COMP 3400 Mainframe Administration[1]

Christian Grothoff
christian@grothoff.org

http://grothoff.org/christian/

[1]These slides are based in part on materials provided by IBM's Academic Initiative.

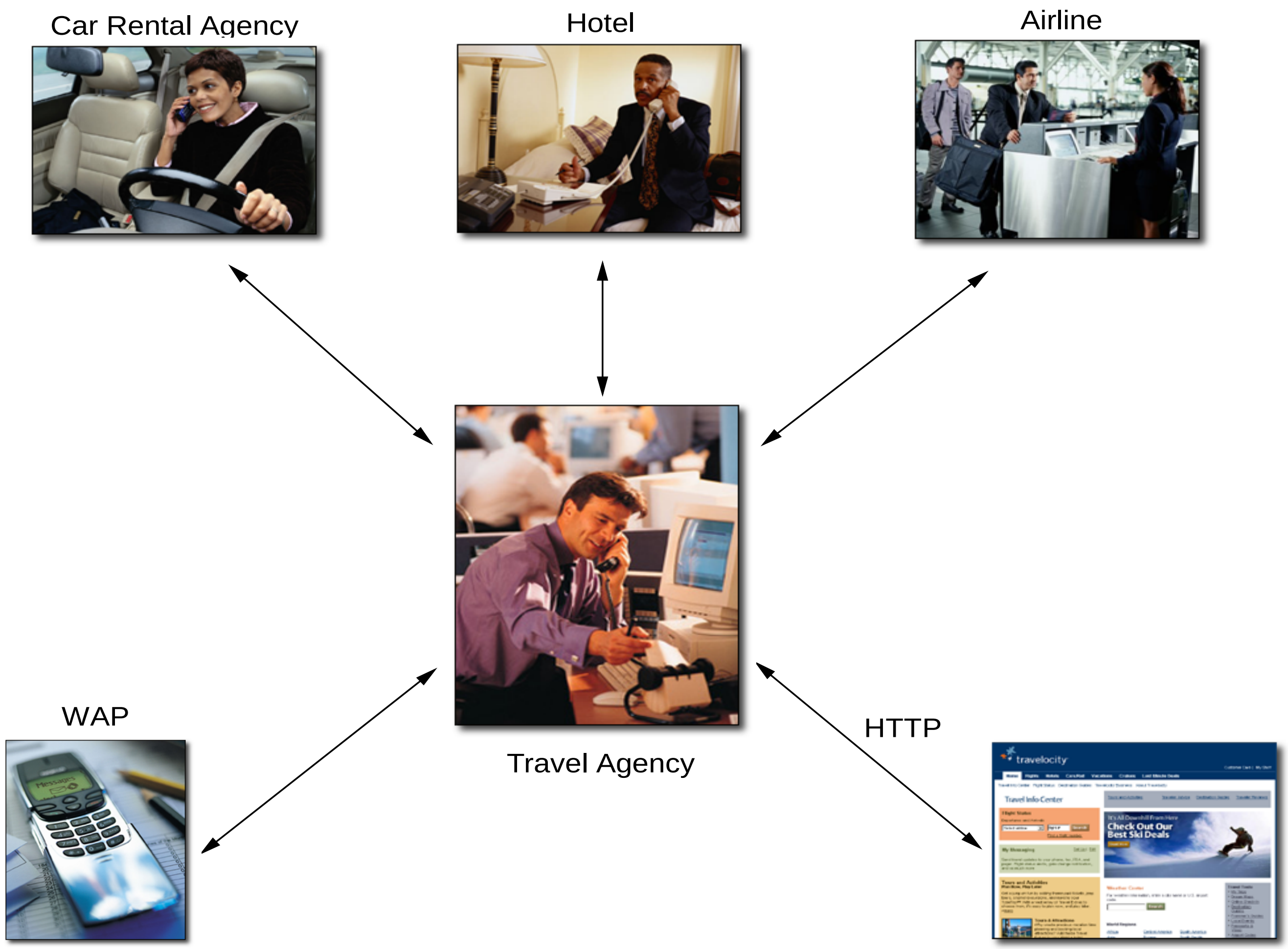
Example of online processing: a travel agency

A travel agency would use online processing for:

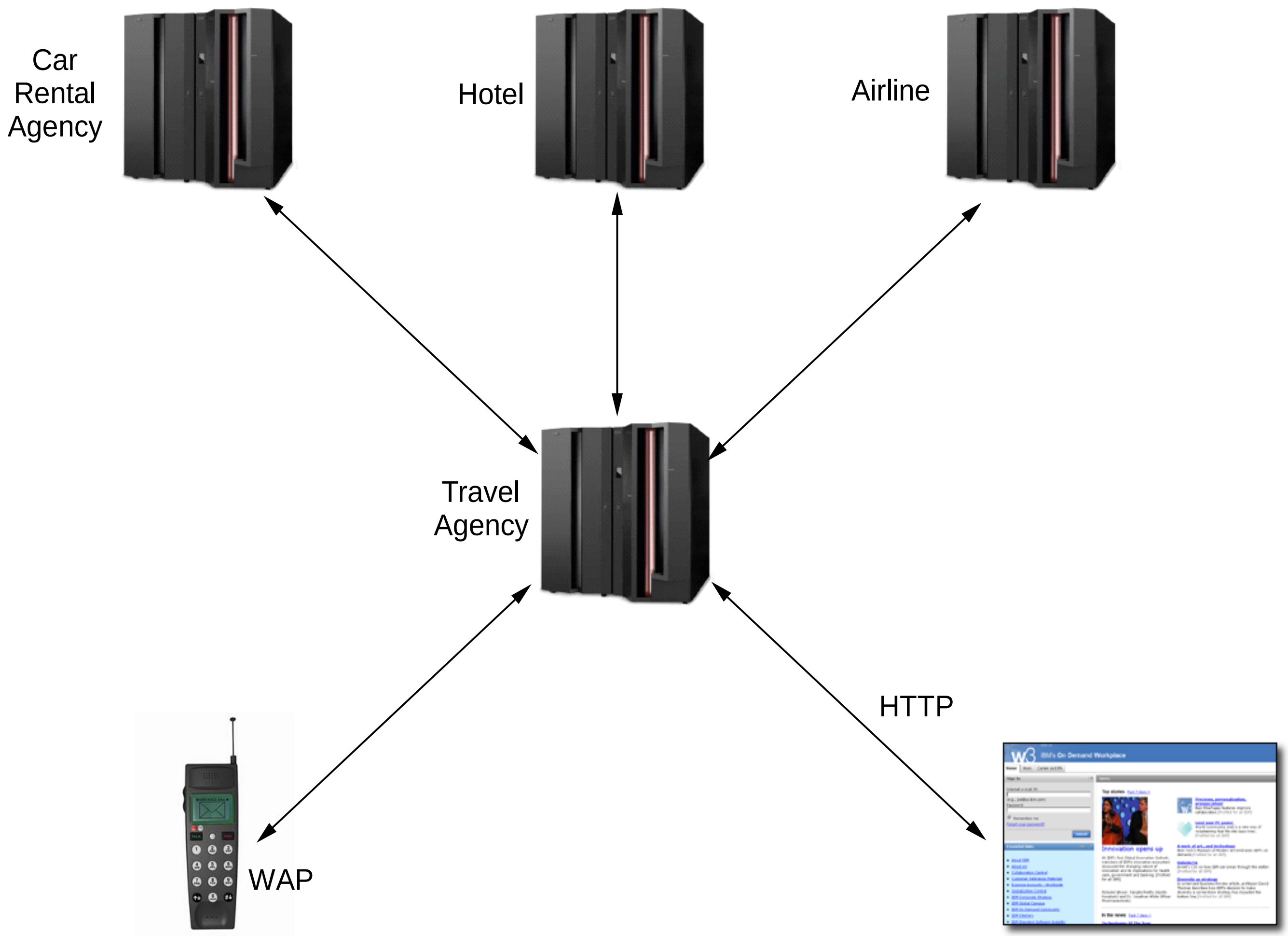
- employee and customer information
- contacts with car rental companies
- hotels
- airline schedules

In contrast to batch processing, changes must be reflected to end-users immediately (in real-time).

