Use Profiles to Monitor and Control Db2 Application Context

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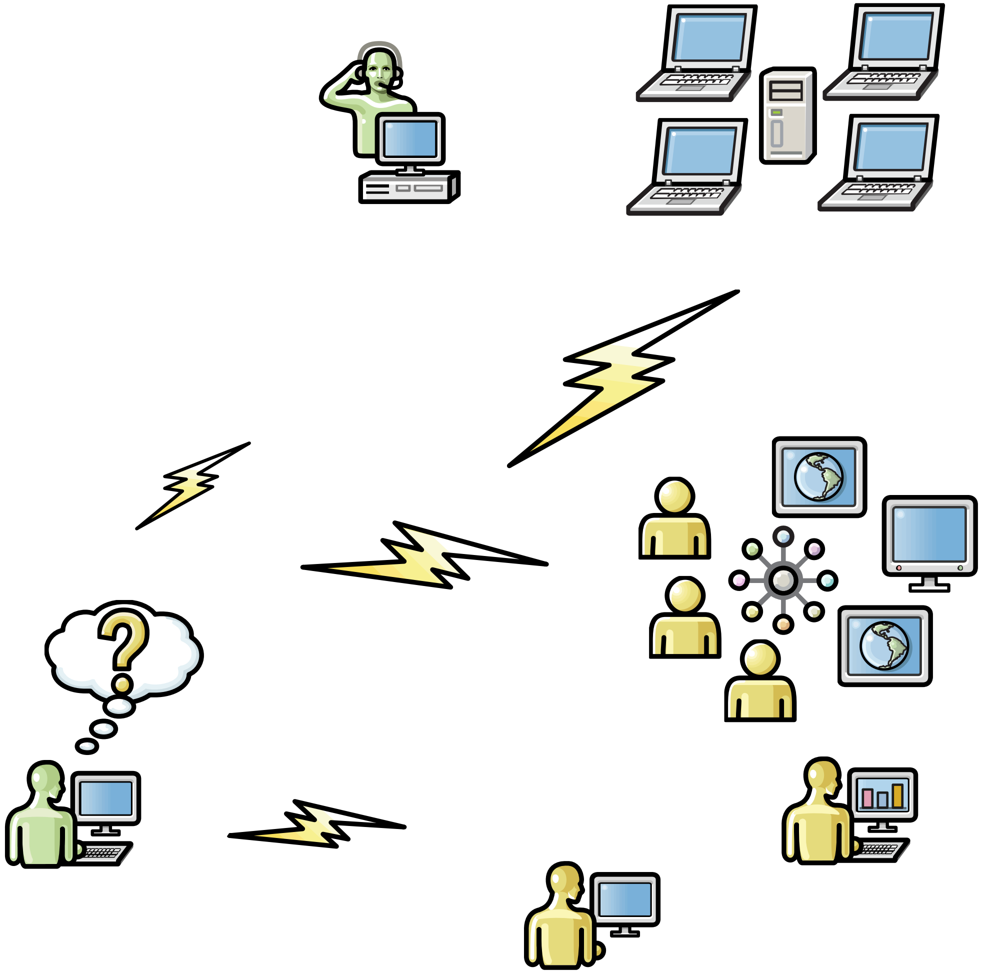
Agenda

- Overview profile monitoring
- Sample definition in profile tables
- Profile table characteristics
- Use cases
- Db2 13 extension to profile table functionality

Db2 for z/OS System Profile Monitoring

- **Resources to manage**
  - Connections
  - Threads
  - Timeouts
  - Special registers, Db2 defined global variables
  - Db2 13 Profile table support for local threads

- **Clients to support**
  - Priorities, demands
  - Variety of applications



Db2 for z/OS: System profile monitoring

- **Use cases:**
  - Prevent workload with denial-of-service attack characteristics
  - Manage migration to new driver level
  - Reserve threads for critical applications
  - Set special registers or global variables
    - Including accelerator, transparent archiving enablement
  - Non-distributed: anticipate production access paths in test
    - Model production values of RIDPOOL, SORTPOOL, BP allocations

