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# ATM System

## Preliminary Design Review

Course: 2021 Summer SYS-650

# Agenda

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- 1. Title/Introduction**
- 2. Use Cases**
- 3. System Requirements**
- 4. Requirements Traceability**
- 5. Functional Architecture**
- 6. Physical Architecture**
- 7. Expanded Sequence Diagrams and IDEF0 Traces**
- 8. System Component Specification**
- 9. Risk Analysis and Mitigation Plan**

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# Introduction

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# Code of Conduct (Honor Pledge)

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***We pledge on our honor that we have not given or received any unauthorized assistance on this assignment/examination. We further pledge that we have not copied any material from a book, article, the Internet or any other source except where we have expressly cited the source.***

# Innoslate Project

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## Team 1 ATM System Innoslate Project Link

### **Dashboard:**

- <https://cloud.innoslate.com/academic/p/7310/dashboard>

### **Metafunction IDEF0:**

- <https://cloud.innoslate.com/academic/p/7310/diagrams/idef0/1036610>

# Goals

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01	<b>Convey a clear understanding of business/stakeholder needs, rationale, and priorities</b>	<ul style="list-style-type: none"><li>• Accomplished by defining the problem and breaking down stakeholders and their expectations for the system, with continuous iteration and refinement.</li></ul>
02	<b>Review system requirements, requirements traceability, and solution approach</b>	<ul style="list-style-type: none"><li>• Accomplished by performing multiple analysis, and establishing system wide and sub-system requirements specification.</li></ul>
03	<b>Show extended application of systems engineering to mitigate risk and ensure functionality</b>	<ul style="list-style-type: none"><li>• Accomplished by developing the initial system level architecture.</li><li>• Accomplished by analyzing possible risks and determining the best mitigation techniques to reduce the risks present.</li></ul>

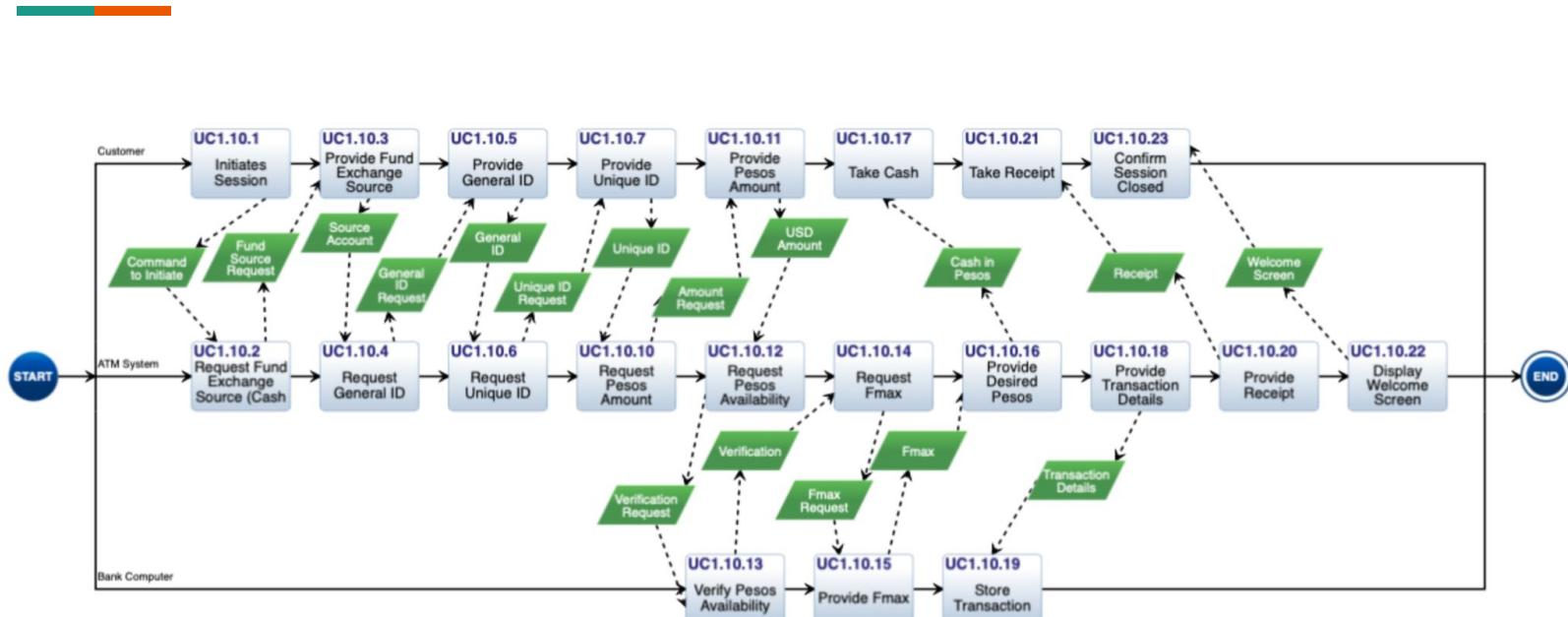
# 2

## New Use Cases - Overview

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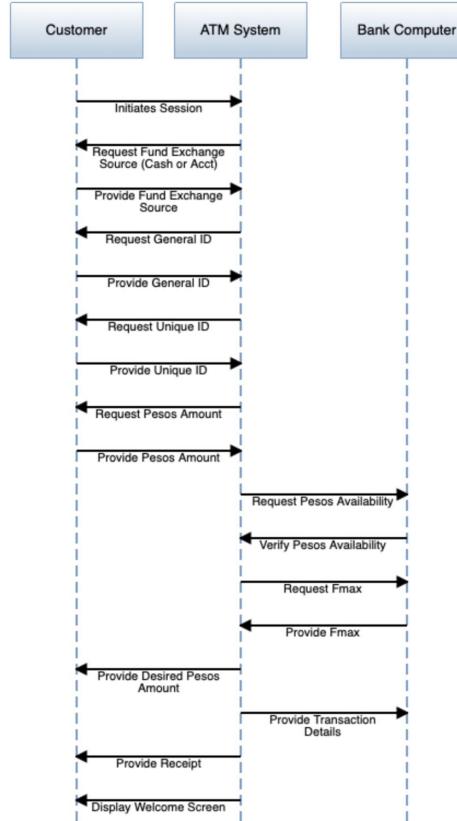
# New Use Case: Exchange USD to Mexican Peso

## Action Diagram



# New Use Case: Exchange USD to Mexican Peso

## Sequence Diagram



# New Use Case: Exchange USD to Mexican Peso

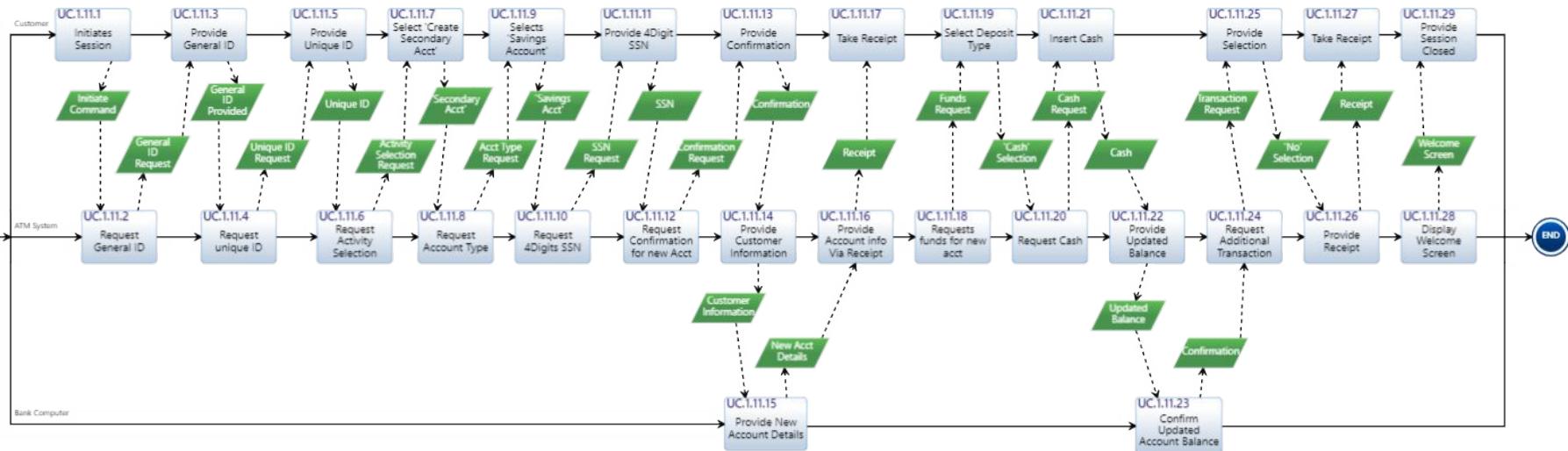
## Use Case Narrative

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- Customer initiates session
- ATM requests user to select source of funds for transfer (cash or account)
- Customer provides source of funds (account)
- ATM requests customer general ID
- Customer provides general ID
- ATM requests customer for unique ID
- Customer provides unique ID
- ATM requests customer for exchange currency type
- Customer provides currency type
- ATM requests customer to provide desired exchange currency withdrawal amount
- Customer provides desired exchange currency withdrawal amount
- ATM requests customer specified withdrawal amount from bank computer
- Bank computer verifies currency amount is available
- ATM requests info for maximum funds available
- Bank computer provides possibly maximum currency able to be obtained by customer
- ATM provides desired exchange currency amount to customer
- ATM provides transaction details to bank computer
- ATM provides receipt to customer
- ATM provides welcome screen to customer

