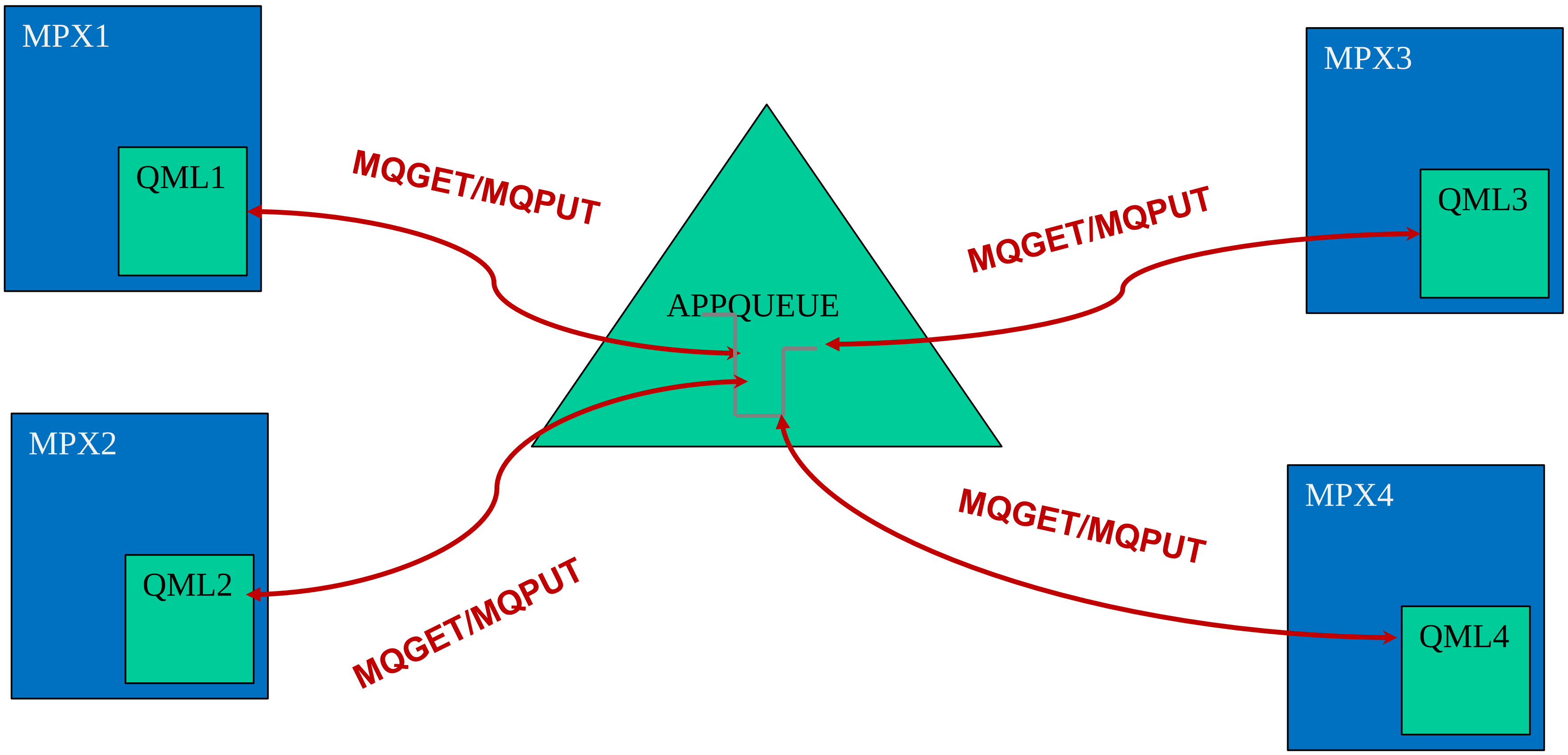
Shared Queues – where is my workload running

Agenda

- **What are shared queues – briefly**
- **What is workload skewing and why is it a problem?**
  - What are the symptoms and causes
    - Asymmetrical Sysplex
    - Connection Skewing
    - Put to Waiting Getter
  - ‘ Local’ favoritism
- **Mitigation Techniques:**
  - Queue Manager Clustering
  - Gateway queue managers
  - CICS CPSM options

Briefly – What is a Shared Queue

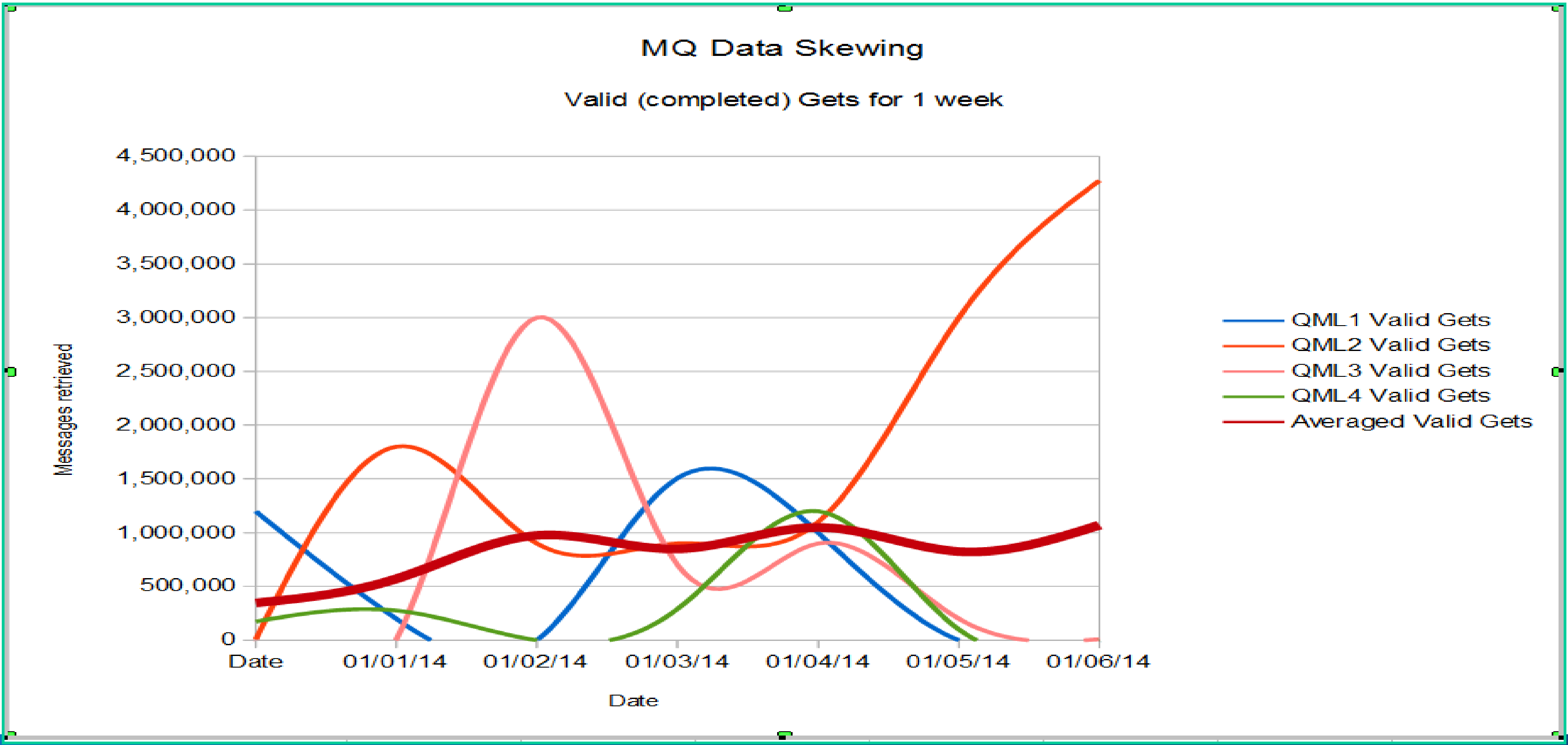


What is a shared queue?

- **Unique to z/OS**
  - Requires a coupling facility to host the queues
  - DB2 data sharing for the queue definitions
  - The gold standard for message availability
- **Treats a shared queues as local to each queue manager in the QSG**
  - Applications can PUT and GET
- **Messages are available as long as one QMGR in the QSG can access the Coupling Facility Structure.**
- **Nonpersistent messages are only ‘lost’ if the structure or CF itself are lost.**

What is MQ Workload Skewing?

- **Workload skewing is detected when MQ driven work, typically transactions, is not close to being evenly distributed across the queue managers.**

