

# EPV Performance University 2021



- z/OS Performance Analysis
- WLM Update
- Db2 Performance Analysis

23rd February 2021






# CICS and IMS transactions



# Agenda

- Goal settings and management
- Resource accounting
- Work Manager delays





# Goal settings and management



# Goal settings and management

- CICS and IMS transactions can be managed:
  - by the velocity goals assigned to the regions
  - towards the response time goals assigned to the transactions
- The second option (aka WLM Server Management) looks much easier to understand from the point of view of setting and measuring the goal
- However, it requires a clear understanding of what WLM does behind the scenes



# Goal settings and management

- To manage CICS and IMS towards transactions goals you should:
  - assign CICS and IMS A.S. to a service class with adequate importance and velocity goal
  - create a transaction service class for a specific group of critical transactions with a response time goal (percentile) under the CICS or IMS subsystems



# Goal settings and management

- Transactions starting with SH and running in the CXA1 subsystem will be assigned to the CXA1SH service class

```
Subsystem-Type  Xref  Notes  Options  Help
-----
                Modify Rules for the Subsystem Type                Row 1 to 2 of 2
Command ==> _____ SCROLL ==> PAGE

Subsystem Type . : CICS      Fold qualifier names?   Y   (Y or N)
Description    . . . CICS rules (report classes only)

Action codes:  A=After      C=Copy          M=Move          I=Insert rule
                B=Before    D=Delete row   R=Repeat       IS=Insert Sub-rule
                                           More ==>

-----Qualifier-----
Action  Type  Name  Start
-----
  _____  1  SI    CXA1
  _____  2  TN    SH*

-----Class-----
Service  Report
-----
DEFAULTS: CXOTH      RCXOTH
           _____
           CXA1SH    RCXA1SH
```



# Goal settings and management

- Then you have to:
  - decide which region you want to manage towards the transaction service class goal (region becomes a server) and which you will manage using velocity
  - go in STC or JES classification rules and by using PF11 find the “Manage Using Goal of” field
  - It should be set to TRANSACTION





# Goal settings and management

- CXA1 region will be managed with a transaction goal
- All the other regions will be managed with a velocity goal

```

Subsystem-Type  Xref  Notes  Options  Help
-----
Command ==> _____ Modify Rules for the Subsystem Type Row 1 to 8 of 47
SCROLL ==> PAGE

Subsystem Type . : STC      Fbld qualifier names?  Y  (Y or N)
Description . . . STARTED TASK

Action codes:  A=After      C=Copy      M=Move      I=Insert rule
                B=Before      D=Delete row R=Repeat    IS=Insert Sub-rule
                <=== More

Action      -----Qualifier-----      Storage      Manage Region
            Type      Name      Start      Critical      Using Goals Of

_____ 1 TN      CXA1      _____ NO      TRANSACTION
_____ 1 TN      CXA2      _____ NO      REGION
_____ 1 TN      CXA3      _____ NO      REGION
_____ 1 TN      CXA4      _____ NO      REGION
_____ 1 TN      CXA5      _____ NO      REGION
_____ 1 TN      CXA6      _____ NO      REGION
_____ 1 TN      CXA7      _____ NO      REGION
_____ 1 TN      CXA8      _____ NO      REGION
    
```



# Goal settings and management

- Most important points to remember:
  - WLM manages regions towards the goal of the most important transactions being served
  - Resources are assigned to the region service classes
  - No resource usage is accounted to the transaction service classes unless you run CICS 5.3 and IMS 14 or above
  - Information about the number of transactions completed and their response time is always provided
  - In addition, information about work manager delays are available

