Evaluating Coupling Facility Lock Structures

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Abstract

- **Evaluating Coupling Facility Lock Structures**
  - Typically, the Coupling Facility lock structures are the most expensive structures in your data sharing environment. In this context, expensive means that lock structure operations typically consume more MSUs on your z/OS images than other types of structures.
  - During this presentation, Peter Enrico will discuss coupling facility lock structures and lock structure performance, so you have the insights you need to help improve performance and reduce MSUs.

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EPS: We do z/OS performance…

- We love to bring you these complimentary webinars and to teach you how to do what we do!
- But remember, we would love to work with you!
  - ***Pivotor - Performance reporting and analysis of your z/OS measurements (i.e. SMF, etc.)***
    - Not just reporting, but cost effective, analysis-based reporting based on our expertise
  - ***Performance Educational Workshops (while analyzing your own data)***
    - Essential z/OS Performance Tuning
    - Parallel Sysplex and z/OS Performance Tuning
    - WLM Performance and Re-evaluating Goals
  - ***Performance War Rooms***
    - Concentrated, highly productive group discussions and analysis

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z/OS Performance Workshop Schedule

- Take note!
  - You will be analyzing your own data during the workshop!
  - All workshops are also available for in-house instruction
  - All 2021 workshops will be presented over the web (i.e. no travel)

- Essential z/OS Performance Tuning
  - Instructor: Scott Chapman
  - June 21 – 25, 2021

- Parallel Sysplex and z/OS Performance Tuning
  - Instructor: Peter Enrico
  - November 16 – 17, 2021

- WLM Performance and Re-evaluating Goals
  - Instructor: Peter Enrico
  - September 20 – 24, 2021

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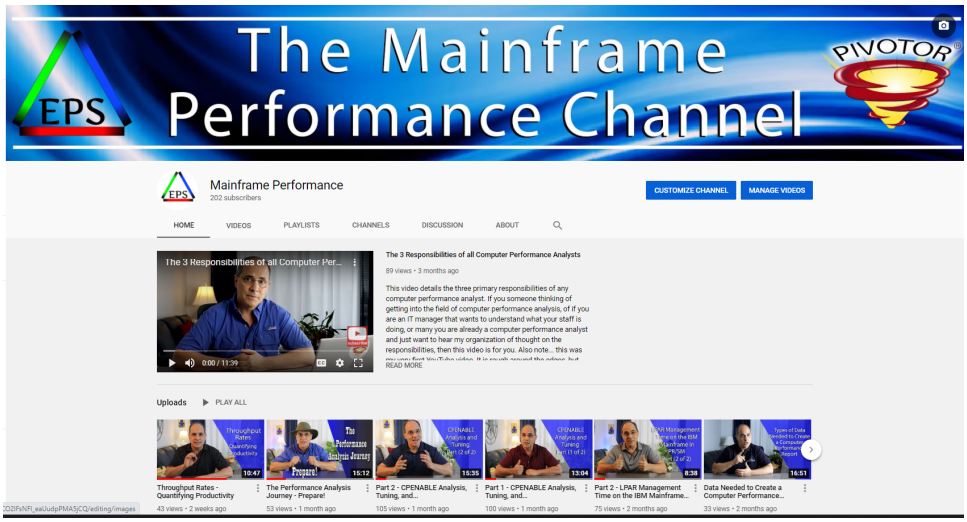

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Like what you see?

- Free z/OS Performance Educational webinars!
  - The titles for our Fall 2020 / Winter 2021 webinars are as follows:
    - ✓ *WLM Response Time Goals Primer*
    - ✓ *Setting Response Time Goals for Modern Applications*
    - ✓ *Evaluating Latent Demand in the Mainframe Environment*
    - ✓ *Adjusting WLM Settings for Latent Demand*
    - ✓ *Improving Performance with Multiple Period Service Classes*
    - ✓ *Preparing for Any z/OS Performance Analysis*
    - ✓ *Evaluating Coupling Facility Lock Structures*
    - *Pivotor Exploration & Feature Update*
    - *Data in Memory (DIM) Primer*
    - *Counting Instructions: Valuable Insights or More Noise?*
  - Let me know if you want to be on our mailing list for these webinars
- If you want a free cursory review of your environment, let us know!
  - We're always happy to process a day's worth of data and show you the results
  - See also: http://pivotor.com/cursoryReview.html