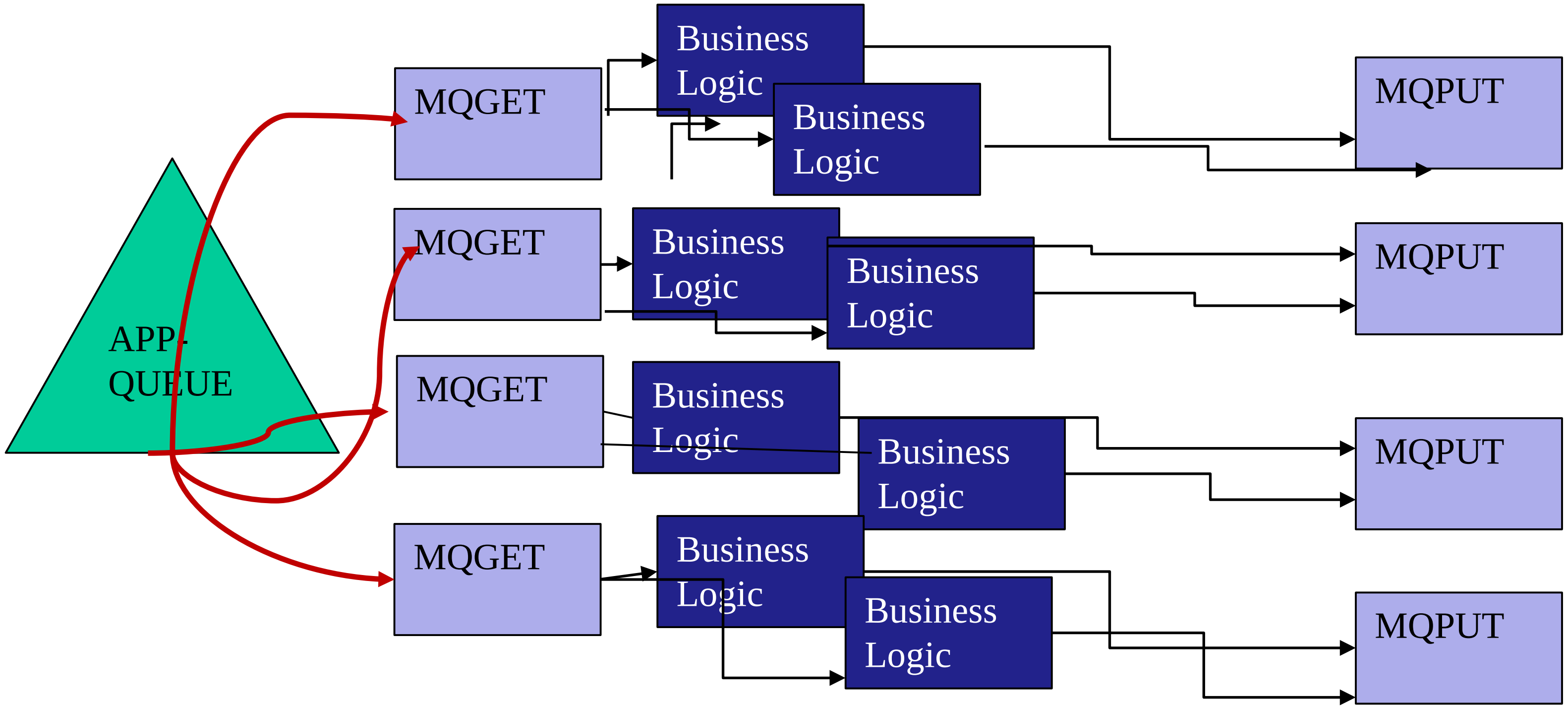


Why is MQ Workload Skewing a problem?

- **This is often less a technical problem, more of a pricing problem**
  - If the MLC ‘rolling average’ is taken from the LPAR that is heavily favored, usage pricing is not going to reflect reality
  - Technical solutions to this problem may prove to be less efficient overall - lower throughput, slower response
  - Using a VUE version of MQ can eliminate this issue

Why is MQ Workload Skewing a problem?

- **Can cause increased capacity demands in downstream workload**
  - Known to produce responsiveness problems
    - Overloading the processing programs
  - Again this can contort MLC charges

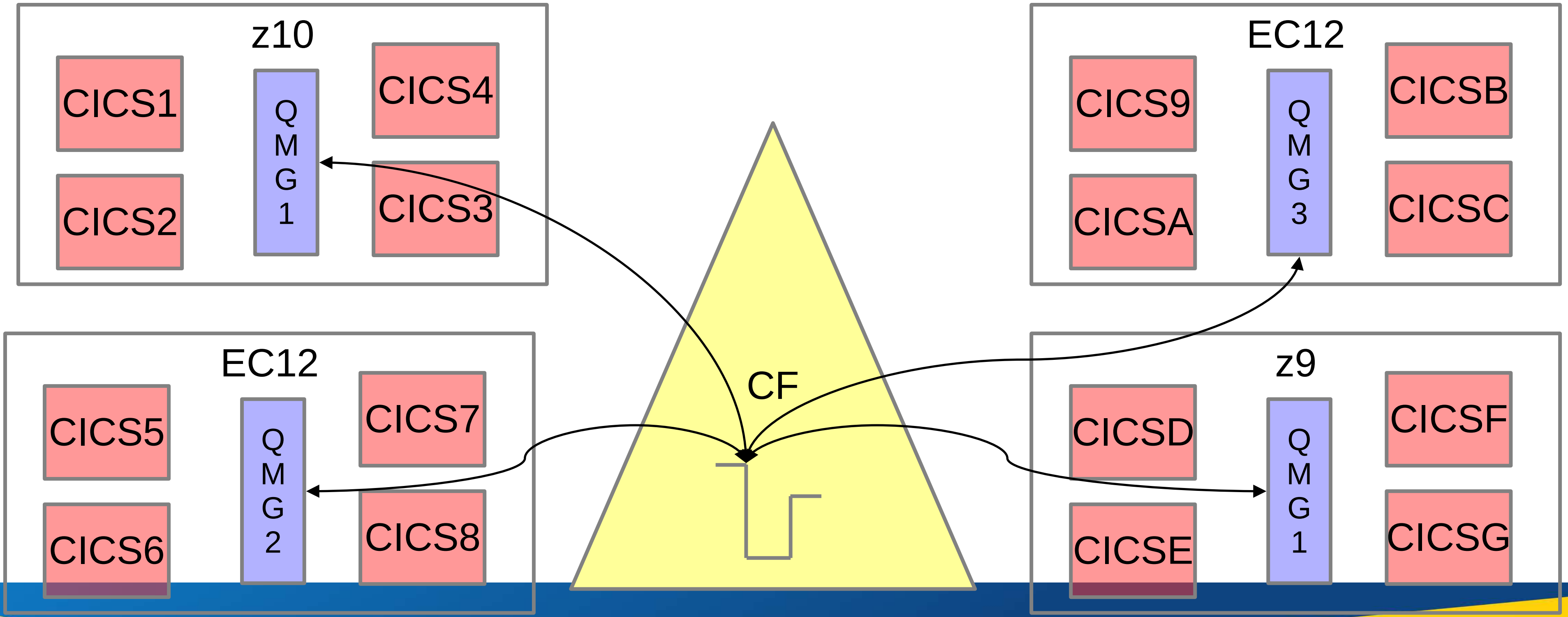


MQ Workload Skewing Causes

- **Workload skewing in a QSG is often a result of the efficiencies of working locally**
  - z/OS, and all subsystems try to process requests locally to take advantage of CPU efficiency

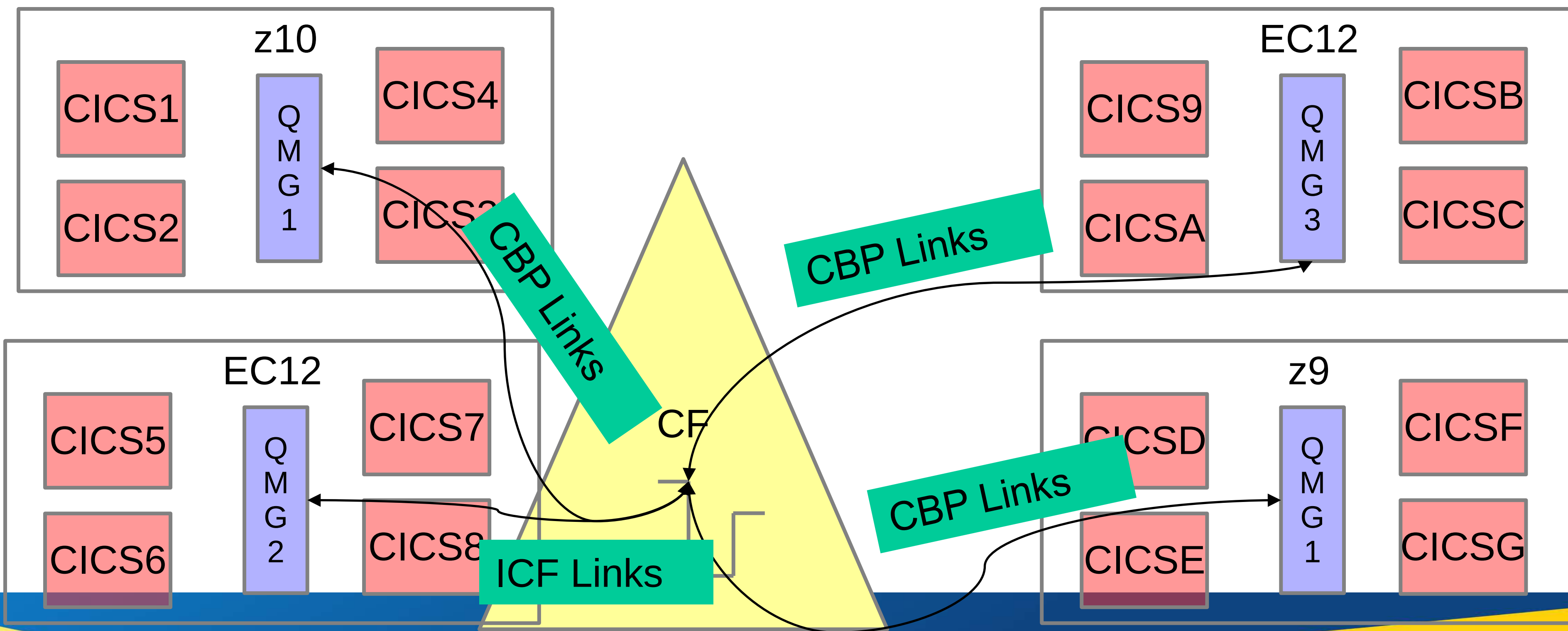
MQ Workload Skewing Causes - Hardware

- **Asymmetric Sysplex**
  - When the LPARs in the Sysplex are not equally weighted
    - Examples include:
      - One LPAR is on an EC12, the others on older hardware
      - Two LPARs have 12 dedicated engines, two have 12 shared



MQ Workload Skewing Causes - Hardware

- **Asymmetric Sysplex**
  - Most common example - One LPAR is co-located with the primary coupling facility, the others are on different CPCs
  - ICF links give much better service times than CBP