- **How to exploit for distributed clients:**
  - Define a distributed application to a profile by qualifier
    - E.g. IP address, or AUTHID and/or ROLE, or driver level, or …
  - Assign values to profiles
    - E.g. threads more granular than single DSNZPARM value for MAXDBAT
    - And/or set special register(s) or global variable(s) for profile(s)

Overview: System Profile Monitoring

- Db2 provided tables
  - SYSIBM.DSN_PROFILE_TABLE
    - Define profile to represent filtering scope or context, a process such as an SQL statement, thread, or connection
  - SYSIBM.DSN_PROFILE_ATTRIBUTES:
    - Define actions for Db2 to take when criteria of the profile is met
    - Specify the
      - Monitoring function type in the KEYWORD column
      - Monitoring action in ATTTRIBUTE1 (warning or exception)
      - Thresholds IN ATTRIBUTE2

- Db2 command START PROFILE after DDF is started
  - START PROFILE issued for each member in a data sharing group
    - START PROFILE status remembered across DDF STOP/START
  - DSN6SYSP PROFILE_AUTOSTART=YES|NO

System profile monitoring: sample tables

SYSIBM.DSN_PROFILE_TABLE

ROLE	AUTHID	LOCATION	PRDID	COLLID	PKGNAME	PROFILEID	PROFILE_ENABLED
	SRVR1					20	Y
			JCC03570			21	Y
		TEST.SVL.IBM.COM				22	Y

SYSIBM.DSN_PROFILE_ATTRIBUTES

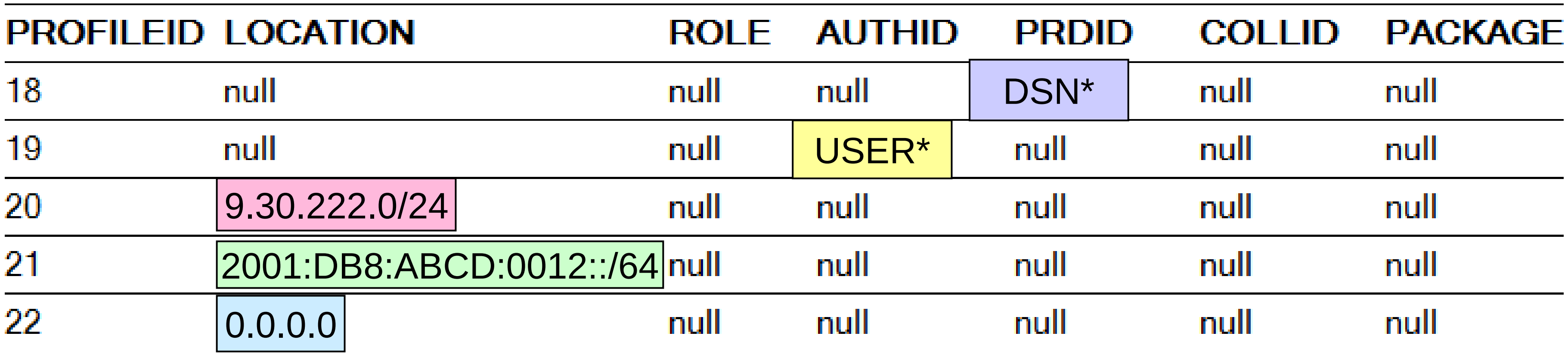
ProfileID	Keywords	Attribute1	Attribute2	Attribute3	Attribute Timestamp
20	MONITOR THREADS	EXCEPTION	10		2011-12-19...
21	MONITOR IDLE THREADS	WARNING	180		2011-12-19…
22	MONITOR CONNECTIONS	WARNING	45		2011-12-19…
22	MONITOR CONNECTIONS	EXCEPTION	90		2011-12-21…

