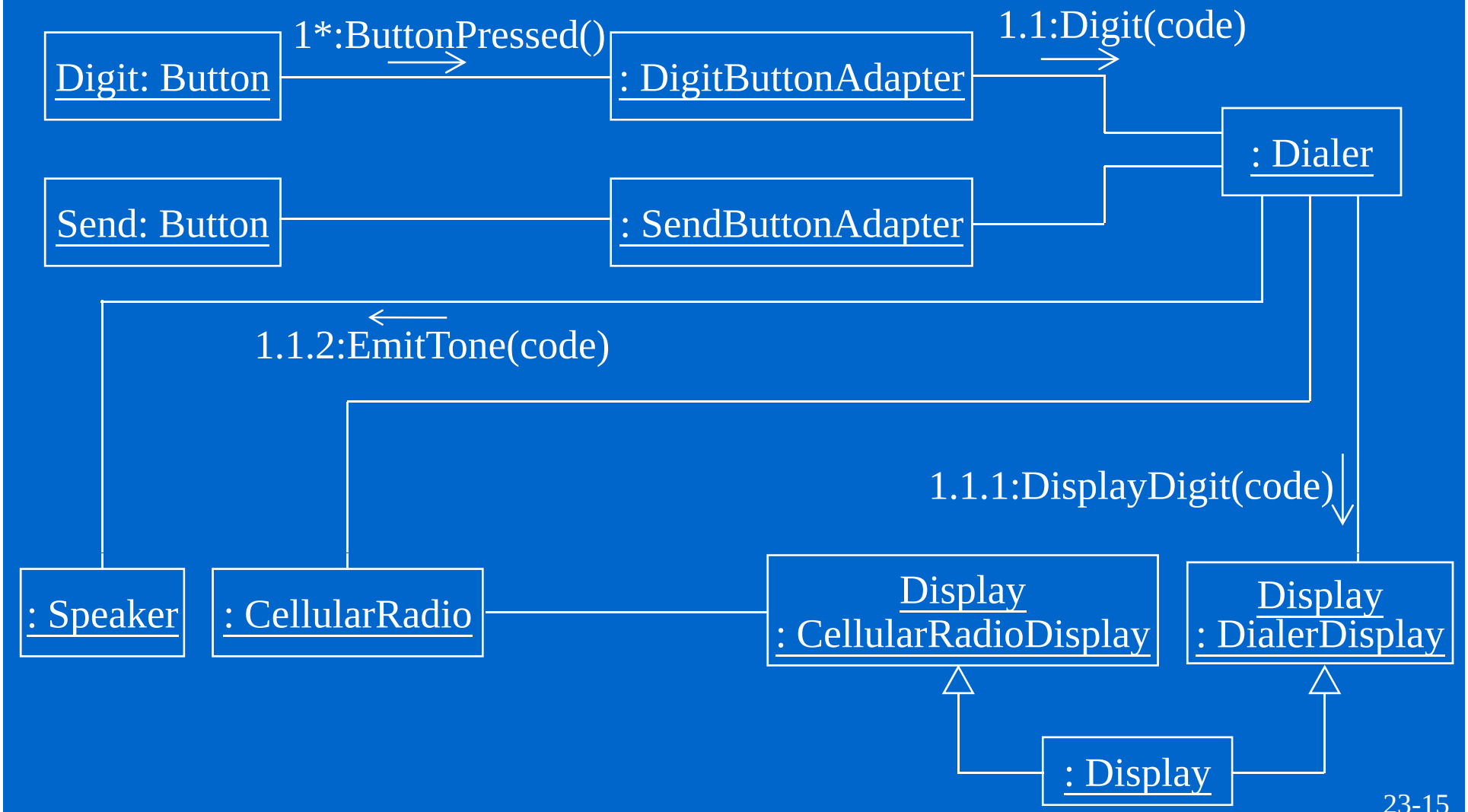

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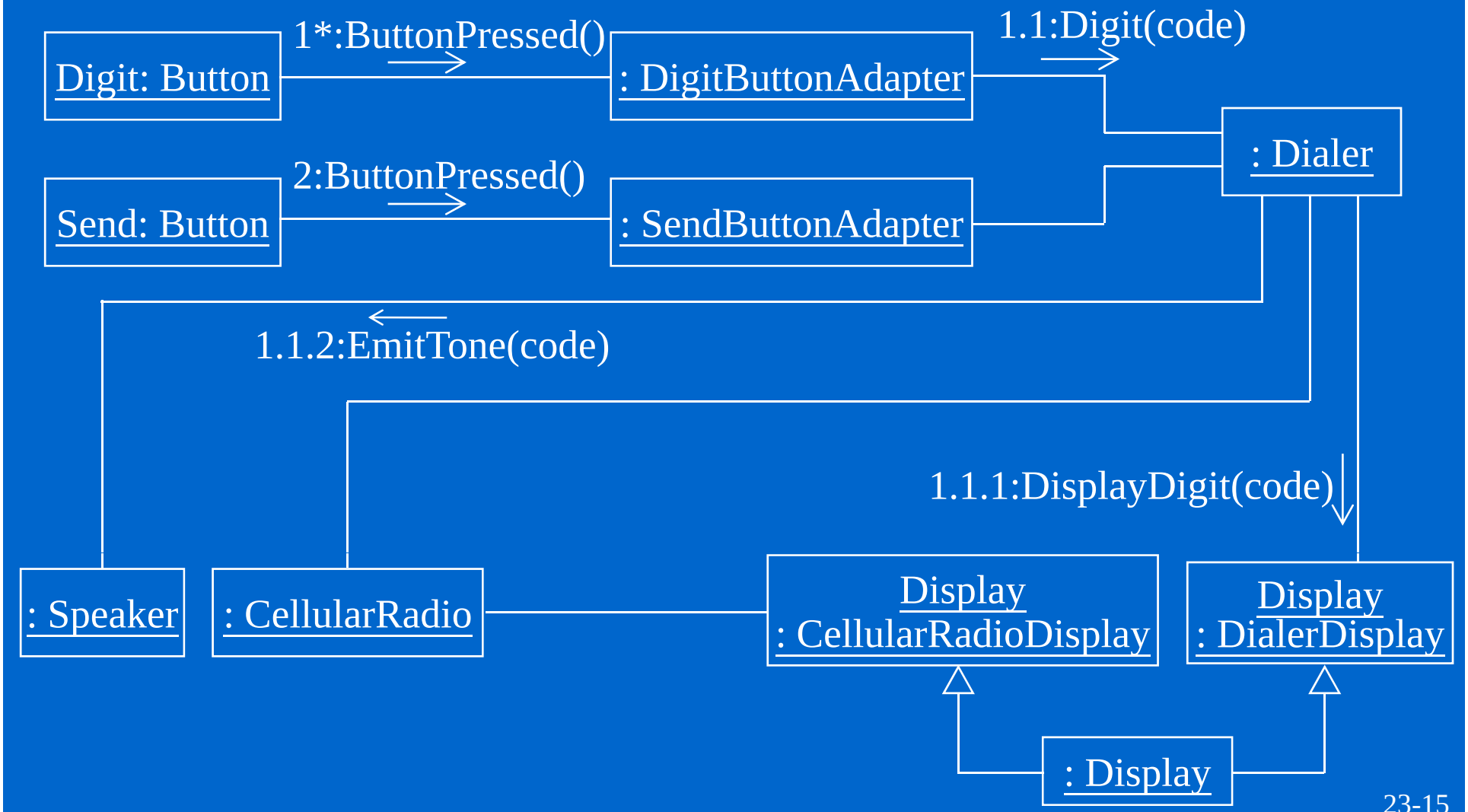

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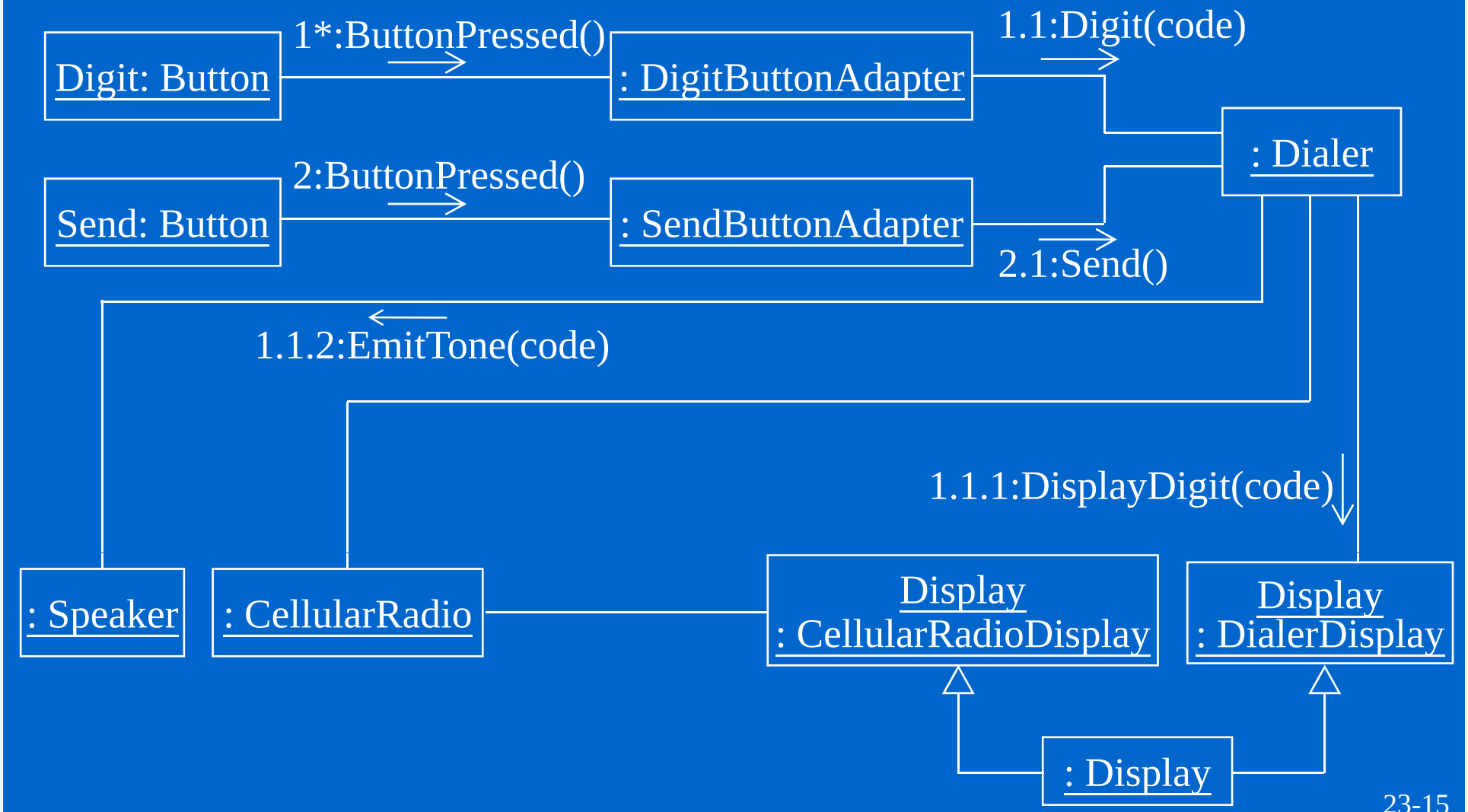

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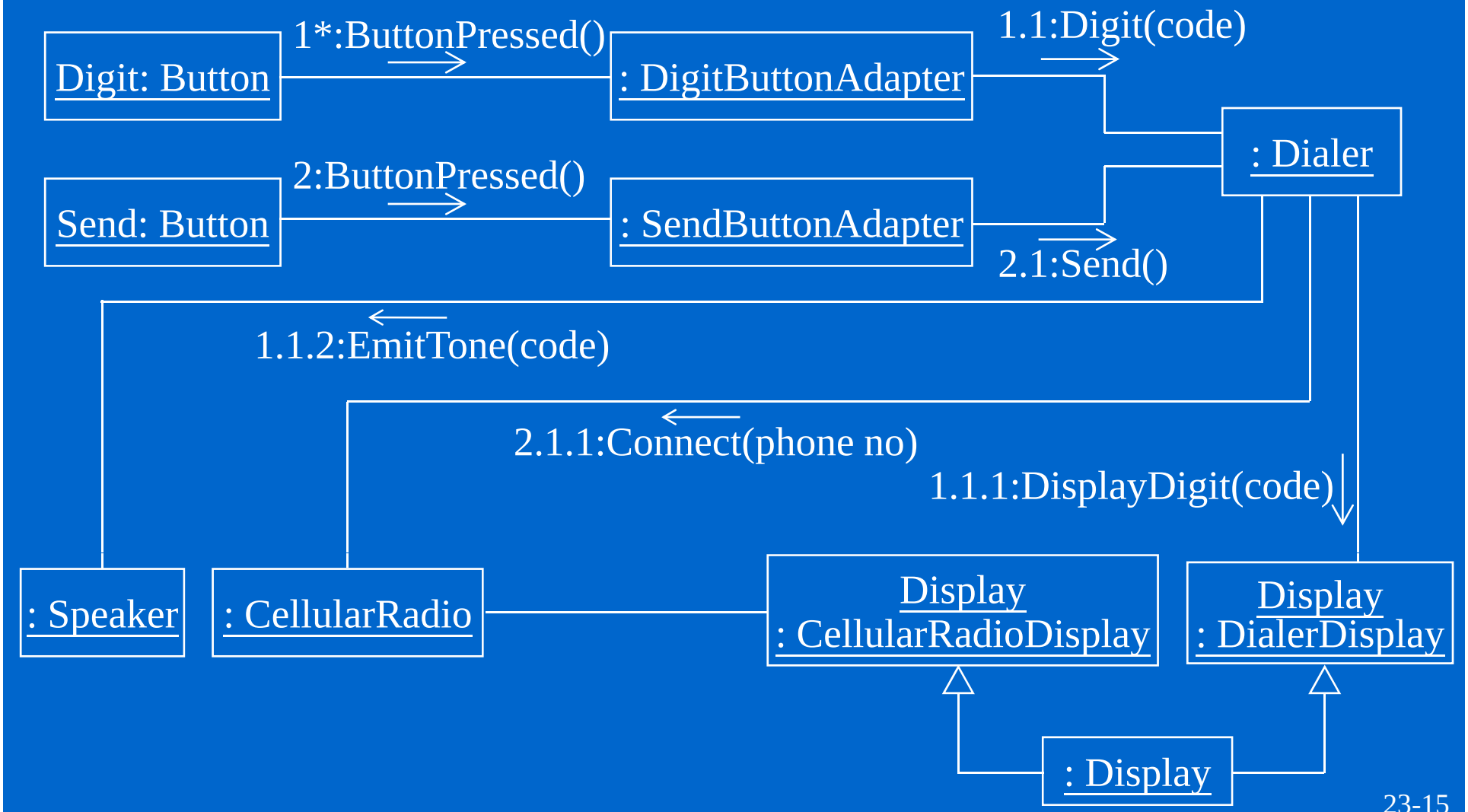

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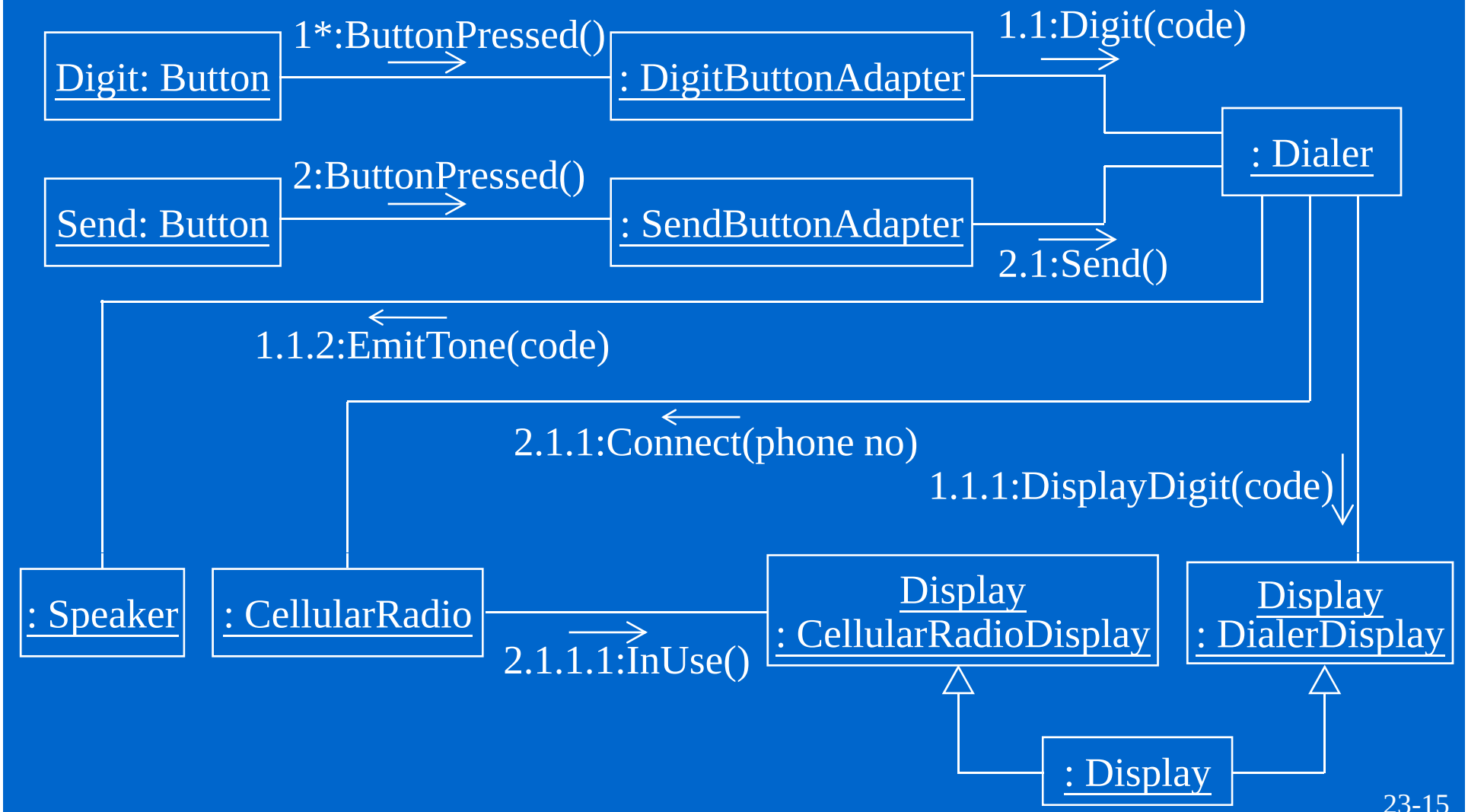