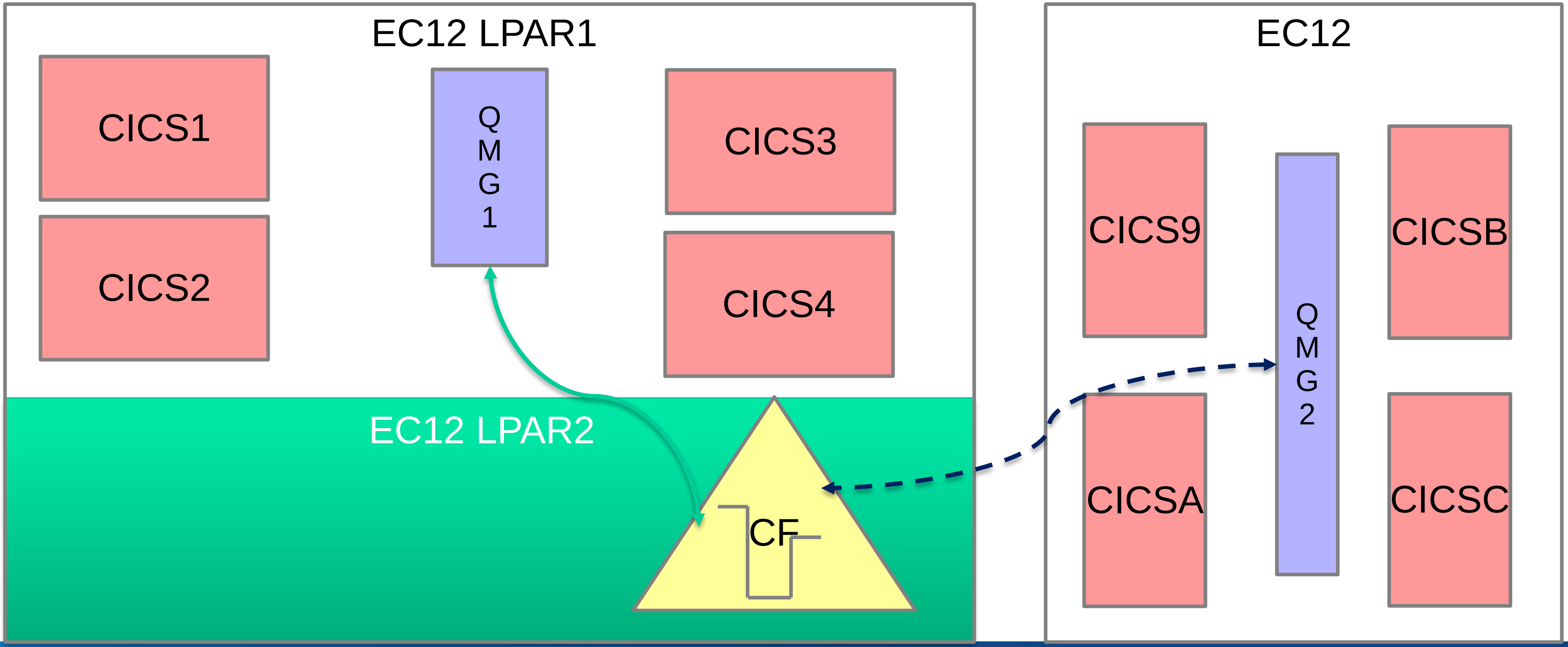
Physical Skewing – CF Activity Report

```
STRUCTURE NAME = QSGBUSER            TYPE = LIST    STATUS = ACTIVE
               # REQ    -------------- REQUESTS -------------   -------------- DE
SYSTEM         TOTAL              #      % OF   -SERV TIME(MIC)-    REASON      #     %
NAME           AVG/SEC           REQ     ALL      AVG    STD_DEV               REQ    R

MPX1             295K   SYNC    295K    26.9      4.3       1.2     NO SCH      0     0
               492.1    ASYNC      0     0.0      0.0       0.0     PR WT       0     0
                        CHNGD      0     0.0   INCLUDED IN ASYNC    PR CMP      0     0
                        SUPPR      0     0.0                        DUMP        0     0

MPX2             802K   SYNC    802K    73.1     17.8       2.5     NO SCH      0     0
                1339    ASYNC      0     0.0      0.0       0.0     PR WT       0     0
                        CHNGD      0     0.0   INCLUDED IN ASYNC    PR CMP      0     0
                        SUPPR      0     0.0                        DUMP        0     0
```

- We (the WSC) tend to use the CF Activity report rather than the MQ Statistics when looking at shared queue usage
- In the example shown above it is easy to see that the MPX2 LPAR is getting a much longer service time (almost 4 times!) than the MPX1 LPAR and that MPX2 is making many more requests.
  - In this particular case, this exposed some internal workload skewing that was not apparent to the customer - except that they were missing SLAs consistently!

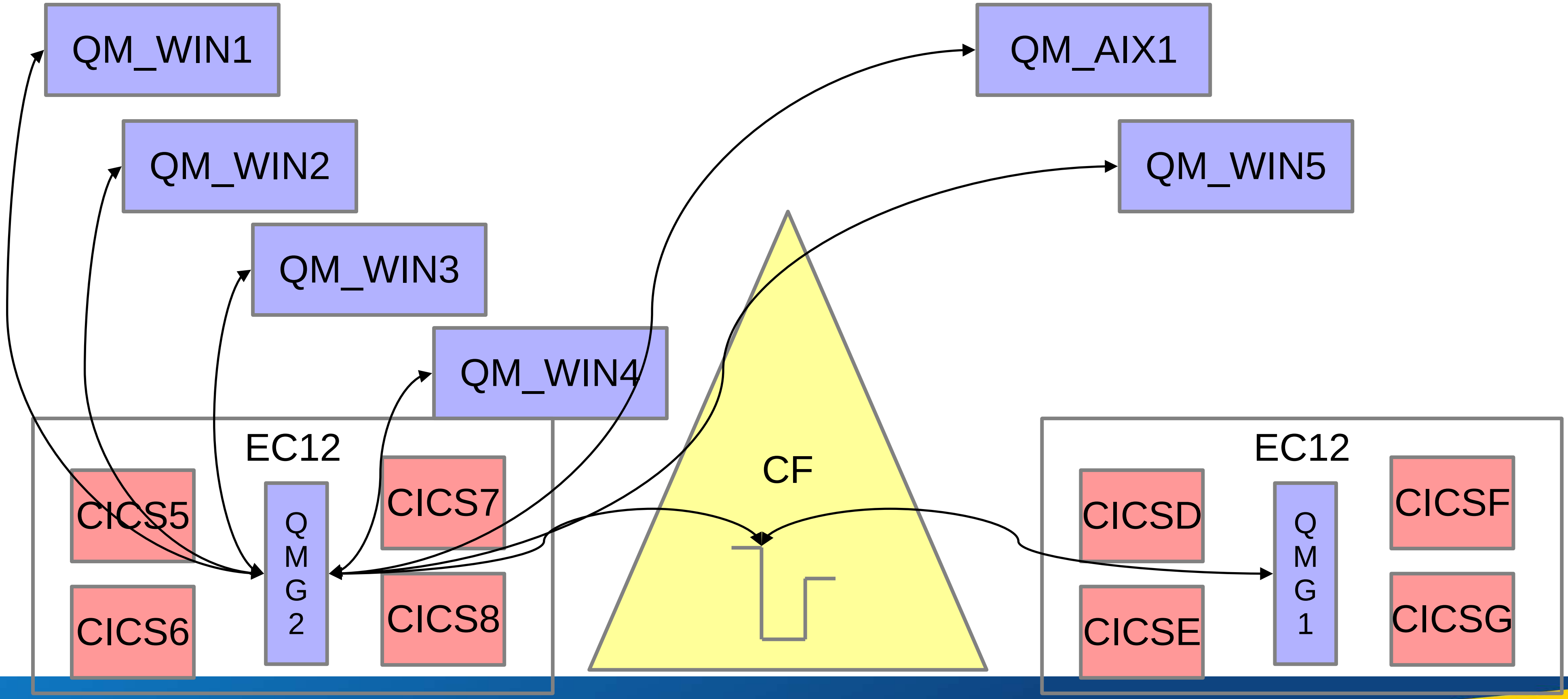
MQ Workload Skewing Causes - Hardware

- **Location of the Coupling Facility**
  - When the coupling facility is internal, LPARs on the same CEC tend to get faster response
  - When the coupling facility is external and one LPAR has more, faster, or less heavily used links it will get faster service



Connection Skewing

- **Connection skewing may be historical**
  - Hard-coded connections to specific queue managers
- **Connection skewing may be the result of a queue manager outage**
  - Connections to a QSG are routed to available queue managers