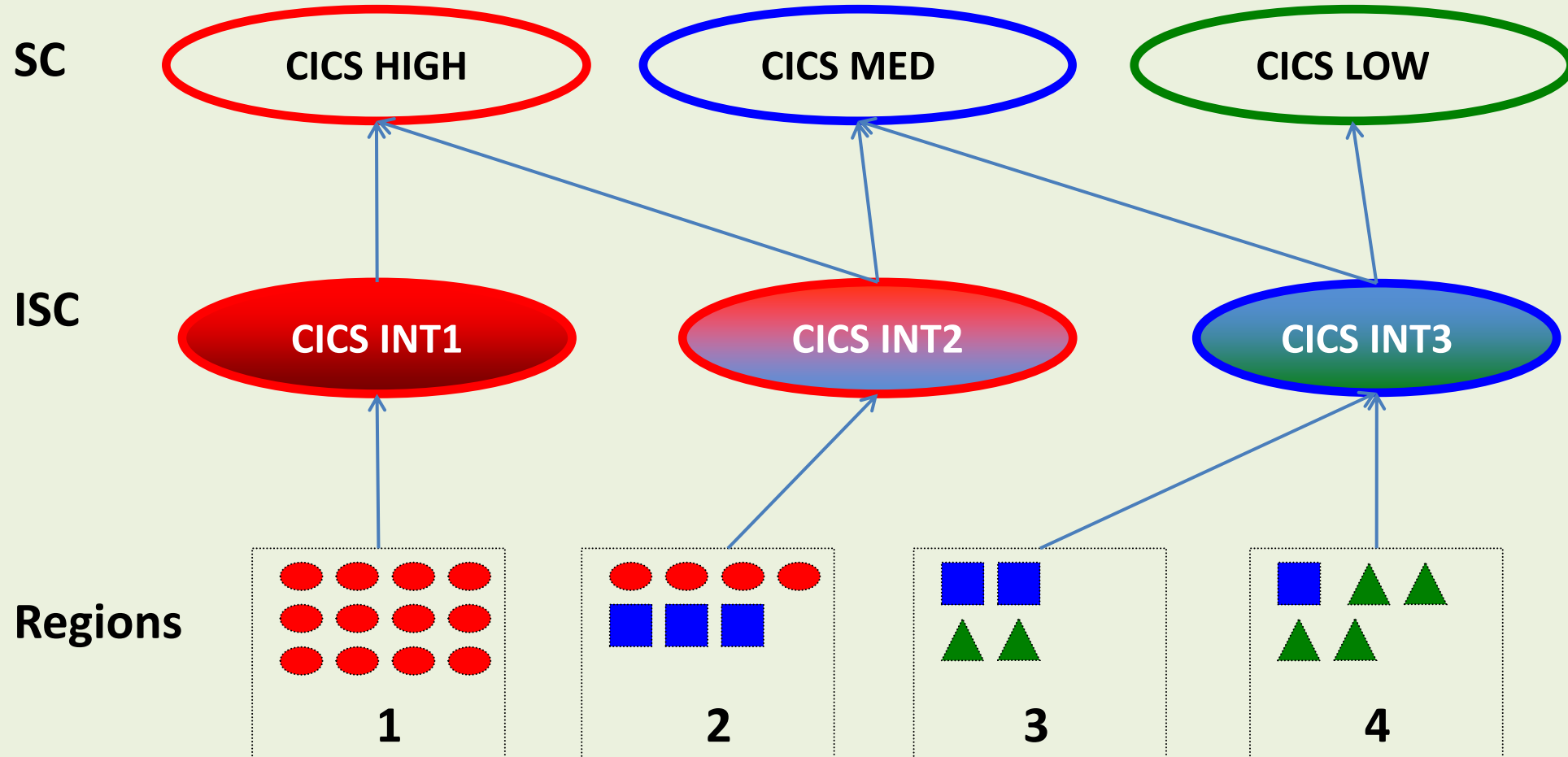


# Goal settings and management

- When you define transaction service classes WLM continuously collects data to understand which region processes which type of work
- WLM creates a topology, including the server address spaces and the service classes of the work requests
- It uses this topology to create internal service classes and manage the server address spaces based on the contribution of each internal service class to the achievement of the external service class goal



# Goal settings and management



# Goal settings and management

- In the previous slide:
  - Region 1 (more likely) and Region 2 should be helped by WLM to try to meet CICS HIGH goal
  - Region 2 (more likely), 3 and 4 should be helped by WLM to try to meet CICS MED goal
  - Region 3 and 4 (more likely) should be helped by WLM to try to meet CICS LOW goal



# Goal settings and management

- You should not mix transactions with very different characteristics in the same service class or CICS regions such as:
  - service transactions with user transactions
  - long-running and short-running transactions
  - CPU-intensive and I/O-intensive
  - transactions with different levels of business importance
- The more service classes you define the more complex is the topology
- Max Internal SC =  $2^n - 1$   
with  $n$  = number of external service classes



# Goal settings and management

- When a service class for CICS and IMS transactions is used, regions are managed to meet the goals of the transaction they are serving and the goals of the CICS and IMS regions are ignored
- You can use the BOTH option in “Manage Using Goal of” field to manage CICS TOR with the region goal while maintaining bookkeeping of transaction completions and response time to the correct service class



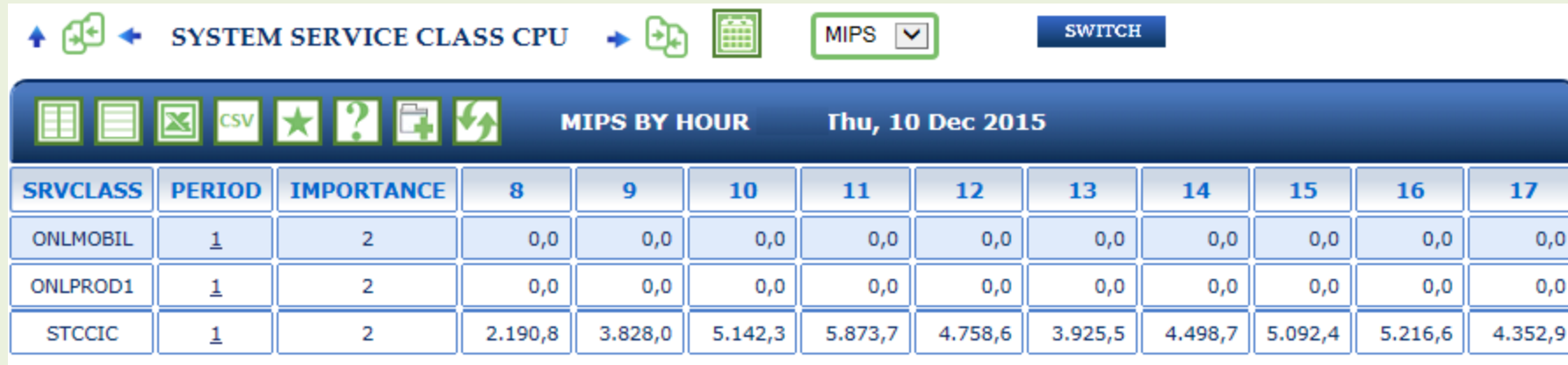


# Resource accounting





# Resource accounting



The screenshot shows a web-based performance monitoring interface. At the top, it displays 'SYSTEM SERVICE CLASS CPU' and 'MIPS' with a dropdown menu. Below this is a navigation bar with icons for various actions and the text 'MIPS BY HOUR' and 'Thu, 10 Dec 2015'. The main content is a table with columns for 'SRVCLASS', 'PERIOD', 'IMPORTANCE', and hours 8 through 17. The table shows that STCCIC has significant MIPS values, while ONLMOBIL and ONLPROD1 have zero values.