- Values in DSN_PROFILE_TABLE cannot be specified in columns of more than one color (excluding black)
- Multiple rows in DSN_PROFILE_TABLE may apply to one user or application instance:
  for example, one profile based on the authid, another profile based on the product id, etc.
- Multiple rows in DSN_PROFILE_ATTRIBUTES can apply to one profile ID

System profile monitoring: wildcard support

- Use wildcard characters in some profile columns to allow matching against a range of AUTHIDs, or product IDs, or IP addresses
  - AUTHID column: use characters ending in * to match any AUTHID beginning with those characters
    - TEMP* in AUTHID would match any authid beginning ‘TEMP’, including TEMP with no trailing characters
  - PRDID column: multiple product identifiers that began with the same characters could match a single profile definition
    - DSN* would match to any version of a Db2 for z/OS requestor
  - LOCATION column supports wildcard matching of IP addresses as described on the next page

Wildcard support: examples



PROFILEID	LOCATION	ROLE	AUTHID	PRDID	COLLID	PACKAGE
18	null	null	null	DSN*	null	null
19	null	null	USER*	null	null	null
20	9.30.222.0/24	null	null	null	null	null
21	2001:DB8:ABCD:0012::/64	null	null	null	null	null
22	0.0.0.0	null	null	null	null	null

- LOCATION=‘9.30.222.251’ matches Profile 20
  - As would any IPv4 address beginning with 9.30.222

- LOCATION=‘2001:DB8:ABCD:0012:0000:0000:0000:1234’ matches profile 21
  - As would any IPv6 address beginning with 2001:DB8:ABCD:0012

- LOCATION='192.168.0.103’ matches profile 22, as does any other IP address that does not match on LOCATION in other DSN_PROFILE_TABLE rows

- The value after ‘/’ in profiles 20 and 21 represents number of bits in the address

Wildcard support, IP address details

- IPv4 subnet address: initial IPv4 address of a subnet followed by subnet prefix:
  - IPv4address/mm where mm is 8, 16 or 24, representing the number of initial bits of an IPv4 address belonging to the subnet
    - /24 means the first 24 bits of the address. In IPv4, the address is in 4 8-bit nodes. So /24 covers the first three nodes as the 'constant' address value. It is also possible to use /8 or /16.
    - Example: 9.30.222.0/24
    - A profile row with this value in LOCATION would match for any IP address in the range from 9.30.222.1 to 9.30.222.254

- IPv6 subnet address: initial IPv6 address of a subnet followed by subnet prefix:
  - IPv6address/mmm where mmm is 16, 32, 48, 64, 80, 96, or 112, representing the number of initial bits of an IPv6 address which belongs in the subnet
    - In IPv6, the value after the slash is also bits, but in IPv6, each node of the address is 16 bits. So in this example first 4 nodes times 16 bits = 64 bits of the 'constant' address.
    - Example: 2001:DB8:ABCD:0012::/64
    - A profile row with this value in LOCATION would match for any IP address in the range from
      - 2001:DB8:ABCD:0012:0000:0000:0000:0000 to
      - 2001:DB8:ABCD:0012:FFFF:FFFF:FFFF:FFFF

- 0.0.0.0, or ::0, which represents any IP address (IPv4 or IPv6, respectively)

System profile monitoring: ROLLBACK attribute

- MONITOR IDLE THREADS behavior with Attribute1 column value EXCEPTION
  - On exception, thread aborted and connection ***terminated***
  - Client may perceive that Db2 is 'unavailable', especially for those clients that have to re-establish the connection resource
  - Exceeding ZPARM IDTHTOIN has same effect

- ROLLBACK option
  - Thread is still aborted
  - Connection remains ***inactive***
  - Client will not have to re-establish connection
  - Options for ATTRIBUTE1 column
    - EXCEPTION_ROLLBACK
    - EXCEPTION_ROLLBACK_DIAGLEVEL1
    - EXCEPTION_ROLLBACK_DIAGLEVEL2

- DSNZPARM IDTHTOIN does NOT apply to distributed thread that meets the criteria for MONITOR IDLE THREADS profile.