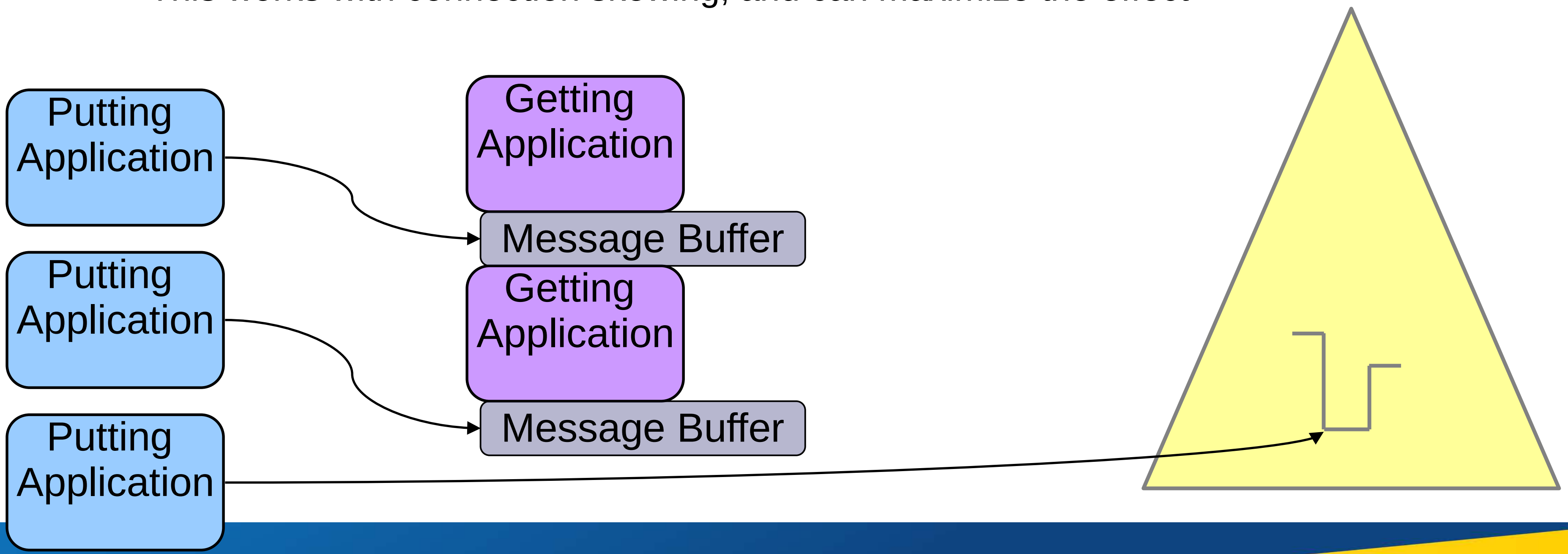


‘Downstream’ consequences

- **We’ve talked about the MLC impact**
- **Resource use**
  - Not every queue manager is sized to absorb the entire workload
  - Log impact of skewing has been seen
    - Rapid Log switches due to heavier workload – increasing I/O and CPU costs
  - Bufferpool/Pageset impact
    - Filling the bufferpool, forced into I/O
  - SMDS impact
    - One queue manager in QSG gets all offloaded messages

MQ Workload Skewing Causes

- **Put to waiting getter**
  - In V6 a performance feature was added called 'put to waiting getter'
  - If a local put, from an application or message channel agent, is done and there is a getting application waiting the message is moved directly to the getting applications buffer
    - There is no posting to a shared queue
    - There is no notification to other available waiting applications
    - The CPU savings can be substantial
    - This works with connection skewing, and can maximize the effect



Put to Waiting Getter – SMF

- **This shows messages flowing across a channel taking advantage of P2WG**

Base_Name	CF Struct	Total_Valid_Gets	Total_Bytes_Put	Total_Valid_Puts	Total_Put2_Waiting_Getter	Puts not to Waiting Getter
SYSTEM.QSG.CHANNEL.SYNCQ	CSQSYSAP	0	0	0	0	0
SHARED.INPUT.QUEUE	APP1	0	4501092223	2095814	2012394	83420

- **The CPU comparison shows why it can be a good thing!**

BASE_NAME	VALID_PUTS	PUT_ELAPSED_TIME	PUT_CPU_TIME	PUT2_WAITING_GETTER	Average PUT ET	Average PUT CT
QLOCAL.PUT2WG	14879	127753	117956	14793	8.59	7.93
QLOCAL.NO.PUT2WG	41547	1025028	1010038	0	24.67	24.31

- **The CPU costs can be 3 times as high!**

MQ Workload Skewing Causes

- **Local Favoritism**
  - When a message is posted to a shared queue, the queue manager where the message is put is typically notified FIRST about the availability.
  - Normal processing by XCF, taking advantage of the efficiency of local processing.

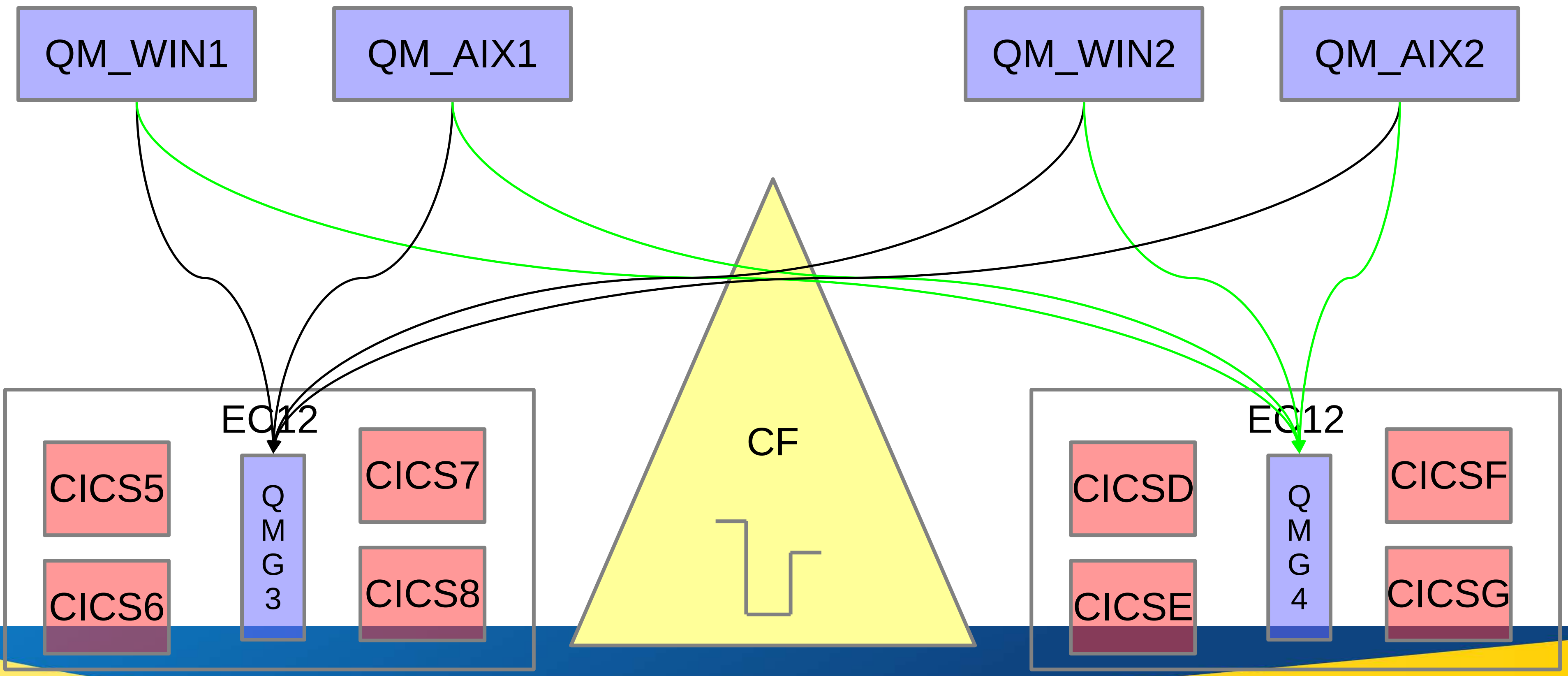
Skewing Mitigation Techniques

- **Queue Manager Clusters**
  - Clusters provide workload balancing across queue managers
  - Works with shared queues to distribute message ‘puts’ across queue managers in the QSG
- **Connection skewing mitigation**
  - Gateway queue managers
  - Re-driving connections
- **CPSM mitigation**

Queue Manager Clustering

•When messages are not bound to a specific queue manager (‘bind not fixed’), the messages are routed evenly across the receiving queue managers

- Black arrows show the first message put to the clustered queue
- Green arrows show the second message