Example of online processing (continued)



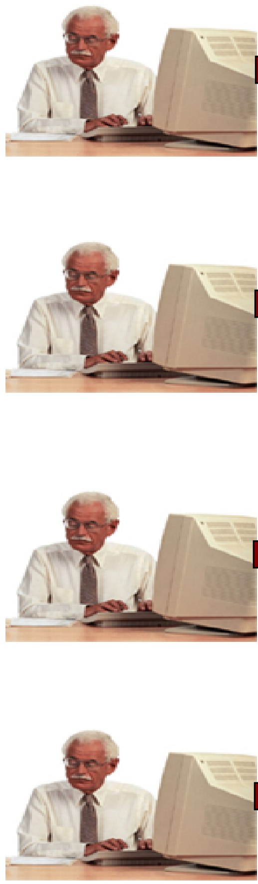
Example of online processing (continued)



Similarities: Online Systems and OSes

- Managing and Dispatching tasks
- Controlling user access
- Managing use of memory
- Managing concurrency of data
- Providing device independence

Characteristics of transactional systems



- Many users
- Repetitive
- Short interactions
- Shared data
- Data integrity
- Low cost / transaction

Terminology

- Multitasking
- Multithreading
- Thread
- Reentrancy
- Commit and roll back

Transactional System Requirements

- Atomicity
- Consistency
- Isolation
- Durability

Commonly known as ACID.

Atomicity

- Either all of the updates performed by the transaction are performed or none of them are.
- Example: if a bank transfers money from one account to another, it must not just withdraw or just deposit, both tasks must either succeed or fail

Consistency

- Databases often have consistency rules
- Example: (global) uniqueness of certain keys, up-to-date indices, etc.
- The consistency property requires that the database remains in a consistent state after the transaction after the transaction is over (assuming it was in a consistent state before)
- Database consistency must be preserved if the transaction was successful as well as if it was aborted!

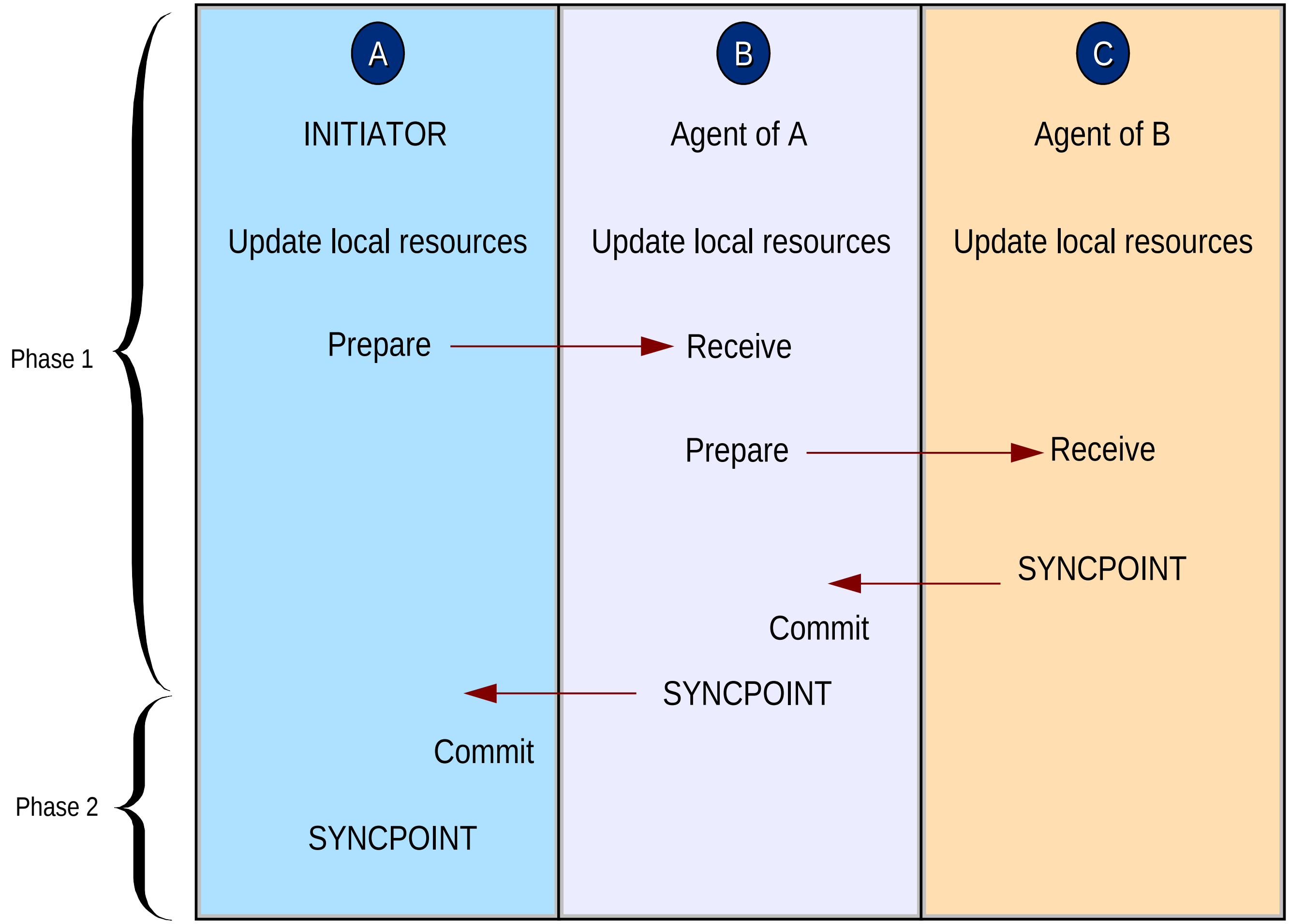
Isolation

- In most database systems, multiple transactions are executed concurrently
- One transaction may read values that another transaction is updating
- Isolation requires that transactions must not see the intermediate state of other transactions.
- Example: if I transfer \$500 from one of my accounts to another and a bank manager queries my total account balance at the same time, the result must not be $\pm$ \$500 of my net balance.

Durability

- After a transaction has reported success, no kind of (conceivable) system failure may undo the transaction
- In particular, this means that the database must guarantee that no other (concurrent, committing) transactions may violate the consistency or isolation properties of the transaction
- Since I/O operations on the actual tables are usually buffered, databases use an (append-only) transaction log that can be played back to recover committed transactions for which not all table updates had been fully written

Two-phase commit



The Resource Recovery Services (RRS)

RRS is the syncpoint coordinator that is build into z/OS.