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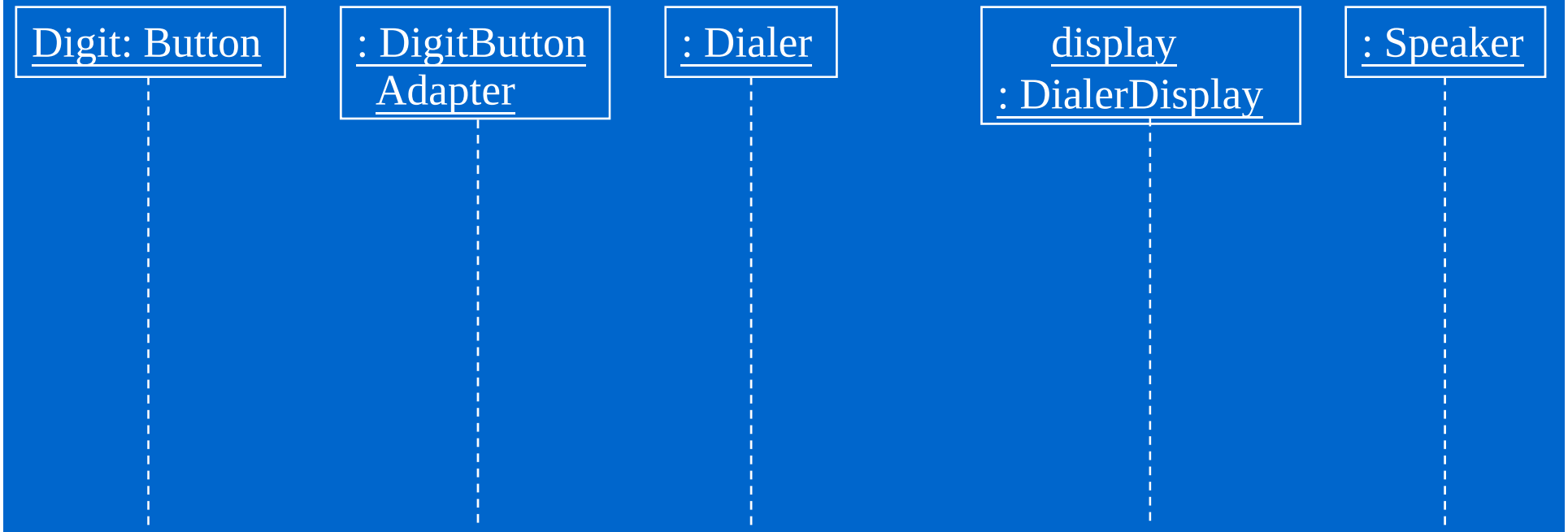

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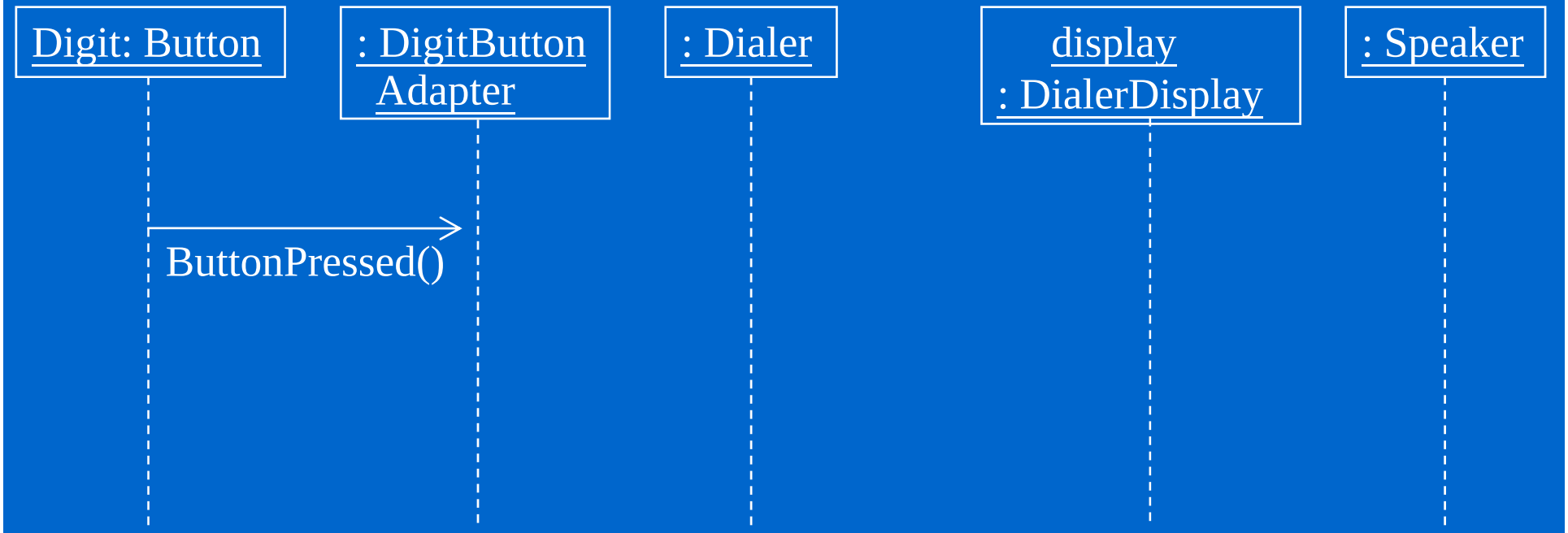

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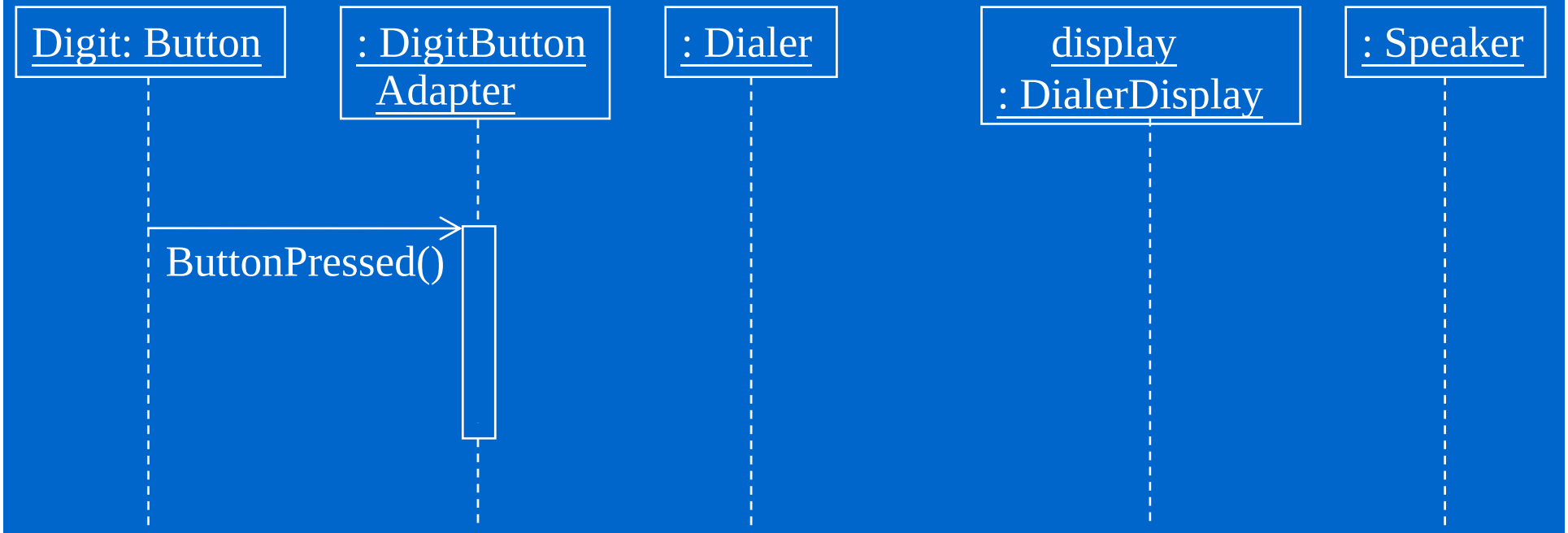

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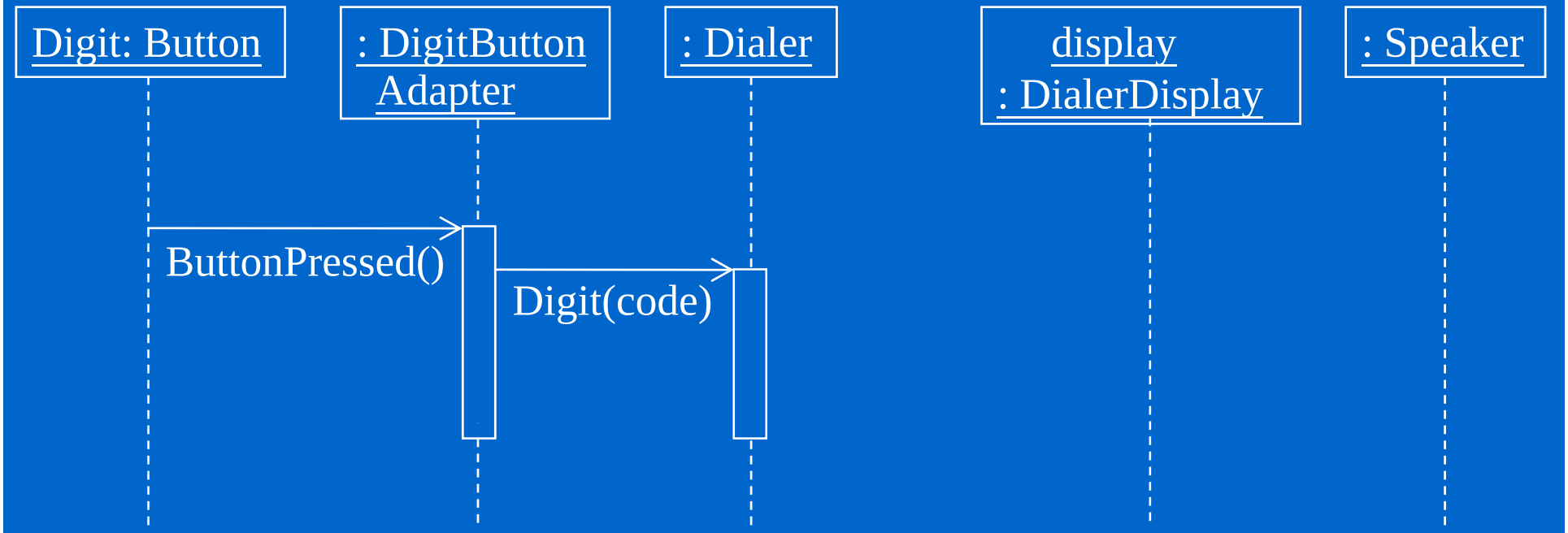

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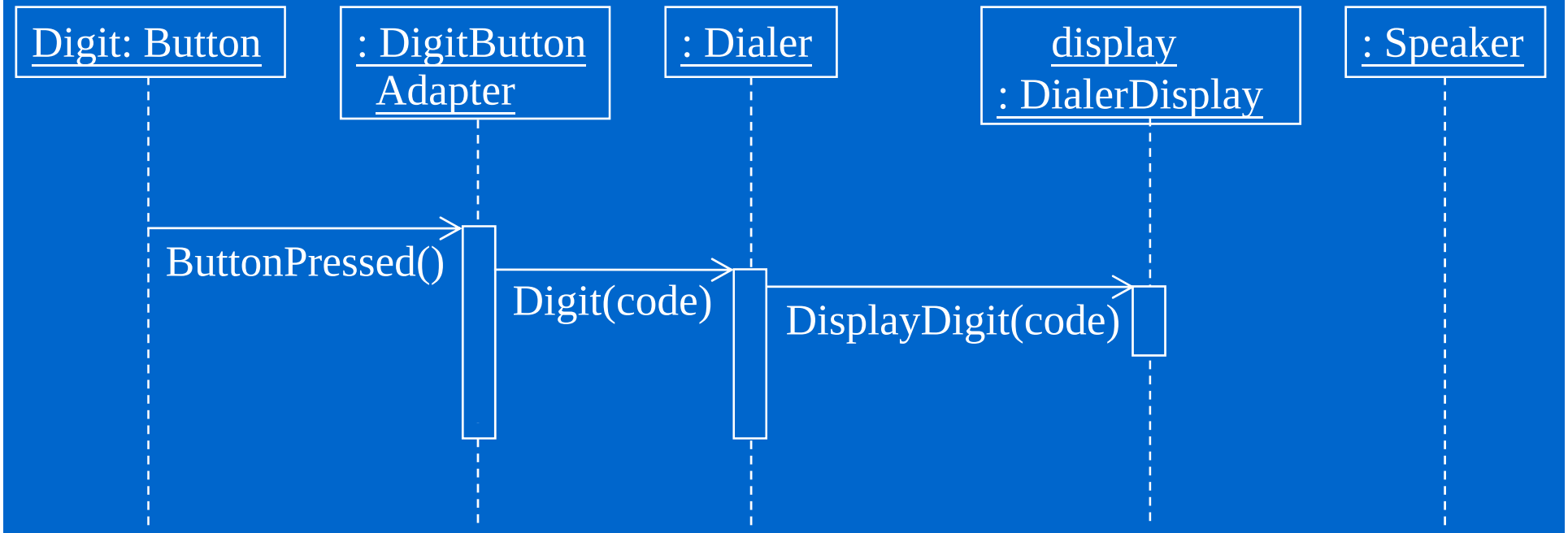

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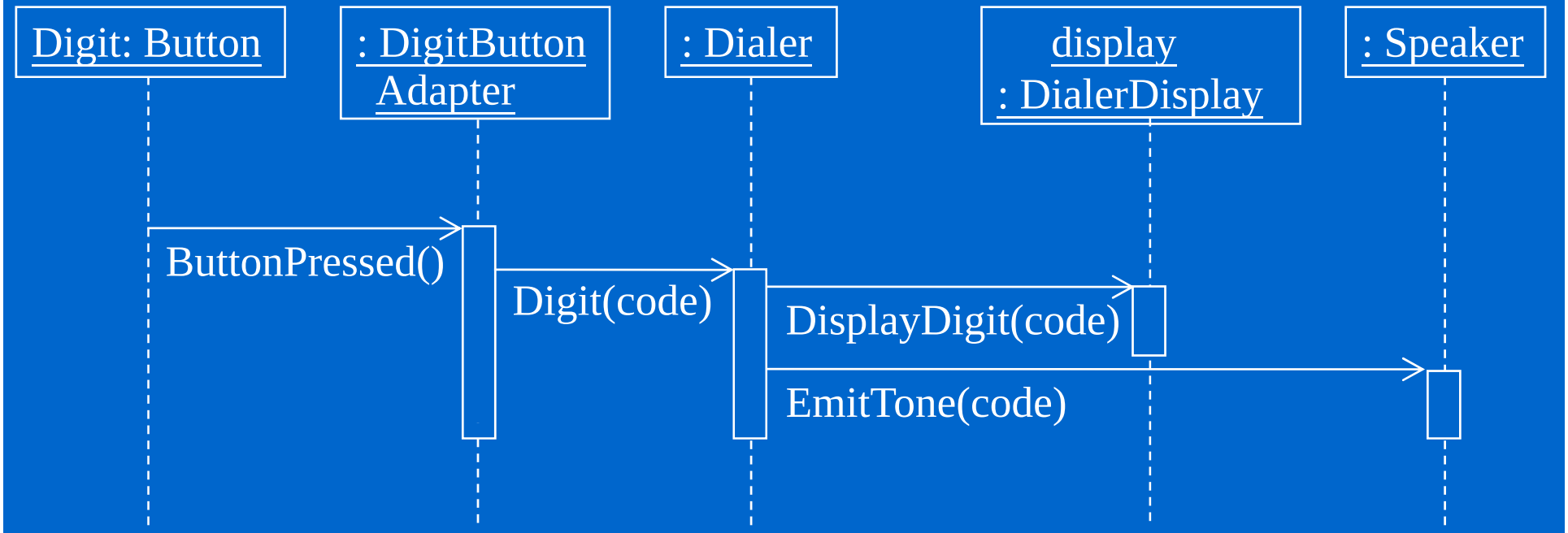