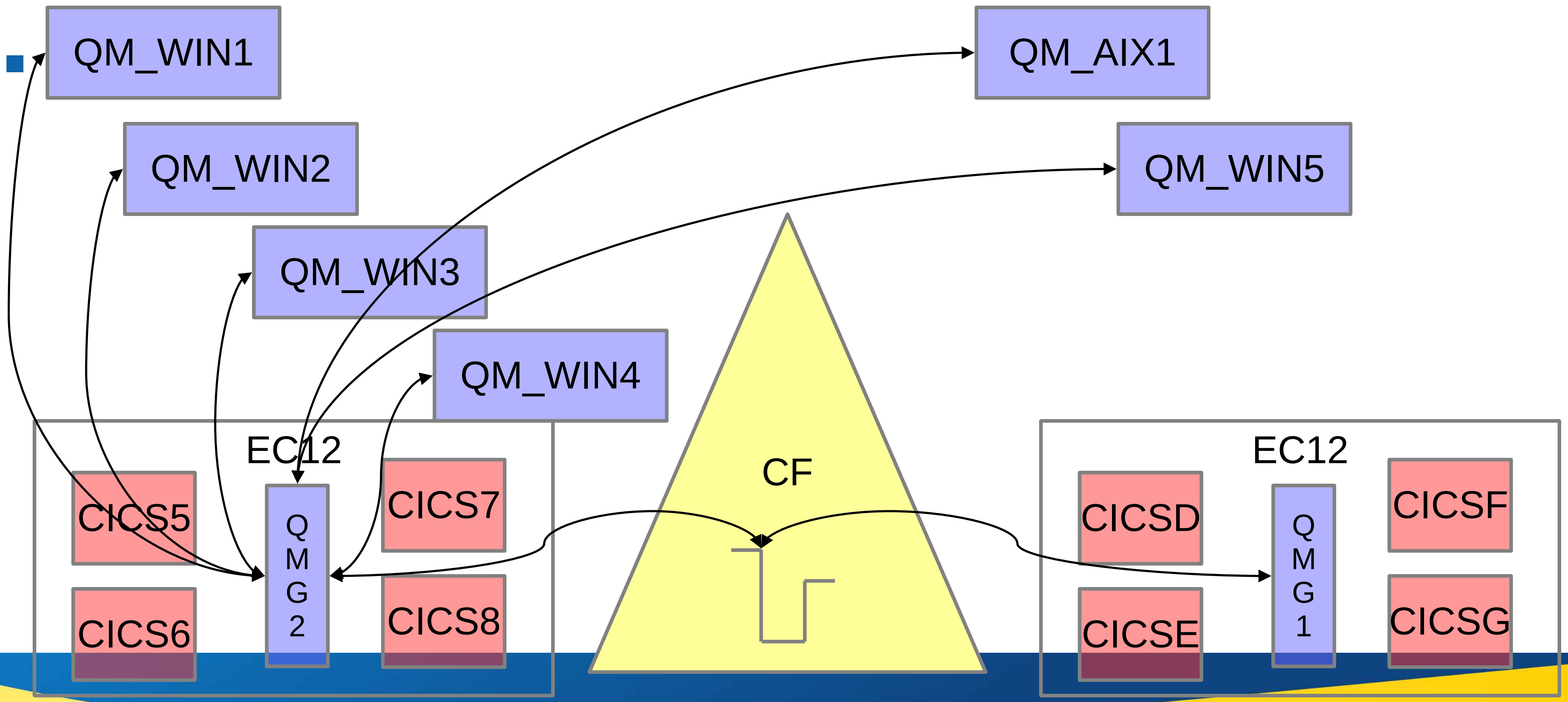


Connection Skewing Mitigation

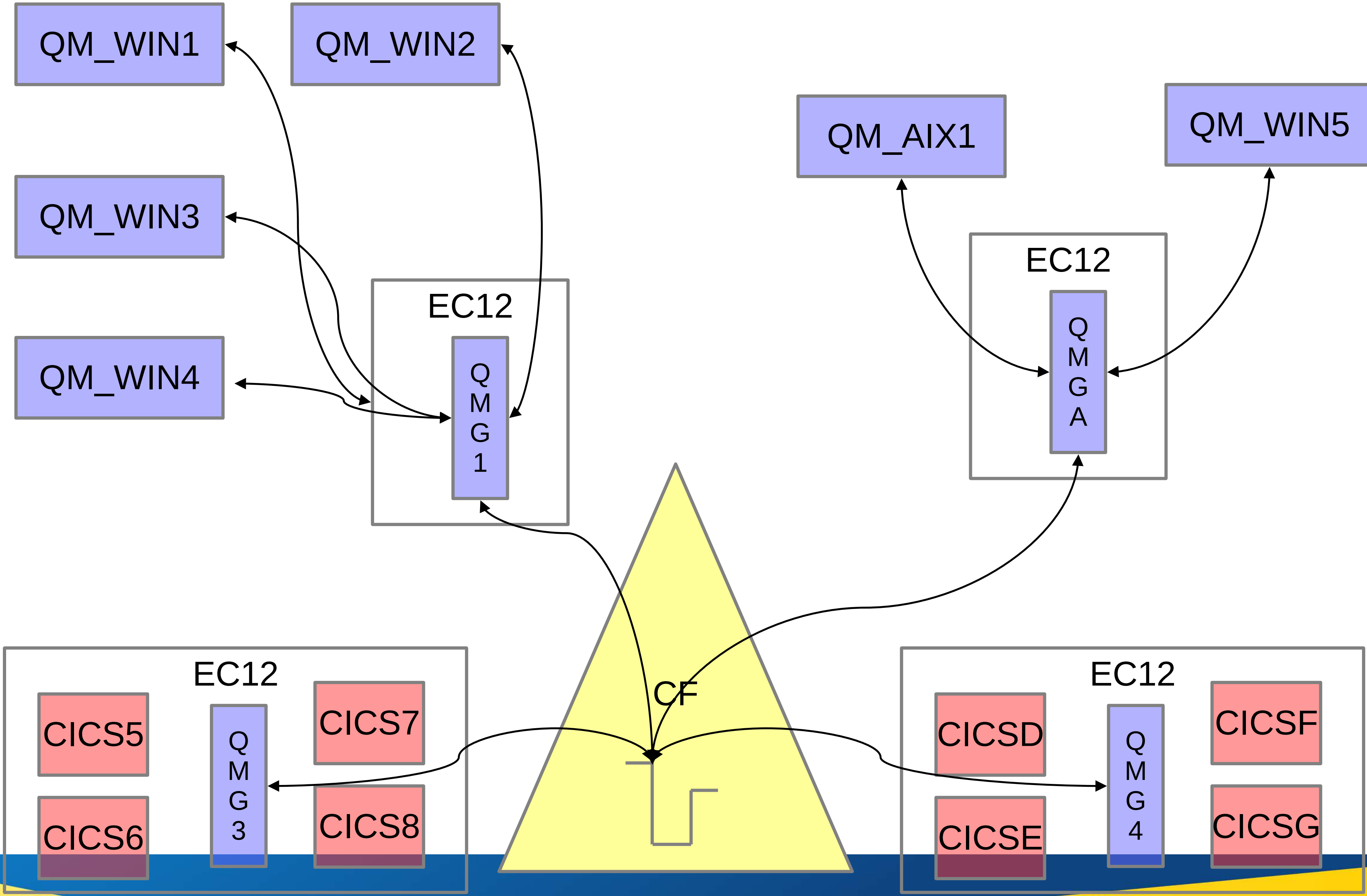
- **The slides that follow outline two mitigation techniques for connection skewing:**
  - Gateway queue managers
  - Re-driving connections

Connection Skewing – No Gateway queue managers

- When external queue managers or clients are passing work directly to application hosting queue managers, every attempt is made to process the work locally
- Environments that use gateway queue managers into the Queue Sharing group often eliminate connection skewing.