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Prepping for an Analysis

- The question is, where do you start?
  - Regardless of the analysis, the pre analysis tasks are the same regardless the subject of the analysis
- Say an analysis needs to be done, but you are not sure how to start:
  - **Newbie**
    - You are a zNextgen professional new to the Z platform
  - **Seasoned z/OS professional**
    - You are an experienced z/OS professional, but performance is not your strong suit
  - **z/OS performance pro**
    - You are a z/OS performance professional

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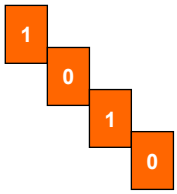
Lock Structures

- CF can be used as a highspeed locking facility by using lock structures
  - Lock structures are centralized lock tables maintained in the CF
- Lock structure made up of
  - Lock table containing information about the serialized resource
  - Lock record containing information about connected users
- Lock structures support
  - Shared lock state
  - Exclusive lock state
  - Application defined lock state
- Uses for lock structures include
  - Synchronous resource serialization
  - Resource contention detection



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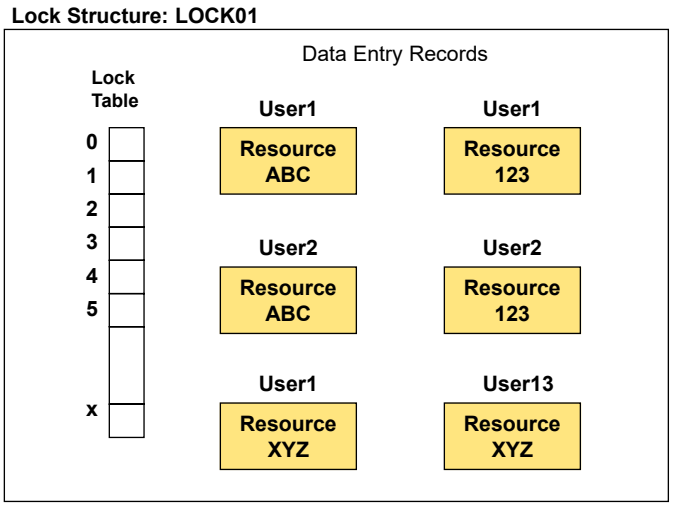
Lock Structure Components

- Lock structure made up of:
  - Lock table containing information about the serialized resource
  - Lock record containing information about connected users



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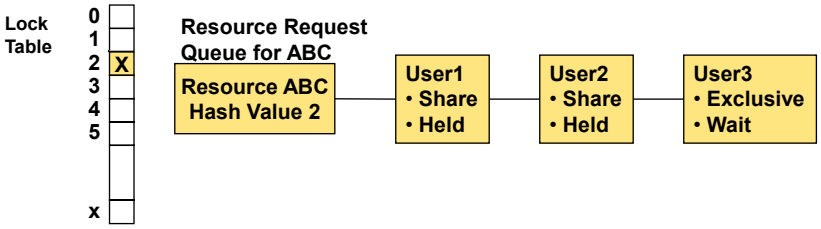
Real Lock Contention

- Contention caused by multiple units of work attempting to serialize on the same resource
  - Factors that influence real lock contention
    - How the locks are being used
    - Amount of time locks are held
    - Degree of data sharing
  - Alleviate real lock contention by tuning the workload (not by tuning the Sysplex or CF structures)



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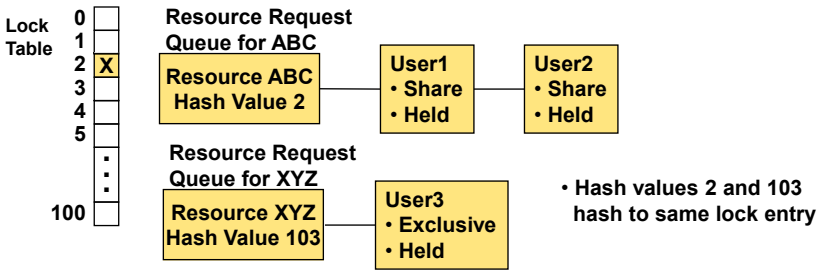
False Lock Contention

- When multiple lock names are hashed to the same lock entry
  - Could result in significant excessive processing overhead to resolve
  - Factors that influence false lock contention include:
    - Size of lock structure , Granularity of locking (record, file, block), Concurrent users connected to lock structure
  - Alleviate false lock contention by increasing lock structure size