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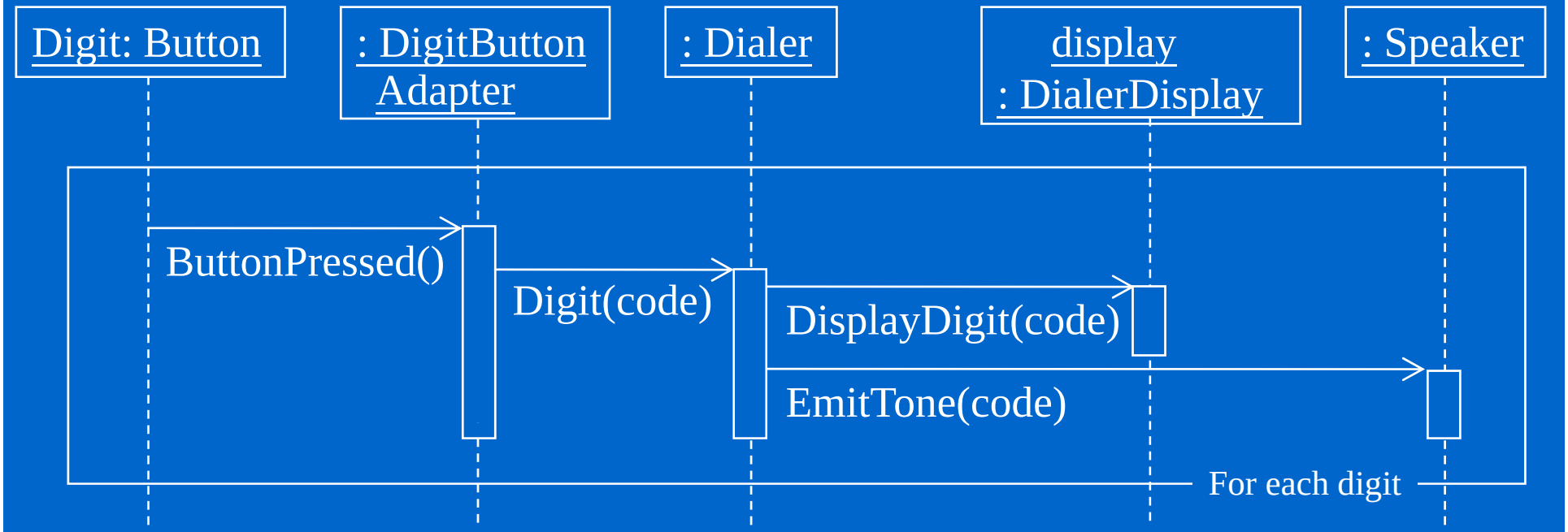

- **lifeline**
- **message**
- **iteration/looping condition**
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Sequence Diagram (cont'd)

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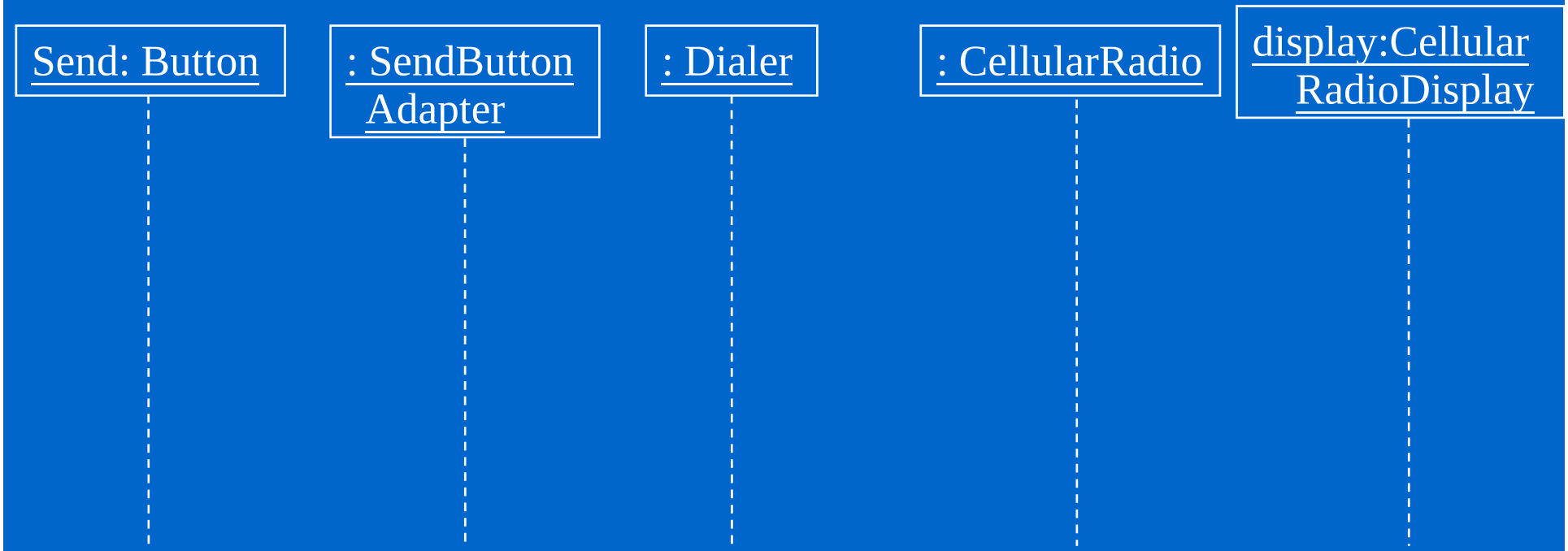

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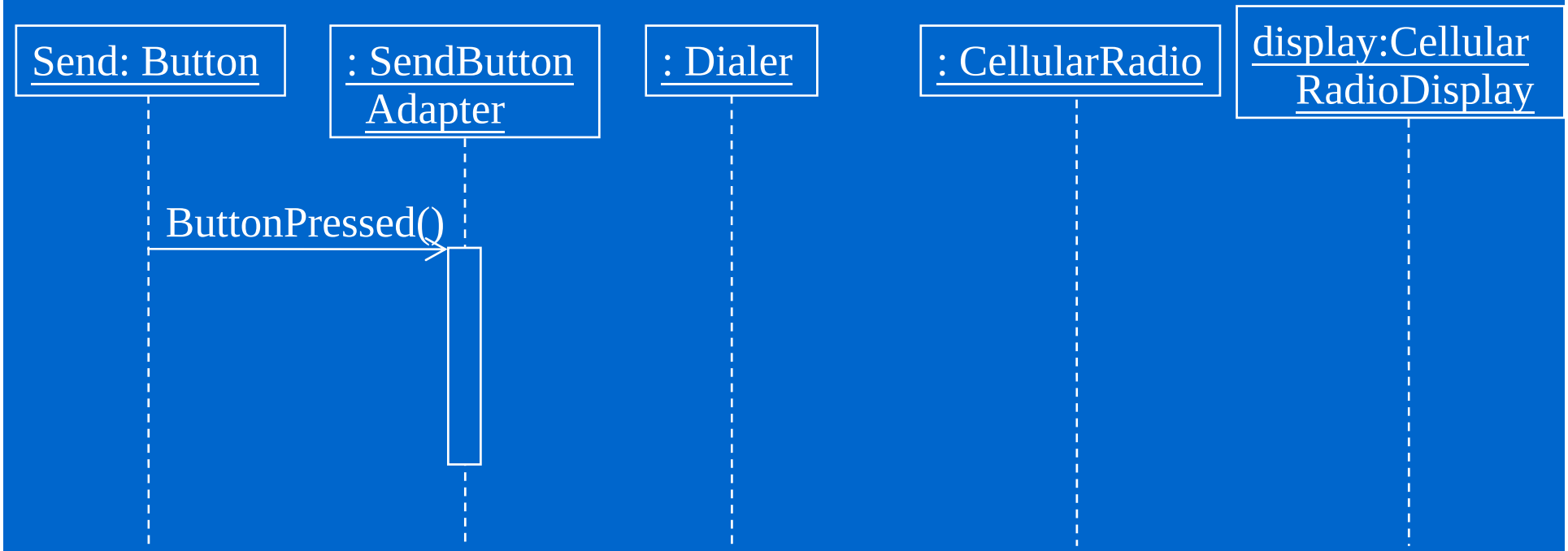

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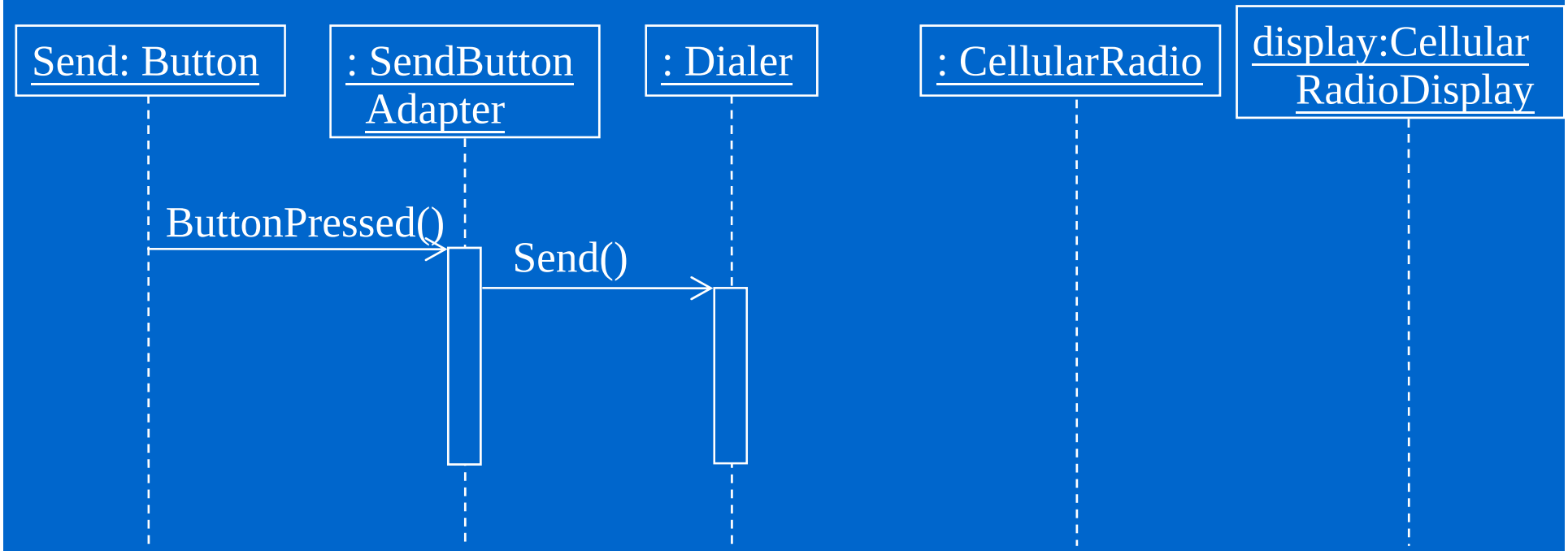

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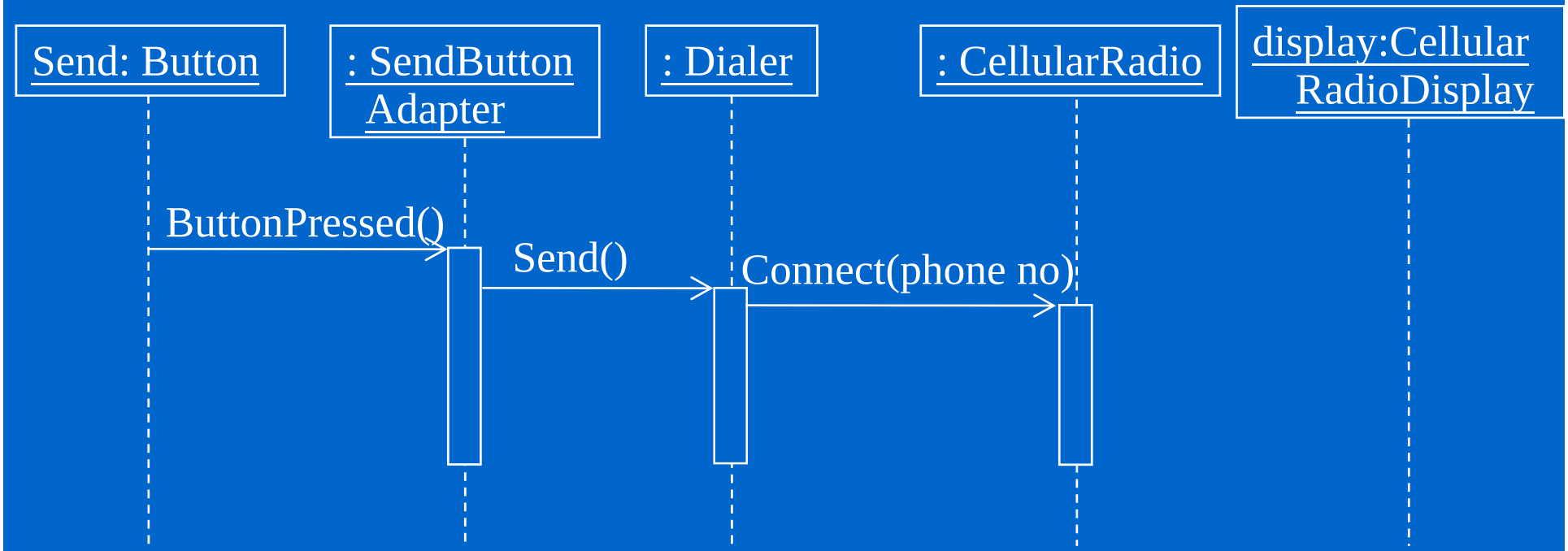

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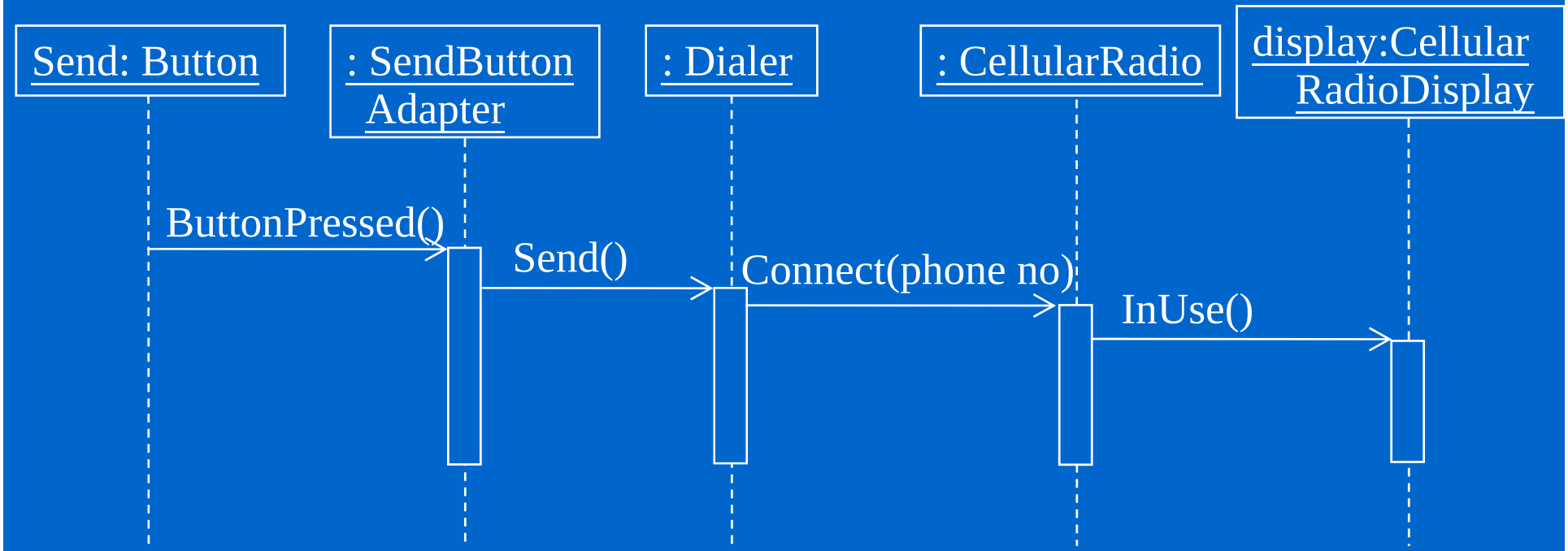