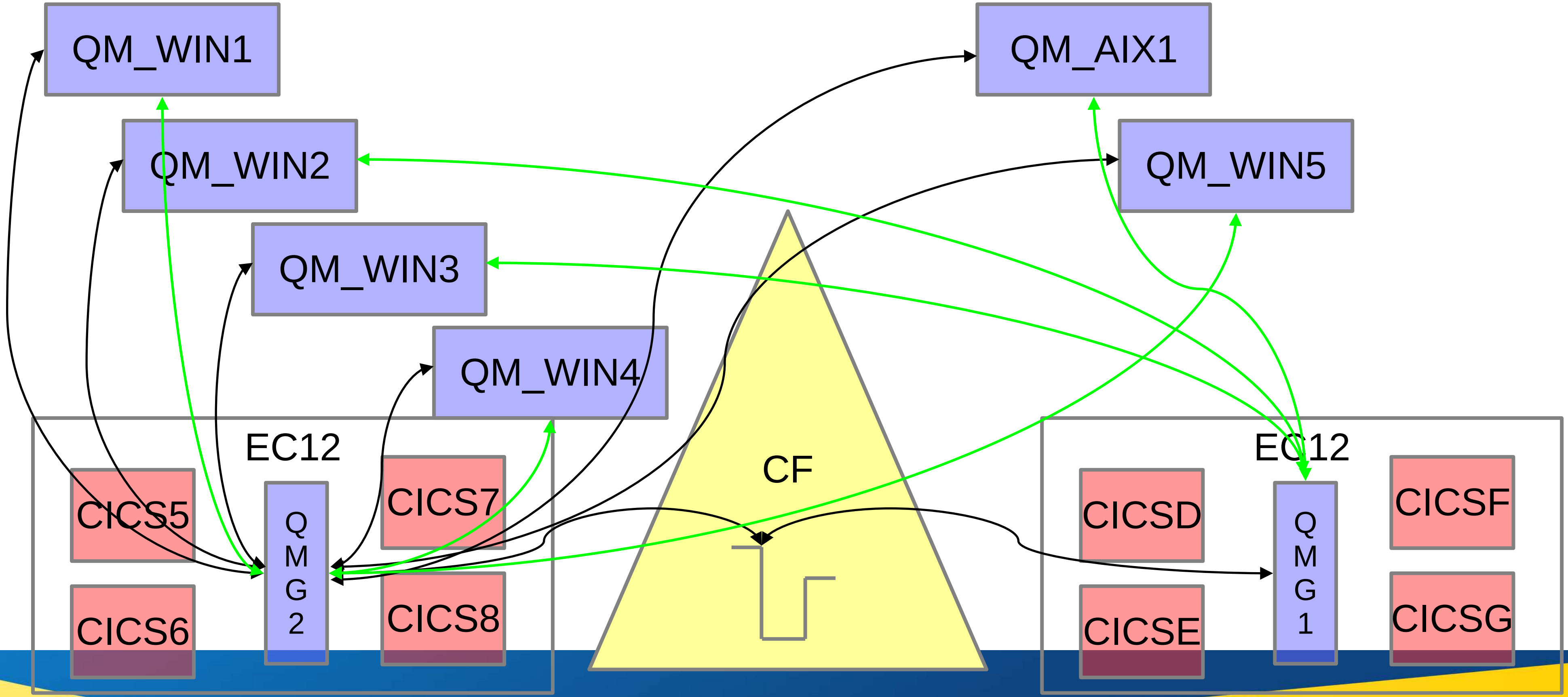


Gateway queue managers – the mitigation



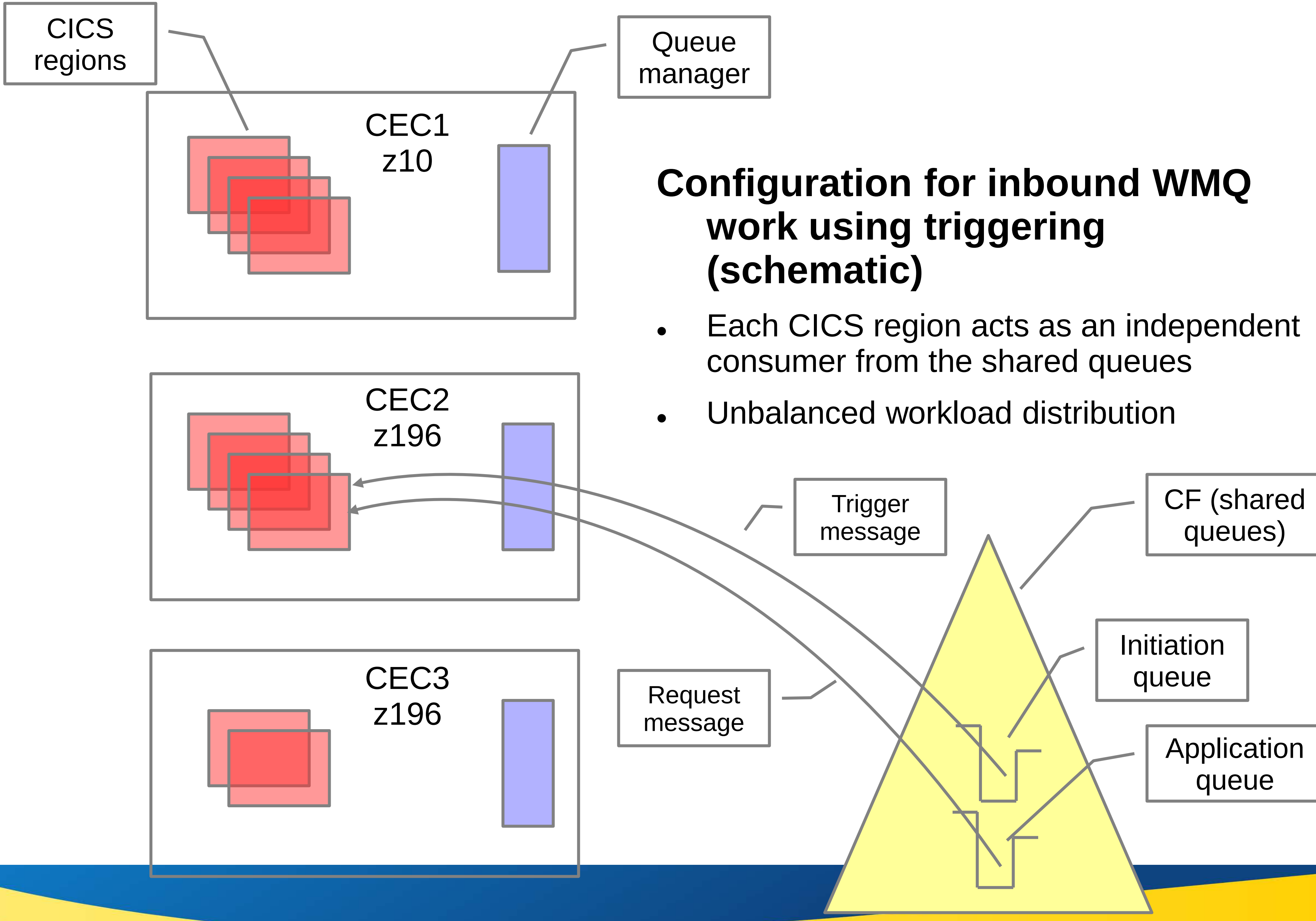
Re-driving Connections

- **When a queue manager is unavailable, inbound connections can get skewed to the other queue manager(s) in the group.**
  - This is normal availability processing!
  - Once a connection is live and active, no attempt is made to balance the connections once all the queue managers are available.



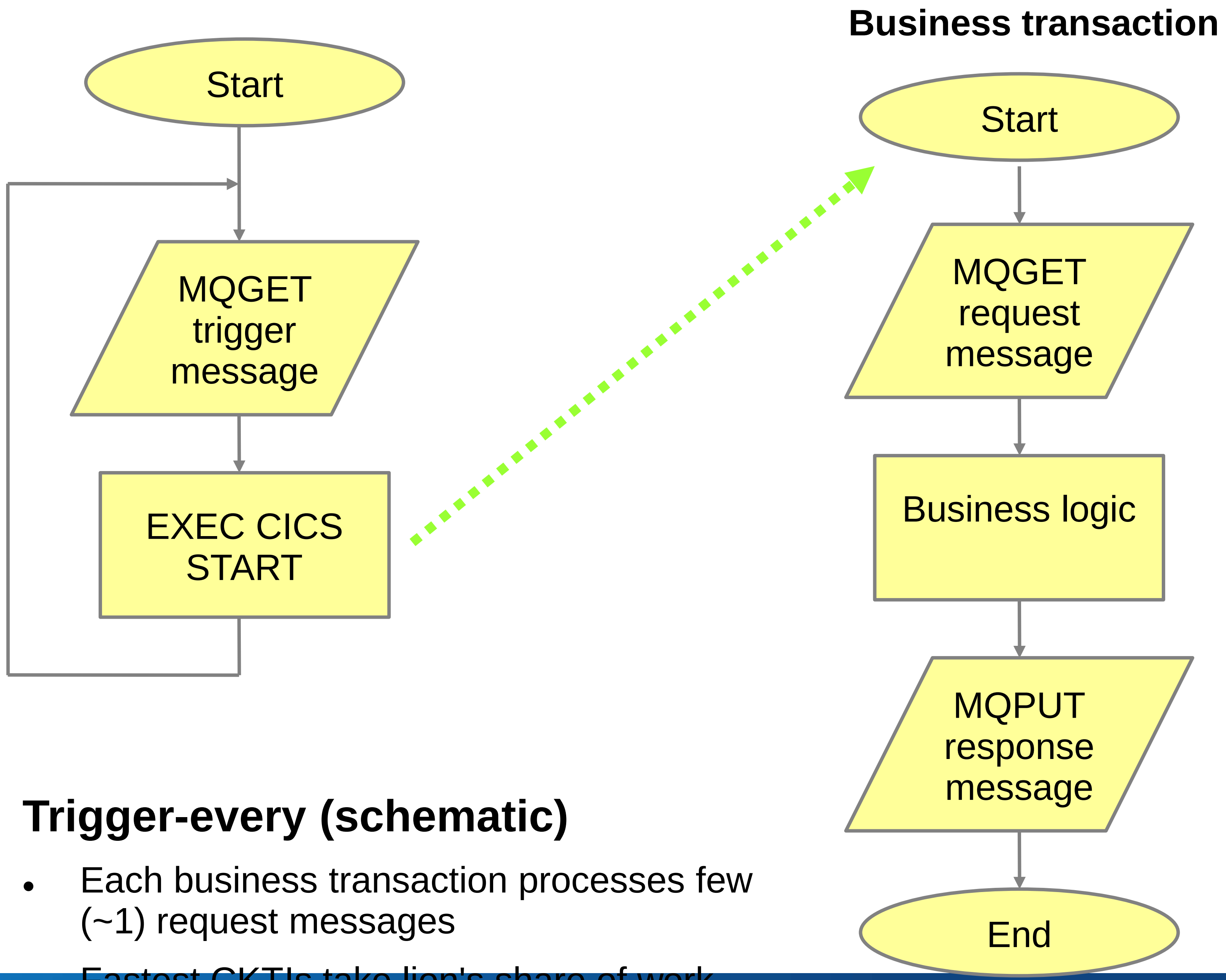
CICS – CPSM Mitigation

- The slides that follow outline a CPSM solution to the skewing problem based on the interaction between MQ triggering (CKTI) and CICS



Configuration for inbound WMQ work using triggering (schematic)

- Each CICS region acts as an independent consumer from the shared queues
- Unbalanced workload distribution