System profile monitoring: ROLLBACK attribute

- If distributed thread qualifies and is idle for longer than the value in ATTRIBUTE2, and
  - Data changes have been made but not committed
    - Thread is aborted, DBAT is pooled
    - Database changes are rolled back
    - Connection is inactive; placed in ***must-abort***
  - Data changes have NOT been made
    - Thread is aborted, DBAT is pooled
    - Connection is inactive; resources may appear to have been lost
      - DGTT, LOB locator, held cursors, kept dynamic statements

Set global variables

- Applies to
  - Transparent Archiving for distr app without application change
  - IDAA query routing from distr app without application change

- Db2 12 supports setting the following global variables in system profile tables
  - SYSIBMADM.GET_ARCHIVE
  - SYSIBMADM.MOVE_TO_ARCHIVE
  - SYSIBM.TEMPORAL_LOGICAL_TRANSACTIONS
  - SYSIBM.TEMPORAL_LOGICAL_TRANSACTION_TIME

- SYSIBM.DSN_PROFILE_ATTRIBUTES table changes
  - KEYWORD value ‘GLOBAL_VARIABLE’ is available
  - ATTRIBUTE1 accepts SET statement for global variables
  - SET statement requires equal sign (=) between the global variable and the value assigned
  - Example: SET SYSIBMADM.MOVE_TO_ARCHIVE = ‘N’

Set global variables

MOVE_TO_ARCHIVE_DEFAULT added to DSNZPARM to set default for SYSIBMADM.MOVE_TO_ARCHIVE

- Rules for defining profiles and criteria for connection attributes do not change
- If unsupported global variables specified in ATTRIBUTE1
  - SYSIBM.DSN_PROFILE_ATTRIBUTES_HISTORY set to ‘REJECTED – UNSUPPORTED SET STATEMENT’
- If supported SET statements contain invalid values
  - SYSIBM.DSN_PROFILE_ATTRIBUTES_HISTORY set to ‘REJECTED – INVALID GLOBAL VARIABLE VALUE’
- Precedence for Global Variables
  - 1. Global variable(s) set explicitly by application SET statement(s)
  - 2. Global variable(s) set in system profile tables
  - 3. Global variable defaults
- In remote applications that match the profile, variable values are set before SQL statements are run
- Authorization
  - Authorization model for setting global variables within application does not apply to global variables set through profile tables
  - User authorized to insert rows into DSN_PROFILE_TABLE and DSN_PROFILE_ATTRIBUTES is considered authorized to set those global variables

System profile monitoring: message granularity

- Requirement: identify applications that exceed system profile thresholds
  - Knowing that a profile was exceeded (WARNING) or taking action when a profile was exceeded (EXCEPTION) is not always sufficient
  - Application information would be helpful to resolve problems or enforce behavior
  - Solution: provide LUWID for threads that exceed profile thresholds

- New messages, new ATTRIBUTE1 values, improved accounting trace
  - Change to DSNT773I: include LUWID for WARNING
  - New message DSNT774I: include LUWID for EXCEPTION
  - Profile ID added to accounting record if a warning or exception threshold is hit for a profile
  - ATTRIBUTE1 in DSN_PROFILE_ATTRIBUTES includes
    - WARNING_DIAGLEVEL3 to issue DSNT773I
    - EXCEPTION_DIAGLEVEL3 to issue DSNT774I

Prevent denial of service attack characteristics

- High TCP connection count, due to old idle Db2 connections that were abandoned by clients, requests for new connections/work is exhausting private storage
  - *Db2 connections are inactive and do NOT hold Db2 resources (DBAT), so Db2 zparm idle thread timeout does not apply*
  - *Idle connections remain for approx. 30 min before being closed by the client*
  - Old idle connections are essentially blocking new work and there is no way to manage this on the server side -> problem needs to be limited to appServer
- Add a Db2 monitor connection profile threshold per appServer
  - Set to ½ of connections for warning
  - It can limit the scope of a connection storm and ensure connections are not consumed by a few misbehaving appServers