- Before changes happen, the Unit of Recovery (UR) is *in-reset*
- While the UR makes changes, it is *in-flight*
- Once a commit request has been made, the UR is *in-prepare*
- After the syncpoint coordinator (RSS) at the **atomic instant** makes a decision, the UR is either *in-commit* or *in-backout*

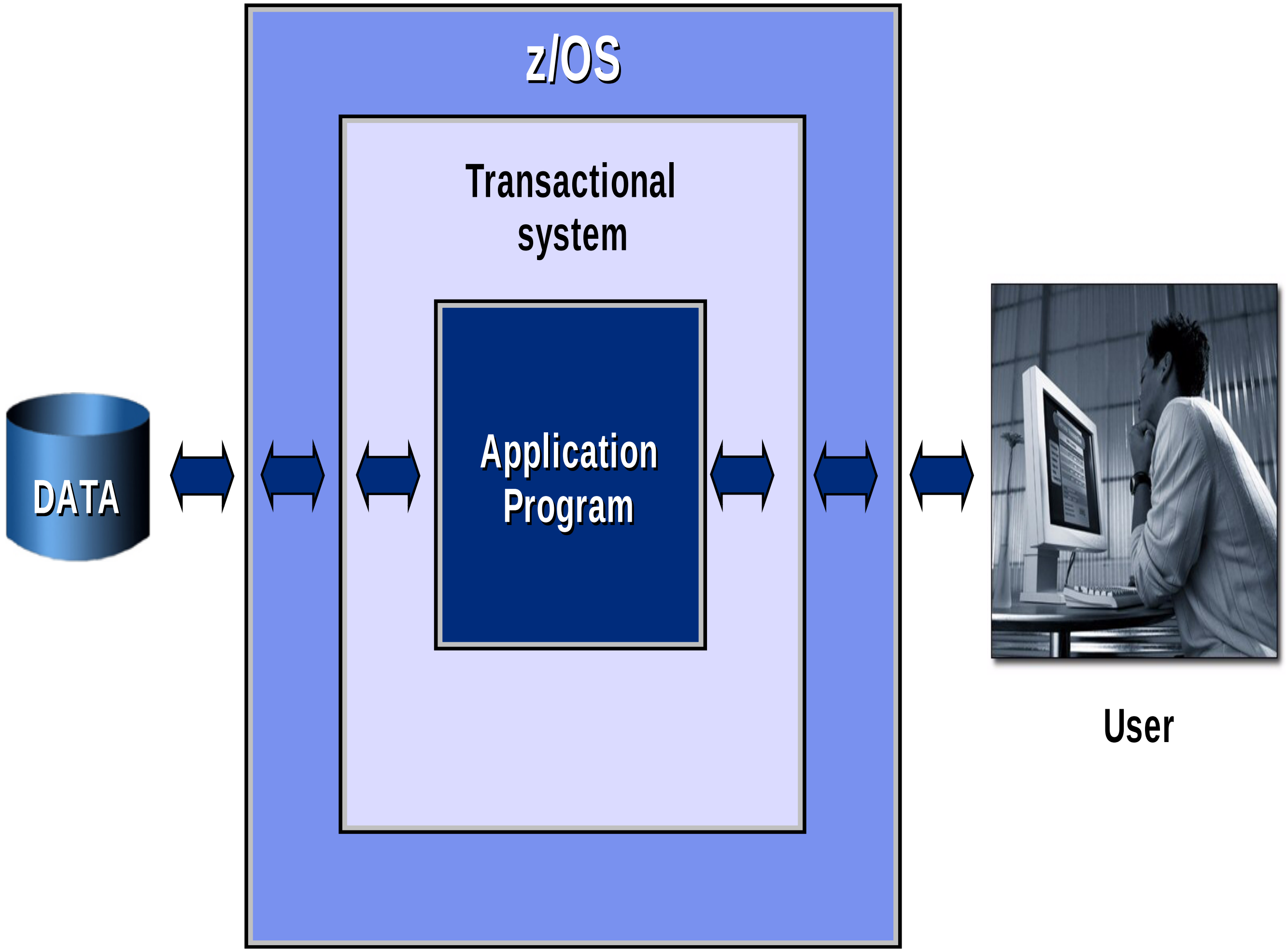
The Customer Information Control System (CICS)

CICS is a subsystem of z/OS which:

- controls transactions to run online applications
- manages the sharing of resources: many users using the same application(s) at the same time
- protects integrity of data
- prioritizes execution as needed

CICS is also available for other platforms.