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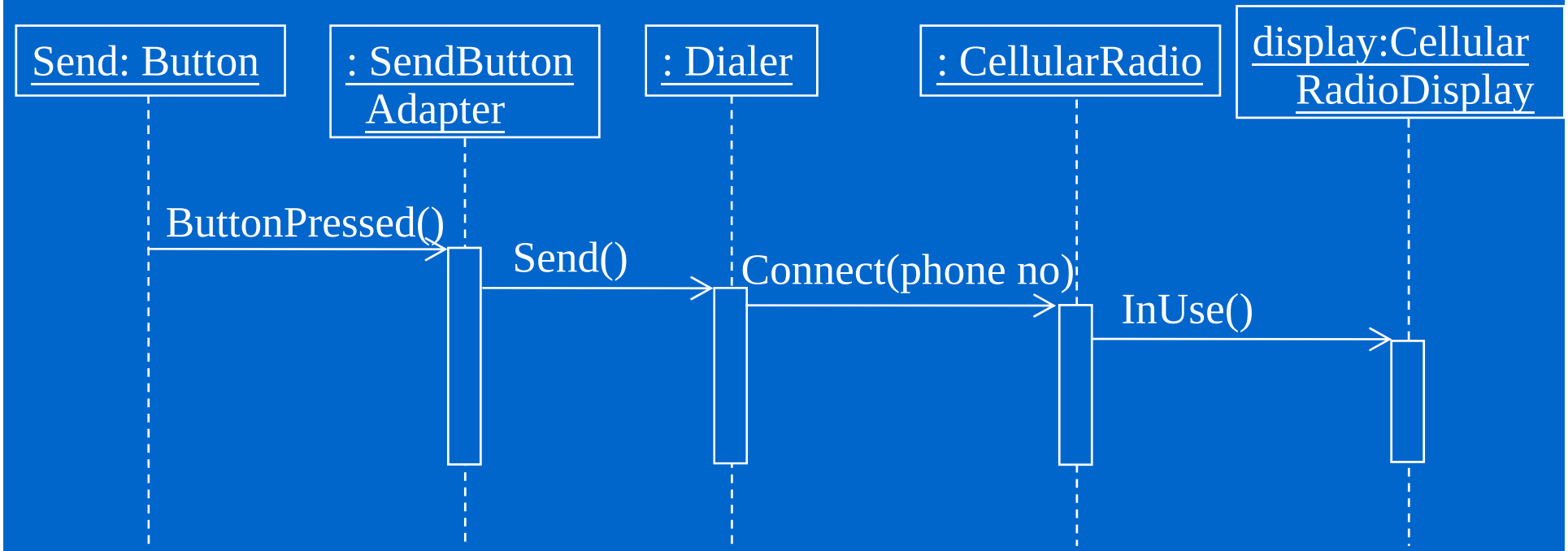

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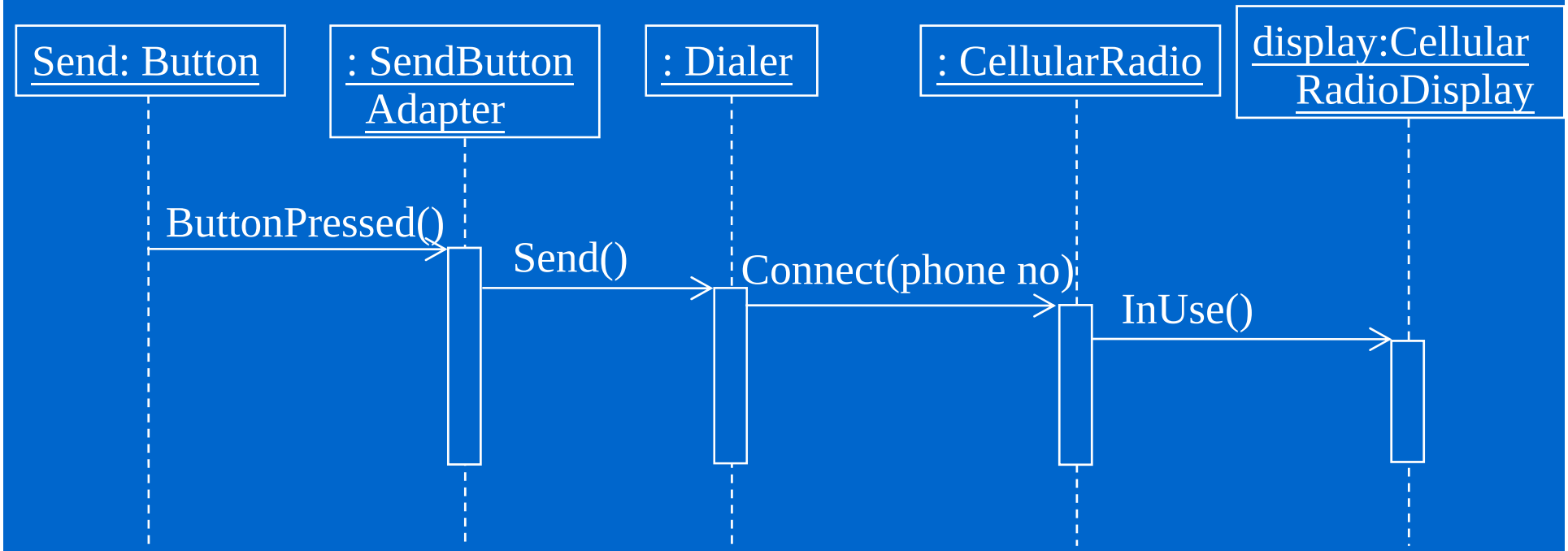

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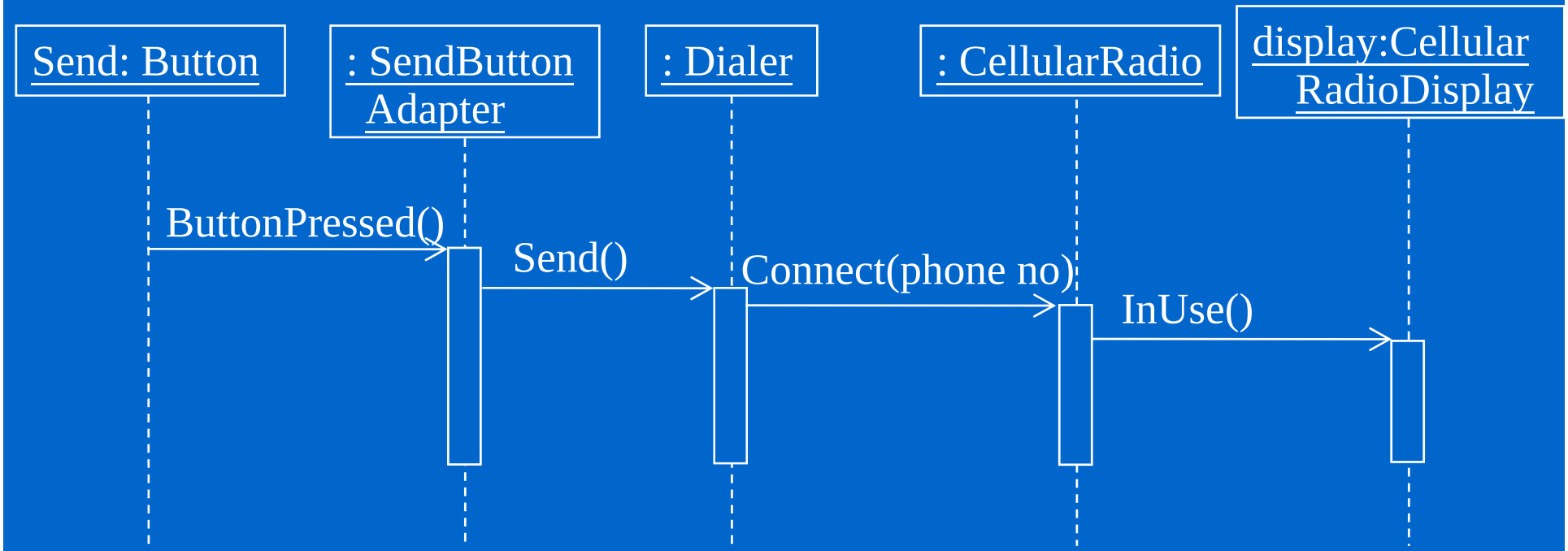

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- Collaboration diagram shows the whole collaboration of objects in a single dense diagram but somewhat obscures the algorithm.

Creation and Deletion of Objects

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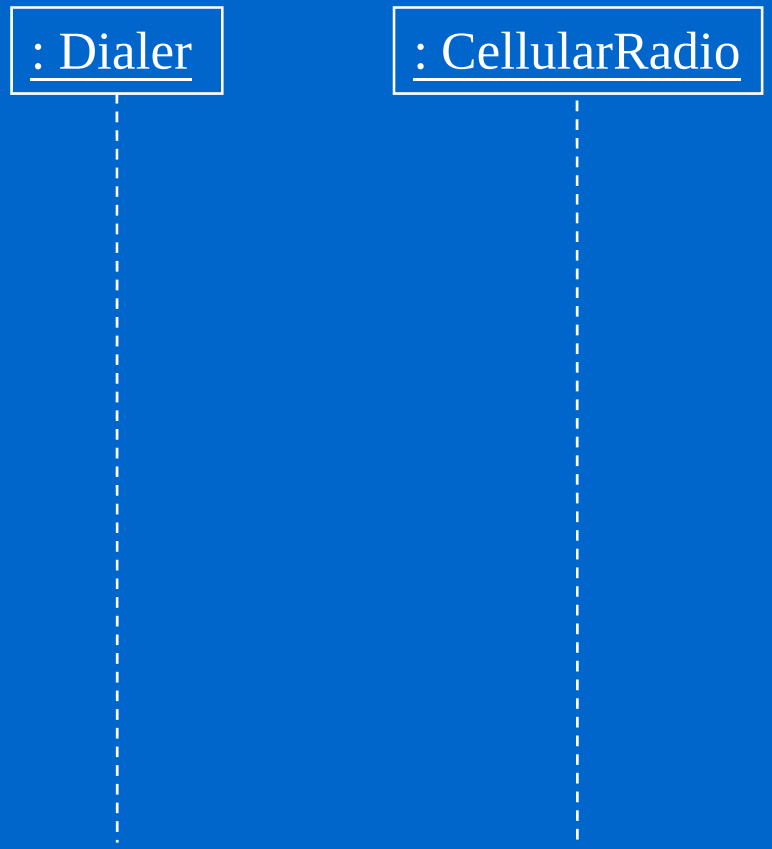

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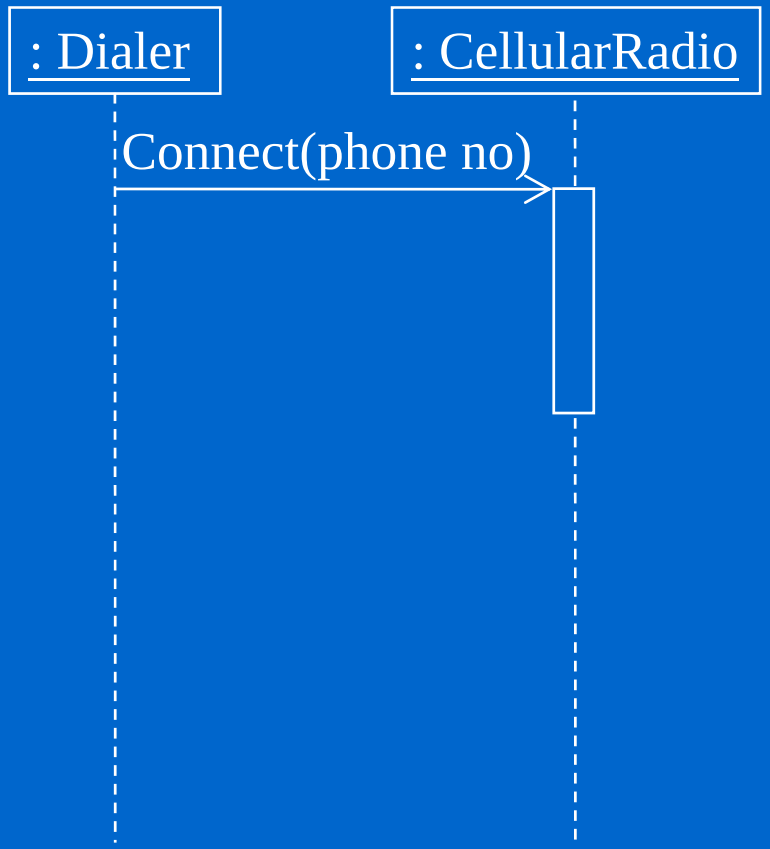

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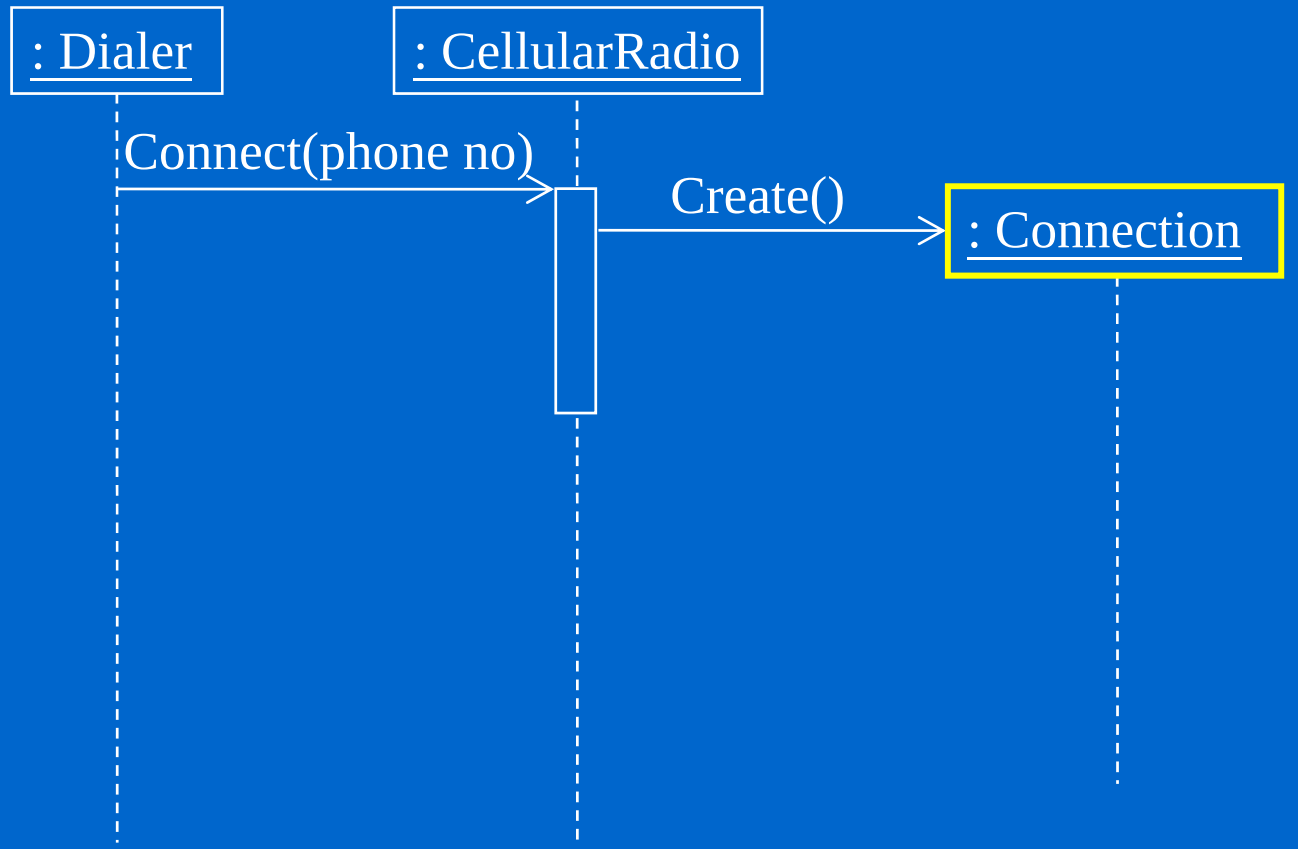

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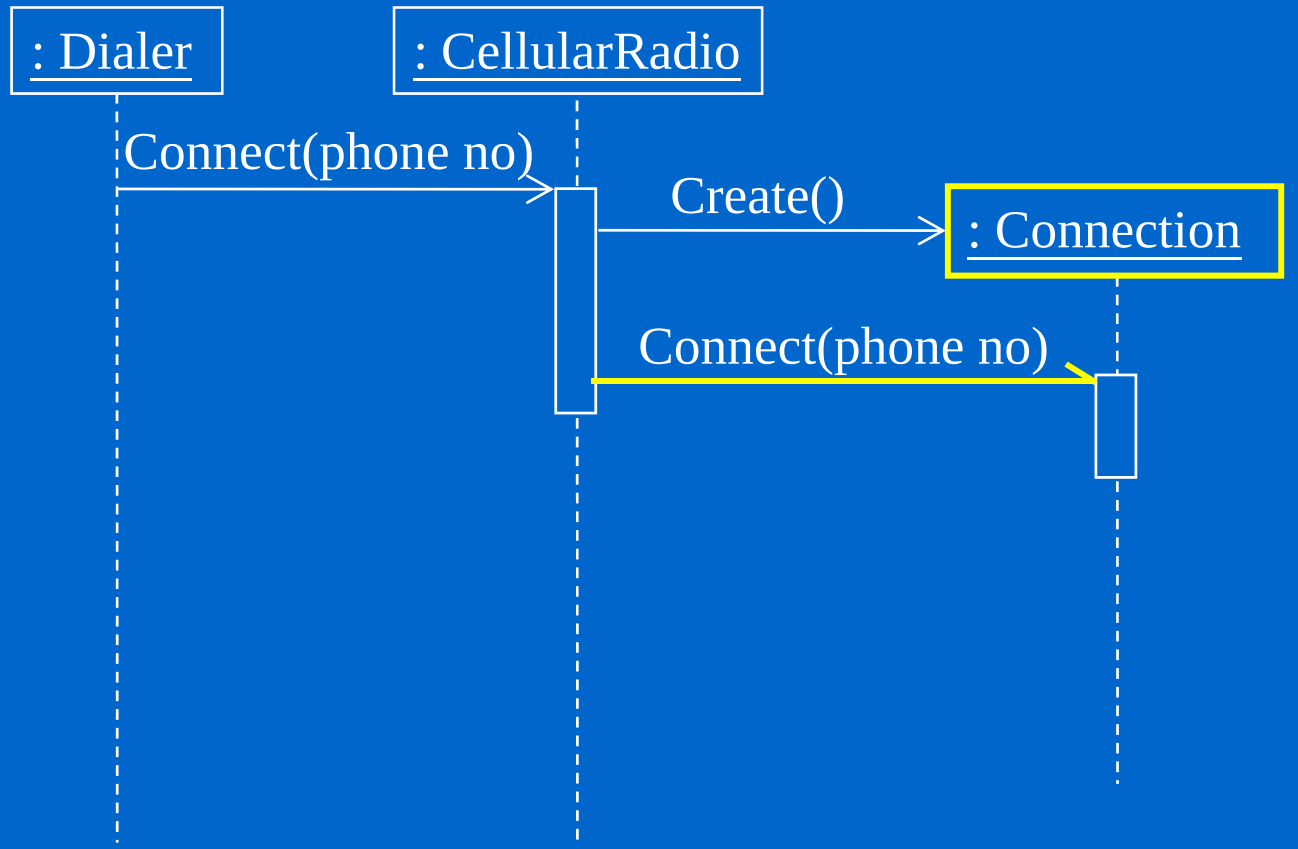