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Lock Structure Performance Considerations

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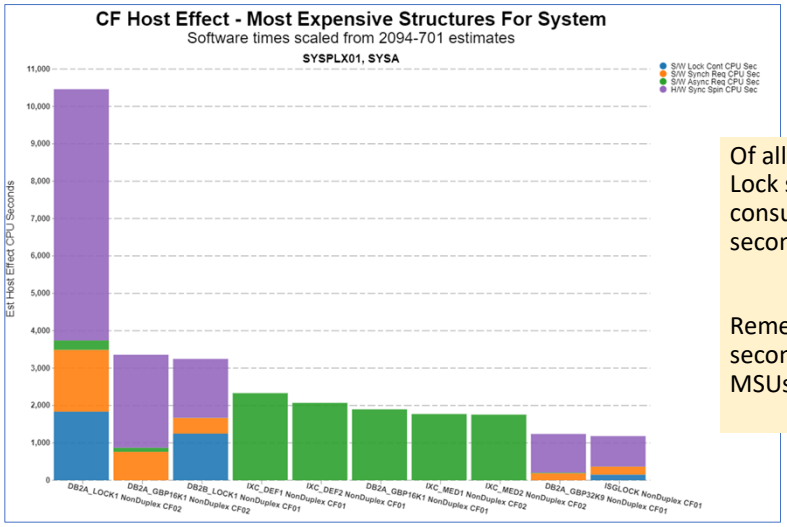
Why Lock Structure Performance Matters



Of all structure types, Lock structures typically consume the most CPU seconds on z/OS.

Remember, CPU seconds translate to MSUs.

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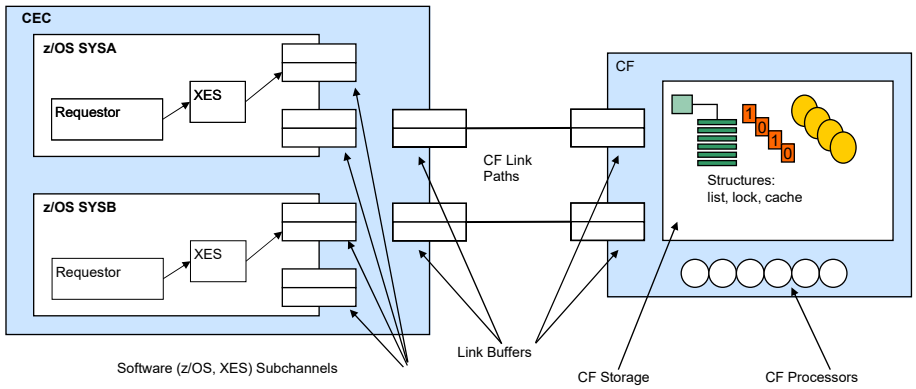
Performance View of a CF Request

- By their nature, lock requests are usually synchronous
  - And synchronous requests 'spin' on z/OS waiting for the CF response



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First examine Lock structure response times

- Standard RMF and CMF reports show response time

```
                                  COUPLING  FACILITY  STRUCTURE  ACTIVITY

STRUCTURE NAME = DB2A_LOCK1          TYPE = LOCK    STATUS = ACTIVE
            # REQ     -------------- REQUESTS -------------   -------------- DELAYED REQUESTS -------------
SYSTEM      TOTAL                 #     % OF  -SERV TIME(MIC)-   REASON     #    % OF  ---- AVG TIME(MIC) -----  EXTERNAL REQUEST
NAME        AVG/SEC               REQ    ALL     AVG    STD_DEV             REQ    REQ   /DEL    STD_DEV   /ALL   CONTENTIONS

  SYSA       1946K   SYNC    1946K    6.7    15.6      8.4     NO SCH     0    0.0    0.0       0.0     0.0   REQ TOTAL      2226K
             1081    ASYNC      0     0.0     0.0      0.0     PR WT      0    0.0    0.0       0.0     0.0   REQ DEFERRED     67K
                     CHNGD      0     0.0  INCLUDED IN ASYNC  PR CMP     0    0.0    0.0       0.0     0.0   -CONT            67K
                                                                                                             -FALSE CONT      16K
  SYSB       3471K   SYNC    3471K   11.9    12.8      7.5     NO SCH    38    0.0   11.4       4.5     0.0   REQ TOTAL      3617K
             1928    ASYNC      0     0.0     0.0      0.0     PR WT      0    0.0    0.0       0.0     0.0   REQ DEFERRED     77K
                     CHNGD      0     0.0  INCLUDED IN ASYNC  PR CMP     0    0.0    0.0       0.0     0.0   -CONT            77K
                                                                                                             -FALSE CONT      14K

     (edited…)
 ------------------------------------------------------------------------------------------------------------------------------------
  TOTAL      29048K   SYNC      29M    100    12.9      7.6     NO SCH   785    0.0    9.7      16.6     0.0   REQ TOTAL        28M
             16138    ASYNC    4497     0.0    81.5     87.9     PR WT      0    0.0    0.0       0.0     0.0   REQ DEFERRED    376K
                      CHNGD       0     0.0                      PR CMP     0    0.0    0.0       0.0     0.0   -CONT           375K
                                                                                                             -FALSE CONT      81K
```