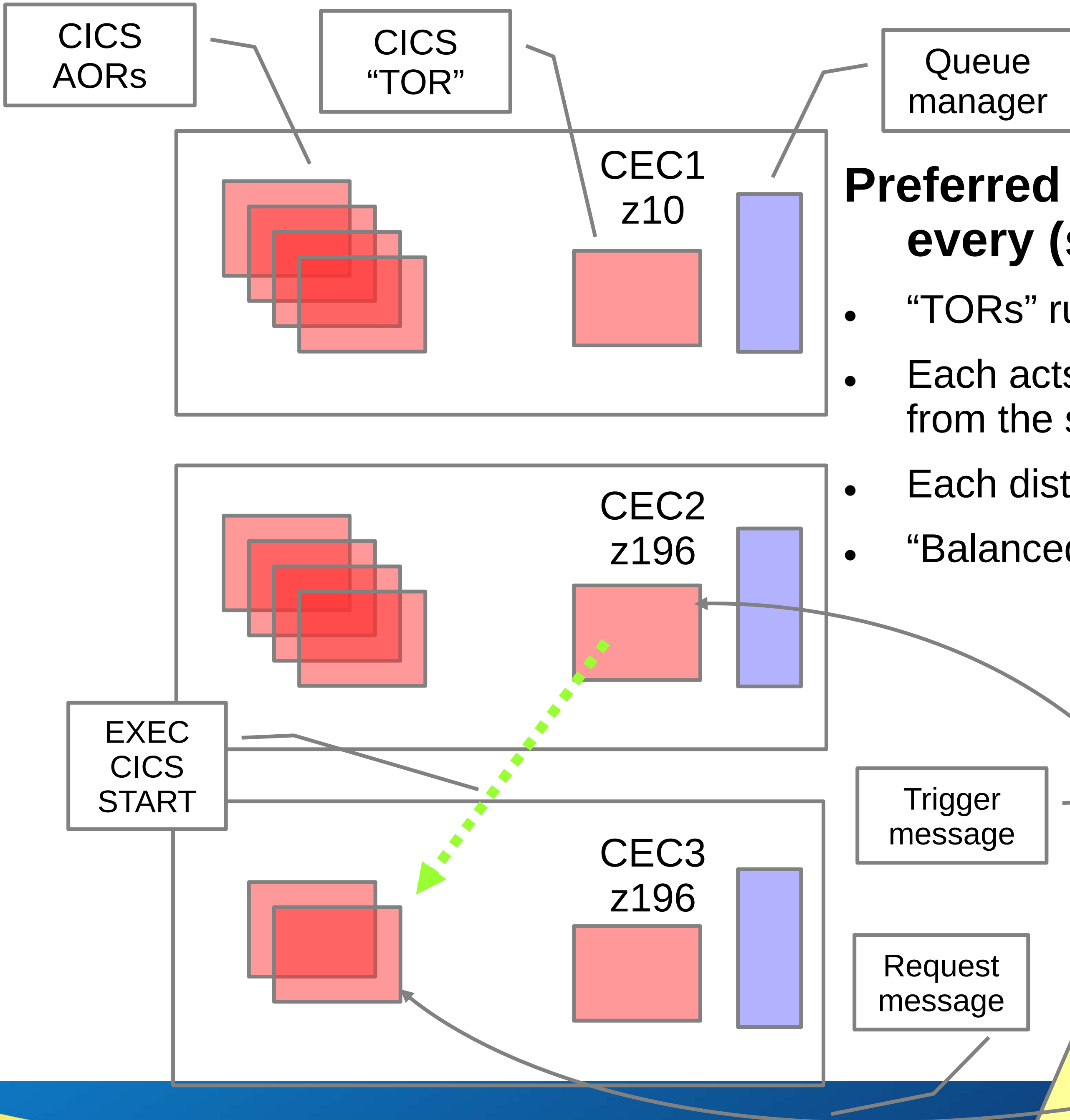


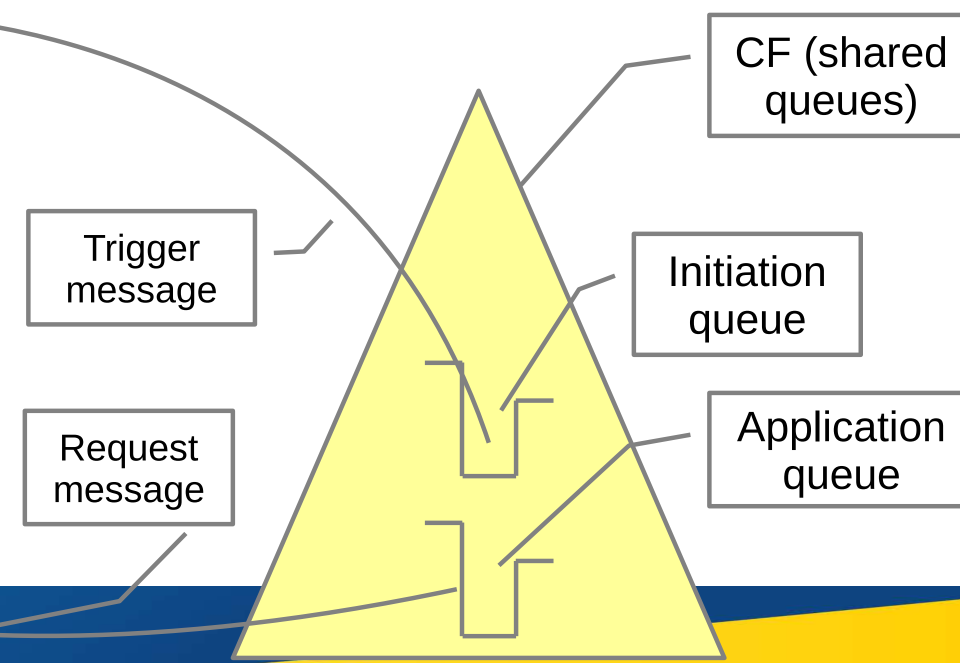
Trigger-every (schematic)

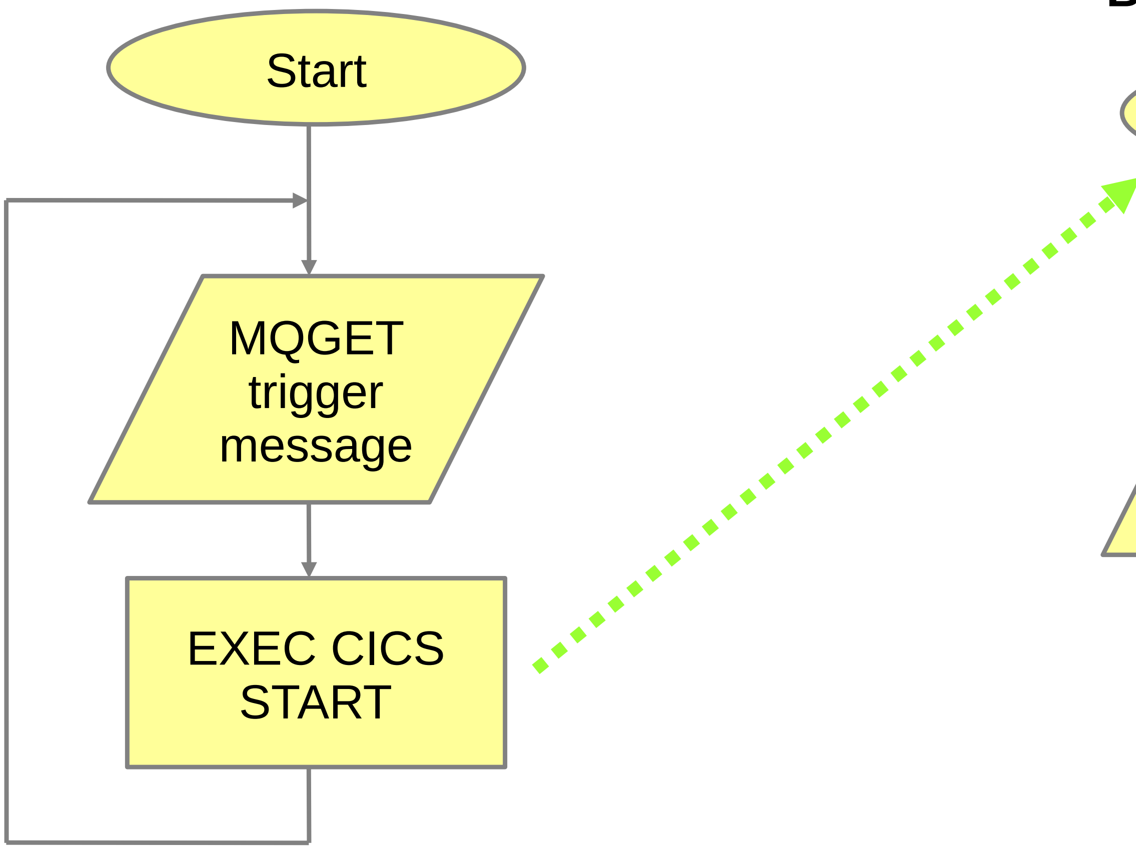
- Each business transaction processes few (~1) request messages
- Fastest CKTIs take lion's share of work

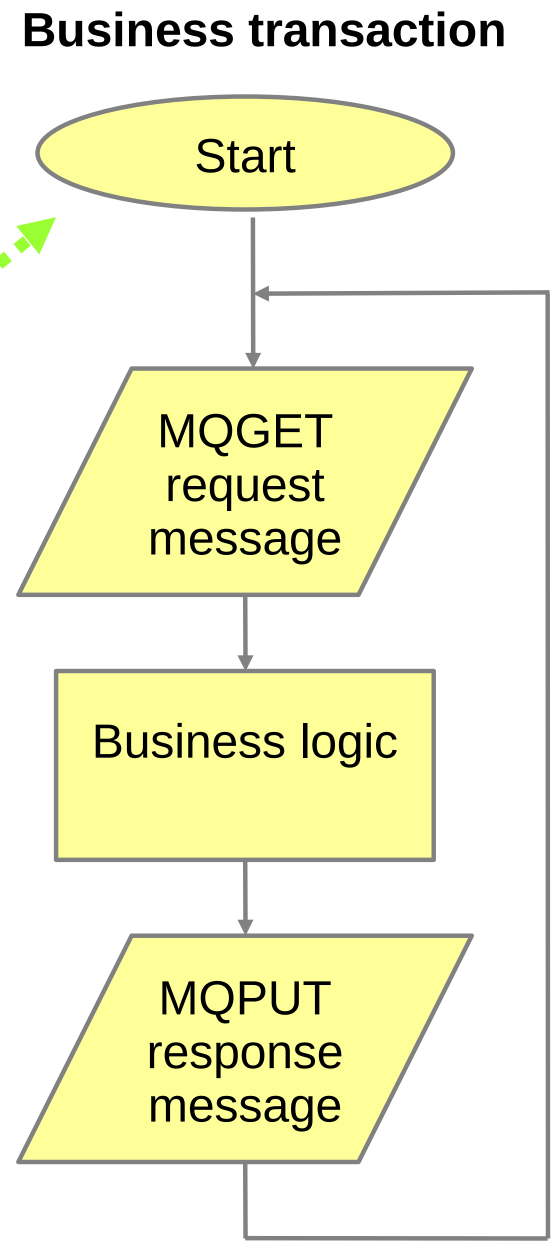
Preferred configuration for trigger-every (schematic)

- “TORs” run CKTI
- Each acts as an independent consumer from the shared init queue
- Each distributes STARTs across all AORs
- “Balanced” workload distribution