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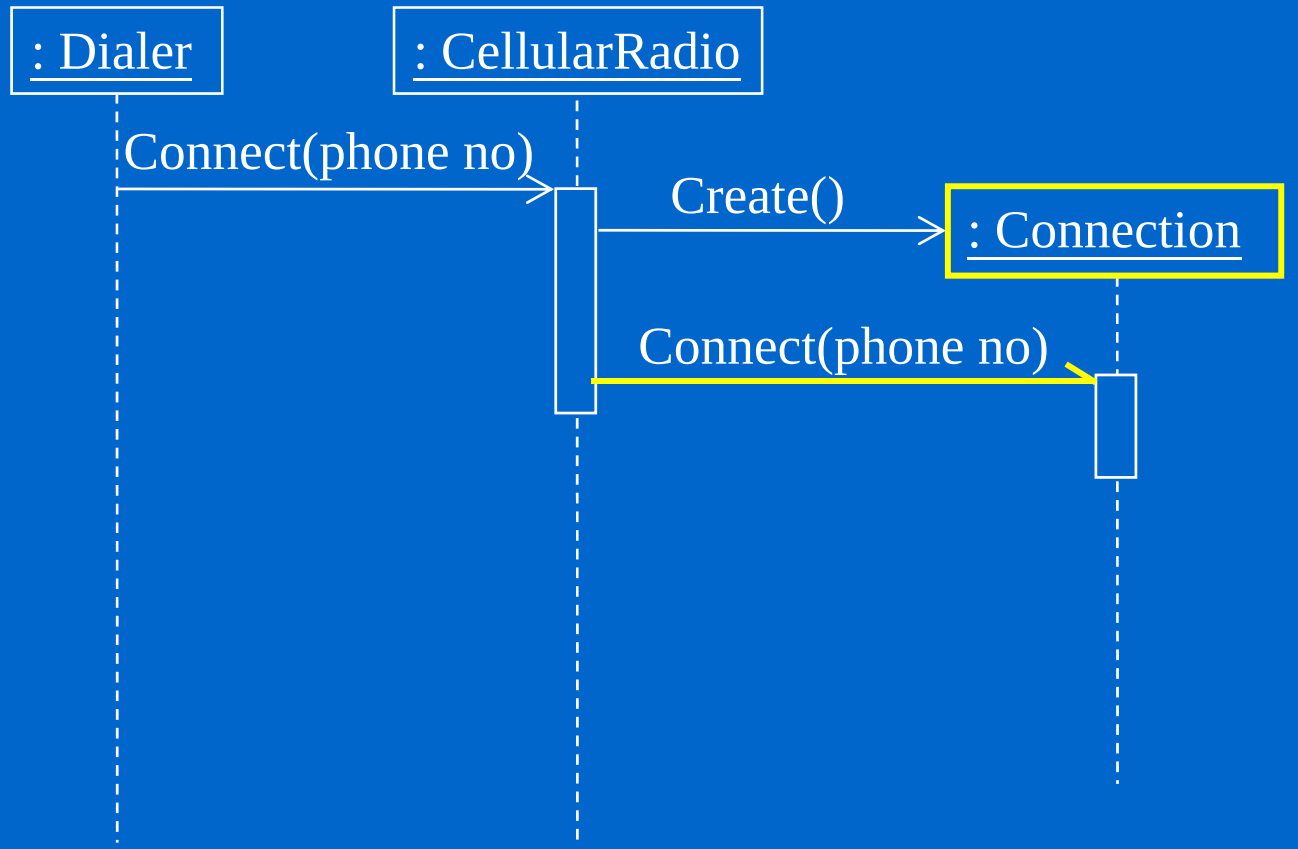

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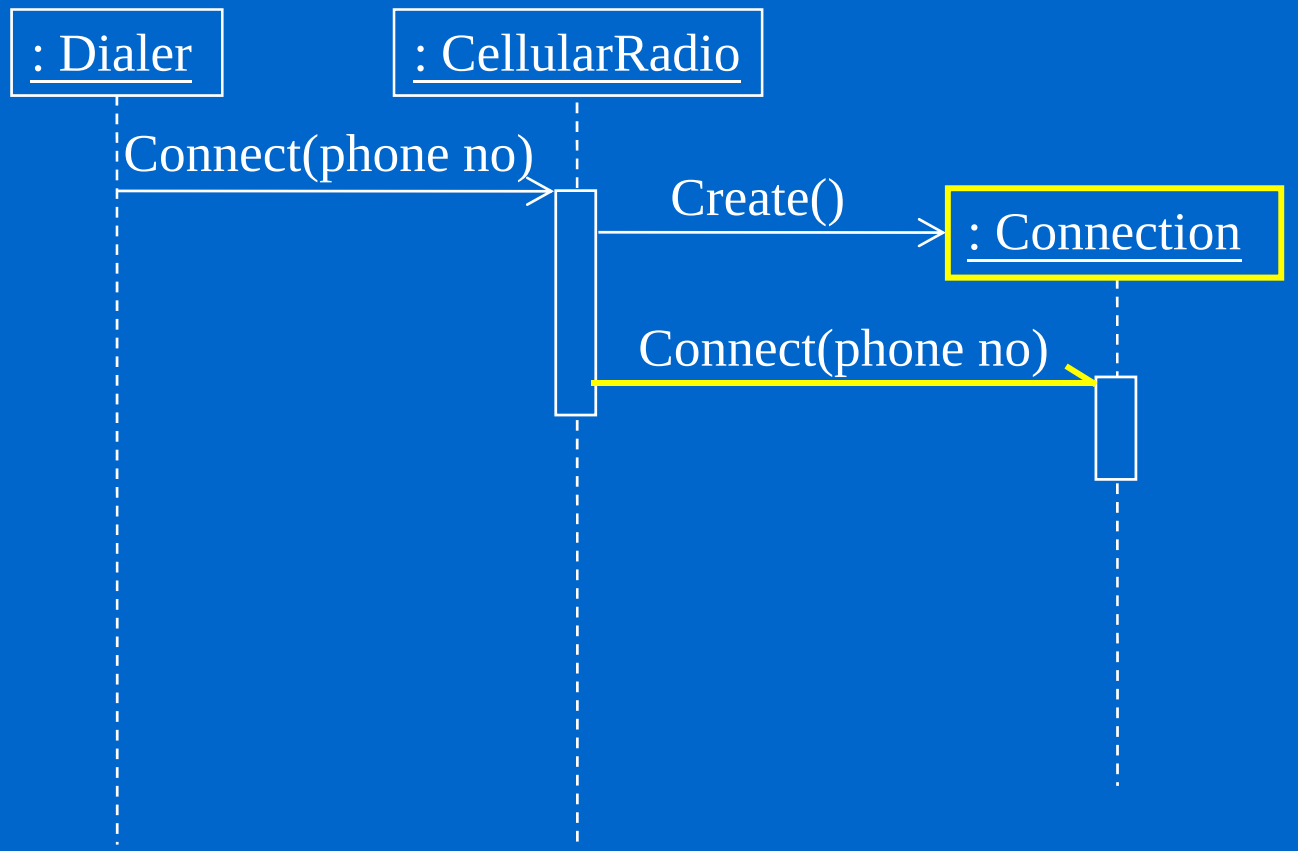

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- An asynchronous message is a message that returns immediately while the receiving object receives the message and activates in a different thread

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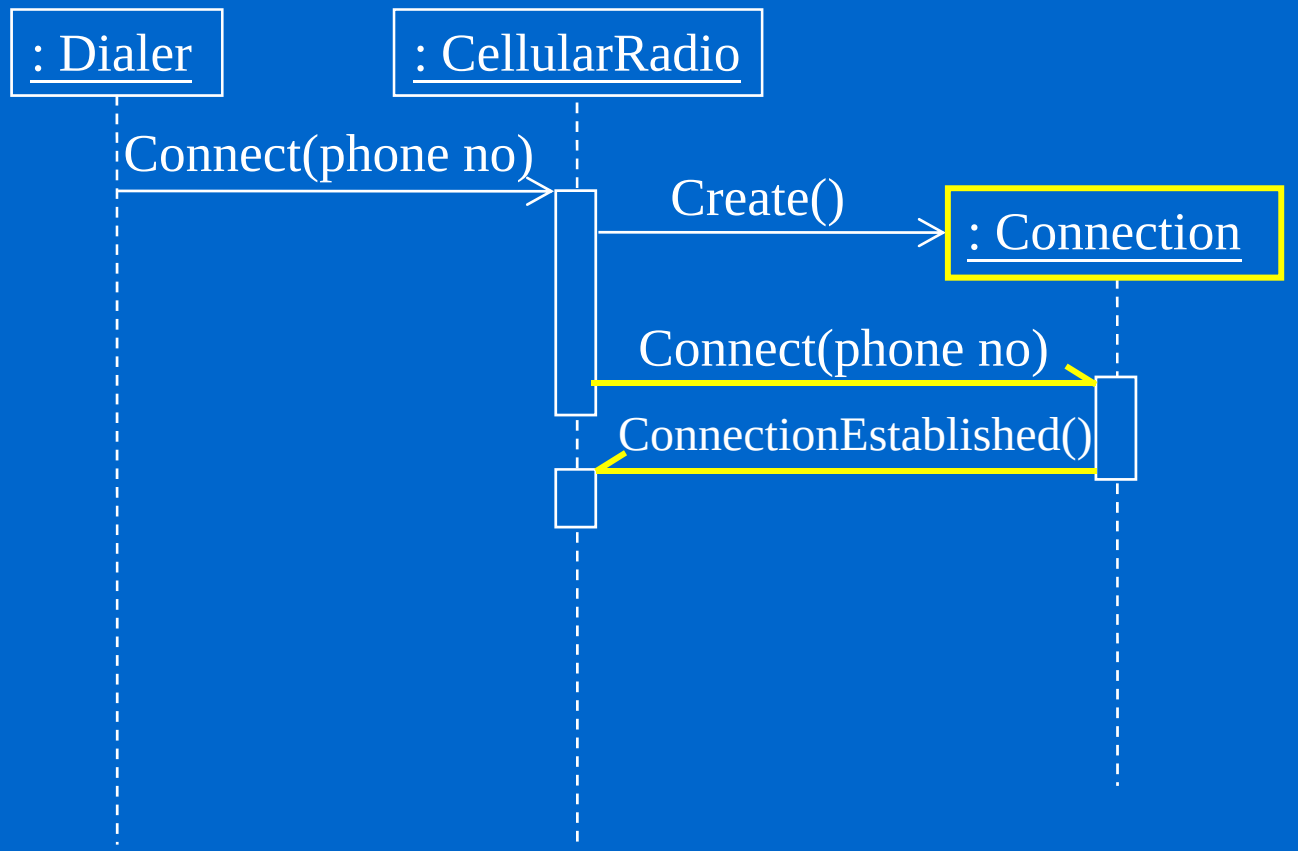

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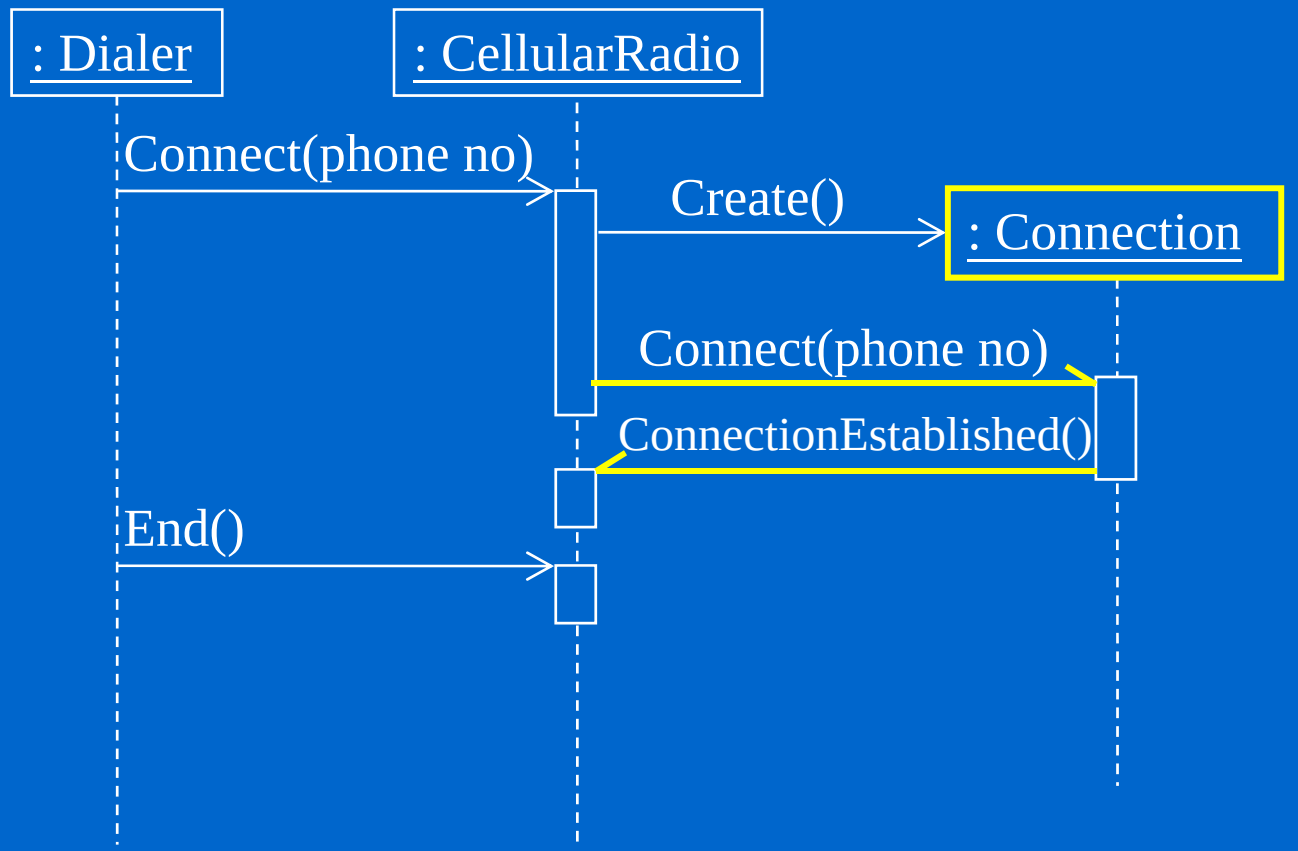

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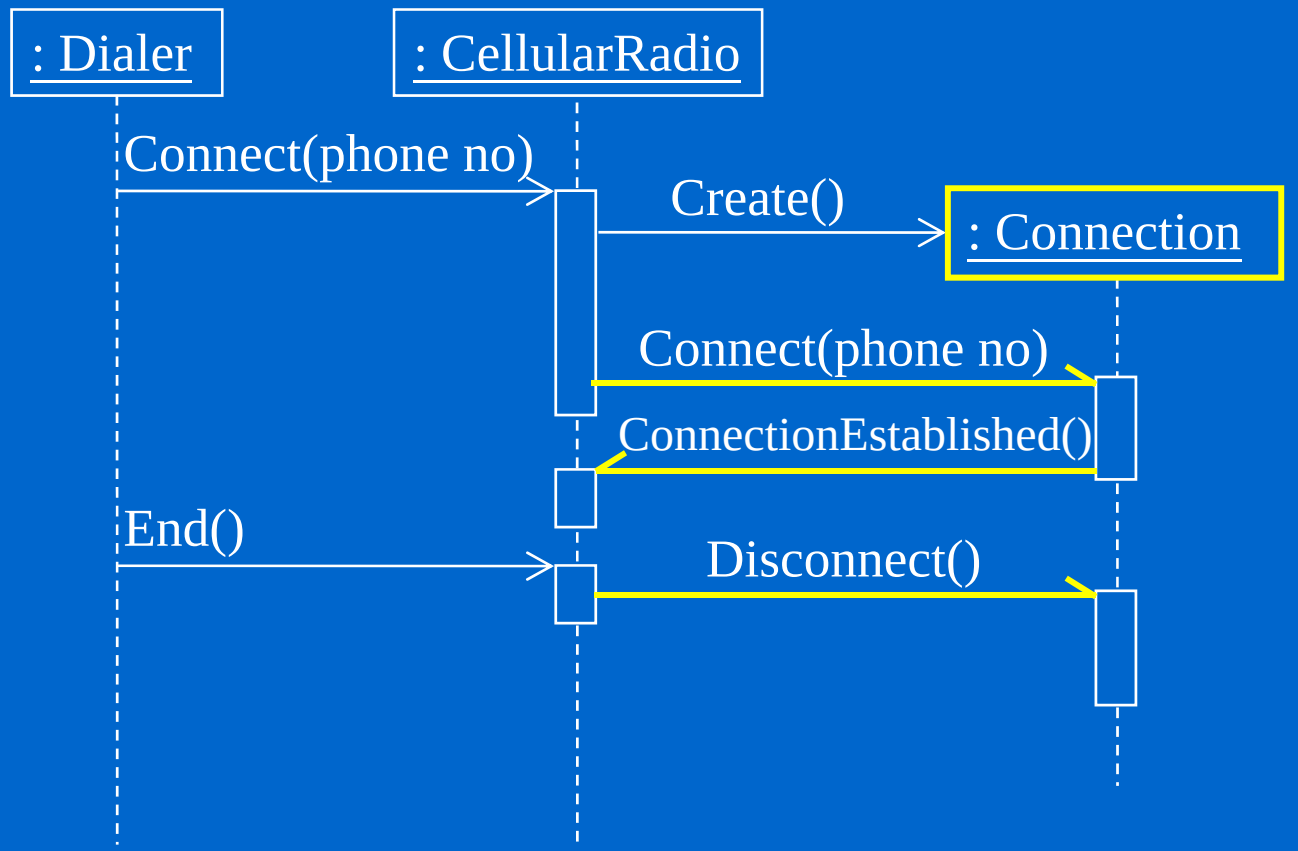