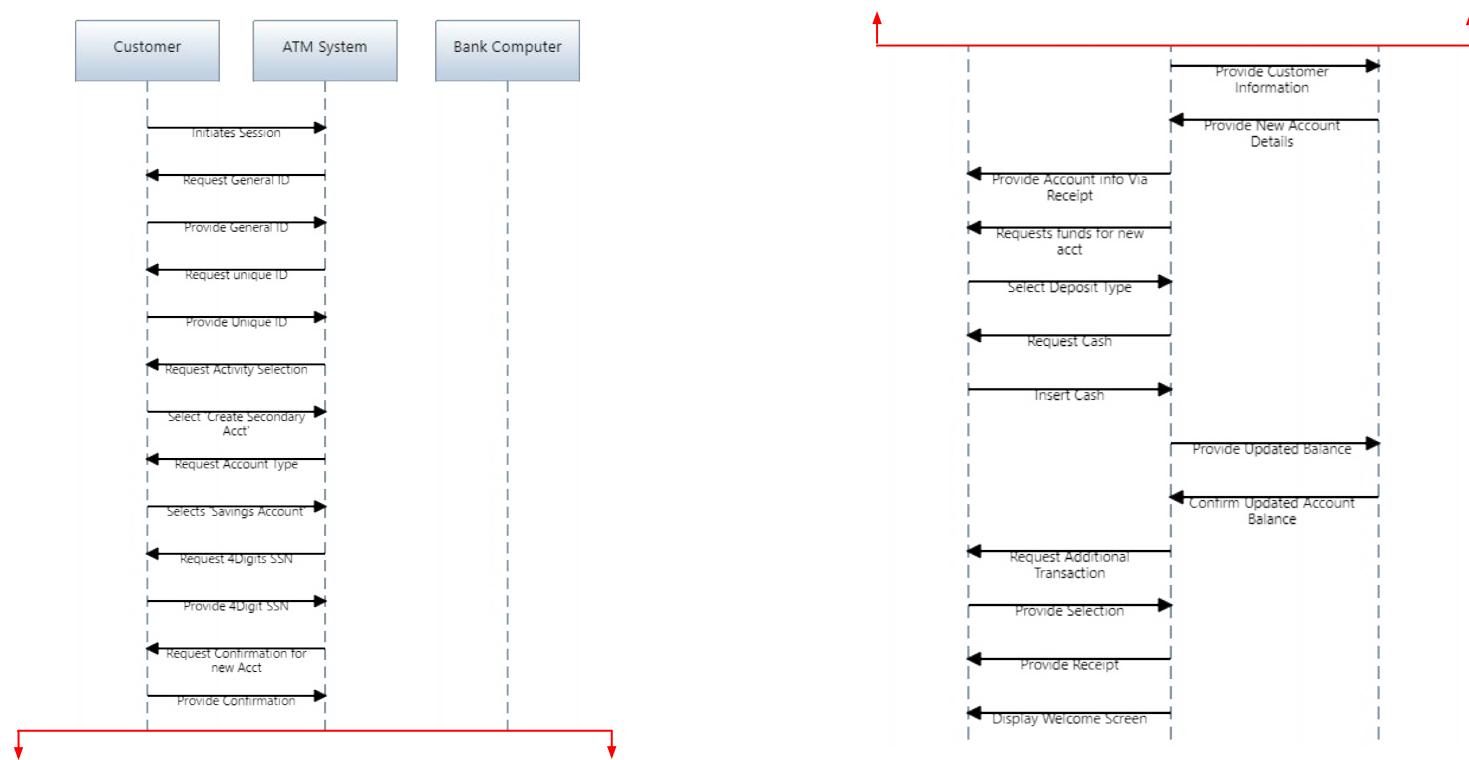
# New Use Case: Create Secondary Account

## Action Diagram



# New Use Case: Create Secondary Account

## Sequence Diagram



# New Use Case: Create Secondary Account

## Use Case Narrative

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- Customer initiates session
- ATM requests customer general ID
- Customer provides general ID
- ATM requests customer for unique ID
- Customer provides unique ID
- ATM Requests activity selection
- Customer Selects 'Create Secondary Account'
- ATM requests 'Account Type'
- Customer selects 'Savings Account'
- ATM request social security number
- Customer provides social security number
- ATM requests confirmation for new account
- Customer sends confirmation for new account
- ATM sends customer information to Bank Computer
- Bank Computer provides account and routing number for new account
- ATM prints out receipt with account and routing number for new account
- ATM requests funds for the new savings account
- Customer selects 'Cash Funds'
- ATM requests cash
- Customer inserts cash
- ATM sends transaction update to Bank Computer
- Bank Computer confirms transaction
- ATM requests another transaction
- Customer selects 'No'
- ATM prints receipt
- ATM displays main menu

# 3

## New System Requirements

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# New System Requirements

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ATM System Requirements		Rationale	Quality Score	Labels
	1.2.13 Provide New Acct Details The ATM System shall provide New Acct Details to the Bank Computer.	S	0% <div style="border: 1px solid red; height: 10px;"></div>	New or Updated Requirements
	1.1.12 Accept Resupply Type The ATM System shall accept Resupply Type from the Bank Employee.	S	0% <div style="border: 1px solid red; height: 10px;"></div>	New or Updated Requirements
	1.1.3 Accept Currency Type The ATM System shall accept Currency Type from the Bank Computer.	S	0% <div style="border: 1px solid red; height: 10px;"></div>	New or Updated Requirements

# 4

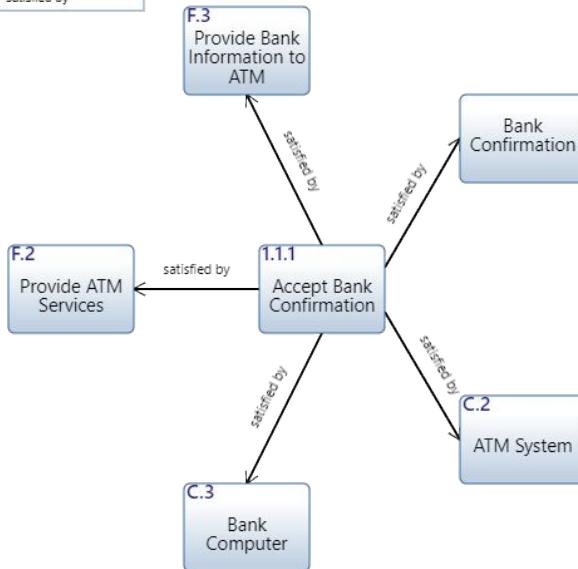
## Requirements

## Traceability

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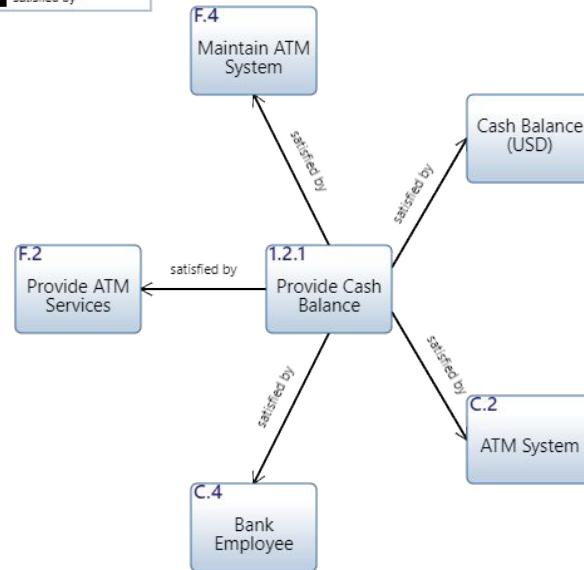
# Requirements Traceability - Input/Output Requirements

Legend  
█ satisfied by



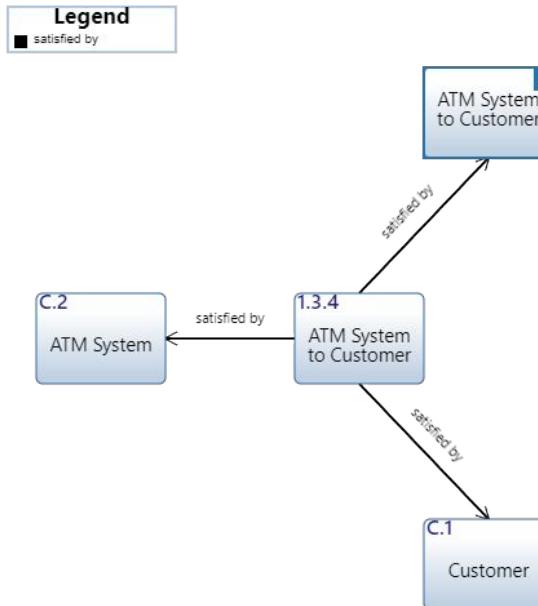
Input Requirement: Accept Bank Confirmation

Legend  
█ satisfied by



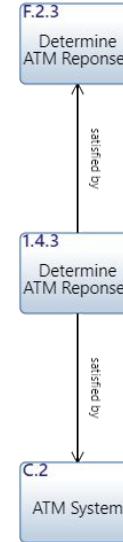
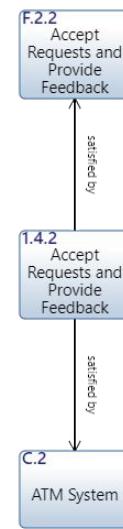
Output Requirement: Provide Cash Balance