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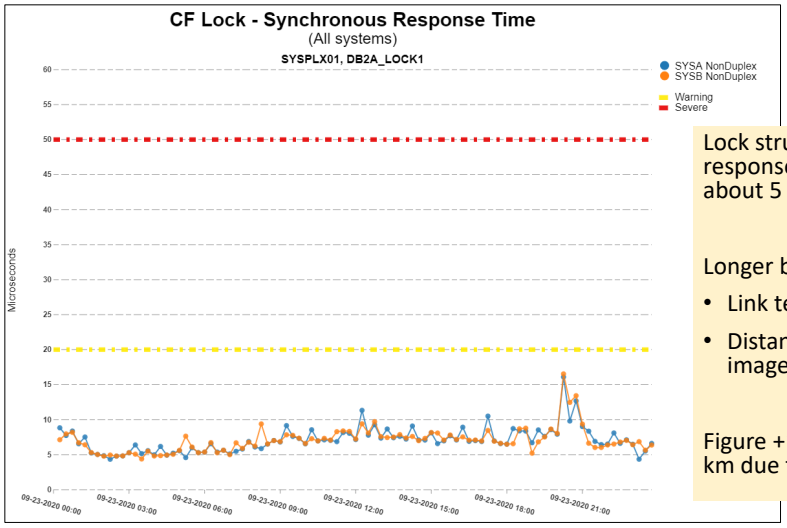
First look at Lock structure Sync response times



Lock structure synchronous response time guidelines are about 5 microseconds.

Longer based on

- Link technology
- Distance between the z/OS image and the CF.

Figure +10 microseconds per km due to speed of light

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Also examine volume of requests

- Standard RMF and CMF reports show response time

COUPLING FACILITY STRUCTURE ACTIVITY

STRUCTURE NAME = DB2A_LOCK1 TYPE = LOCK STATUS = ACTIVE

SYSTEM NAME	# REQ TOTAL AVG/SEC		REQUESTS # REQ	% OF ALL	-SERV TIME(MIC)- AVG	STD_DEV	REASON	DELAYED REQUESTS # REQ	% OF REQ	AVG TIME(MIC) /DEL	STD_DEV	/ALL	EXTERNAL REQUEST CONTENTIONS	
SYSA	1946K	SYNC	1946K	6.7	15.6	8.4	NO SCH	0	0.0	0.0	0.0	0.0	REQ TOTAL	2226K
	1081	ASYNC	0	0.0	0.0	0.0	PR WT	0	0.0	0.0	0.0	0.0	REQ DEFERRED	67K
		CHNGD	0	0.0	INCLUDED IN ASYNC		PR CMP	0	0.0	0.0	0.0	0.0	-CONT	67K
													-FALSE CONT	16K
SYSB	3471K	SYNC	3471K	11.9	12.8	7.5	NO SCH	38	0.0	11.4	4.5	0.0	REQ TOTAL	3617K
	1928	ASYNC	0	0.0	0.0	0.0	PR WT	0	0.0	0.0	0.0	0.0	REQ DEFERRED	77K
		CHNGD	0	0.0	INCLUDED IN ASYNC		PR CMP	0	0.0	0.0	0.0	0.0	-CONT	77K
													-FALSE CONT	14K
(edited…)														
TOTAL	29048K	SYNC	29M	100	12.9	7.6	NO SCH	785	0.0	9.7	16.6	0.0	REQ TOTAL	28M
	16138	ASYNC	4497	0.0	81.5	87.9	PR WT	0	0.0	0.0	0.0	0.0	REQ DEFERRED	376K
		CHNGD	0	0.0			PR CMP	0	0.0	0.0	0.0	0.0	-CONT	375K
													-FALSE CONT	81K