CICS in a z/OS system



Languages Supported by CICS

- COBOL (including OO COBOL)
- C/C++
- Java
- PL/1
- Assembler

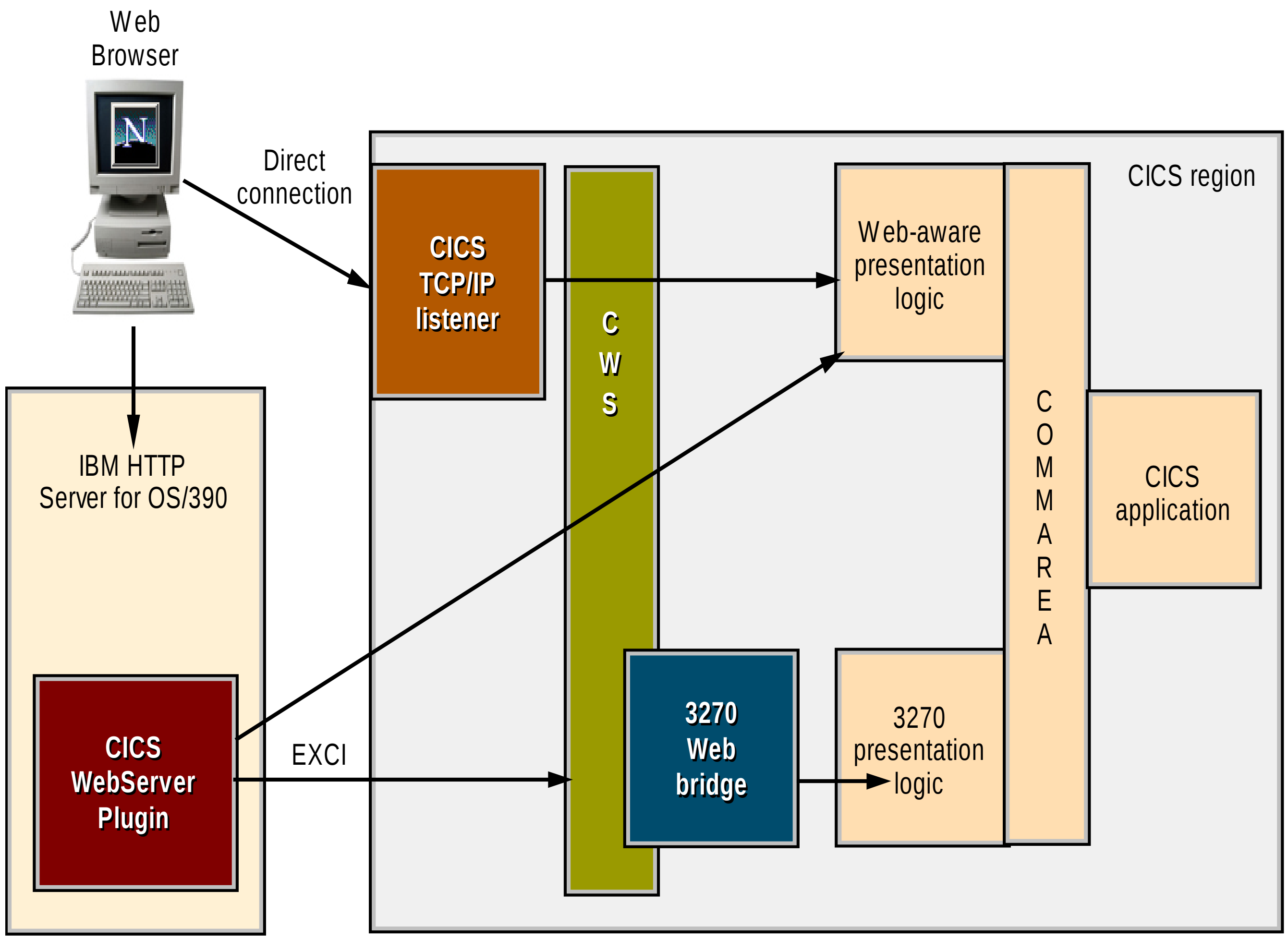
Platforms Supported by CICS

- z/Series (z/OS, OS/390, VSE)
- AIX
- HP-UX
- Solaris
- Windows

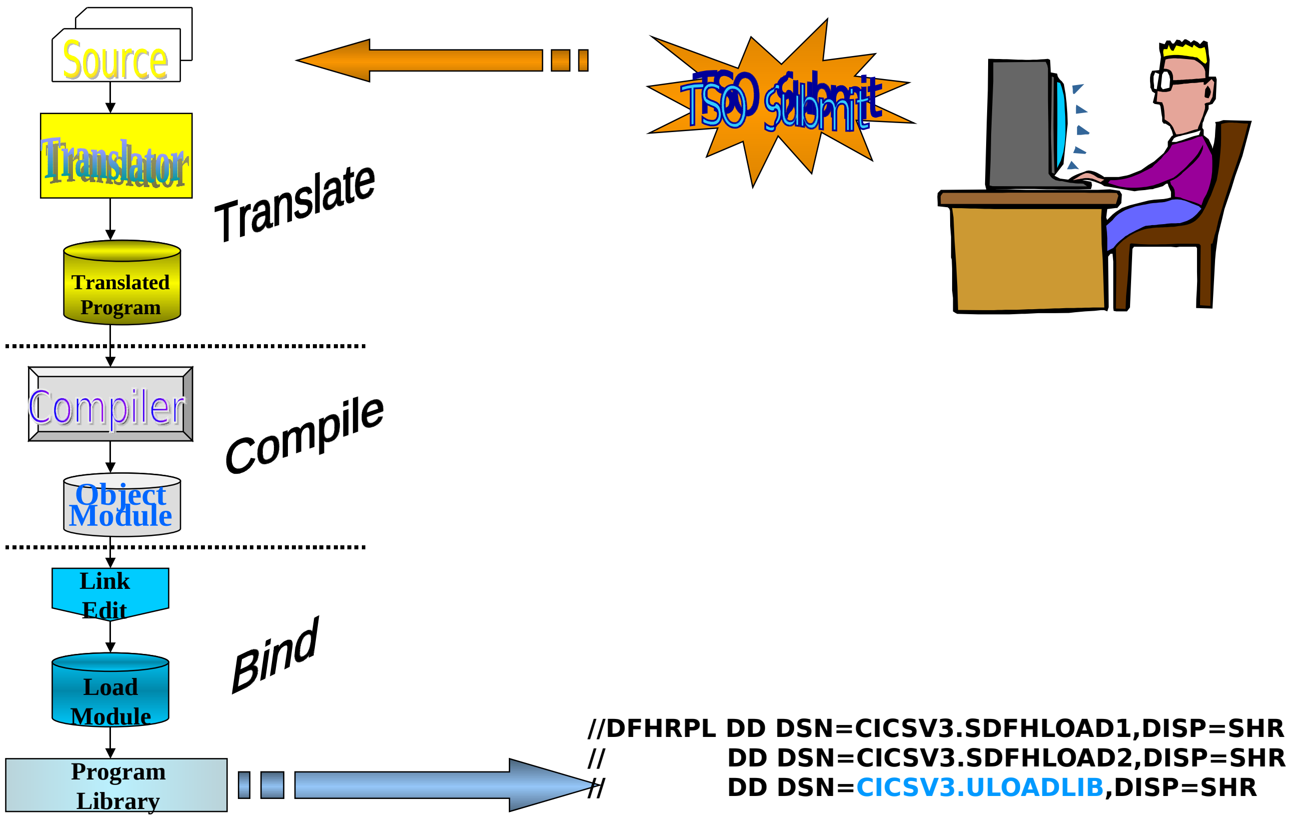
CICS features

- Task Control
- Basic Mapping Support
- File Control
- Program Control
- Storage Control
- Transient Data Control
- Journal Control (logging)
- Trace Control
- Dump Control
- Interval Control

Example: CICS Web Support



Compiling (COBOL) for CICS



CICS Programming commands

CICS commands are embedded into the normal source code:

```
EXEC CICS
  function option option ...
END-EXEC.
```

The specific syntax depends a bit on the language used.

Example CICS Programs

We will now see an example showing the use of CVDAs and the DFHVALUE function. The code:

- Tests whether the file named PAYROLL is closed
- If so, changes the UPDATE and DELETE option values for the file to UPDATEABLE and NOTDELETEABLE respectively (records can be updated but not deleted)
- DFHVALUE relates the internal representation of the status to the (human readable) value name
- Returns to CICS

Example: COBOL

```
WORKING-STORAGE SECTION.
01 FILE-STATUS-INFO.
  02 UOPST PIC S9(8) COMP.
  02 UUPD PIC S9(8) COMP.
  02 INFILE PIC x(8).
...
CICS-REQUESTS.
  MOVE 'PAYROLL ' TO INFILE.
  EXEC CICS INQUIRE FILE(INFILE)
            OPENSTATUS(UOPST) END-EXEC.
  IF UOPST = DFHVALUE(CLOSED)
     MOVE DFHVALUE(UPDATABLE) TO UUPD
     EXEC CICS SET FILE(INFILE)
               UPDATE(UUPD)
                NOTDELETEABLE END-EXEC.
  EXEC CICS RETURN.
```

Example: C

```
#define INFILE "PAYROLL "
main()
{
  long int mopst;
  long int mupd;
...
  EXEC CICS INQUIRE FILE(INFILE)
            OPENSTATUS(mopst);
  if (uopst == DFHVALUE(CLOSED) )
  {
     uupd = DFHVALUE(UPDATEABLE);
     EXEC CICS SET FILE(INFILE)
                   UPDATE(uupd)
                   NOTDELETEABLE;
  }
  EXEC CICS RETURN;
}
```

Example: PL/1

```
DCL (UPST,UUPD) FIXED BIN(31),
    INFILE CHAR(8);
...
  INFILE='PAYROLL ';
  EXEC CICS INQUIRE FILE(INFILE)
            OPENSTATUS(UOPST);
  IF UOPST = DFHVALUE(CLOSED) THEN DO:
    UUPD = DFHVALUE(UPDATABLE);
    EXEC CICS SET FILE(INFILE)
                UPDATE(UUPD)
                NOTDELETEABLE; END;
  EXEC CICS RETURN;
```