# Requirements Traceability - Interface Requirements



**External Interface: ATM System to Customer**

# Requirements Traceability - Functional Requirements

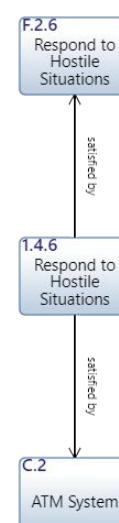


Provide Access

Accept Requests and  
Provide Feedback

Determine ATM  
Responses

# Requirements Traceability - Functional Requirements (cont.)



**Communicate with Bank**

**Provide Features for Resupply and Maintenance**

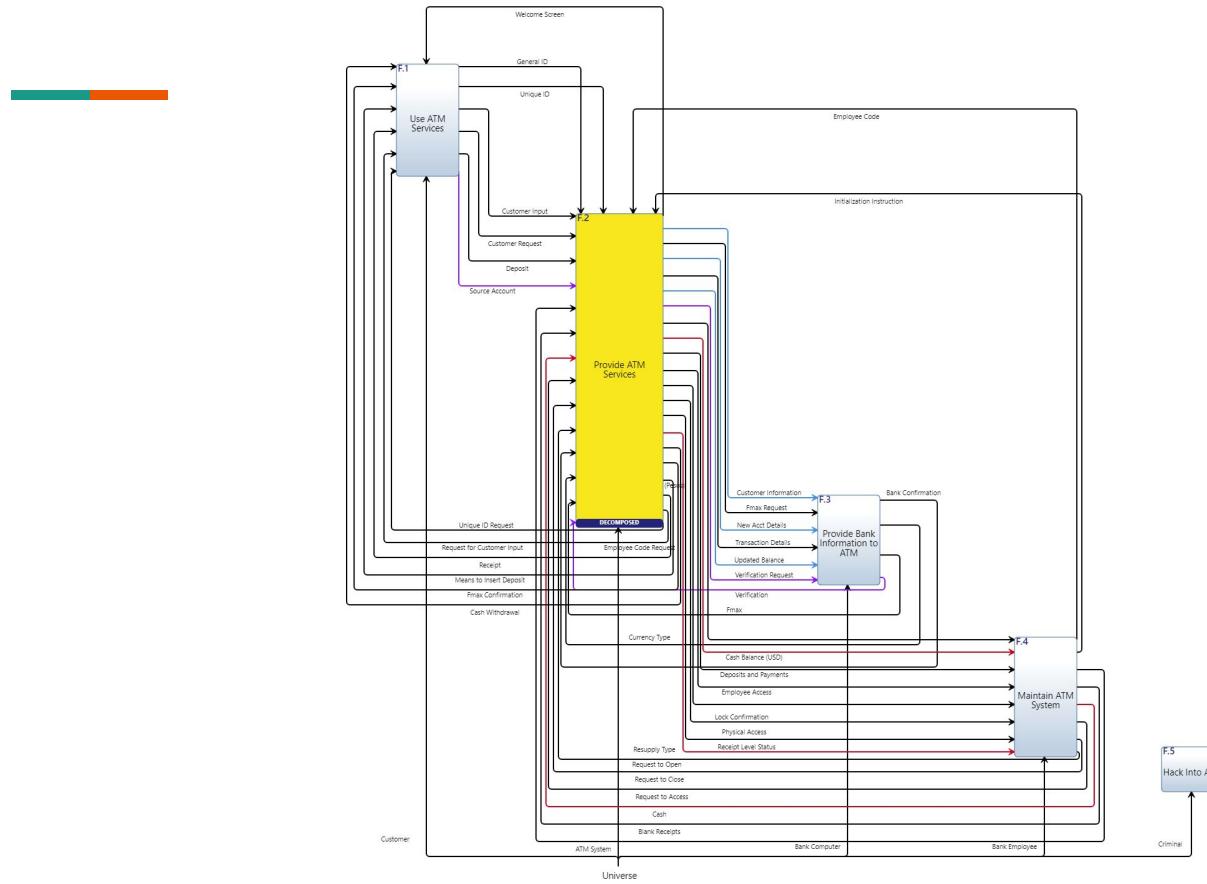
**Respond to Hostile Situations**

# 5

# Functional Architecture

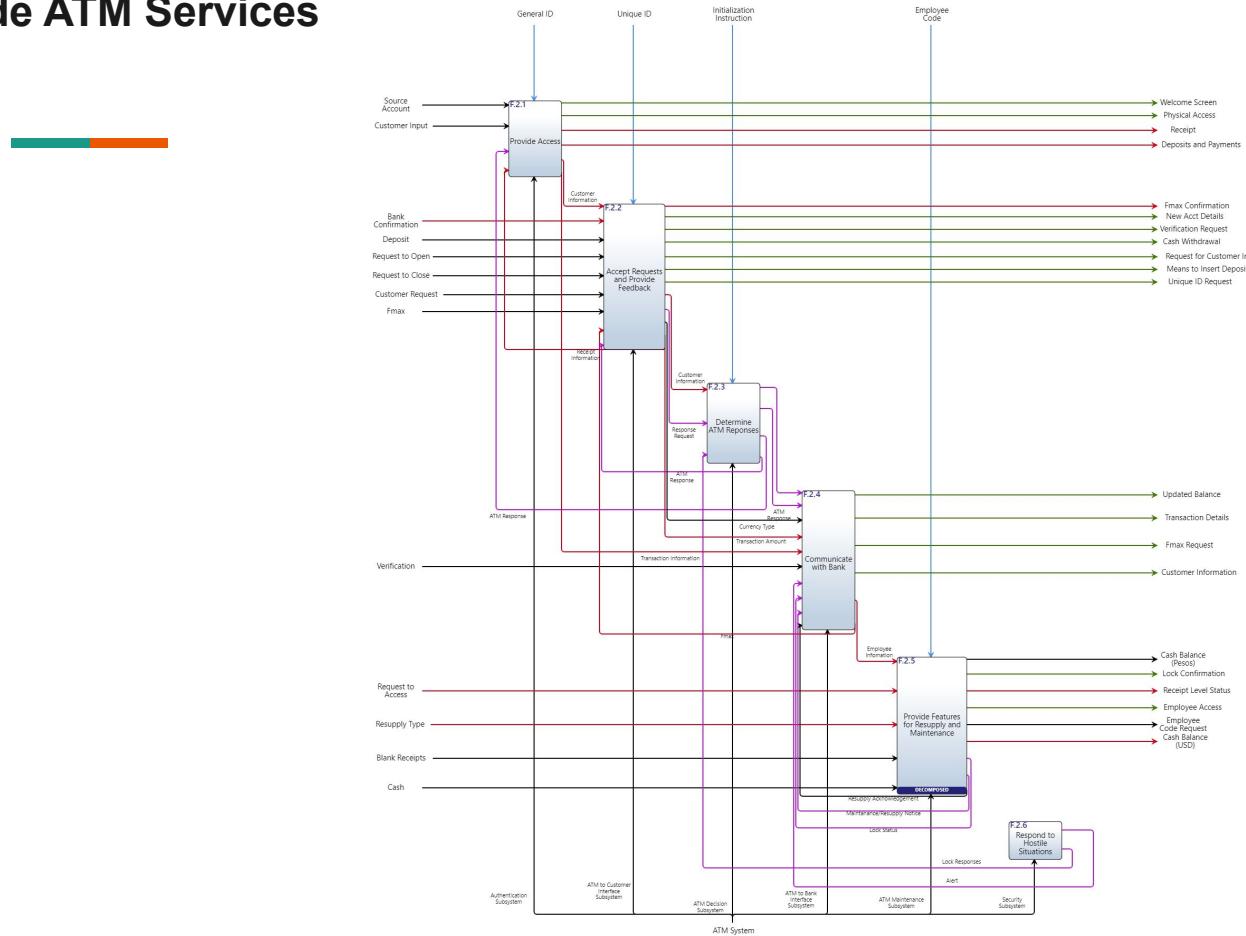
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# ATM System - IDEF0: Top Level Metafunction



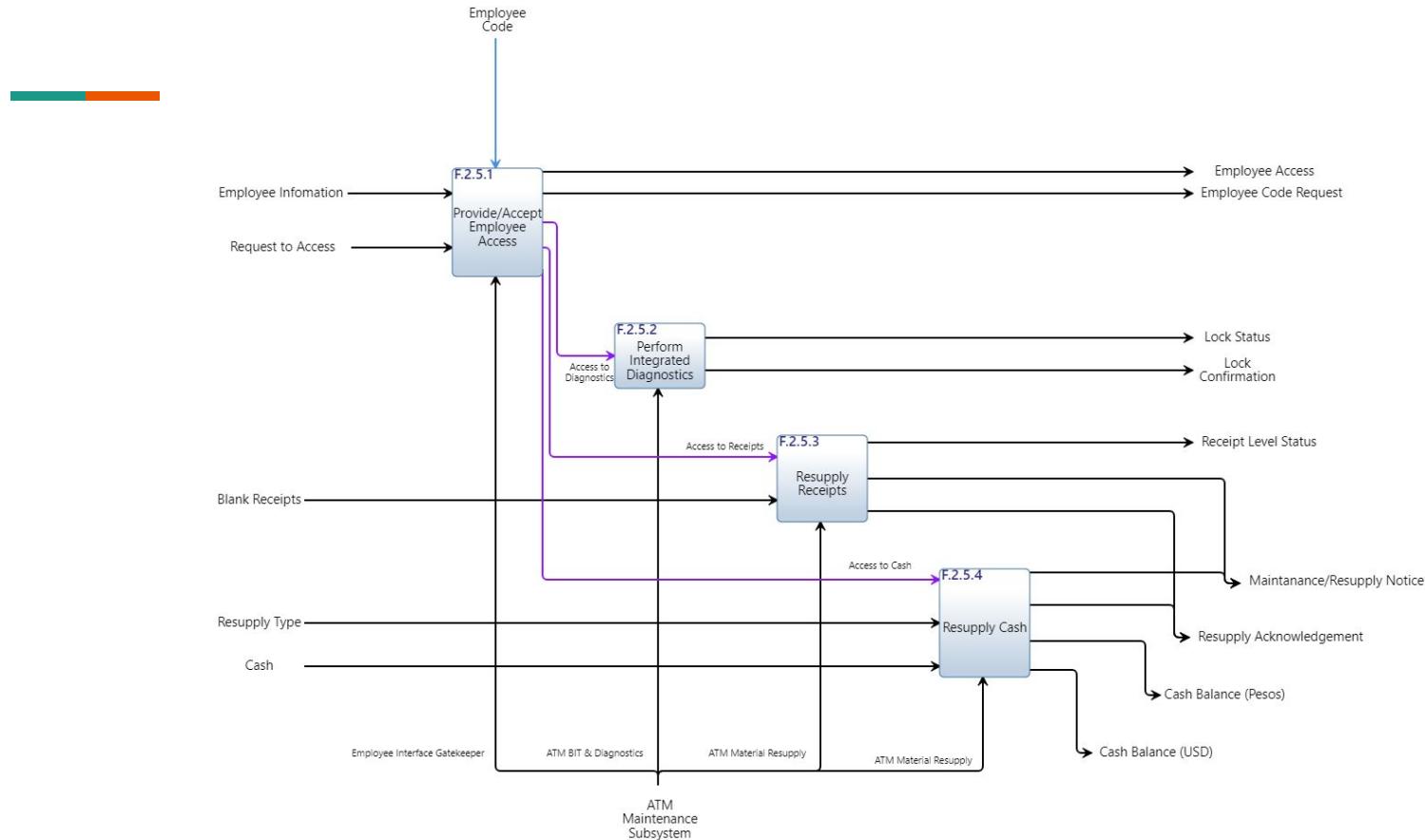
# ATM System - IDEF0: First Level Function

## Provide ATM Services



# ATM System - IDEF0: Second Level Function

## Provide Features for Resupply and Maintenance



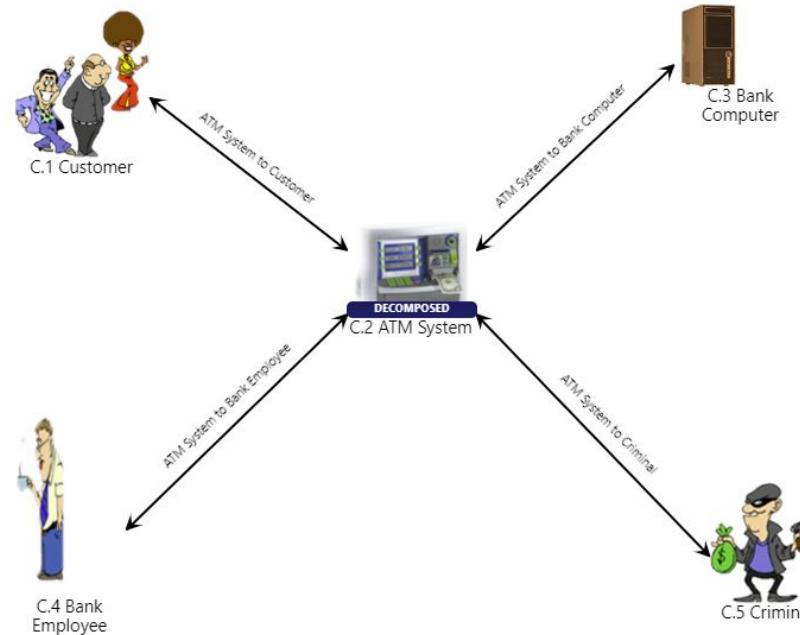
# 6

# Physical Architecture

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# ATM System - Universe Asset Diagram