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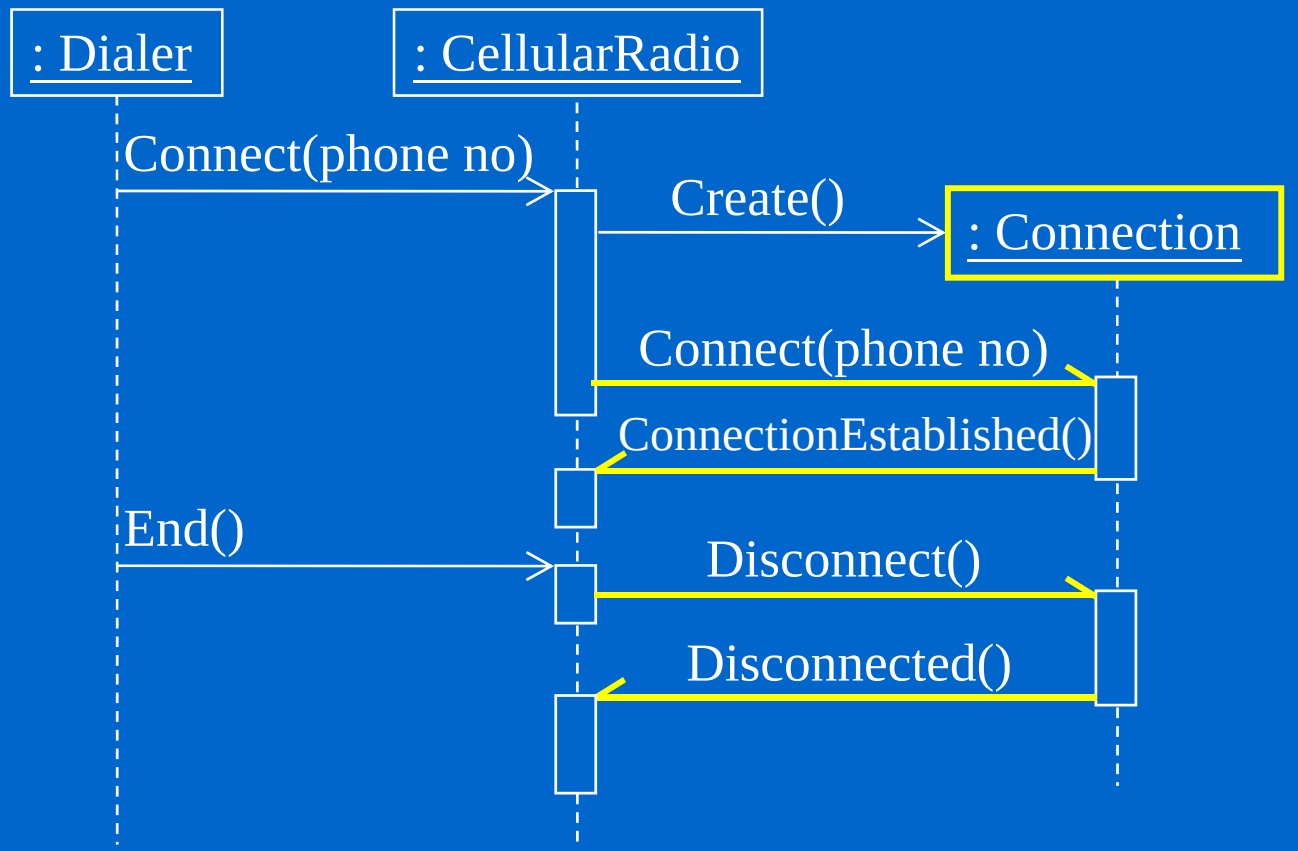

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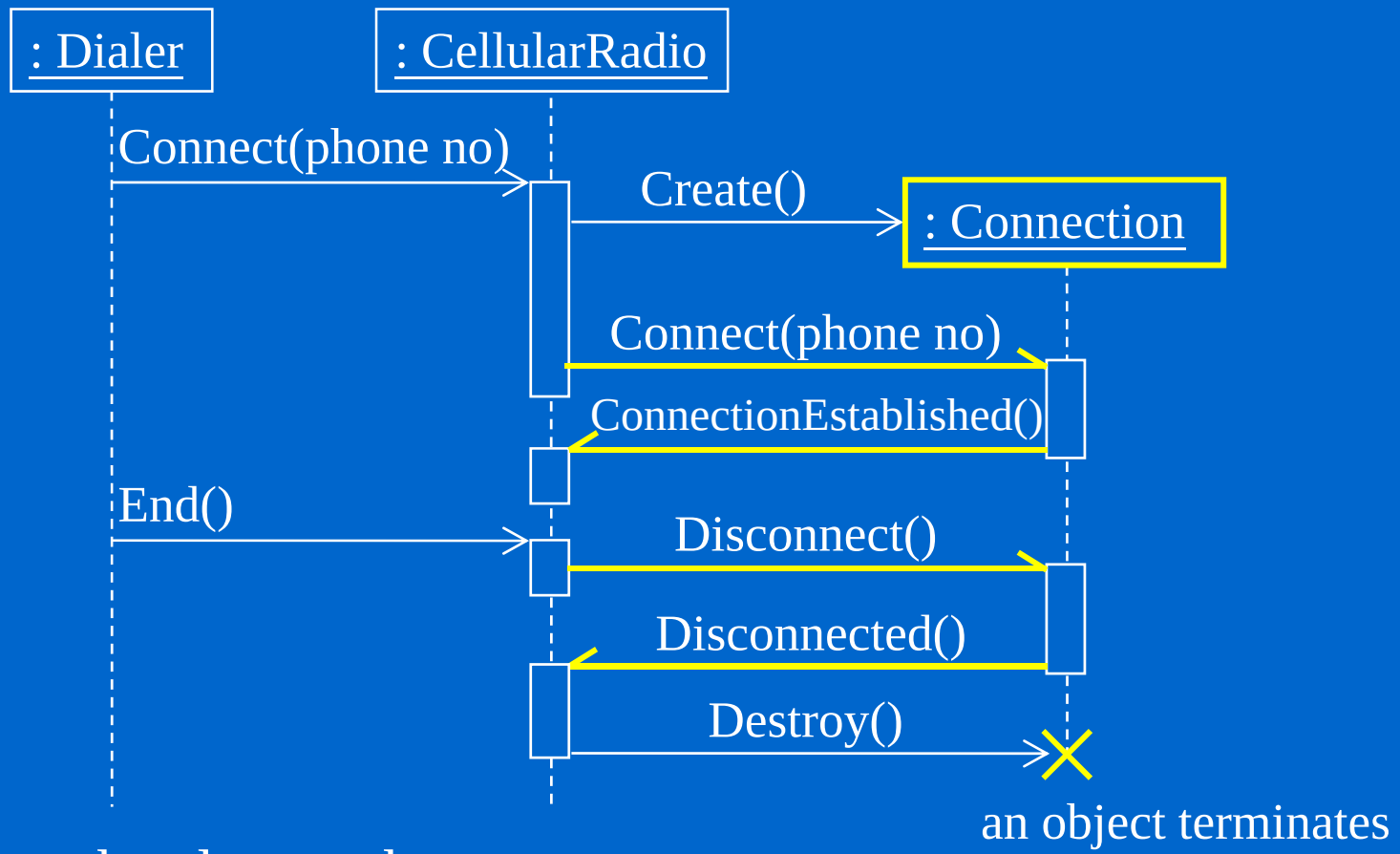

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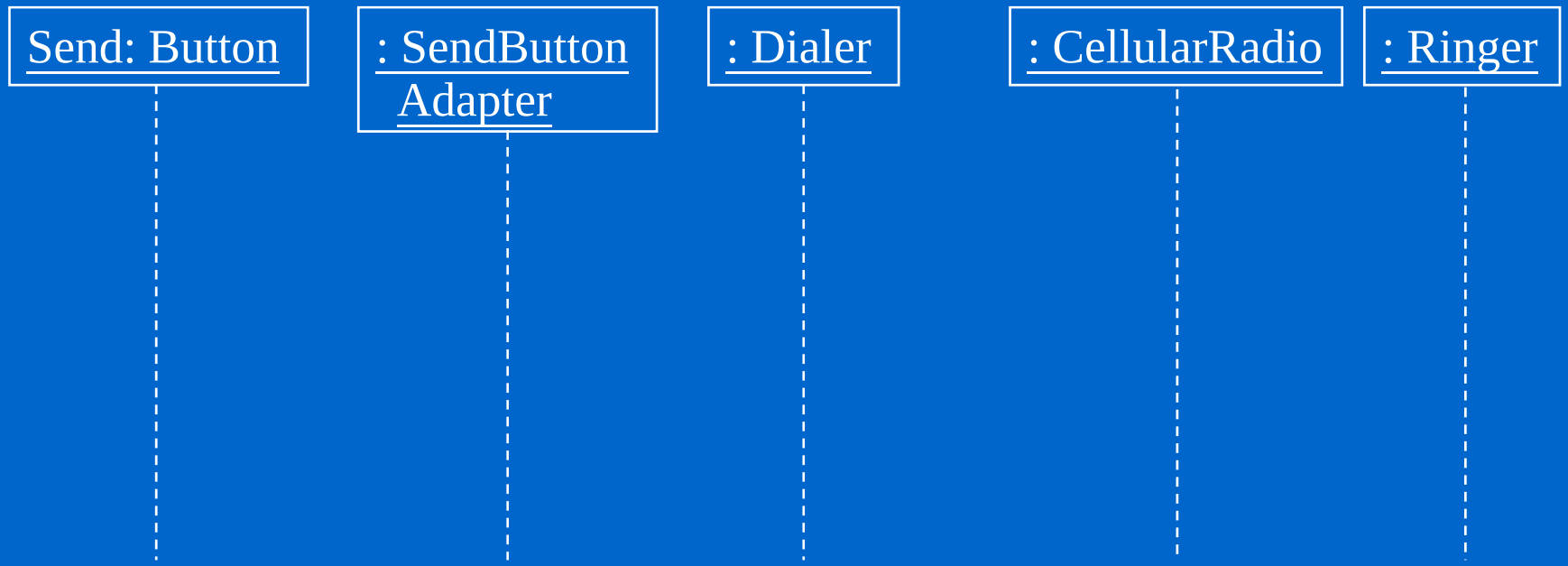

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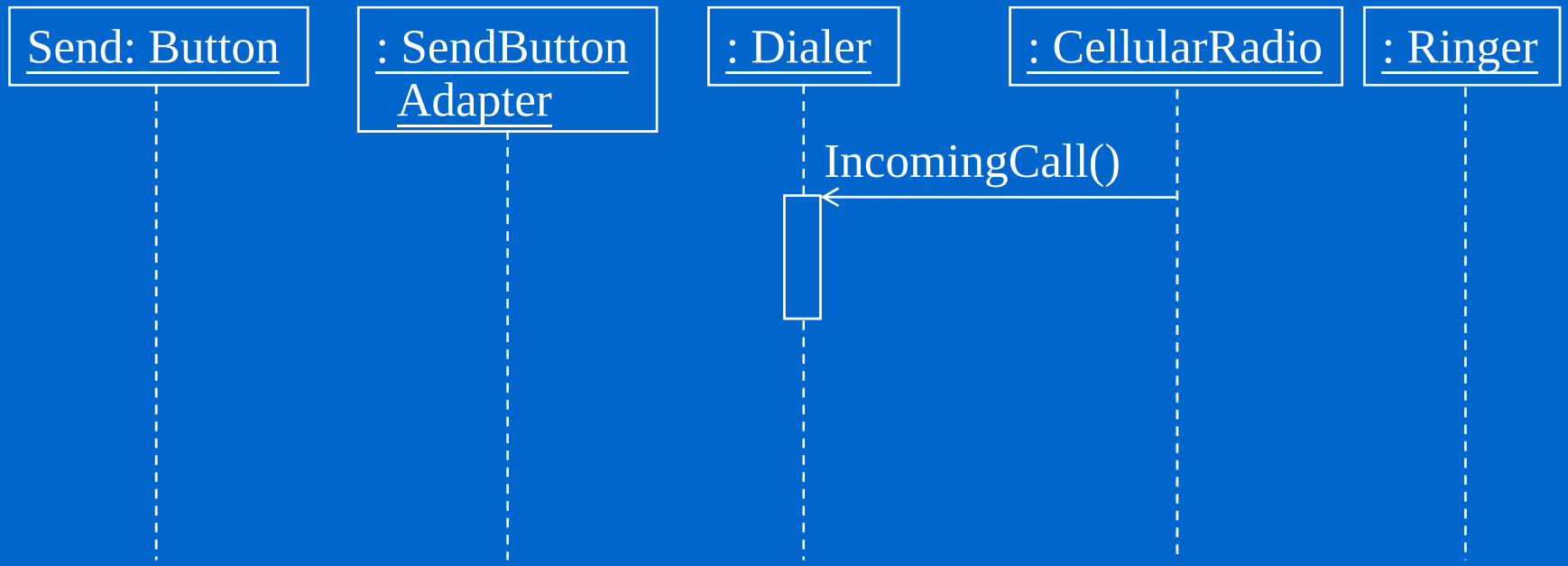

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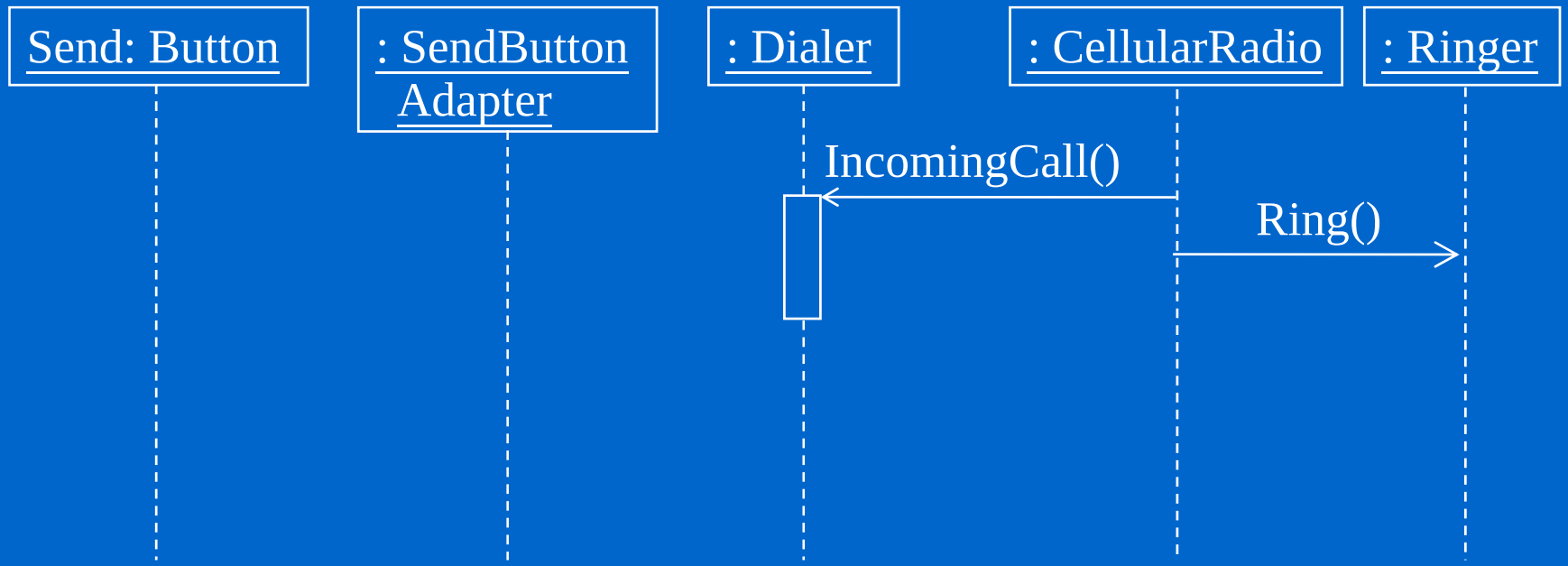