Example: Assembler

```
DFHE1STG
UOPST DS F *OPEN STATUS
UUPD DS F *UPDATE STATUS
INFILE DS CL8 *FILE NAME
...
MVC INFILE,=CL8'PAYROLL '
EXEC CICS INQUIRE FILE(INFILE) X
OPENSTATUS(UOPST)
CLC UOPST,DFHVALUE(CLOSED)
BNE OPENLAB
MVC UUPD,DFHVALUE(UPDATEABLE)
EXEC CICS SET FILE(INFILE) x
UPDATE(UUPD)
NOTDELETEABLE
OPENLAB EXEC CICS RETURN
```

Basic Mappping Support (BMS)

BMS is used to interact with users using a terminal:

- EXEC CICS SEND – display a screen on the terminal
- EXEC CICS RECEIVE – read data from terminal

BMS Example

```
EXEC CICS
         SEND MAP ( 'ORCHM01' )
              MAPSET ( 'ORCHM01')
              ERASE
END-EXEC.
EXEC CICS
         RECEIVE MAP ('ORCHM01')
              MAPSET('ORCHM01')
              INTO (workstorage area)
END-EXEC.
```

Defining the screens

- BMS macros are a form of assembler language
- The "assembler" generates a physical map which:
  - builds the screen
  - merges variable data between program and screen
  - sends variables back to the program

The BMS Macros

BMS Maps are composed of three simple macros:

- DFHMSD – name of map set (one per file)
- DFHMDI – name of map (many per map set)
- DFHMDF – field screen definitions and location (many per map)

Source for these is on Marist in `CICSTS13.CICS.SDFHMAC(DFHMxx)`.

Example

```
        PRINT NOGEN
ORCHM01 DFHMSD  TYPE=MAP,MODE=INOUT,CNRL=FREEKB,LANG=COBOL,TIOAPFX=YES
ORCHM01 DFHMDI  SIZE=(24,80)
        DFHMDF POS=(01,01),LENGTH=01,ATTRB=(ASKIP,DRK,FSET),   x
               INITIAL='1'
        DFHMDF  POS=(01,25),LENGTH=3,ATTRB=(ASKIP,BRT),        x
               INITIAL='PURCHASE  ORDER - - - FILE INQUIRY'
        DFHMDF POS(03,30),LENGTH=13,ATTRB=ASKIP,               x
               INITIAL='ORDER  NUMBER'
ORDER#  DFHMDF POS=(03,44),LENGTH=10,ATTRB=(NUM,BRT,IC)
        DFHMDF POS=(04,32),LENGTH=11,ATTRB=ASKIP,INITIAL='DEPARTMENT'
...
        DFHMSD  TYPE=FINAL
```

Example User Screen

ABCD Average salary by department

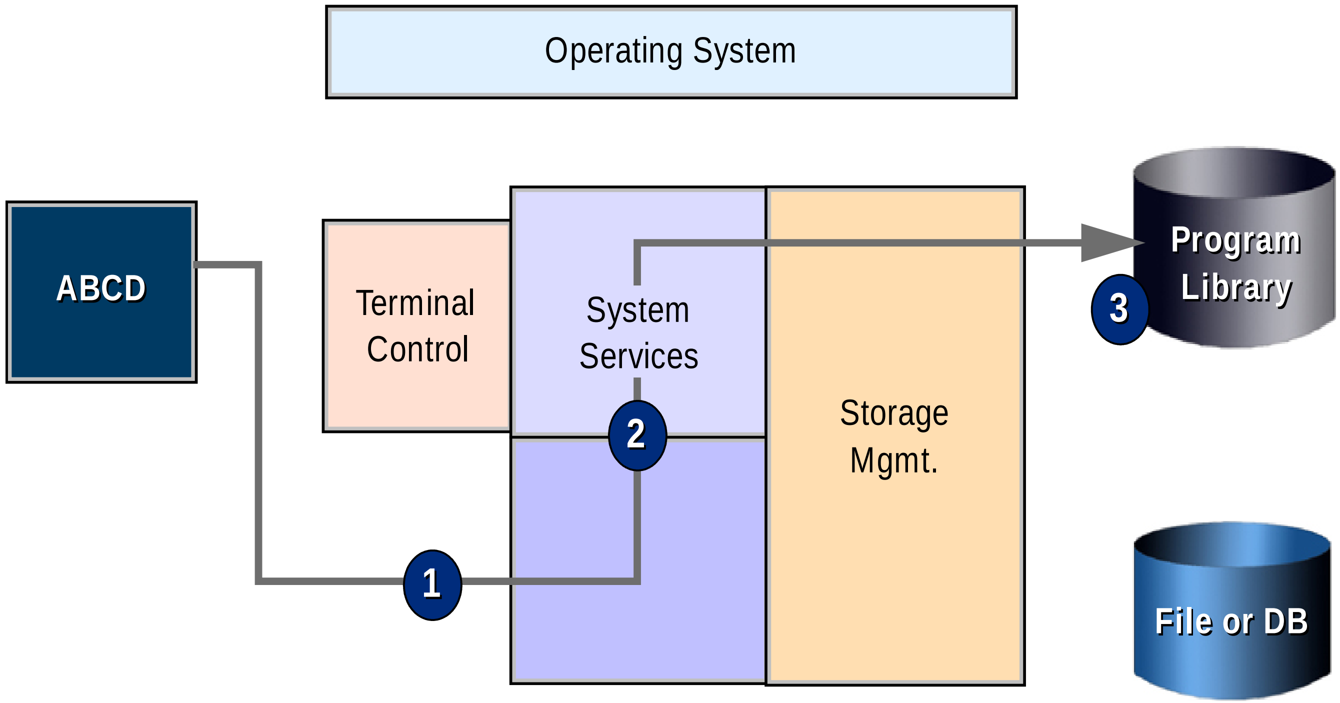
Type a department number and press enter.