ProfileID	Keywords	Attribute1	Attribute2	Attribute3	Attribute Timestamp
20	MONITOR THREADS	EXCEPTION	10		2011-12-19...
22	MONITOR CONNECTIONS	WARNING	90		2011-12-19…
22	MONITOR CONNECTIONS	EXCEPTION	180		2011-12-19…

Sample: Manage Migration to New Driver Level

- Identify driver level by activating distributed location statistics stats class(7) which is ifcid(365)
- Still difficult to convince clients to upgrade driver level
  - Define profile table entry for PRDID of driver level that needs to be migrated and ATTRIBUTE1 column to WARNING for period of time.
  - Update ATTRIBUTE1 column to EXCEPTION to prevent old driver level to connect to DB2 when ready to enforce

ROLE	AUTHID	LOCATION	PRDID	COLLID	PKGNAME	PROFILEID	PROFILE_ENABLED
			JCC03570			21	Y
		TEST.SVL.IBM.COM				22	Y

ProfileID	Keywords	Attribute1	Attribute2	Attribute3	Attribute Timestamp
21	MONITOR THREADS	WARNING_DIAGLEVEL2	1		2011-12-19…
22	MONITOR CONNECTIONS	WARNING	45		2011-12-19…

Db2 13 extension to profile table functionality
Profile table support for local threads

- Current behavior
  - Profile tables can be used by DBA to set special registers for distributed threads only
  - Local applications cannot easily change:
    - Special registers
    - Global variables
  - Application developer required to make changes to local applications