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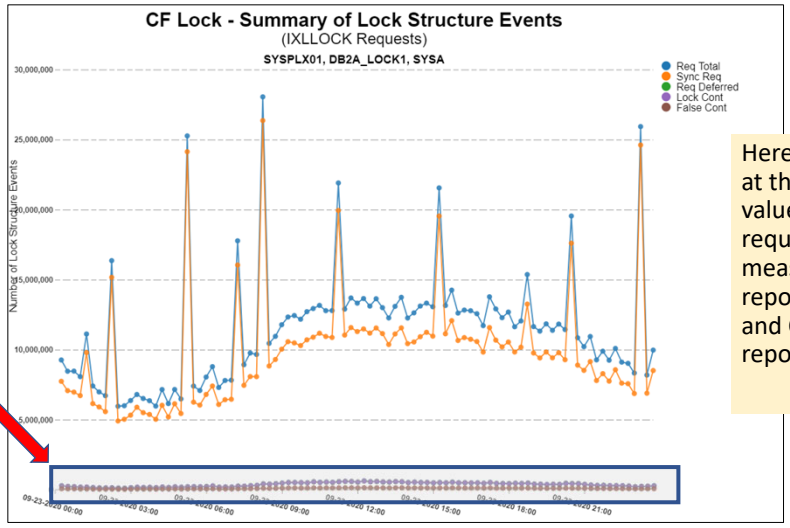
Requests over time (Deferred, Cont, False Cont)



Let's look at these measurements

Here we are looking at the absolute values of the all the request measurements reports on the RMF and CMF text reports.

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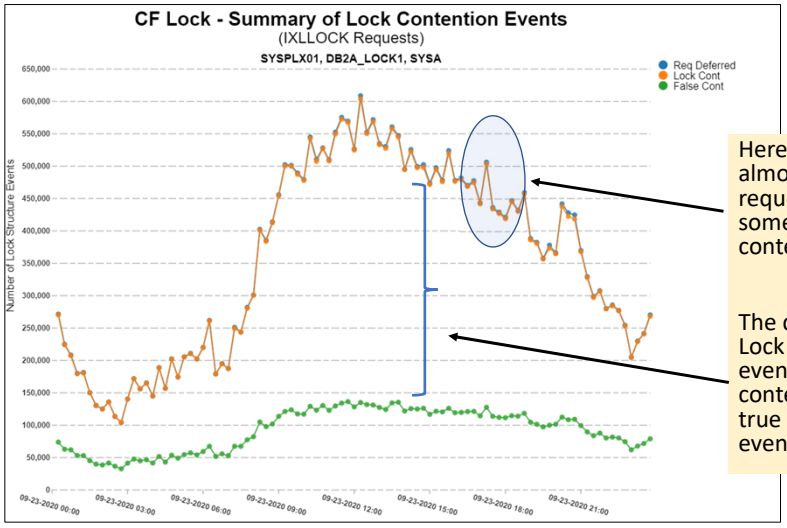
Requests over time



Here we see that almost all deferred requests are due to some sort of contention event

The delta between Lock contention events and false contention events is true contention events

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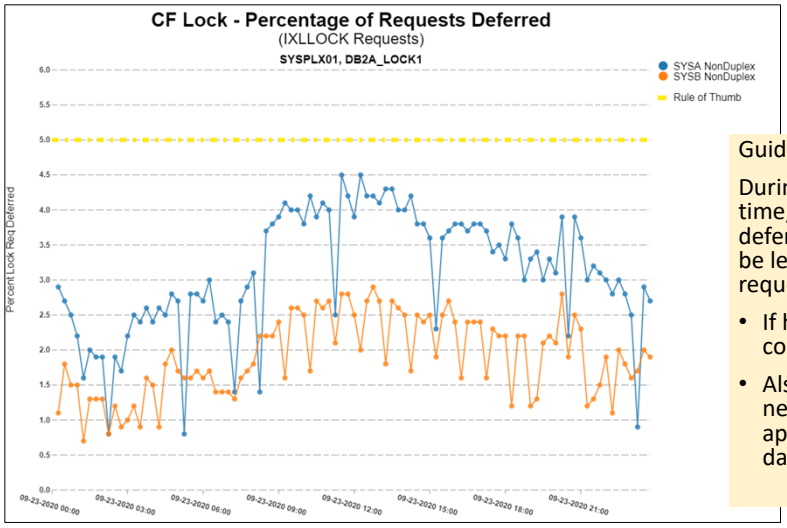
Percentage of Lock requests deferred



Guideline:

During prime periods of time, percentage of deferred requests should be less than 5% of all requests.