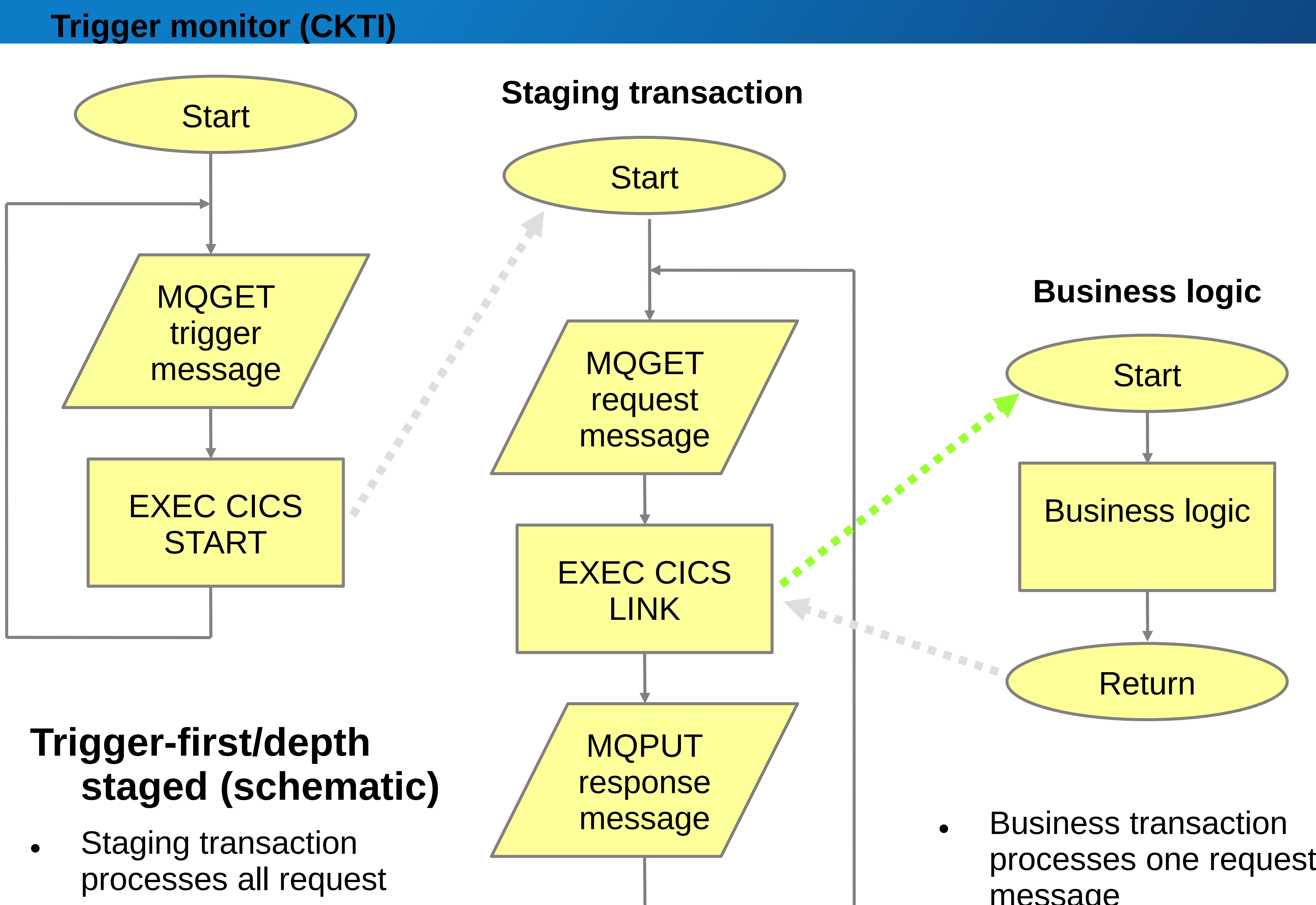






Trigger-first/depth (schematic)

- Each business transaction processes many (~all) request messages
- Fastest CKTI takes lion's share of work
- Corresponding business transaction takes lion's share of the work



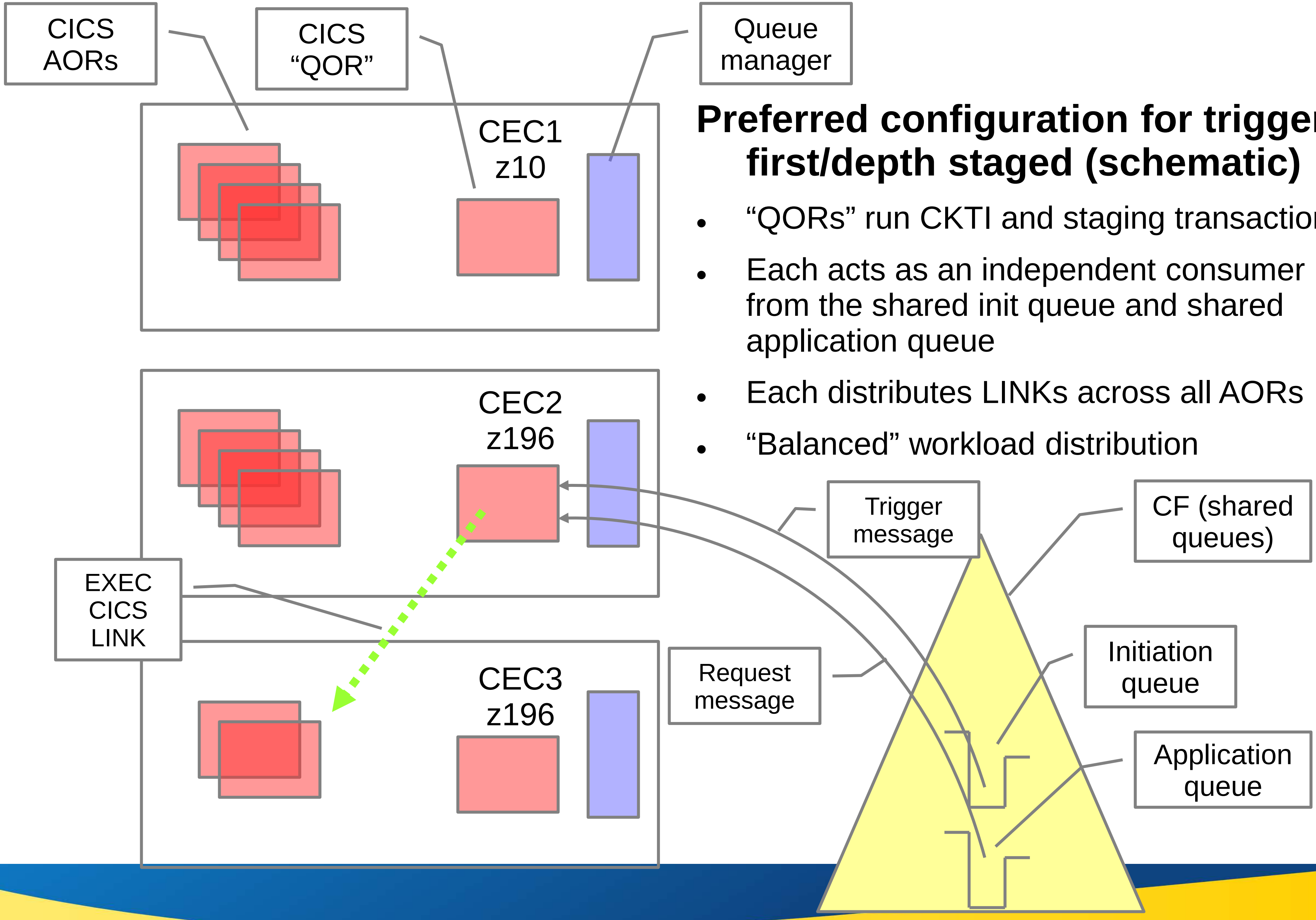
Trigger-first/depth staged (schematic)

- Staging transaction processes all request messages

- Business transaction processes one request message

Preferred configuration for trigger-first/depth staged (schematic)

- "QORs" run CKTI and staging transaction
- Each acts as an independent consumer from the shared init queue and shared application queue
- Each distributes LINKs across all AORs
- "Balanced" workload distribution



Highlights

- **Solution uses proven technology for CPSM routing:**
  - Each TOR/QOR uses link-neutral goal algorithm
    - Selects target AOR based on AOR load and health
    - Does not “prefer” local (= same LPAR) AORs
    - Even distribution across AORs, but ...
    - … responds to transient load/health variation
  - XCF MRO for “remote” STARTs or LINKs
    - High-performance System z sysplex technology
    - Uses coupling facility (CF) instead of TCP/IP stack
  - Sysplex-optimised workload routing
    - Highly responsive to transient variations
    - Uses CF to maintain current status for AORs
- **Continuous operation and high availability through WMQ shared queues:**
  - “Glitchless” recovery from region/LPAR/CEC outage
  - “Instant” redistribution of workload
  - In-flight messages backed-out, restart in another CICS region
- **High throughput:**
  - Exploits all available capacity
  - Highly responsive to transient spare capacity

MQ Workload Balance Summary

- **MQ is a message delivery system, it does not try to balance workload**
- **Balancing the workload is attempting a technical solution for what is often a pricing problem**
  - Beware spending a lot of effort for a solution to a temporary problem as well!
  - Turning off performance improvements like put to waiting getter will impact all applications, not just the skewed ones
- **There are some mitigation techniques that can help the overall environment**
  - Clustering!
  - Gateway queue managers
  - Using CPSM to make appropriate routing decisions

Additional Resources

- **The following links are to additional information about WMQ**
  - Queue Sharing Groups:
    http://publib.boulder.ibm.com/infocenter/wmqv7/v7r1/topic/com.ibm.mq.explorer.doc/e_qsg.htm
  - Clustering:
    http://publib.boulder.ibm.com/infocenter/wmqv7/v7r1/topic/com.ibm.mq.doc/qc11220_.htm
  - Intercommunication
    http://publib.boulder.ibm.com/infocenter/wmqv7/v7r1/topic/com.ibm.mq.doc/zx00011_.htm
  - Redbooks:
    - IBM WebSphere MQ V7.1 and V7.5 Features and Enhancements
      http://www.redbooks.ibm.com/abstracts/sg248087.html?Open
    - High Availability in WebSphere Messaging Solutions
      http://www.redbooks.ibm.com/abstracts/sg247839.html?Open
    - WebSphere MQ Queue Sharing Group in a Parallel Sysplex environment (dated, but still good basic information)
      http://www.redbooks.ibm.com/redpieces/abstracts/redp3636.html?Open
  - Lyn's first YouTube video:
    http://www.youtube.com/playlist?list=PL9N7JP2yU3T8JycrCOvEPM8c-0UdE97VT

MQ Workload Balance - thanks

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