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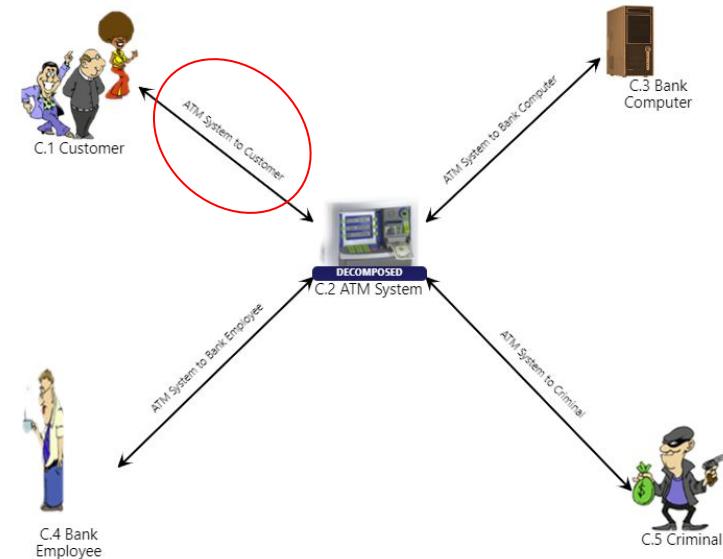


# ATM System - Universe Asset Diagram I/O Example

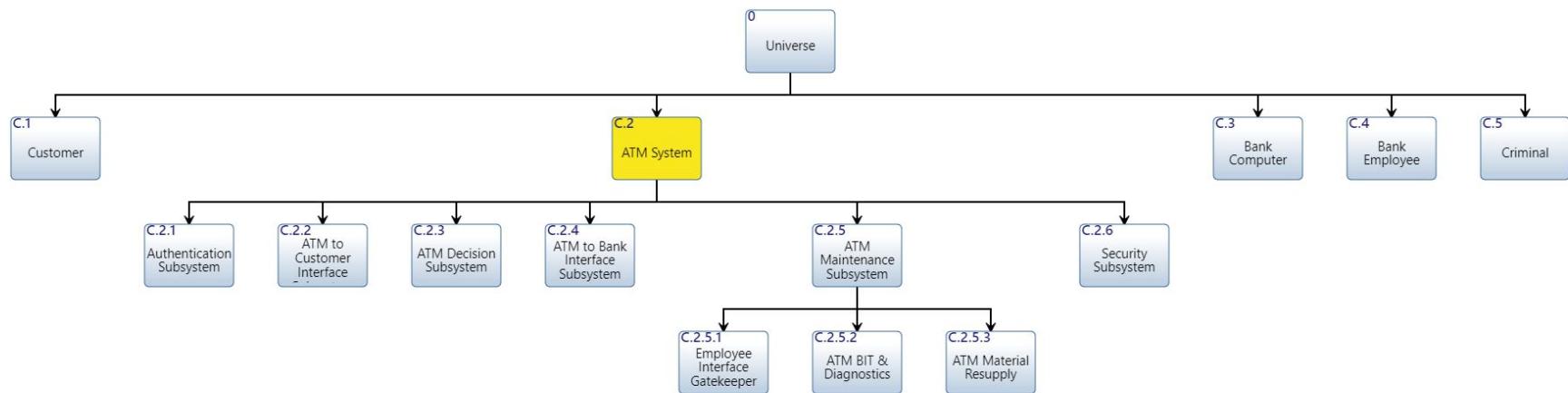
connects to Asset 2	Add ▾
C.1 Customer	
C.2 ATM System	

transfers Input/Output 13	Add ▾
Cash Withdrawal	
Customer Input	
Customer Request	
Deposit	
Fmax Confirmation	
General ID	
Means to Insert Deposit	
Receipt	
Request for Customer Input	
Source Account	
Unique ID	
Unique ID Request	
Welcome Screen	

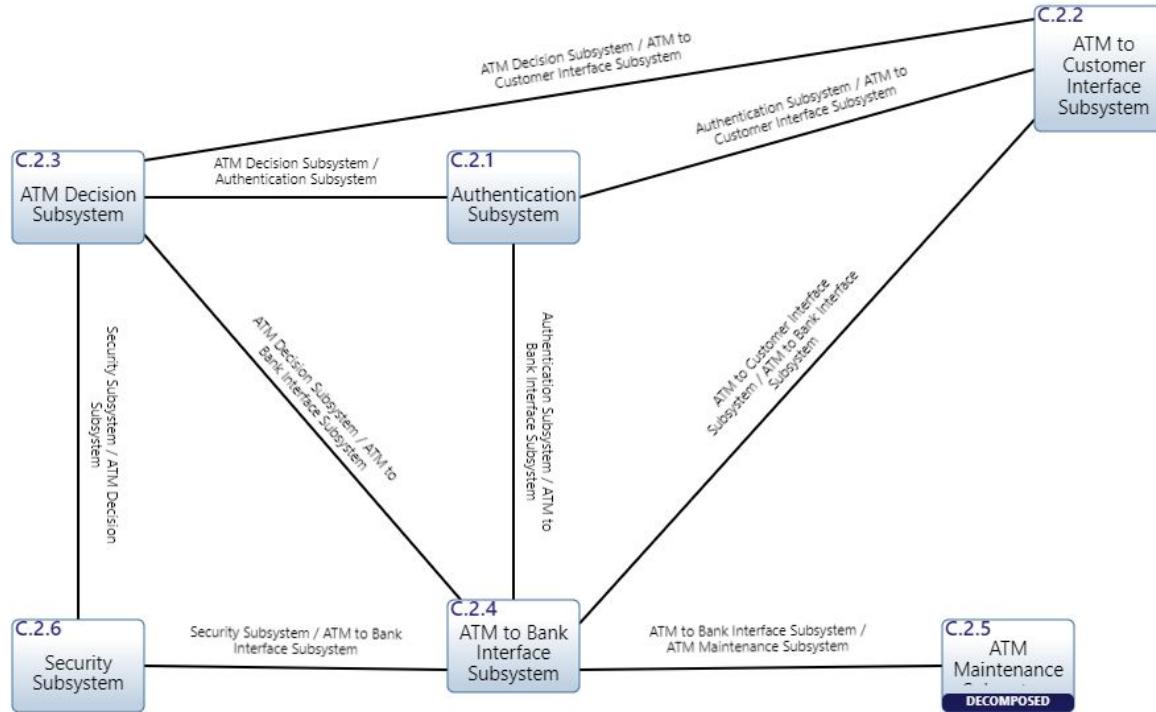


# ATM System - Universe Hierarchy Chart



# ATM System - System Asset Diagram

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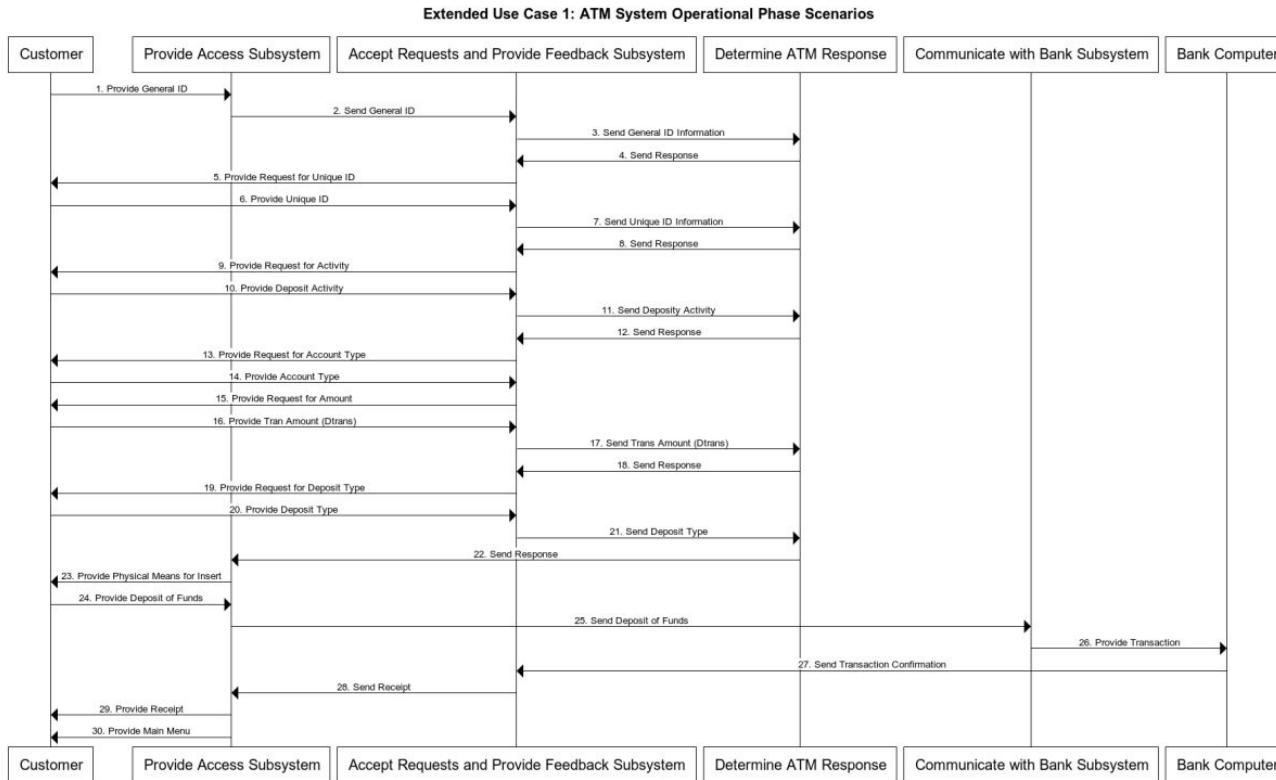
# 7