SRVCLASS	PERIOD	IMPORTANCE	8	9	10	11	12	13	14	15	16	17
ONLMOBIL	<u>1</u>	2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
ONLPROD1	<u>1</u>	2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
STCCIC	<u>1</u>	2	2.190,8	3.828,0	5.142,3	5.873,7	4.758,6	3.925,5	4.498,7	5.092,4	5.216,6	4.352,9

- No resource is accounted to ONLMOBIL and ONLPROD1 (CICS versions older than 5.3) which have a percentile response goal for CICS transactions
- Everything is accounted to STCCIC assigned to the CICS regions
- The same happens with IMS older than V14



# Resource accounting

↑ ↻ ← SERVICE CLASS RESPONSE TIME DISTRIBUTION → ↻ 📅

📄 📄 📄 CSV ★ ? 📄 ↻ ONLMOBIL PERIOD=1 IMP=2 DURATION=0 GOALTYPE=PERCENTILE GOAL=0,025 PERCENT=90 Thu, 10 Dec 2015

BUCKET	TOTAL	8	9	10	11	12	13	14	15	16	17
<= 0,01	4.548.538	195.043	239.794	276.240	304.209	295.338	278.889	265.042	282.039	299.645	263.171
<= 0,015	249.500	10.580	12.163	14.221	16.067	15.976	15.088	14.410	15.580	16.902	15.040
<= 0,017	175.853	7.764	8.856	10.321	11.299	11.035	10.166	9.740	10.548	11.411	11.182
<= 0,020	187.709	9.120	10.422	11.781	12.366	12.045	10.825	10.070	10.657	11.369	10.581
<= 0,022	92.196	4.766	5.198	5.547	5.779	5.406	5.120	4.603	4.971	5.427	5.065
<= 0,025	124.175	7.110	8.954	6.458	6.299	5.636	5.386	4.757	5.081	5.479	5.336
INGOAL	5.377.971	234.383	285.387	324.568	356.019	345.436	325.474	308.622	328.876	350.233	310.375
<= 0,027	69.147	4.365	6.557	4.362	3.010						
<= 0,030	51.717	2.560	4.267	3.586	2.513						
<= 0,032	55.418	2.903	3.929	4.477	3.030						
<= 0,035	28.550	1.613	1.899	2.283	1.608						
<= 0,037	35.902	2.108	2.285	2.536	2.145						
<= 0,050	92.701	6.309	5.650	6.037	5.641						
<= 0,100	215.830	11.885	6.702	12.709	18.359						
> 0,100	28.525	1.421	869	901	978	689	590	923	1.744	3.060	2.819
OVERGOAL	577.790	33.164	32.158	36.891	37.284	32.767	30.403	27.660	30.121	31.749	28.585
ENDED	5.955.761	267.547	317.545	361.459	393.303	378.203	355.877	336.282	358.997	381.982	338.960
PCTGOAL	90	88	90	90	91	91	91	92	92	92	92

- Transaction counts and response time distribution provided for ONLMOBIL



# Resource accounting

- New SMF metrics providing SU by transactions allow to separate transactions' and regions' consumption:
  - R723TSUCP, SU consumed by transactions, executed on GCP
  - R723TSUSP, SU consumed by transactions, executed on zIIP
  - R723TSUOCP, SU consumed by transactions, eligible to run on zIIP, but executed on GCP
- Available from CICS 5.3 and IMS 14



# Resource accounting

## Exercise 1

- A CICS region has been assigned to the CICSREG service class and by using the “old” metrics you can see its CPU usage in the peak hour is 792 CPU seconds
- The new R723TSUCP metric will tell you that the portion of the region CPU used by transactions is 58.320.000 service units
- The system SU rate is 90.000

What is the region overhead?



# Resource accounting

## Exercise 1

- CPU seconds used by transactions is:

$$58.320.000 \text{ SU} / 90.000 \text{ SU/sec} = 648 \text{ sec}$$

- Region overhead is:

$$(792 \text{ sec} - 648 \text{ sec}) / 792 \text{ sec} = 18,2\%$$





# Work Manager delays



# Work manager delays

- WLM provides a wide set of macros (Workload Management Services) with the primary objective of allowing cooperation with the z/OS subsystems (Work Managers) in order to achieve the required performance goals and provide information on how well these goals have been achieved
- With CICS and IMS, these services are used when running service classes with transaction goals
- Similar enclave services are always used for WebSphere service classes



# Work manager delays

- The most important basic services are:
  - IWM4CON; to establish a connection with WLM
  - IWM4CLSY; to classify an incoming request in the appropriate Service Class period
  - IWM4DIS; to disconnect from WLM