- New behavior

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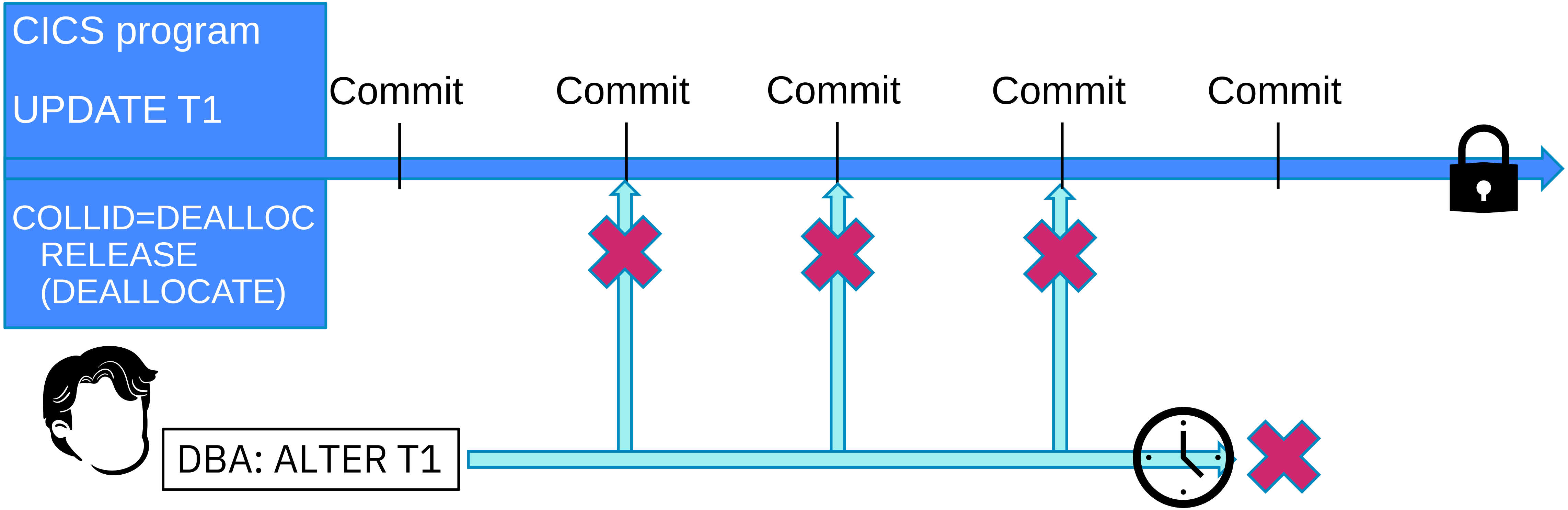
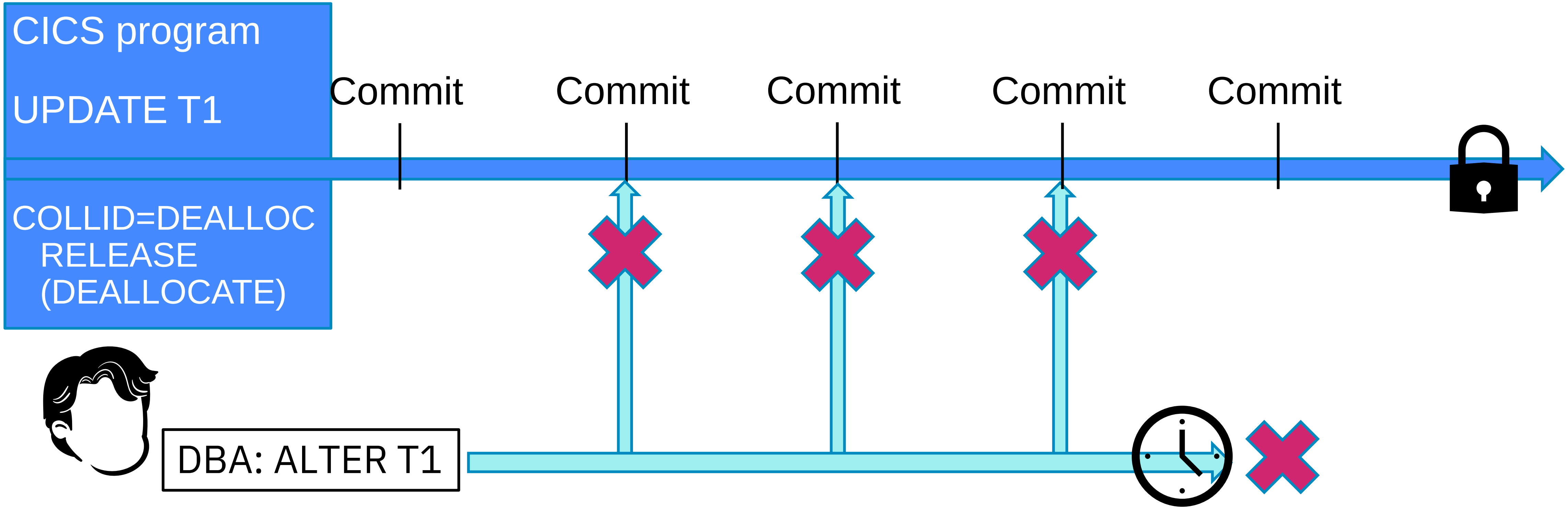
  - Profile tables enhanced
    - Local thread support in some situations
    - New special register:
      - CURRENT LOCK TIMEOUT
    - New built-in global variable:
      - SYSIBMADM.DEADLOCK_RESOLUTION_PRIORITY
    - New keyword: RELEASE_PACKAGE

Challenge scenario:
RELEASE(DEALLOCATE) and ALTER TABLE



DBA needs to add a new column to the table T1, However packages are bound with the bind option RELEASE(DEALLOCATE) prevents DDL execution

Solution scenario (1|3)



DBA: INSERT INTO SYSIBM.DSN_PROFILE TABLE ... ;
INSERT INTO SYSIBM.DSN_PROFILE_ATTRIBUTES ... ;

Solution scenario (2|3)