## Expanded Sequence Diagrams and IDEF0 Traces

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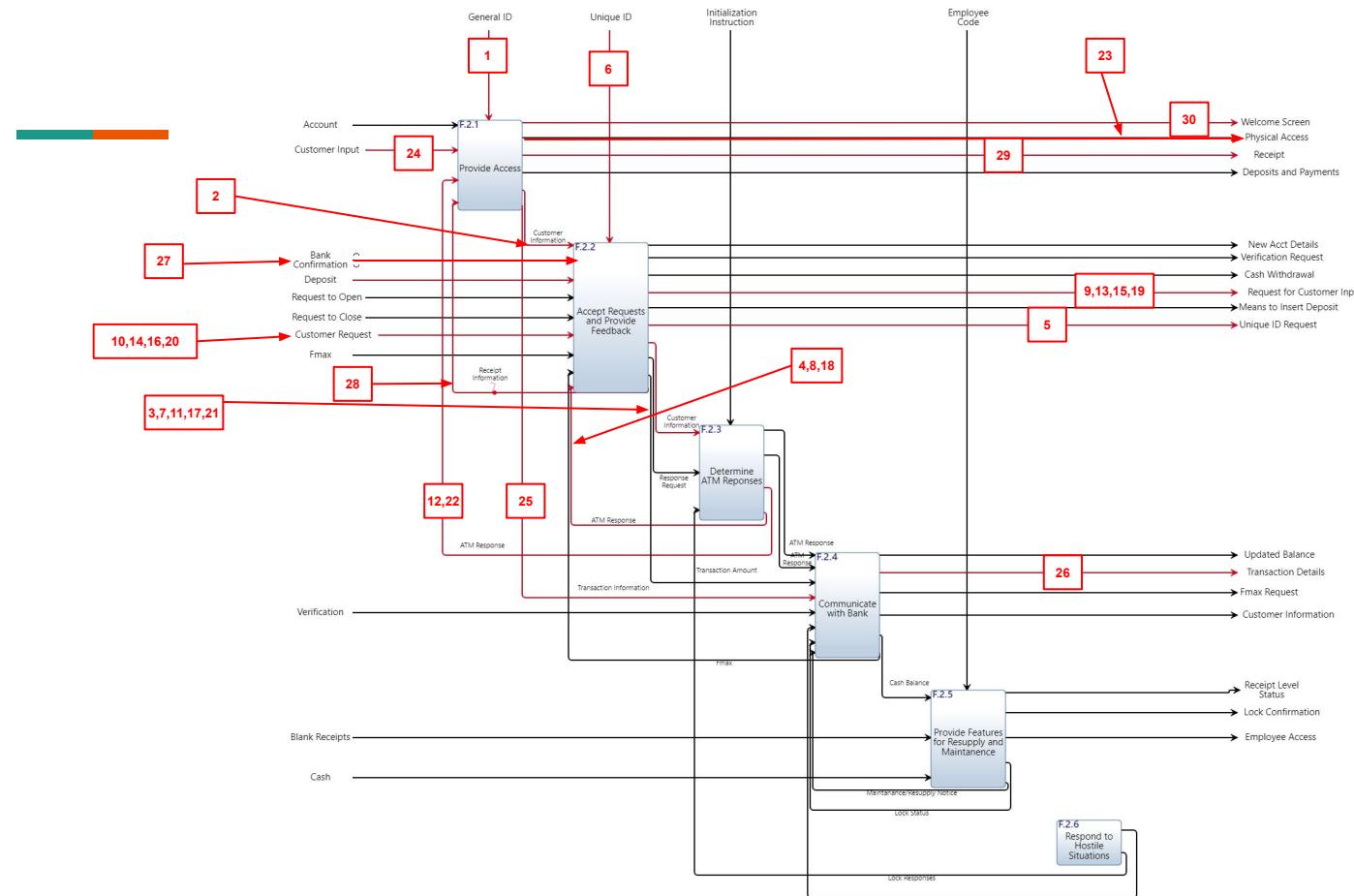
# Use Case 1.1: Customer Makes Deposit

## Expanded Sequence Diagram



# Use Case 1.1: ATM System Operational Phase Scenario

## First-level IDEF0 Tracing



# Use Case 1.1: ATM System Operational Phase Scenarios

## Summary Observations

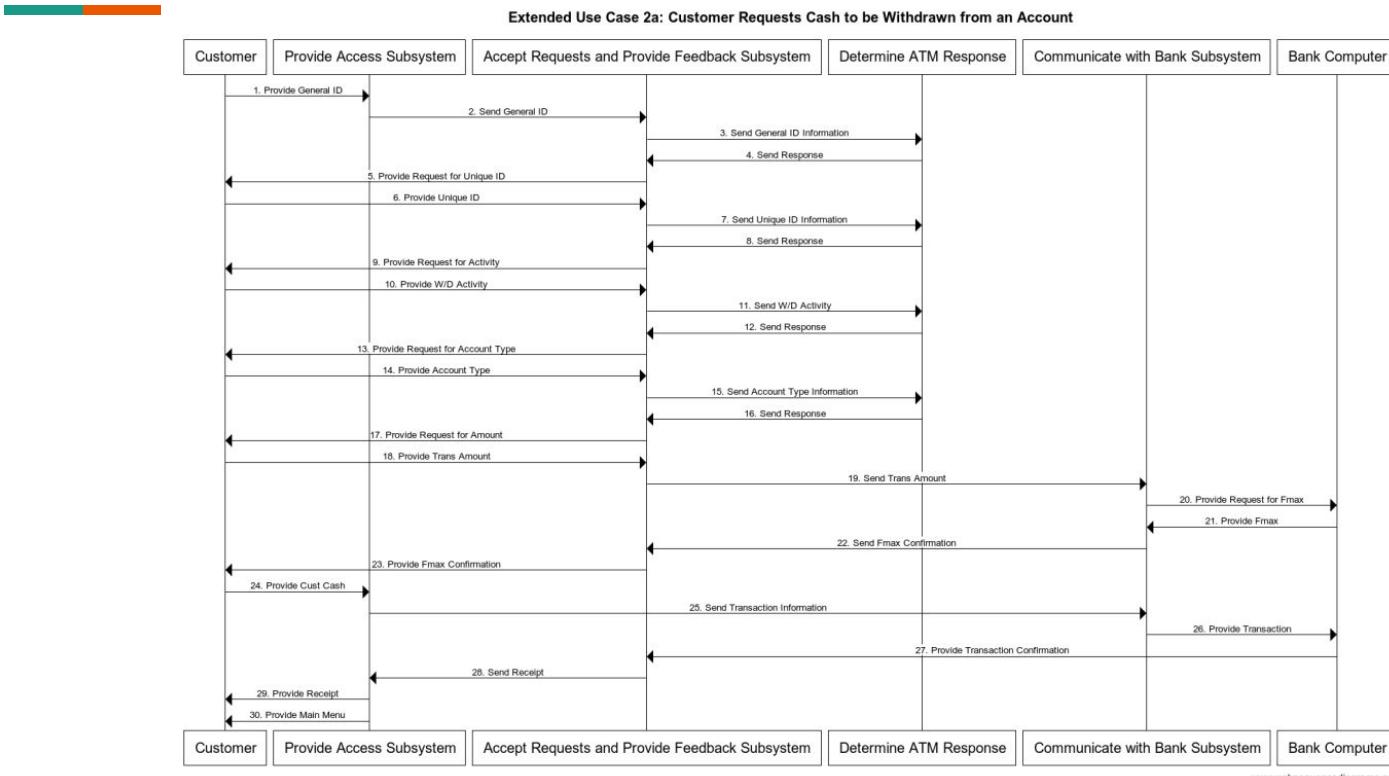
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As a result of the expanded use case diagram for Use Case 1, we made the following corrections:

- We added “Customer Information” from F.2.1 (Provide Access) to F.2.2 (Accept Requests and Provide Feedback)
- We added “Customer Information” **from** F.2.2 (Accept Requests and Provide Feedback) to F.2.3 (Determine ATM Response)
- We added “Transaction Information” **from** F.2.1(Provide Access) to F.2.4 (Communicate with Bank)
- We added “Receipt Information” **from** F.2.2 (**Accept Requests and Provide Feedback**) to F.2.1 (**Provide Access**)
- We added “Bank Confirmation” **from** Bank Computer to F.2.2 (Accept Requests and Provide Feedback).
- Moved the external output “Receipt” from F.2.2 (Accept Requests and Provide Feedback) function to the F.2.1(Provide Access) function.

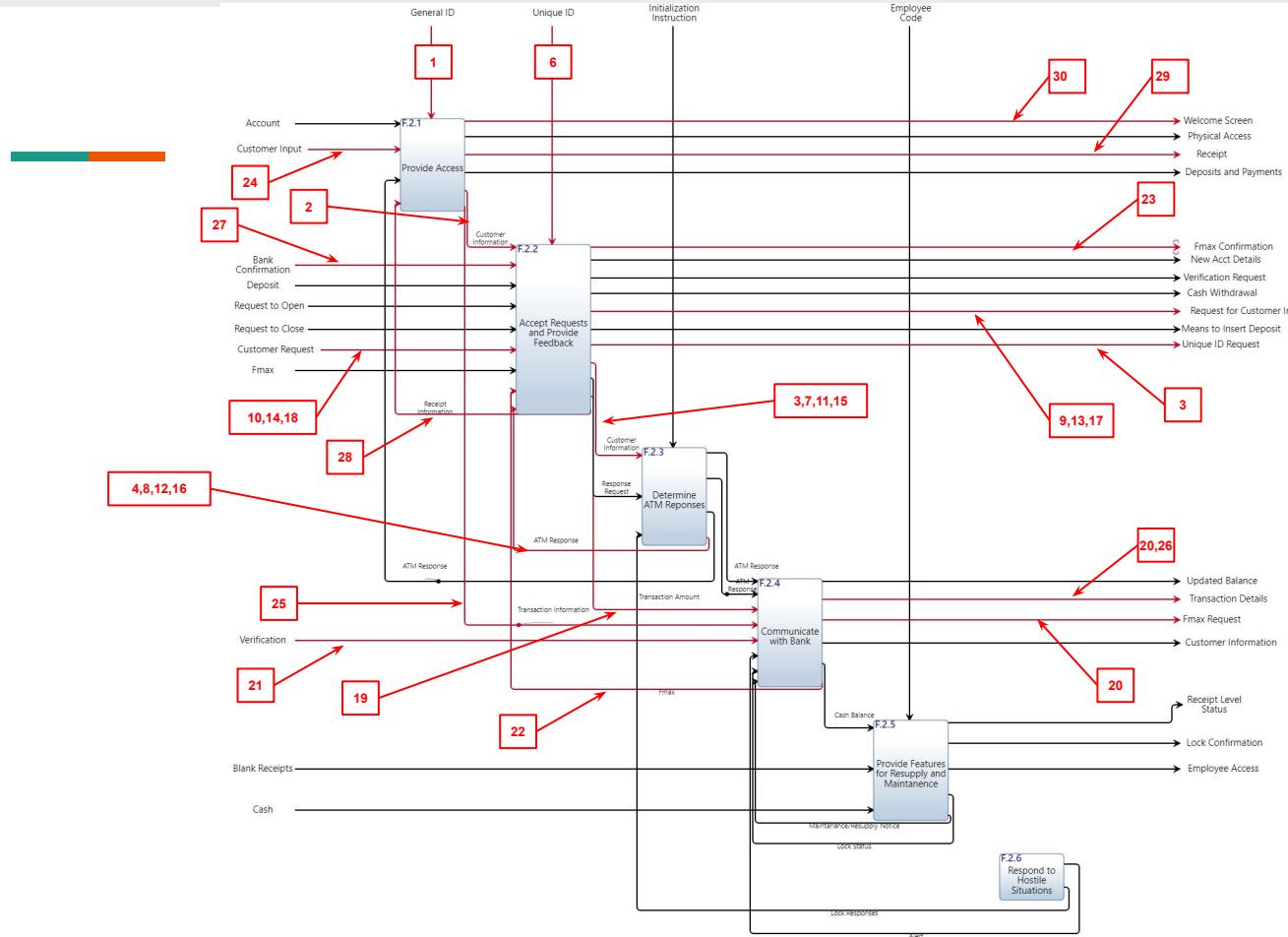
# Use Case 1.2: Customer Requests Cash to be Withdrawn from an Account