Department number: A02

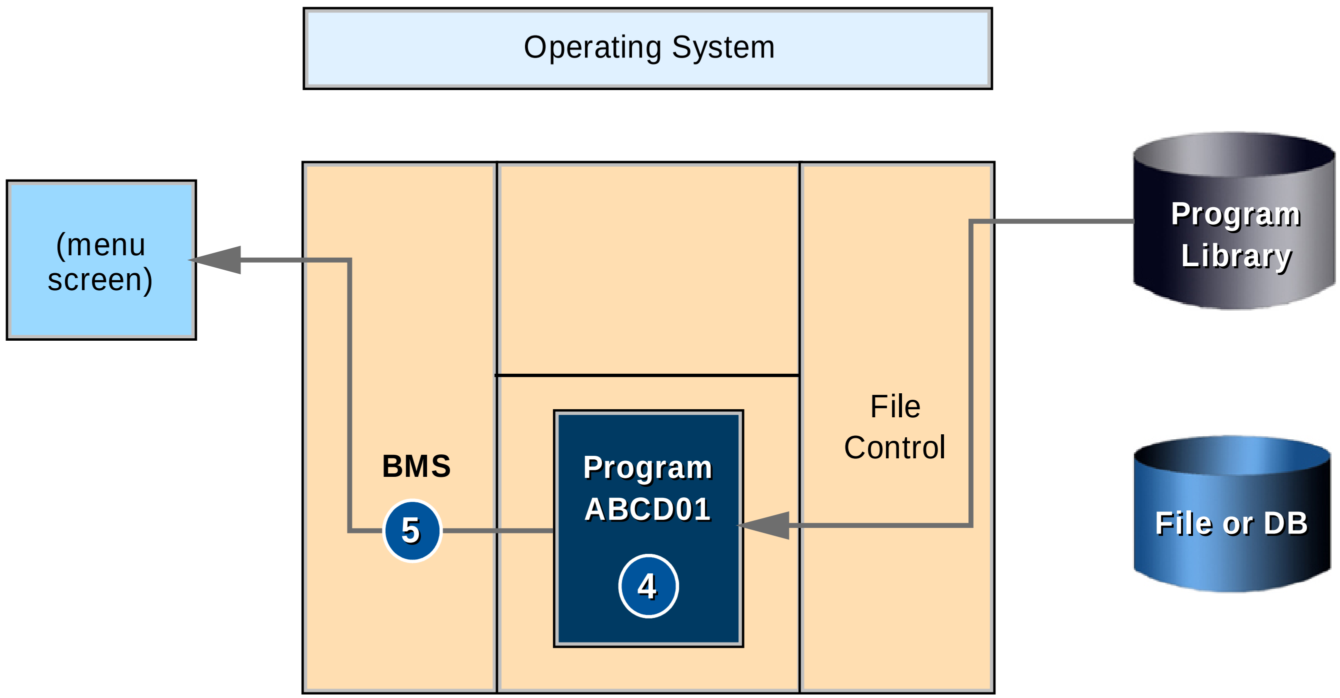
Average salary($): 58211.58

F3: Exit

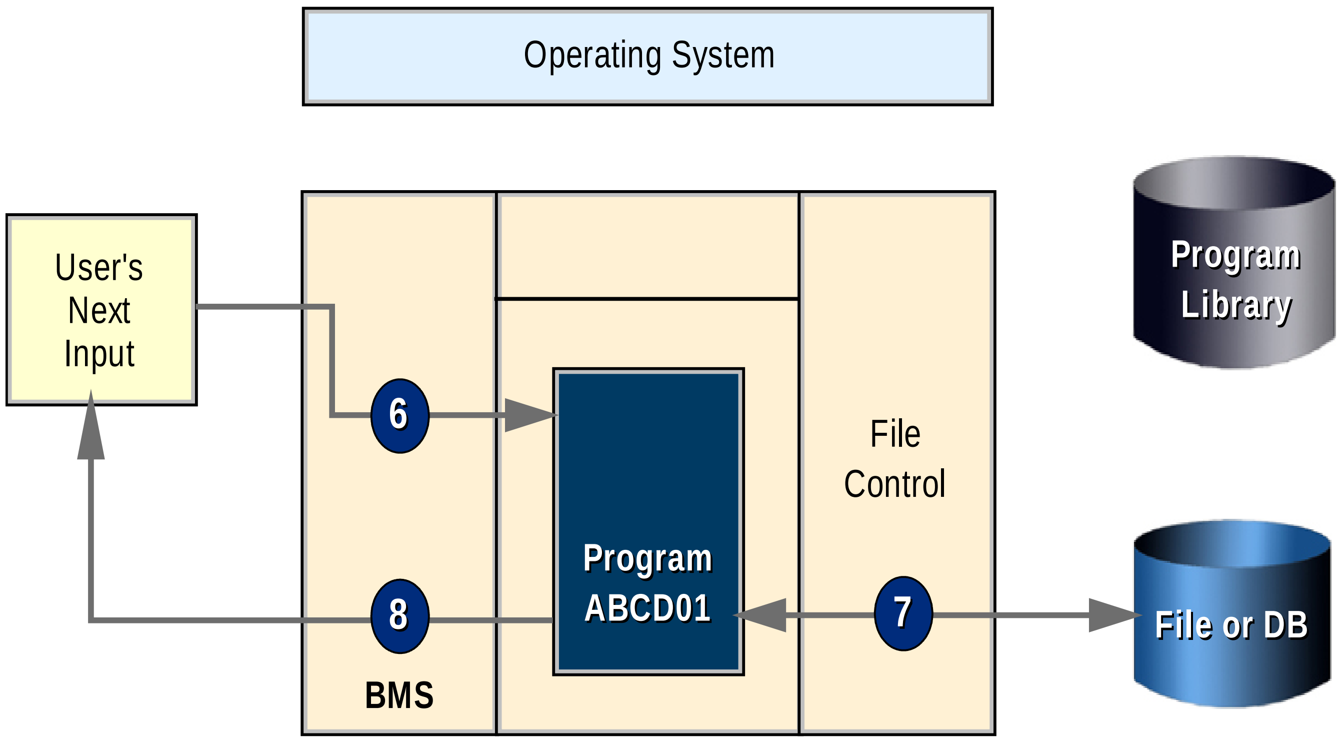
CICS transaction flow (1/3)



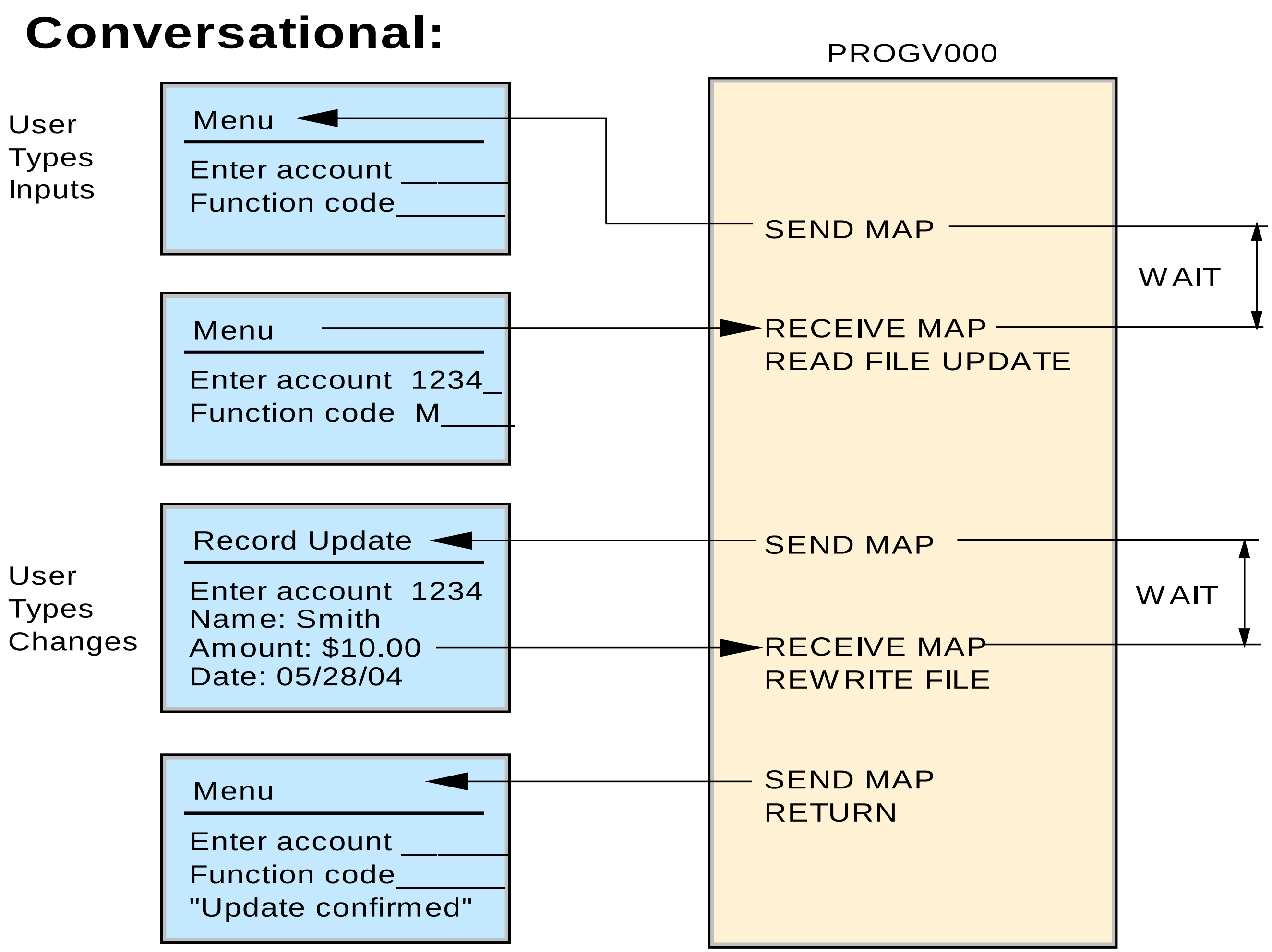
CICS transaction flow (2/3)