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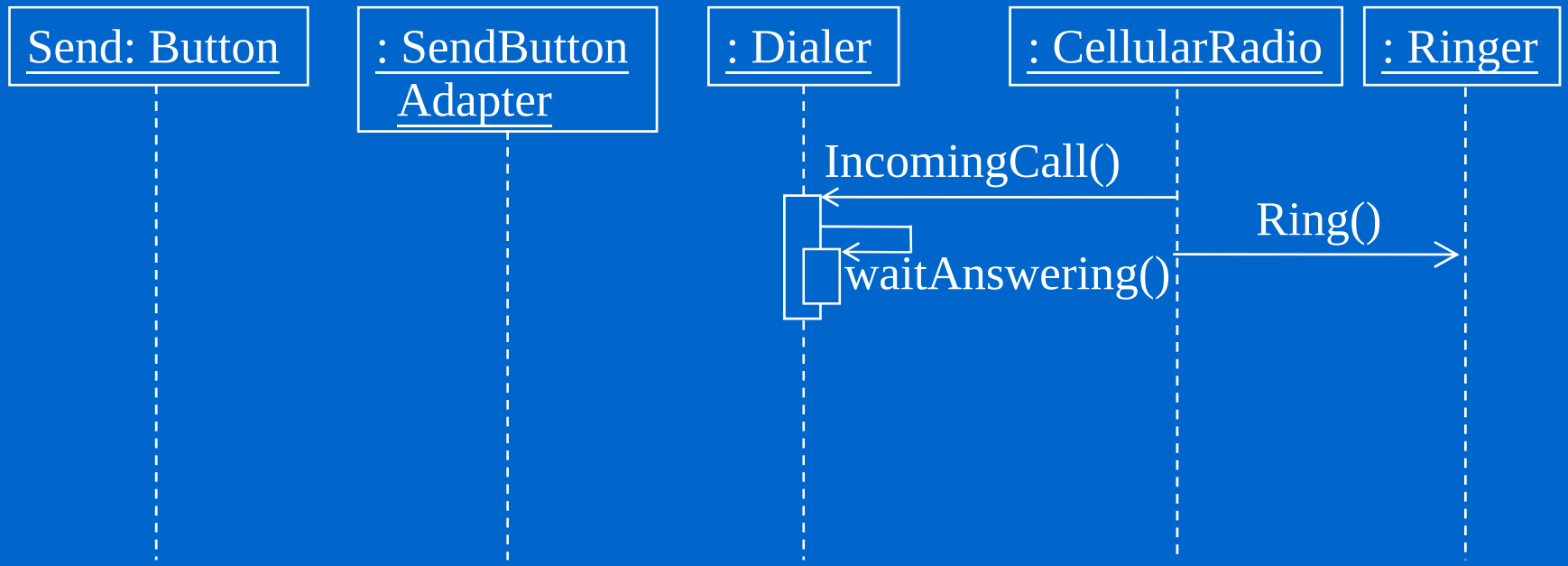

- : Dialer enters waitAnswering state after receiving IncomingCall() message.

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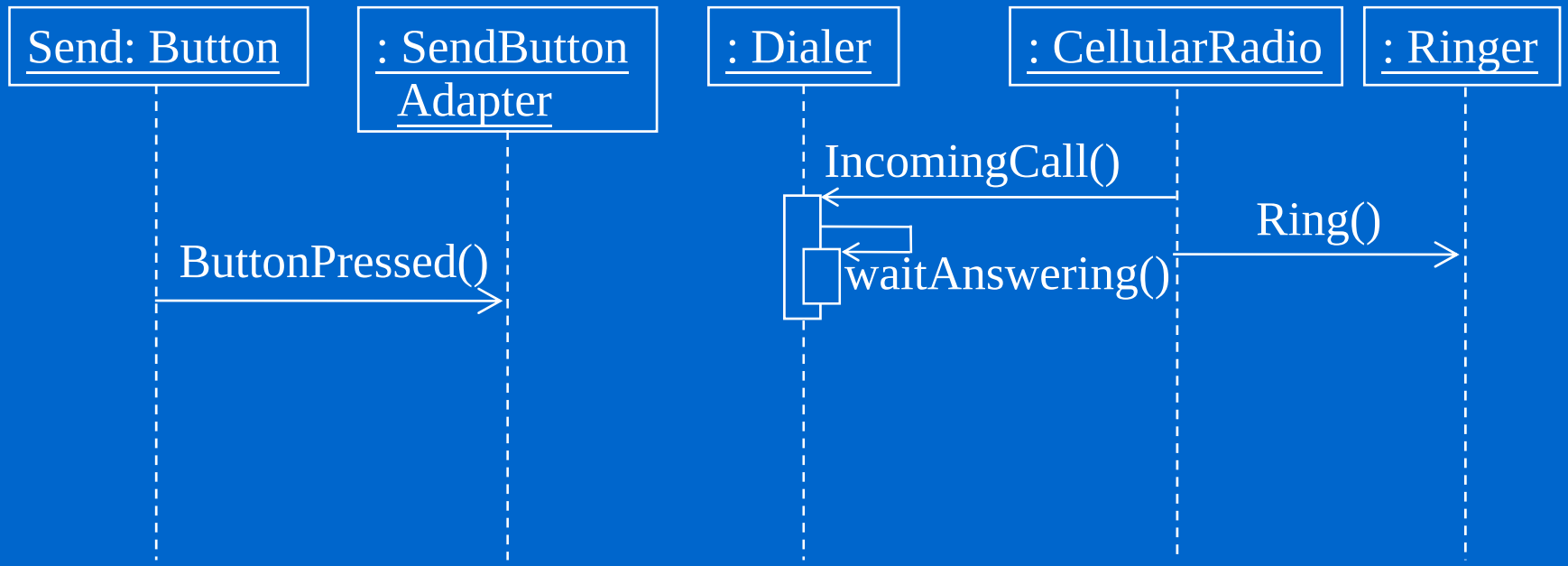

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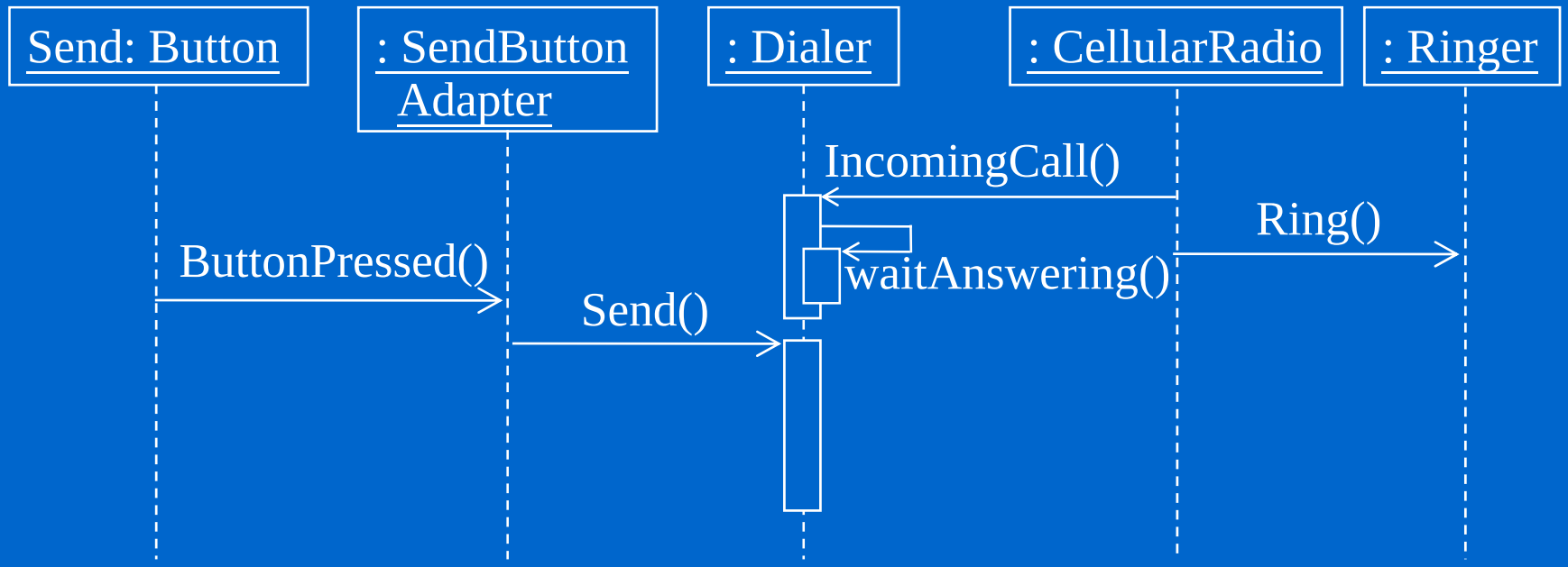

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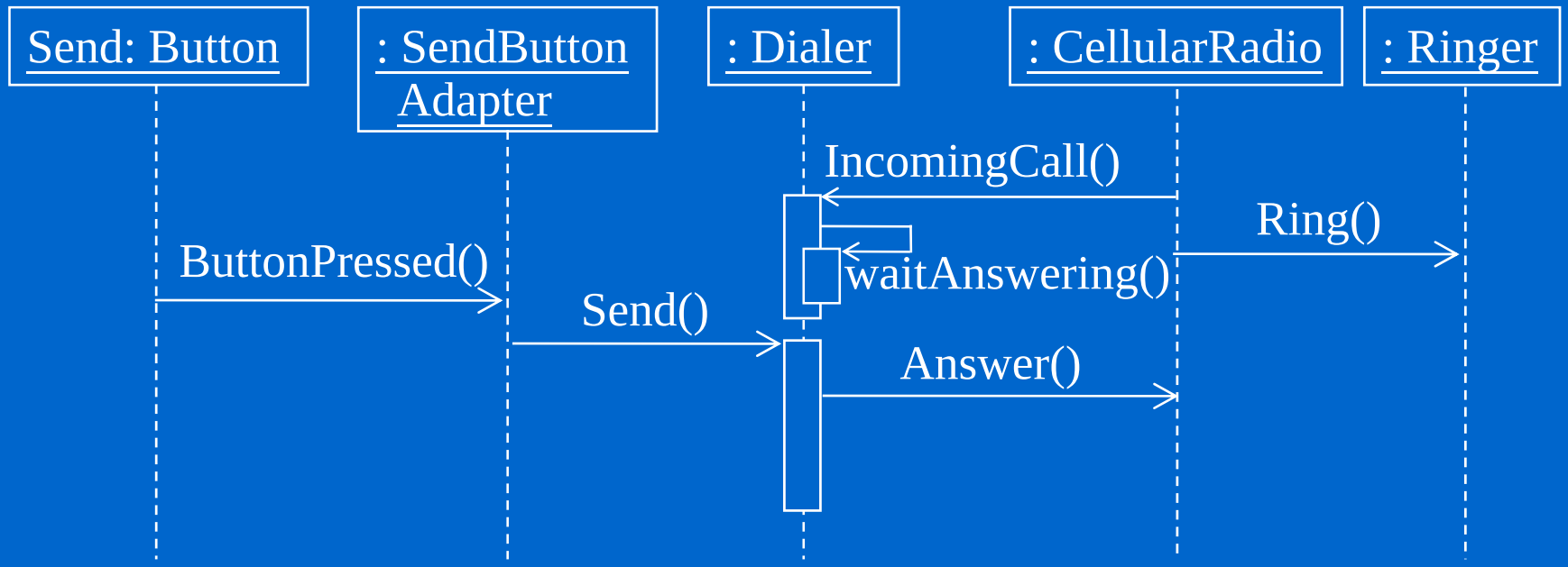

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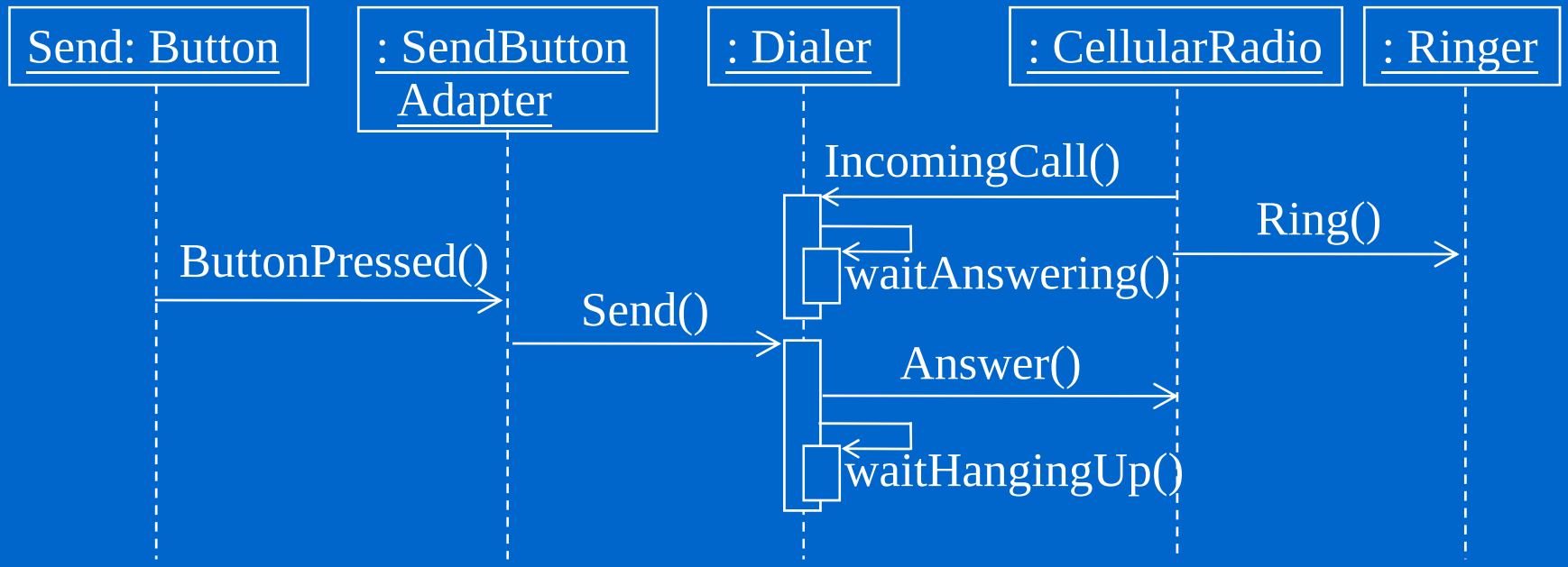

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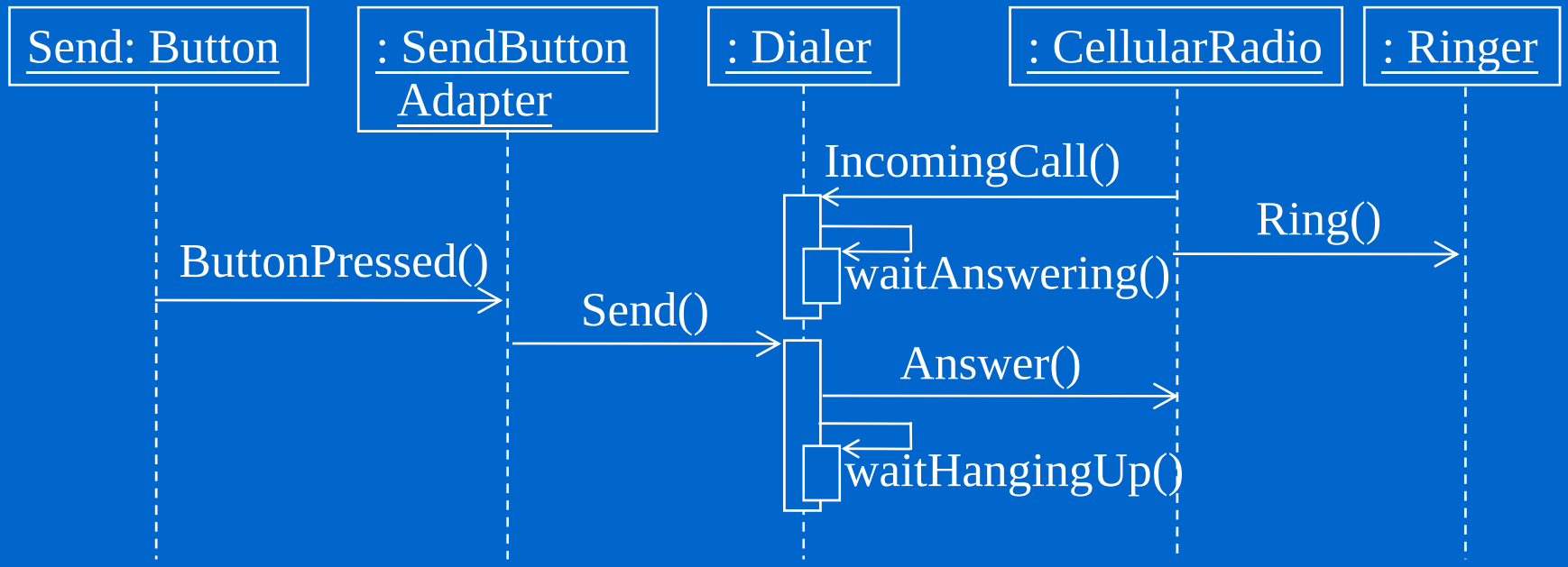

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- Most activation rectangles have been omitted for clarity, only show the activation rectangles for : Dialer.