## Expanded Sequence Diagram



# Use Case 1.2: Customer Requests Cash to be withdrawn from an Account

## First-level IDEF0 Tracing



## Use Case 1.2: Customer Requests Cash to be Withdrawn from an Account

### Summary Observations

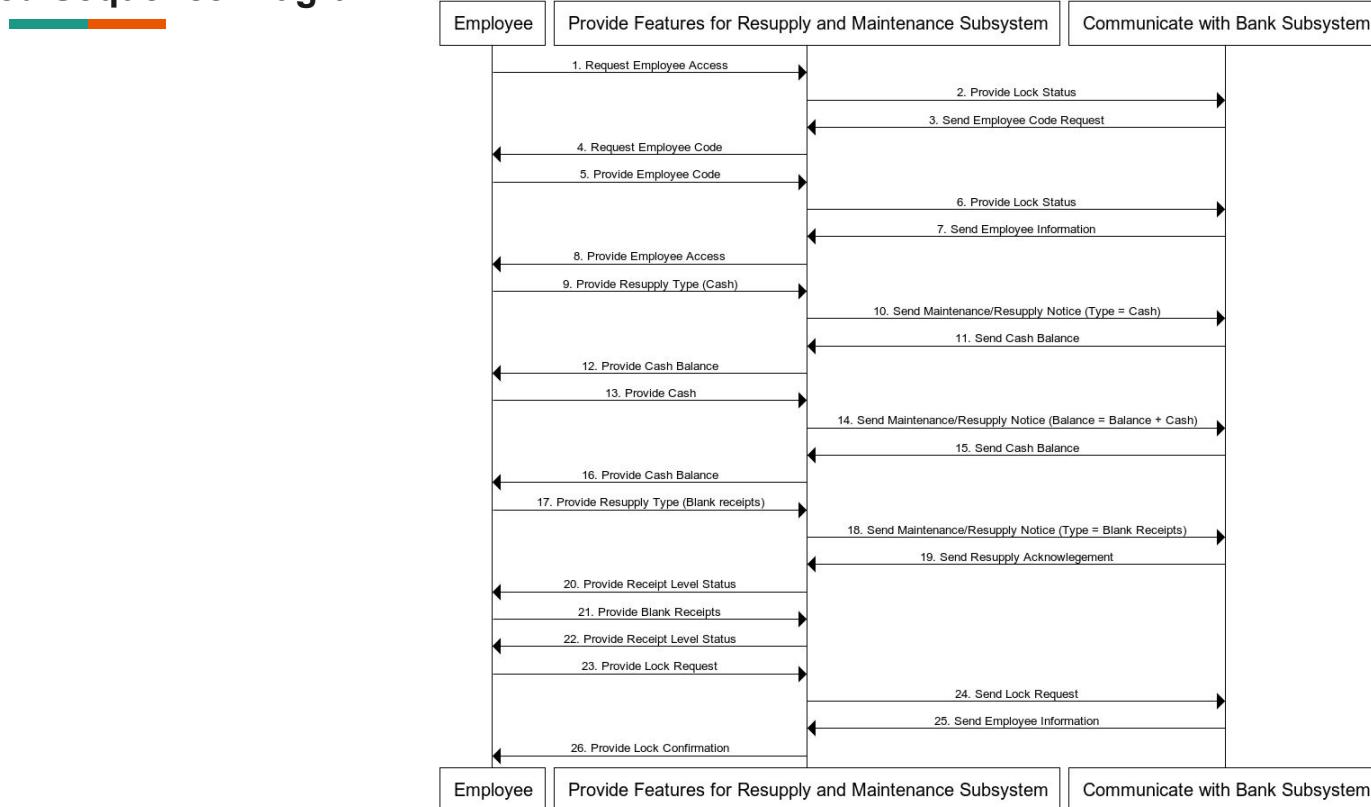
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As a result of the expanded use case diagram for Use Case 2a, we made the following corrections:

- We added “Fmax” from F.2.4 (Communicate with Bank) to F.2.2 (Accept Requests and Provide Feedback)
- We added “Fmax Confirmation” F.2.2 (Accept Requests and Provide Feedback) to the Customer.
- We added “Transaction Amount” from F.2.2 (Accept Requests and Provide Feedback) to F.2.4 (Communicate with Bank)

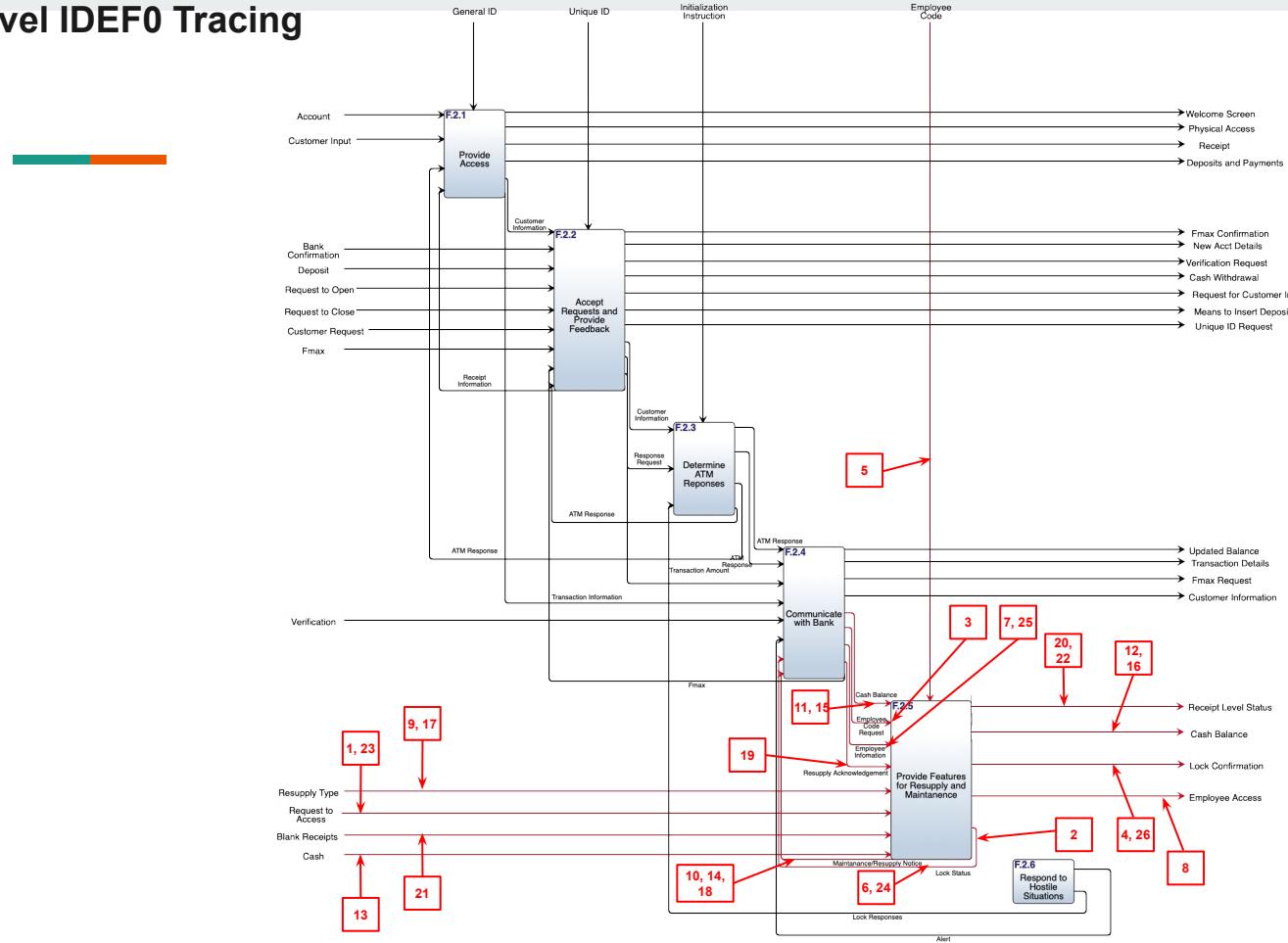
# Use Case 2.1: Routine Re-supply Operation