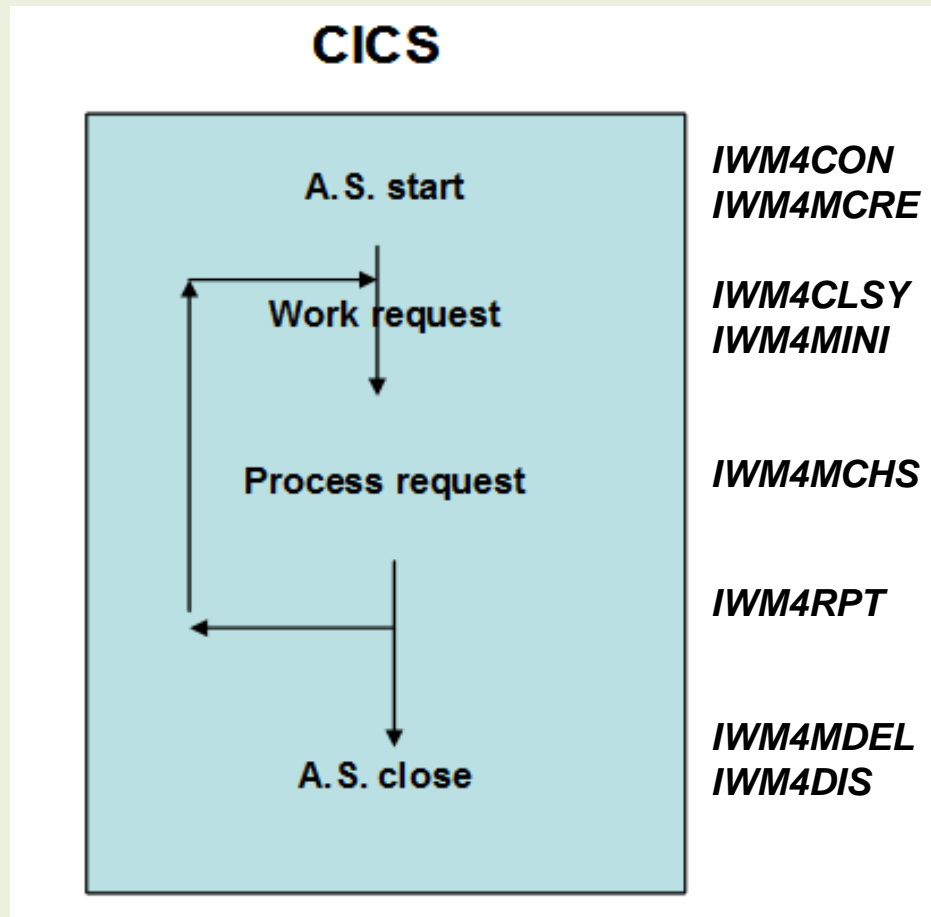


# Work manager delays

- The most important services measuring activity and delays are:
  - IWM4MCRE; to create a monitoring environment (normally called Performance Block – PB)
  - IWM4MRLT; to relate to an existing PB for the same work request creating a dependent monitoring environment; normally used by database managers as DB2 and IMS
  - IWM4MINI; to initialize the PB
  - IWM4MCHS; to record the state of a work request
  - IWM4MXFR; to return the information collected in the dependent monitoring environment; normally used by database managers as DB2 and IMS
  - IWM4MNTF; to report the completion of an execution phase
  - IWM4RPT; to report the response time of a completed work request
  - IWM4MDEL; to delete the PB