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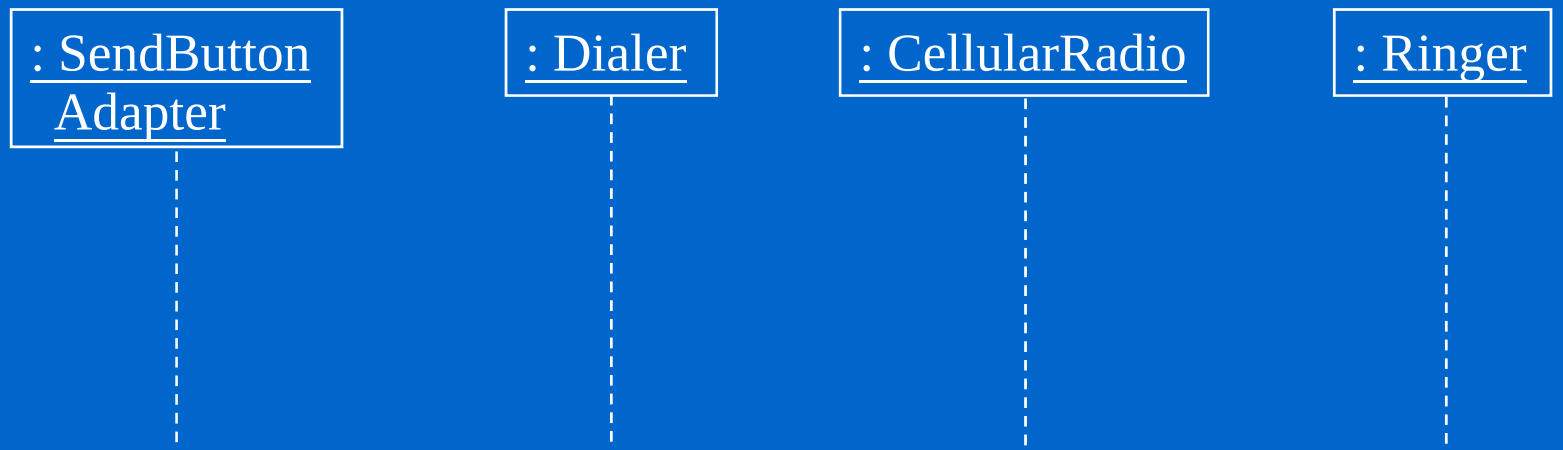

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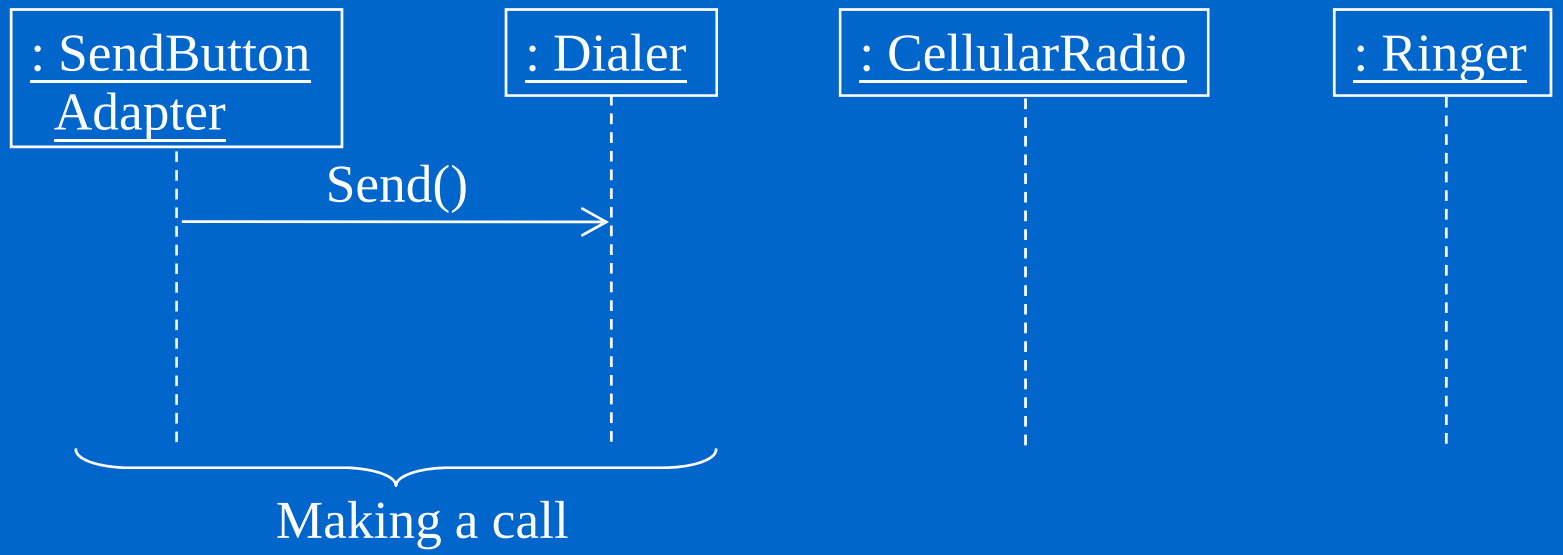

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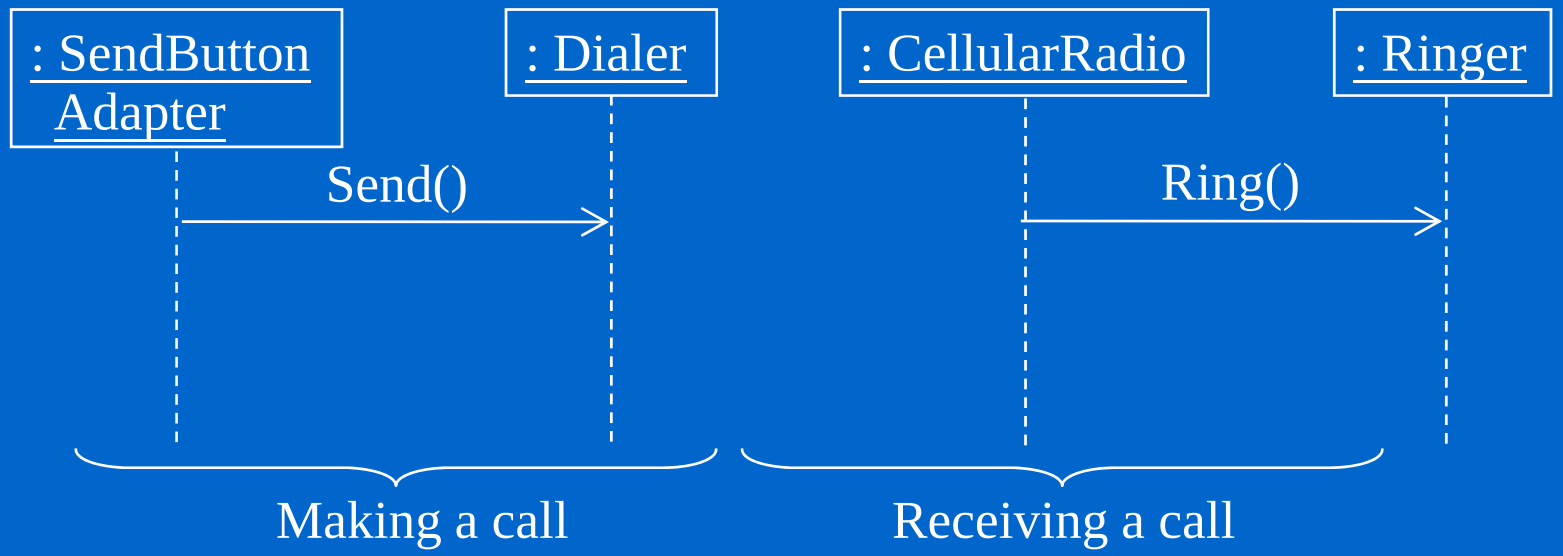

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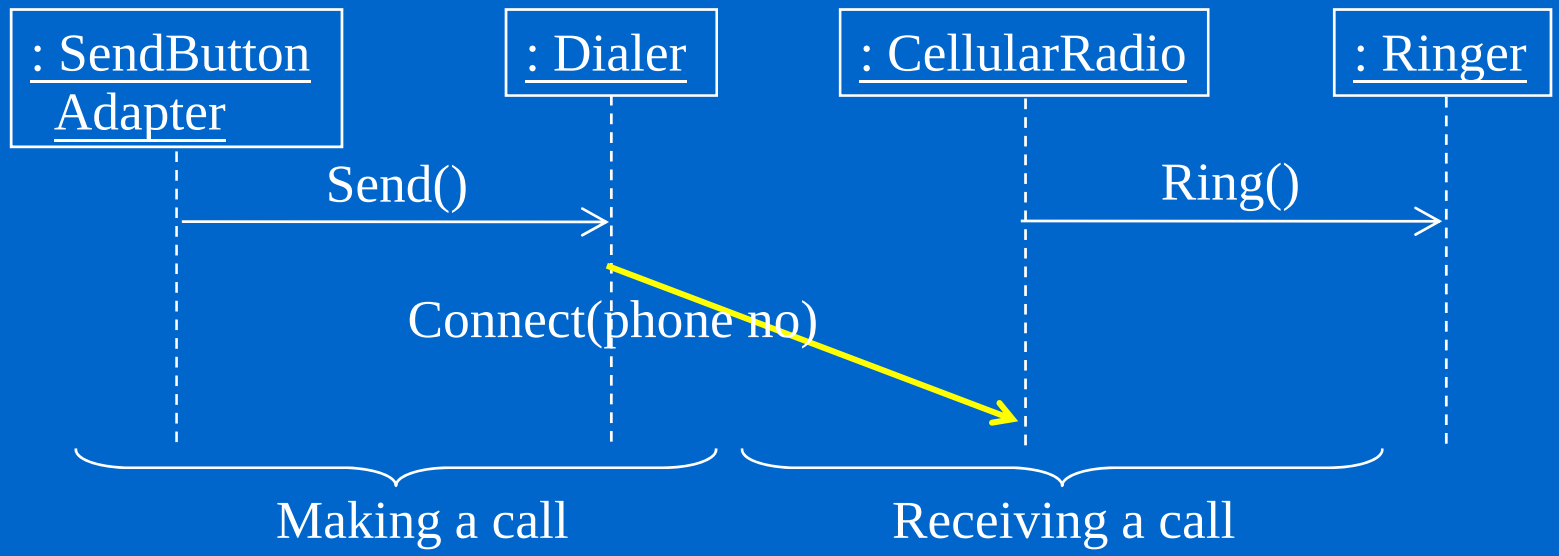

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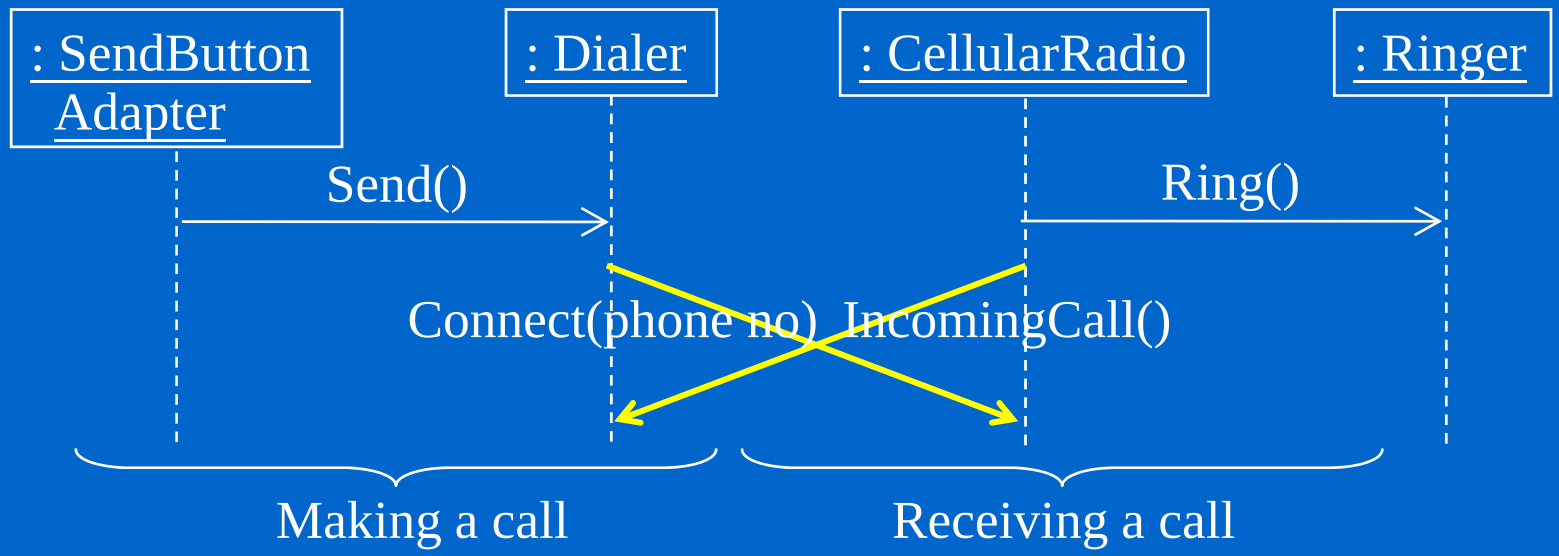
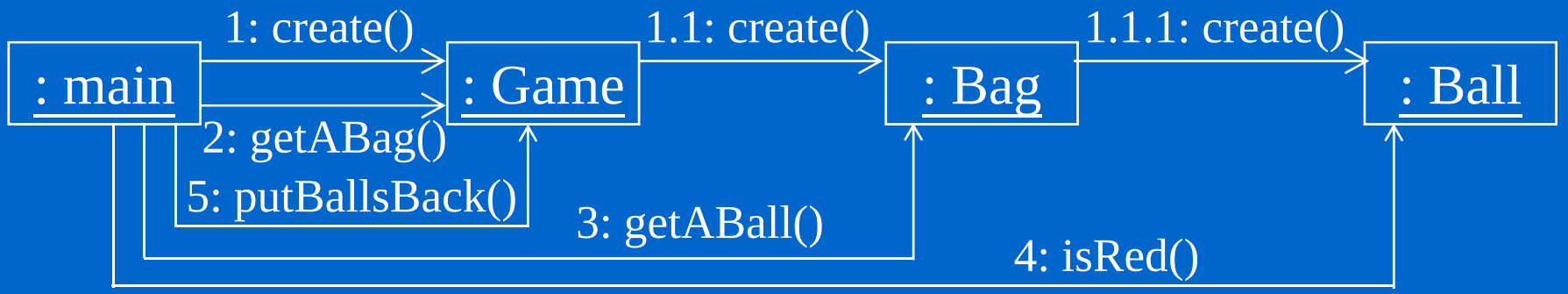


- "Making a call" is initiated by the user, while "Receiving a call" is initiated independently by another user.
- Message with a downward angle shows the elapsed time between the sending of the message and its reception.
- The **crossing of messages** indicates the race condition, which should be handled carefully by both : Dialer and : CellularRadio objects with state diagrams.

Three Bags Example



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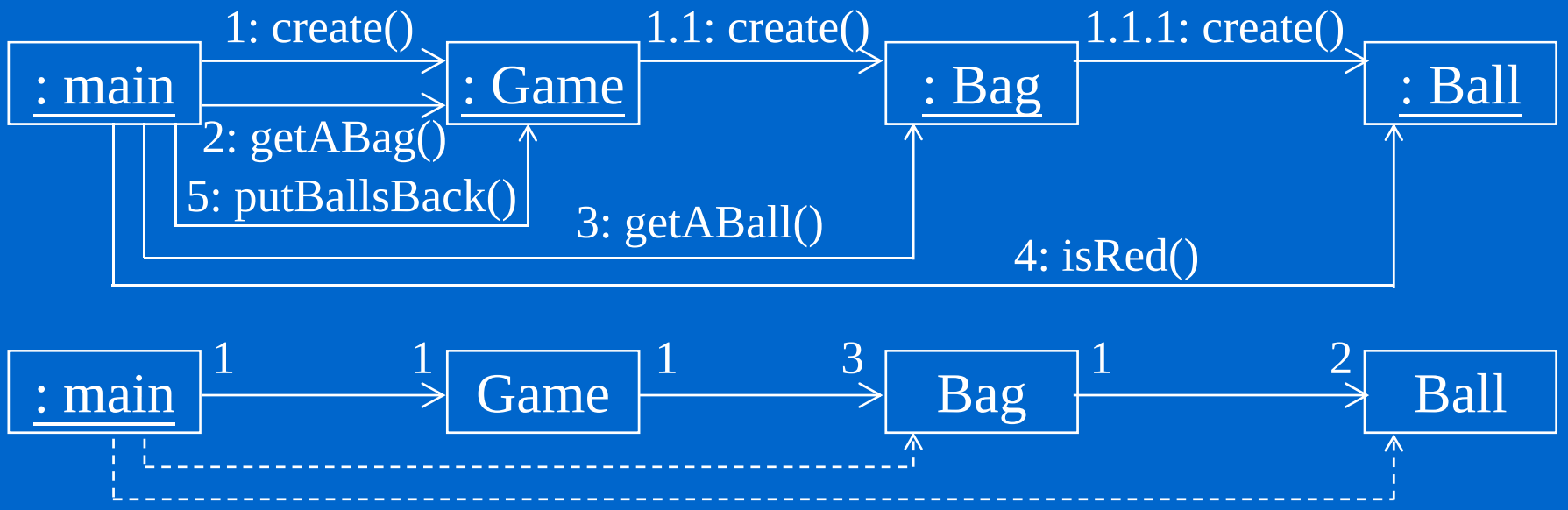

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