- If higher, check false contention
- Also, could be due to need to tune application and database

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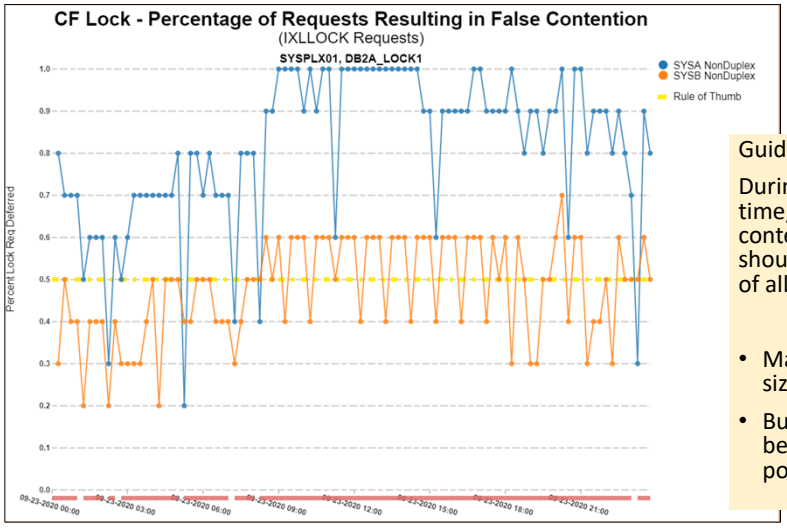
Percentage of False contention requests



Guideline:

During prime periods of time, percentage of false contention requests should be less than 0.5% of all requests.

- May need to increase size of structure
- But size would need to be increased to next power of 2, plus some.

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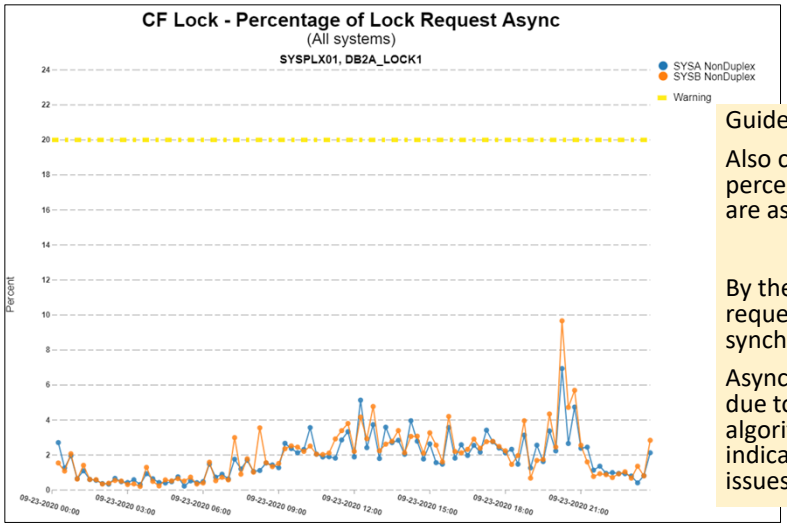
Percentage of Lock Requests Async



Guideline:

Also check what percentage of requests are asynchronous.

By their nature, Lock requests are synchronous.

Async requests occur due to heuristic algorithms, and could indicate response time issues

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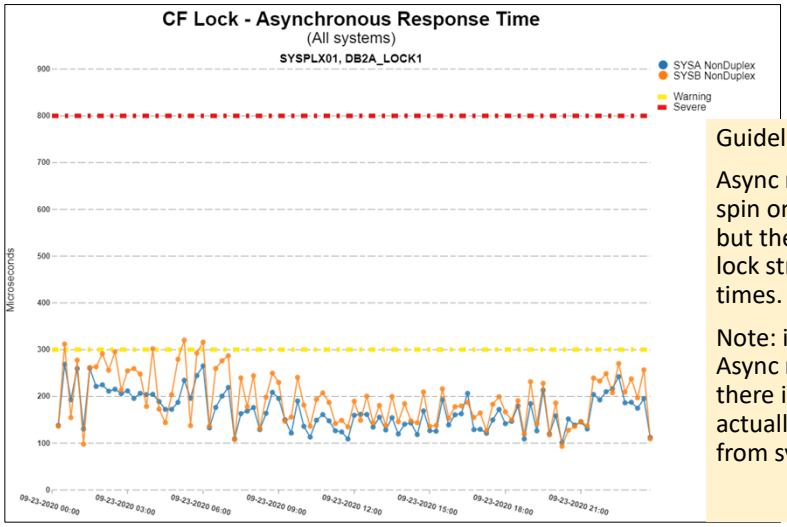
Look at Lock structure Async response times