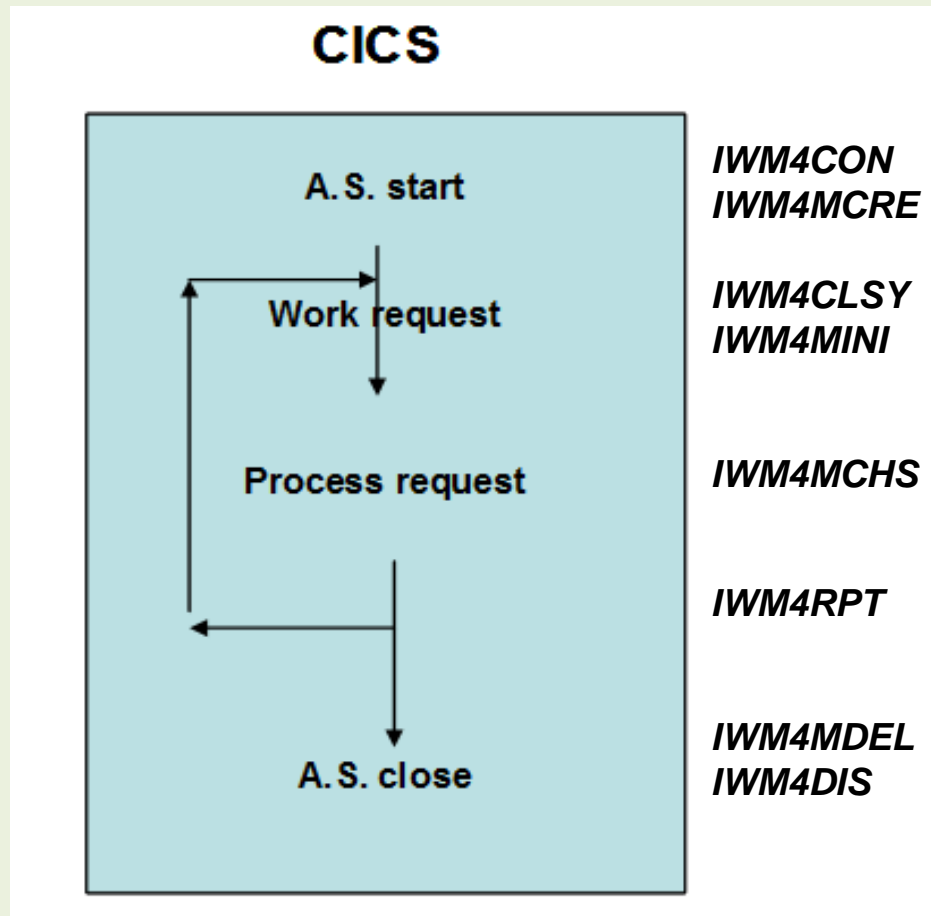
# Work manager delays



- At CICS initialization the IWM4CON and IWM4MCRE services are invoked to connect to WLM and create the PBs (depending on MAXTASK)
- As soon as a work request arrives the IWM4CLSY and IWM4MINI services are invoked to classify the request and initialize a PB



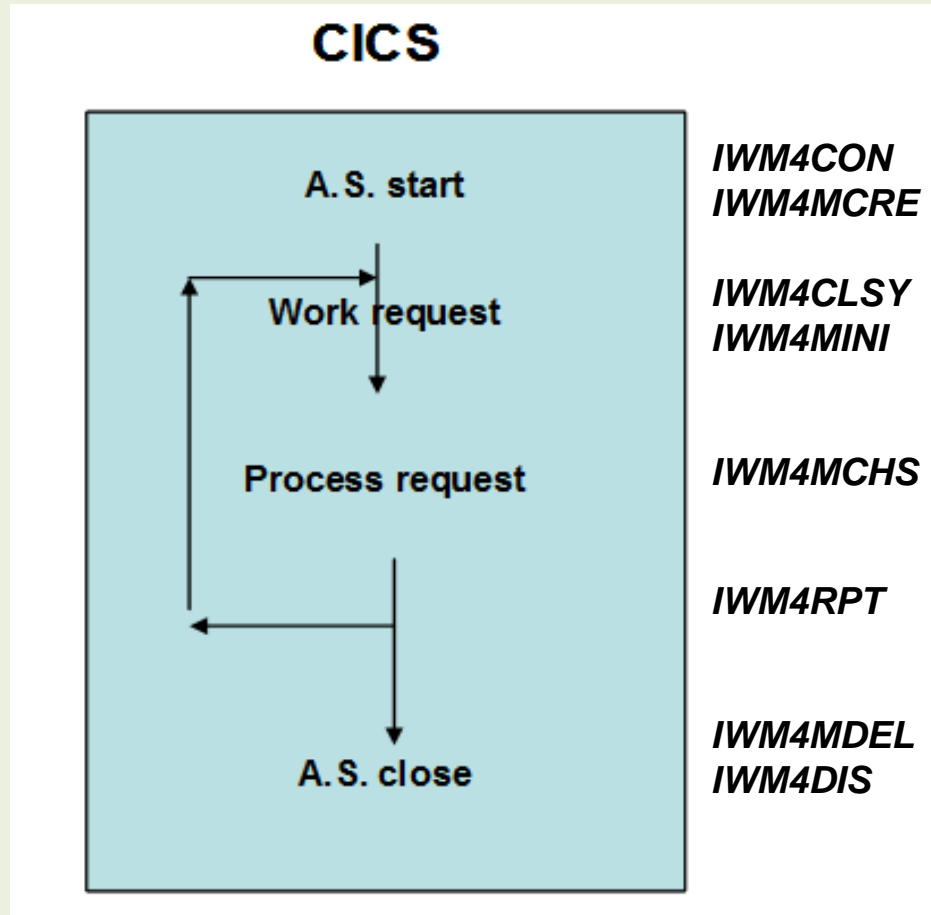
# Work manager delays



- Every time the work request changes state the IWM4MCHS service is invoked to record state information
- When the request completes the IWM4RPT service is invoked to report the request completion.
- At CICS termination the IWM4MDEL and IWM4DIS services are invoked to delete the PBs and disconnect from WLM



# Work manager delays



- In this simple configuration, information on the using, idle and delay states are only collected for the CICS EXEcution phase
- This information is reported in the EPV Work Manager delays view



# Work manager delays

- When a DB call is encountered the work request is passed to the DB AS and the IWM4MRLT service is issued by the DB AS to initialize the PB creating a dependent monitoring environment and relating it to the one created by CICS AS
- Every time the work request changes state, both in CICS and DB AS, the IWM4MCHS service is invoked to record state information