- INSERT INTO SYSIBM.DSN_PROFILE_TABLE…

PROFILEID	COLLID	PROFILE_ENABLE
99	DEALLOC	Y

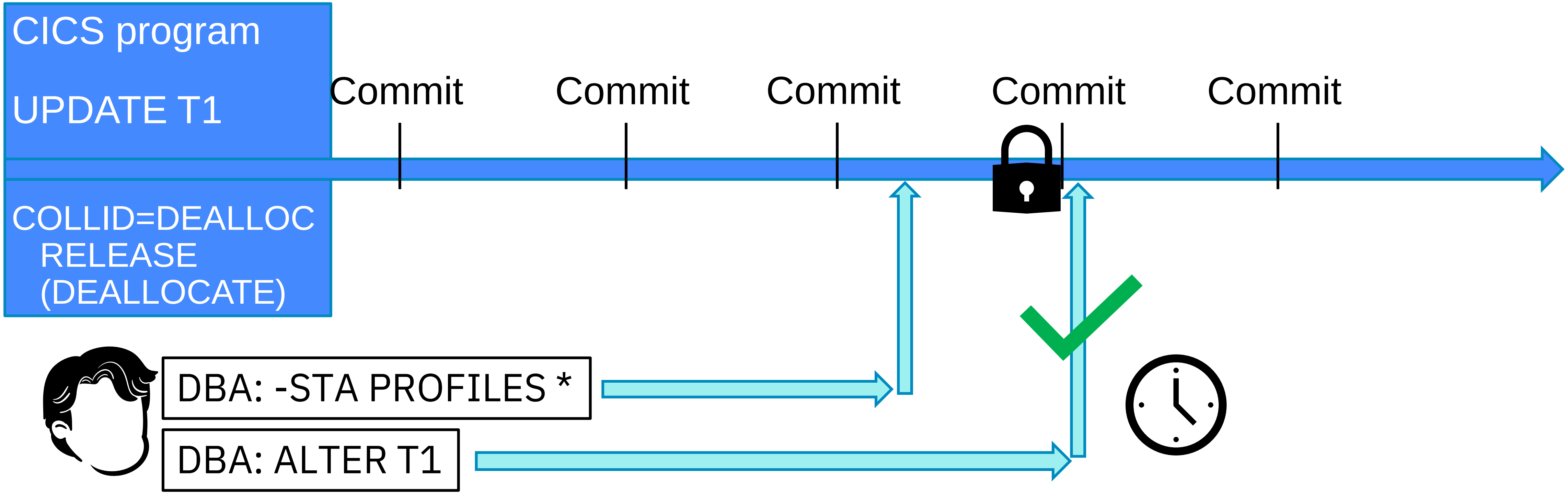
- INSERT INTO SYSIBM.DSN_PROFILE_ATTRIBUTES…

PROFILEID	KEYWORD	ATTRIBUTE1	ATTRIBUTE2
99	RELEASE_PACKAGE	COMMIT	2

ATTRIBUTE1 COMMIT overrides the RELEASE setting for the collection

ATTRIBUTE2 determines scope: NULL – distributed only; 1 – local only; 2 – local and distributed

Solution scenario (3|3)



```
SET CURRENT LOCK TIMEOUT = 60 -- assuming IRLMRWT is 30
SET SYSIBMADM.DEADLOCK_RESOLUTION_PRIORITY = 255
ALTER TABLE T1 ADD C1 INT
```

* as described on prior page

Profile table support for local threads – other details

- The scope of each SET assignment statement (remote, local, or both) is specified through the ATTRIBUTE2 column of the DSN_PROFILE_ATTRIBUTES table.
- **For remote threads:** Profiles are evaluated and SET statements are processed only when the first package is loaded, and the first non-SET statement within that package is executed.
- **For local threads:** Profiles are evaluated and SET statements are processed when each package is loaded.

Summary

- Understand profile monitoring as important capability to influence workload behavior
- Review use cases applicable in your environment
- Db2 13 extended profile table functionality for local threads