## Expanded Sequence Diagram



# Use Case 2.1: Routine Re-supply Operation

## First-level IDEF0 Tracing



# Use Case 2.1: Routine Re-supply Operation

## Summary Observations

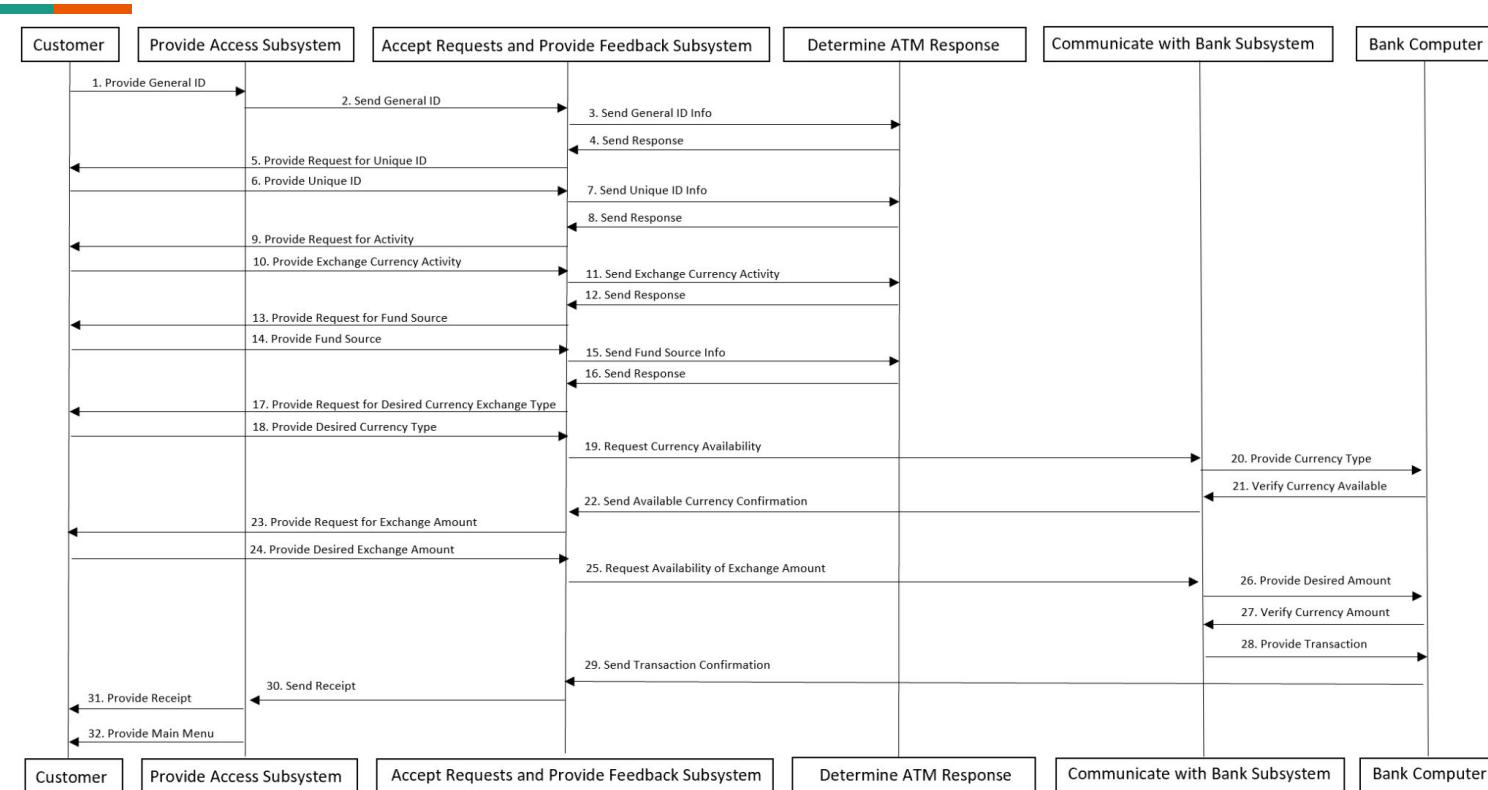
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As a result of the expanded use case diagram for Bank Employee Scenario #1, we made the following corrections:

- Removed ATM response from F.2.3 (Determine ATM Response) to F.2.5 (Provide Features for Resupply and Maintenance)
- Added Cash Balance from F.2.4 (Communicate with Bank) to F.2.5 (Provide Features for Resupply and Maintenance)
- Moved Deposits and Payments Output to from F.2.5 (Provide Features for Resupply and Maintenance) to F.2.1 (Provide Access)
- Added Receipt Level Status Output from F.2.5 (Provide Features for Resupply and Maintenance)
- Added Cash Balance Output from F.2.5 (Provide Features for Resupply and Maintenance)
- Added Request to Access Input to F.2.5 (Provide Features for Resupply and Maintenance)
- Added Employee Code Request from F.2.4 (Communicate with Bank) to F.2.5 (Provide Features for Resupply and Maintenance)
- Added Send Employee Information from F.2.4 (Communicate with Bank) to F.2.5 (Provide Features for Resupply and Maintenance)
- Added Resupply Type Input to F.2.5 (Provide Features for Resupply and Maintenance)
- Added Resupply Acknowledgement from F.2.4 (Communicate with Bank) to F.2.5 (Provide Features for Resupply and Maintenance)

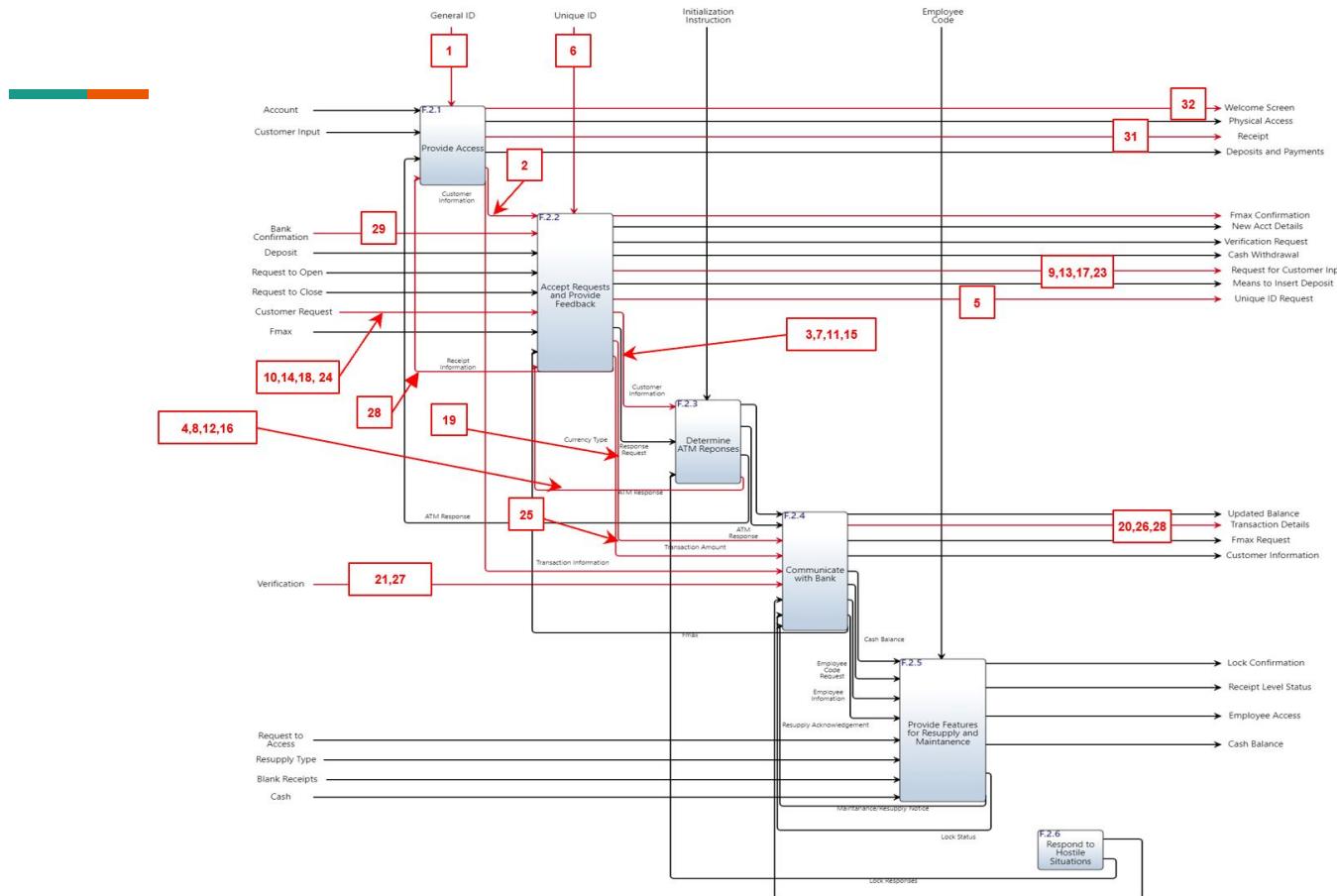
# Use Case 1.10: Customer Change/Exchange Currency

## Expanded Sequence Diagram



# Use Case 1.10: Customer Change/Exchange Currency

## First-level IDEF0 Tracing



# Use Case 1.10: Customer Change/Exchange Currency

## Summary Observations

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As a result of the expanded use case diagram for Team Defined Scenario #1, we made the following corrections:

- We added “Currency Type” from F.2.4 (Communicate with Bank) to F.2.2 (Accept Requests and Provide Feedback)

# 8

# System Component Specification

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# ATM Maintenance Subsystem Specification

## Input Requirements

ATM Maintenance Subsystem Requirements		Rationale
-	1 Functional Requirements	N/A
-	1.1 Input Requirements	N/A
	1.1.1 Accept Blank Receipts The ATM Maintenance Subsystem shall accept Blank Receipts from the Bank Employee.	S
	1.1.3 Accept Employee Code [Control] The ATM Maintenance Subsystem shall accept Employee Code from the Bank Employee.	S
	1.1.5 Accept Employee Infomation The ATM Maintenance Subsystem shall accept Employee Infomation from the ATM to Bank Interface Subsystem.	S
	1.1.6 Accept Request to Access The ATM Maintenance Subsystem shall accept Request to Access from the Bank Employee.	S
	1.1.8 Accept Resupply Type The ATM Maintenance Subsystem shall accept Resupply Type from the Bank Employee.	S
	1.1.9 Accept Cash The ATM Maintenance Subsystem shall accept Cash from the Bank Employee.	S

# ATM Maintenance Subsystem Specification

## Output Requirements

Add After Maintenance Subsystem Requirements		Rationale
-	1 Functional Requirements	N/A
+	1.1 Input Requirements	N/A
-	1.2 Output Requirements	N/A
	1.2.1 Provide Cash Balance (USD) The ATM Maintenance Subsystem shall provide Cash Balance (USD) to the Bank Employee.	S
	1.2.2 Provide Employee Access The ATM Maintenance Subsystem shall provide Employee Access to the Bank Employee.	S
	1.2.3 Provide Lock Confirmation The ATM Maintenance Subsystem shall provide Lock Confirmation to the Bank Employee.	S
	1.2.4 Provide Lock Status The ATM Maintenance Subsystem shall provide Lock Status to the ATM to Bank Interface Subsystem.	S
	1.2.5 Provide Maintenance/Resupply Notice The ATM Maintenance Subsystem shall provide Maintenance/Resupply Notice to the ATM to Bank Interface Subsystem.	S
	1.2.6 Provide Receipt Level Status The ATM Maintenance Subsystem shall provide Receipt Level Status to the Bank Employee.	S
	1.2.7 Provide Cash Balance (Pesos) The ATM Maintenance Subsystem shall accept Cash Balance (Pesos) from the ATM to Bank Interface Subsystem.	S
	1.2.8 Provide Employee Code Request The ATM Maintenance Subsystem shall accept Employee Code Request from the ATM to Bank Interface Subsystem.	S
	1.2.9 Provide Resupply Acknowledgement The ATM Maintenance Subsystem shall accept Resupply Acknowledgement from the ATM to Bank Interface Subsystem.	S