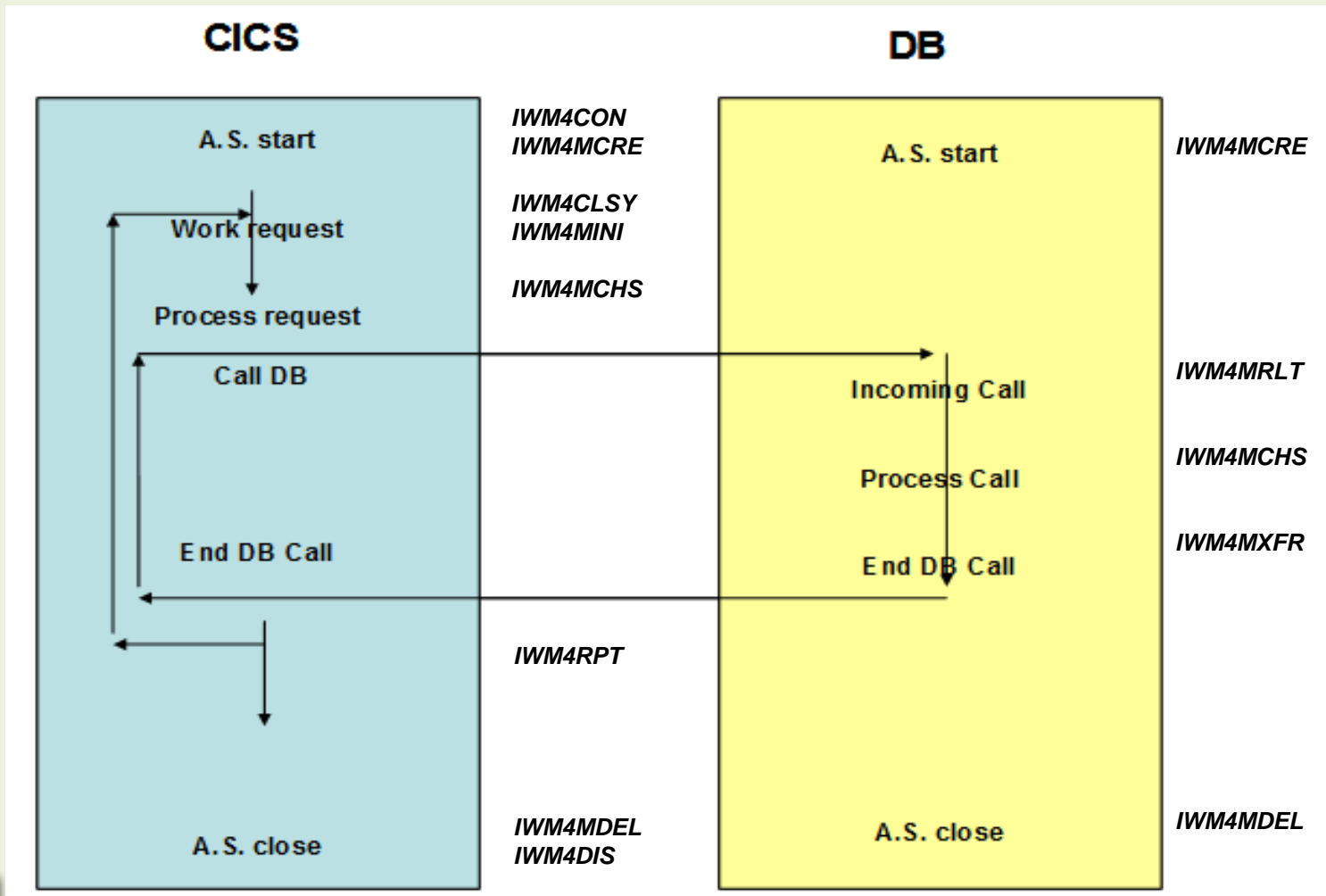


# Work manager delays

- When the DB call has been processed, DB AS invokes the IWM4MXFR service to send back the information collected
- When the request completes the IWM4RPT service is invoked by CICS AS to report the request completion
- At DB AS termination the IWM4MDEL service is invoked to delete the PBs
- At CICS AS termination the IWM4MDEL and IWM4DIS services are invoked to delete the PBs and disconnect from WLM



# Work manager delays



- In this case you will find information on the using, idle and delay states both for the CICS and DB (DB2 or IMS) EXECution phases
- This information is reported in the EPV Work Manager delays view