Guideline:

Async requests will not spin on the z/OS CPU, but they do elongate lock structure response times.

Note: in addition to Async response time, there is a cost to actually convert request from sync to async.

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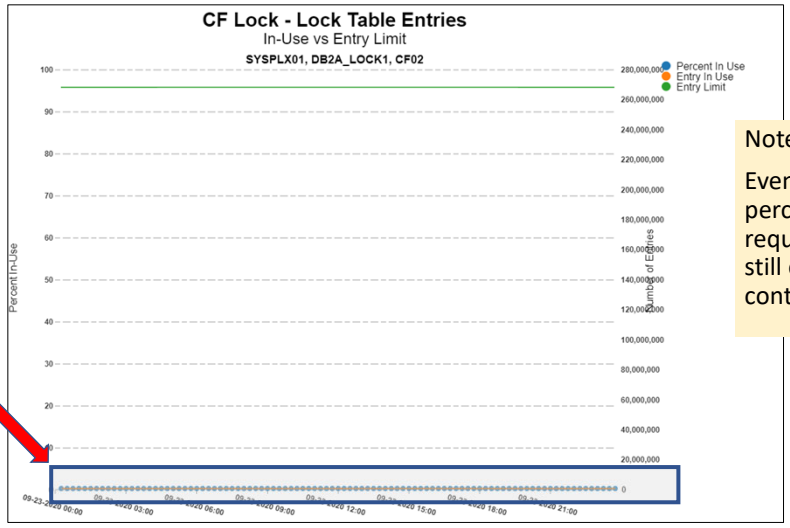
Percent Lock Table In Use

Let's look at these measurements



Note:

Even with a small percentage of lock table requests in use, you will still experience false contention requests.

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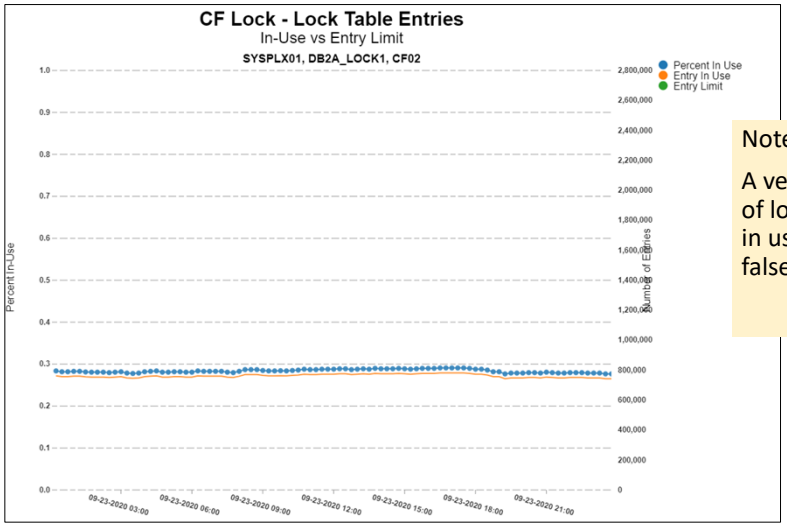
Percent Lock Table In Use



Note:

A very small percentage of lock table entries are in use, yet we still see false contention.

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Other lock structure considerations

- There are other lock structure considerations that were not discussed in this webinar, but need to be considered:
  - Lock structure placement
  - Coupling facility link technologies
  - Lock structure duplexing
  - Exploitation of asynchronous lock duplexing
  - Controls for heuristic algorithms to convert sync to async
  - Subchannel utilizations
  - Lock structure element sizing
  - Etc…
- Maybe for a future webinar?

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Please Take Poll

Jamie has some reminders

Then Scott and Peter will take questions

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