# ATM Maintenance Subsystem Specification

## Interface Requirements

ATM Maintenance Subsystem Requirements		Rationale
	1 Functional Requirements	N/A
	1.1 Input Requirements	N/A
	1.2 Output Requirements	N/A
	1.3 External Interface Requirements	N/A
	1.3.1 ATM to Bank Interface Subsystem / ATM Maintenance Subsystem The ATM Maintenance Subsystem shall interface with the ATM to Bank Interface Subsystem through the ATM to Bank Interface Subsystem / ATM Maintenance Subsystem.	S

# ATM Maintenance Subsystem Specification

## Functions Requirements

ATM Maintenance Subsystem Requirements		
	Rationale	◆
- 1 Functional Requirements	N/A	
+ 1.1 Input Requirements	N/A	
+ 1.2 Output Requirements	N/A	
+ 1.3 External Interface Requirements	N/A	
- 1.4 Functions Requirements	N/A	
1.4.1 Provide/Accept Employee Access The ATM Maintenance Subsystem shall Provide/Accept Employee Access.	S	
1.4.2 Perform Integrated Diagnostics The ATM Maintenance Subsystem shall Perform Integrated Diagnostics.	S	
1.4.3 Resupply Receipts The ATM Maintenance Subsystem shall Resupply Receipts.	S	
1.4.4 Resupply Cash The ATM Maintenance Subsystem shall Resupply Cash.	S	

# ATM Maintenance Subsystem Specification

## System-wide Requirements

ATM Maintenance Subsystem Requirements		Rationale
+	1.4 Functions Requirements	N/A
-	2 System-wide Requirements	N/A
-	2.1 Operating Costs	N/A
	2.1.1 Provide integrated diagnostics to reduce maintenance efforts The ATM maintenance subsystem integrated diagnostics shall self-test such that no on-site employees are required for diagnosis.	S SYNTHESIS: By providing a working and maintained ATM services, the branch may reduce the number of bank offices by 2.
	2.1.2 Provide customer service to reduce the required number of bank personnel The ATM maintenance subsystem shall provide consistent banking services such that withdrawal/deposit services require no in-person personnel.	S SYNTHESIS: By providing a working and maintained ATM services, the branch may reduce peak hour staffing requirements.
	2.1.3 Cost no more than \$1000 per month to operate The ATM maintenance subsystem shall cost no more than \$1000 per month to operate; the design goal is \$666.	S APPORTIONMENT: The Maintenance Subsystem is appropriated 2/3 of the \$1500/month operating cost, per 2.1.3 System Requirement.
-	2.2 Operating Performance	N/A
-	2.2.3 Availability	
	2.2.3.1 Have a Mean Time Between Failures (MTBF) of greater than 9 months The ATM maintenance subsystem shall have a Mean Time Between Failures (MTBF) of greater than 9 months; the design goal is 12 months.	S EQUIVALENCE: The Maintenance Subsystem will have the responsibility of self-correcting failures to reduce the MTBF. Failures will require in-field correction through this subsystem.
	2.2.3.2 Have a Mean Time To Repair (MTTR) of less than 4 hours The ATM maintenance subsystem shall have a Mean Time To Repair (MTTR) of less than 4 hours; the design goal is 2 hours.	S EQUIVALENCE: The Maintenance Subsystem is responsible for appropriate maintainer access, as well as the proper interfaces for repair.

# 9

## Risk Analysis & Potential Mitigations

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# ATM Risk Table

Description	Likelihood	Impact Cost	Impact Schedule	Impact Technical	Overall Impact	Overall Risk Level
A network outage causes a disruption in ATM services	4	2	3	2	2	3
Incorrect transaction reported to banking subsystem	2	5	4	4	3	3
ATM accepts deposited counterfeit currency as valid	2	4	3	3	3	2
Incorrect foreign currency exchange rate	4	1	2	1	3	4

Note:

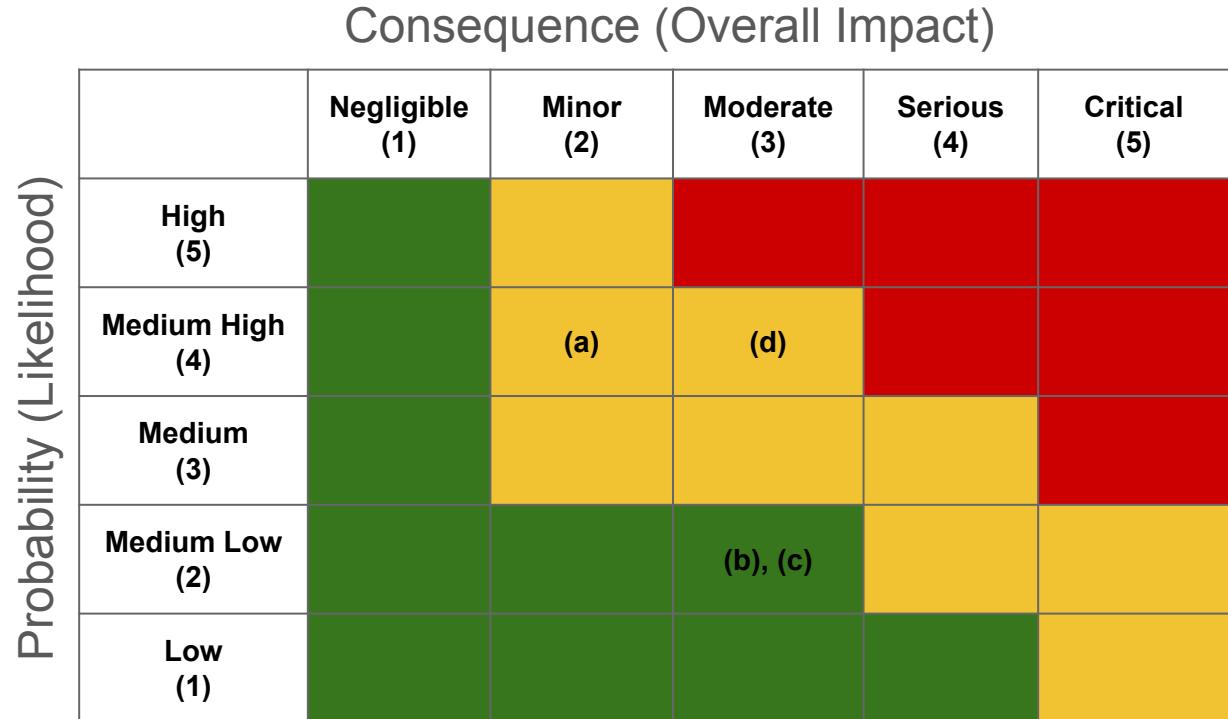
The overall impact was found by using a customer and design weighted average of the cost, schedule, and technical impacts of the given risk. The overall risk level was found by weighting the overall impact against the likelihood of occurrence.

1 - Lowest  
5 - Highest

# ATM Risk Matrix

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Description	Abbreviation
A network outage causes a disruption in ATM services	(a)
Incorrect transaction reported to banking subsystem	(b)
ATM accepts deposited counterfeit currency as valid	(c)
Incorrect foreign currency exchange rate	(d)



# ATM Risk Prioritization

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Based on the ATM Risk Matrix, the risks have been listed out below in priority order, with 1 being the highest priority risk and 4 being the lowest.

1. **Incorrect foreign currency exchange rate**
  - a. This risk is top priority as an incorrect currency exchange rate can be exploited by an dishonest actor to steal money from the ATM.
  - b. This is a risk during the duration of the ATM's lifecycle, however, proper mitigation will greatly reduce the likelihood associated with this specific risk.
1. A network outage causes a disruption in ATM services
  - b. A network outage will render the ATM useless until the network has returned.
  - c. This is a risk during the duration of the ATM's lifecycle.
1. Incorrect transaction reported to banking subsystem
  - b. This risk occurs when the ATM withdraws/deposits the incorrect amount of money from/to a customer. The overall impact is considered moderate as having an incorrectly reported transaction will cause inaccuracies in banking balance sheets. The likelihood of this risk is considered medium low as the ATM Maintenance Subsystem will perform routine self diagnostics that will catch incorrectly reported transactions before they become an issue.
  - c. This is a risk that can occur throughout the duration of the ATM's lifecycle, with the highest impact occurring during the operational phase of the system.
1. ATM accepts deposited counterfeit currency as valid
  - b. This risk is considered the lowest priority since mitigation practices are already in place for the ATM system that make the likelihood of the system accepting counterfeit currency negligible. Also, any user depositing counterfeit currency will have their identity tracked and video surveillance via the ATM hostile situation subsystem.
  - c. This is a risk during the duration of the ATM's lifecycle, however, proper mitigation will greatly reduce the likelihood associated with this specific risk.

# ATM “Top” Risk

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- **Risk:** The “top” risk of our system is an incorrect foreign currency exchange rate
- **Risk Approach:** The team will implement a design plan to mitigate this risk
- **Mitigation Justification:** The mitigation plan will be software based and have minimal impact on both cost and schedule, however, an unmitigated alternative has critical impacts.
- **Mitigation Approach:** The ATM will only perform the foreign currency exchange function when an exchange rate can be acquired from a minimum of two (2) external trusted sources within ten (10) seconds from the time of request, each rate must be within 0.25% of each other, and the higher price will be used.

# ATM “Top” Risk Monitoring & Control

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- A log of all foreign currency exchange transactions on the ATM will be kept on record. This log will be compared to a historical exchange rate graph, and the difference between the two exchange rates will be plotted. This historical plot will allow for monitoring of the risk, and the ability to ensure that proper exchange rates were used historically. This method will be updated on an hourly interval for live monitoring.
- Tracking during development phase through simulation: Run continuous simulation using live exchange rates, and execute currency exchanges at random times of the day for a minimum of 3 times per day. Data will be plotted and monitored.
- The architecture modeling tool could be used to assist with tracking risks by flowing requirements down from the functions as a means for mitigation.