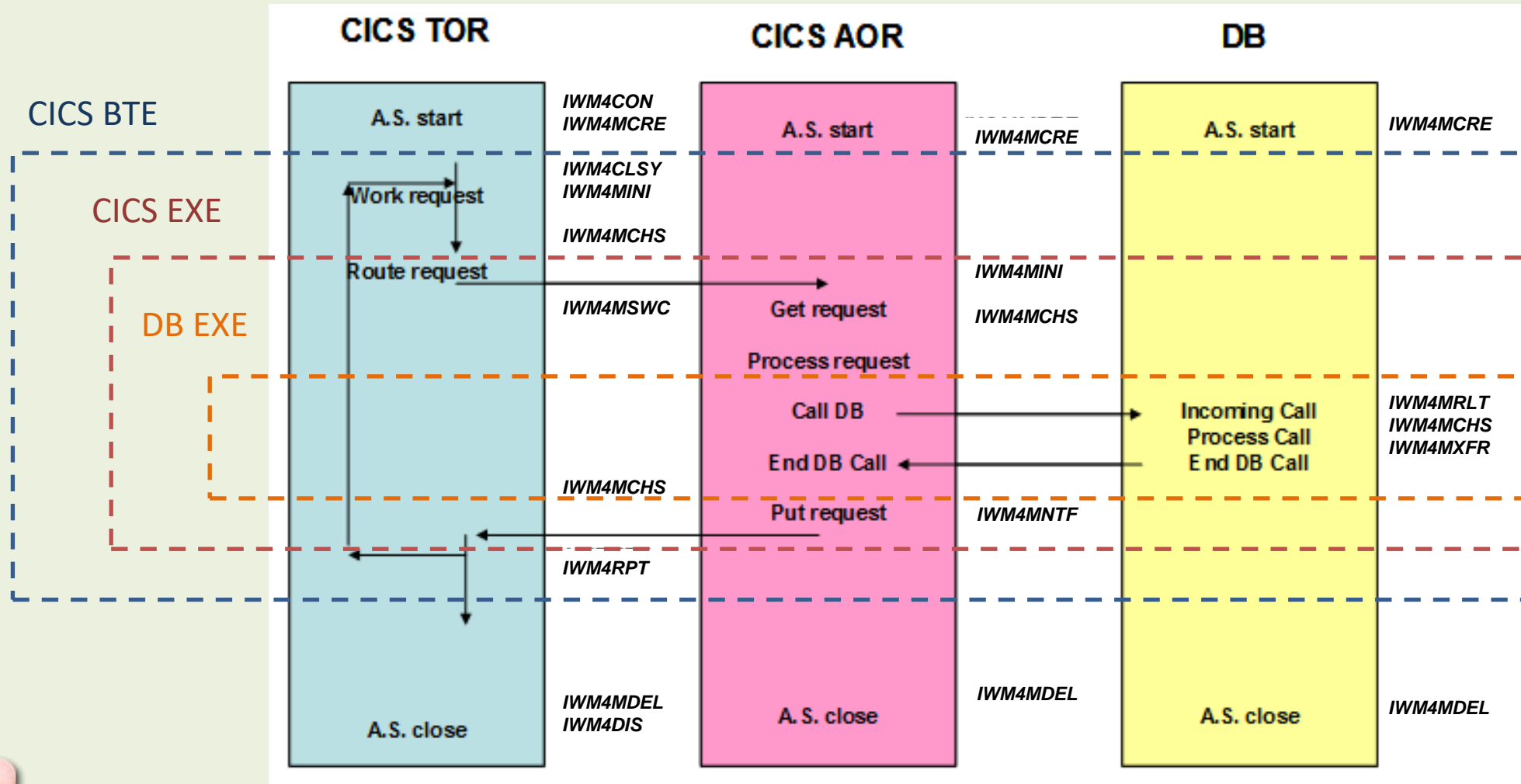
# Work manager delays

- In a CICS TOR/AOR configuration, the schema showing the invocation of WLM services is a bit more complicated
- There is also a CICS Begin To End phase (not present in IMS)





# Work manager delays



# Work manager delays

↑ ↓ SERVICE CLASS WORK MANAGER DELAYS → ↺ ↻

FIMSFTR - PERIOD=1

SYSTEM	HOURL	SUBS TYPE	PHASE	TRANS STATES	ACTIVE SUB	ACTIVE APPL	READY	IDLE	DELAY	LOCK	IO	PROD	LTCH	MISC
					BASE STATES					DELAY STATES				
	15	IMS	E	18.304	18.304	0	0	0	0	0	0	0	0	0
	15	DB2	E	10.094	2.087	0	0	0	8.007	2.630	2.410	3	2.317	647
	16	DB2	E	113.824	5.676	0	0	0	108.148	18.233	4.024	9	84.301	1.581
	16	IMS	E	27.677	27.677	0	0	0	0	0	0	0	0	0
	17	DB2	E	10.273	882	0	0	0	9.391	2.432	713	3	5.403	840
	17	IMS	E	15.978	15.978	0	0	0	0	0	0	0	0	0
	18	IMS	E	20.198	20.198	0	0	0	0	0	0	0	0	0
	18	DB2	E	19.146	2.529	0	0	0	16.617	4.921	2.702	476	7.595	923
	19	DB2	E	266.573	14.752	0	0	0	251.821	72.549	10.221	362	164.205	4.484
	19	IMS	E	65.085	65.085	0	0	0	0	0	0	0	0	0
	17	IMS	E	15.978	15.978	0	0	0	0	0	0	0	0	0
	18	IMS	E	20.198	20.198	0	0	0	0	0	0	0	0	0
	18	DB2	E	19.146	2.529	0	0	0	16.617	4.921	2.702	476	7.595	923
	19	DB2	E	266.573	14.752	0	0	0	251.821	72.549	10.221	362	164.205	4.484
	19	IMS	E	65.085	65.085	0	0	0	0	0	0	0	0	0



# Work manager delays

↑ ↓ SERVICE CLASS WORK MANAGER DELAYS ↵ 📄

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FIMSFTR - PERIOD=1

SYSTEM	HOUR	SUBS TYPE	PHASE	TRANS STATES	ACTIVE SUB	ACTIVE APPL	READY	IDLE	DELAY	LOCK	IO	PROD	LTCH	MISC
					BASE STATES					DELAY STATES				
	15	IMS	E	18.304	18.304	0	0	0	0	0	0	0	0	0
	15	DB2	E	10.094	2.087	0	0	0	8.007	2.630	2.410	3	2.317	647
	16	DB2	E	113.824										
	16	IMS	E	27.677										
	17	DB2	E	10.273										
	17	IMS	E	15.978										
	18	IMS	E	20.198										
	18	DB2	E	19.146										
	19	DB2	E	266.573										
	19	IMS	E	65.085										
	17	IMS	E	15.978										
	18	IMS	E	20.198	20.198	0	0	0	0	0	0	0	0	0
	18	DB2	E	19.146	2.529	0	0	0	16.617	4.921	2.702	476	7.595	923
	19	DB2	E	266.573	14.752	0	0	0	251.821	72.549	10.221	362	164.205	4.484
	19	IMS	E	65.085	65.085	0	0	0	0	0	0	0	0	0