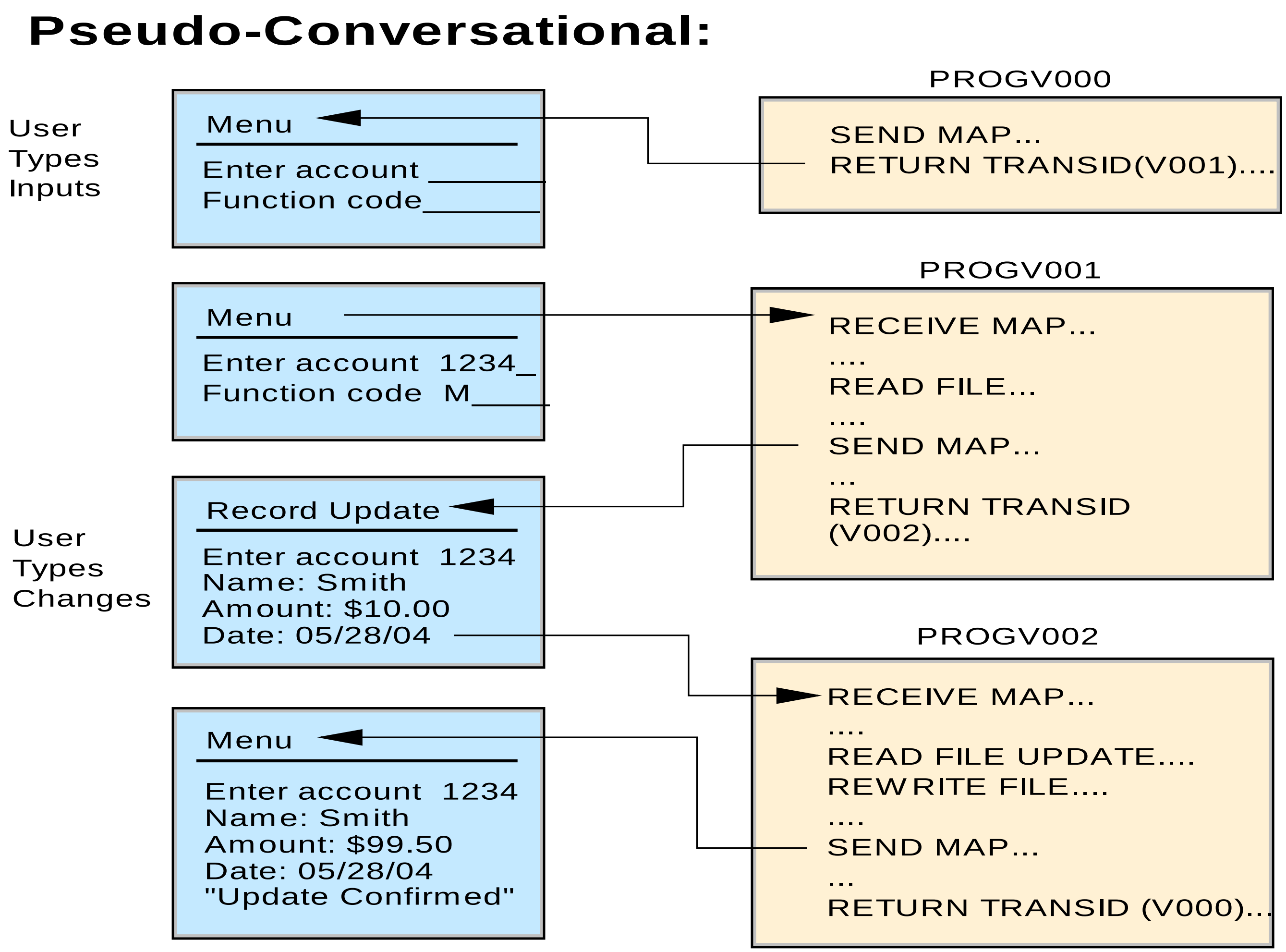
CICS transaction flow (3/3)



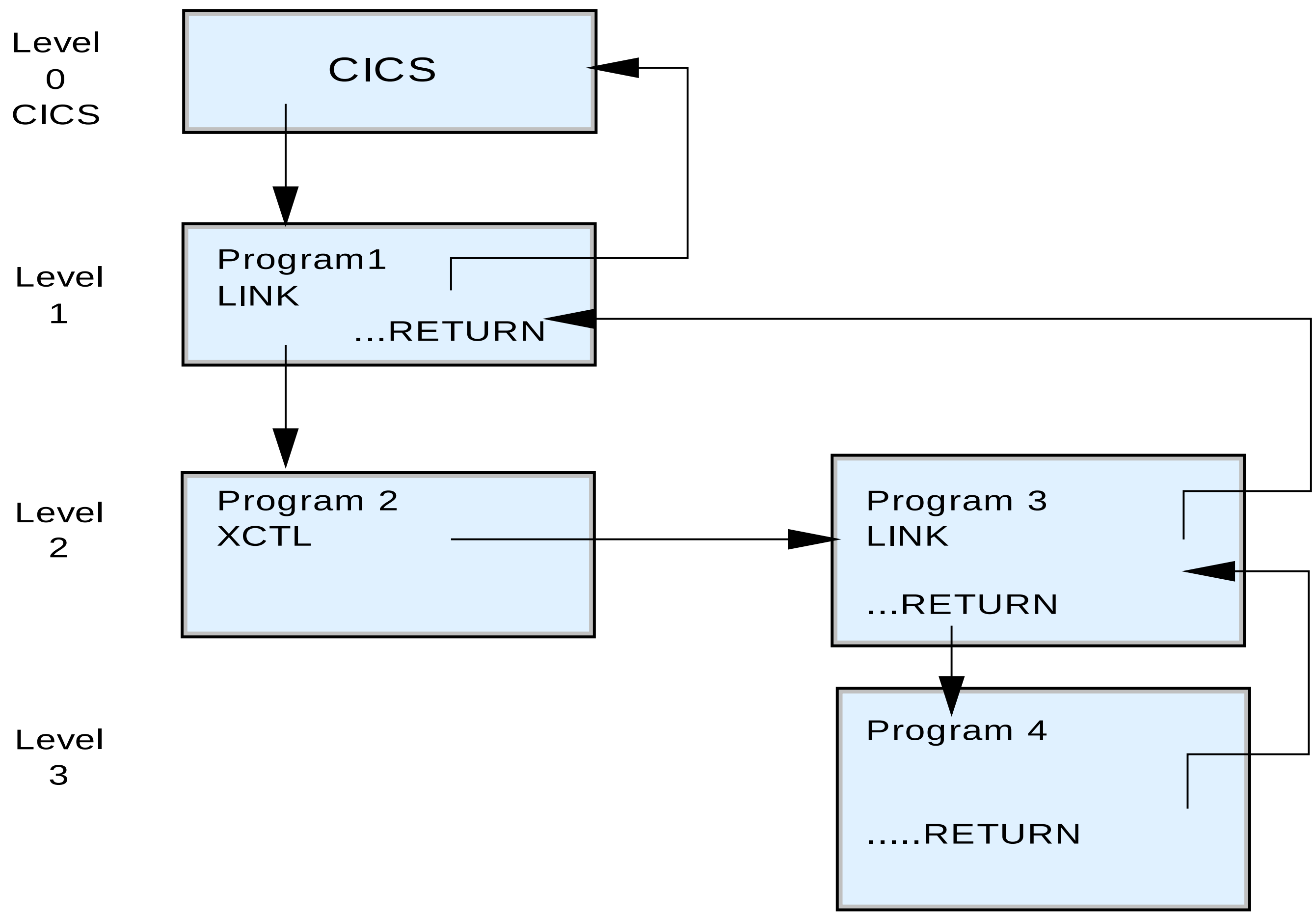
Conversational Style



Pseudo-Conversational Style



CICS Program Control Constructs



The CICS Communication Area (COMMAREA)

- Area is automatically provided to you via the translator phase
- Part of the DATA DIVISION / LINKAGE SECTION in COBOL
- Initially provides one byte to be used as a status word
- Can range up to 32k in size

Example: COMMAREA in COBOL[2]

```
01  DFHCOMMAREA.
        05 PROCESS-SW                PIC X.
             88 INITIAL-ENTRY        VALUE '0'.
             88 VERIFICATION         VALUE '1'.
        05 ACCOUNT-NUMBER            PIC X(10).
...
EXEC LINK PROGRAM(ACCTPGM)
          COMMAREA(DFHCOMMAREA)
          LENGTH(11)
END-EXEC.
```

[2] See also: http://publib.boulder.ibm.com/infocenter/cicsts/v2r3/index.jsp?topic=/com.ibm.cics.ts23.doc/dfhp3/dfhp36o.htm

CICS Programming Roadmap

- Design application
- Write & compile & test program
- Define program & transaction in CICS resources
- Define other resources (files, queues, etc.) in CICS resources
- Make resources known to CICS[3]

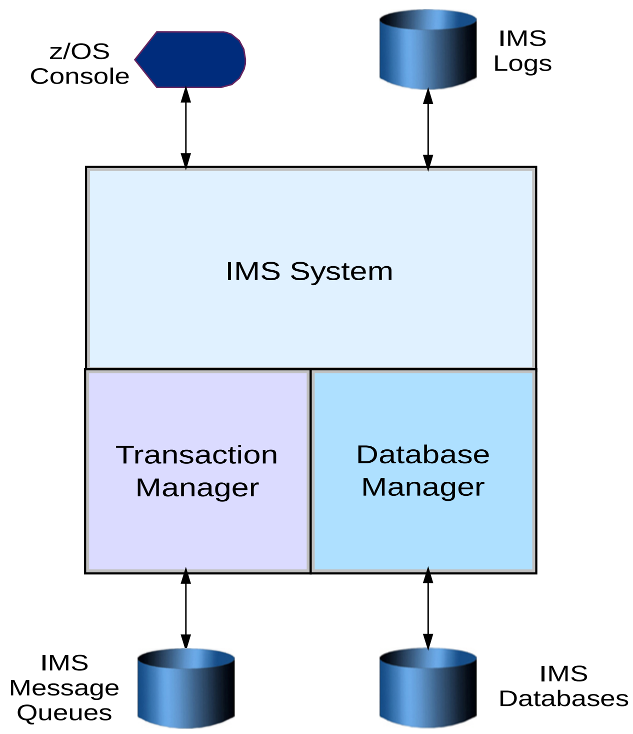
[3] See http://publib.boulder.ibm.com/infocenter/cicsts/v3r2/topic/com.ibm.cics.ts.doc/pdf/dfha4c00.pdf

The Information Management System (IMS)

IMS is another application used for online processing consisting of three components:

- Transaction Manager (TM)
- Database Manager (DB)
- System services (common services for TM and DB)

IMS Overview



IMS Transaction Manager Messages

An operator of an IMS terminal can send four kinds of messages to IMS TM; the destination determines the kind of message:

Another terminal Logical terminal name in the first 8 bytes

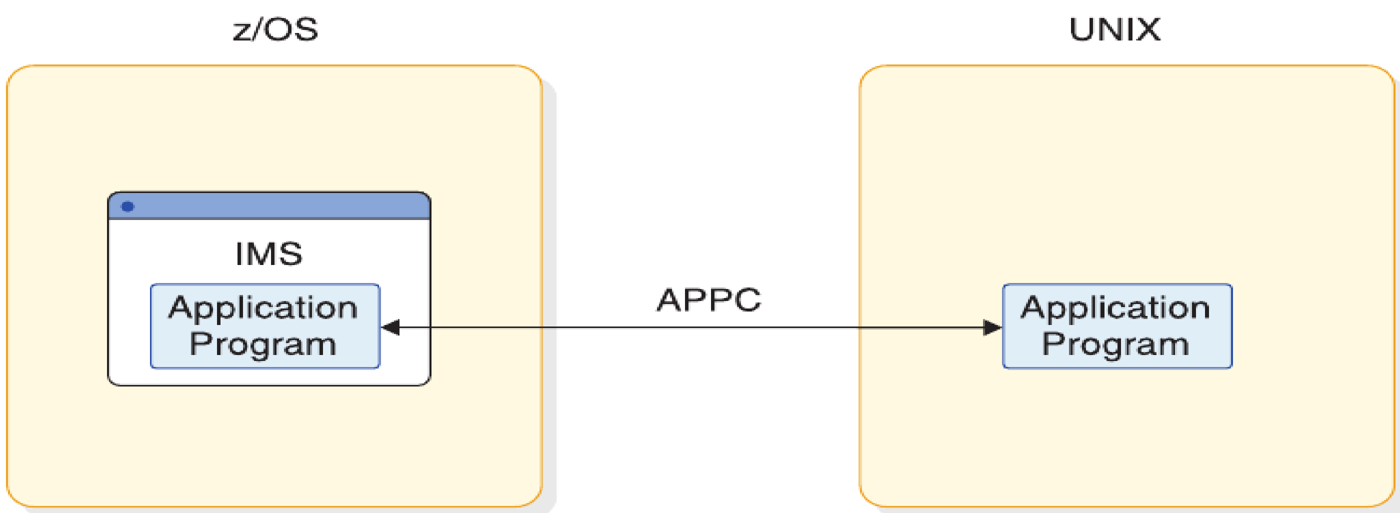
Application program Transaction code in the first 8 bytes

IMS TM A "/" (slash) in the first byte (command for IMS TM)

Message switch service Messages for the Advanced Program to Program Communication (APPC) feature of IMS[4]

[4]See `http://publibz.boulder.ibm.com/epubs/pdf/dfsccgh0.pdf` (IMS APPC documentation)

IMS APPC


z/OS
UNIX
IMS
Application Program
APPC
Application Program

Questions

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