HOUR	Start of the measurement interval; the same hour can be reported in many rows if some requests span through many phases (see PHASE);
SUBS TYPE	Subsystem type, it can be: CICS, IMS, CB (Websphere) or DB2; DB2, during the execution of a CICS or IMS transaction, contributes to gathered information into PB.
PHASE	Execution phase. 2 phases are possible: BeginToEnd (B) and Execution (E); a transaction can span through only one BeginToEnd phase and many Execution phases;
TRANS STATES	Total number of samples.



# Work manager delays

↑ ↓ SERVICE CLASS WORK MANAGER DELAYS → ↻ 📅

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SYSTEM	HOUR	SUBS TYPE	PHASE	TRANS STATES	ACTIVE SUB	ACTIVE APPL	READY	IDLE	DELAY	LOCK	IO	PROD	LTCH	MISC
					BASE STATES					DELAY STATES				
	15	IMS	E	18.304	18.304	0	0	0	0	0	0	0	0	0
	15	DB2	E	10.094	2.087	0	0	0	8.007	2.630	2.410	3	2.317	647
ACTIVE SUB					5.676	0	0	0	108.148	18.233	4.024	9	84.301	1.581
					27.677	0	0	0	0	0	0	0	0	0
ACTIVE APPL					882	0	0	0	9.391	2.432	713	3	5.403	840
					15.978	0	0	0	0	0	0	0	0	0
READY					20.198	0	0	0	0	0	0	0	0	0
					2.529	0	0	0	16.617	4.921	2.702	476	7.595	923
IDLE					14.752	0	0	0	251.821	72.549	10.221	362	164.205	4.484
					65.085	0	0	0	0	0	0	0	0	0
DELAY					15.978	0	0	0	0	0	0	0	0	0
					20.198	0	0	0	0	0	0	0	0	0
					2.529	0	0	0	16.617	4.921	2.702	476	7.595	923
					14.752	0	0	0	251.821	72.549	10.221	362	164.205	4.484
					65.085	0	0	0	0	0	0	0	0	0

ACTIVE SUB	Transactions are active in the subsystem; this doesn't mean that transactions are in execution, the subsystem could be waiting for some resource;
ACTIVE APPL	Transactions are active in the application;
READY	Transactions are ready to execution but the subsystem gave priority to other transactions;
IDLE	No transactions can be executed; subsystem is IDLE;
DELAY	Transactions are delayed; delay reasons are detailed in the following section (see Delay States section).



# Work manager delays

SYSTEM	HOURLY	LOCK	I/O	CONV	DIST	LOCL	SYSP	REMT	TIME	PROD	LTCH	MISC
		Waiting for lock; CICS, IMS or DB2;	Waiting for I/O; CICS, IMS or DB2;	Waiting for an answer during a conversation; transactions could be "switched" to another server Address Space (from CICS TOR to CICS AOR); see Switched States section; CICS;	Waiting for an answer from a distributed server; Websphere;	Waiting for a session start with a server of the same system; CICS;	Waiting for a session start with a server of the same sysplex; CICS;	Waiting for a session start with a server of the same network; CICS;	Waiting for a timer wakeup; CICS;	Waiting for service from another product; in CICS this could be DBCTL, in Websphere this could be DNS or TCP; CICS, Websphere;	Waiting for latch; DB2;	Waiting for unknown reasons; CICS;
	15											
	15											
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	19											
	17											
	18											
	18											
	19											
	19											



# Work manager delays

SSLT	Waiting for a SSL thread from control region; the request is delayed because control region cannot process incoming SSL thread requests; Websphere;
REGT	Waiting for a non SSL thread from control region; the request is delayed because control region cannot process incoming thread requests; Websphere;
WORK	Not used;
BPMI	Waiting for I/O due to buffer pool misses; DB2;
TYP1	Not used;
TYP2	Not used;
TYP3	Not used;
TYP4	Waiting for an answer, after a distributed COMMIT request, from RRS; Websphere;
TYP5	Not used;
TYP6	Indicates a delay in ZIOP processing; Websphere;



# Work manager delays

TYP7	Configuration problem in DNS or TCP/IP; Websphere;
TYP8	Waiting for an answer, after a J2C connection, from DB2, IMS or CICS; Websphere;
TYP9	Not used;
TYP10	Servant called the CR to perform one of the following actions: 1.LocateFunction, 2.ControlFunction, 3.FlushService, 4.FRCAService, 5.PushService, 6.GIOPOutboundResponseFragmentService, 7.GIOPOutboundRequestFragmentService, 8.SIBusMessageListenerDispatch; Websphere;
TYP11	Waiting for an answer, after a RMI/IIOP request, from another server; Websphere;





# Questions?

