Coupling Technology
Overview and Planning

What's the right stuff for me?

SHARE Boston

EWCP

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IBM

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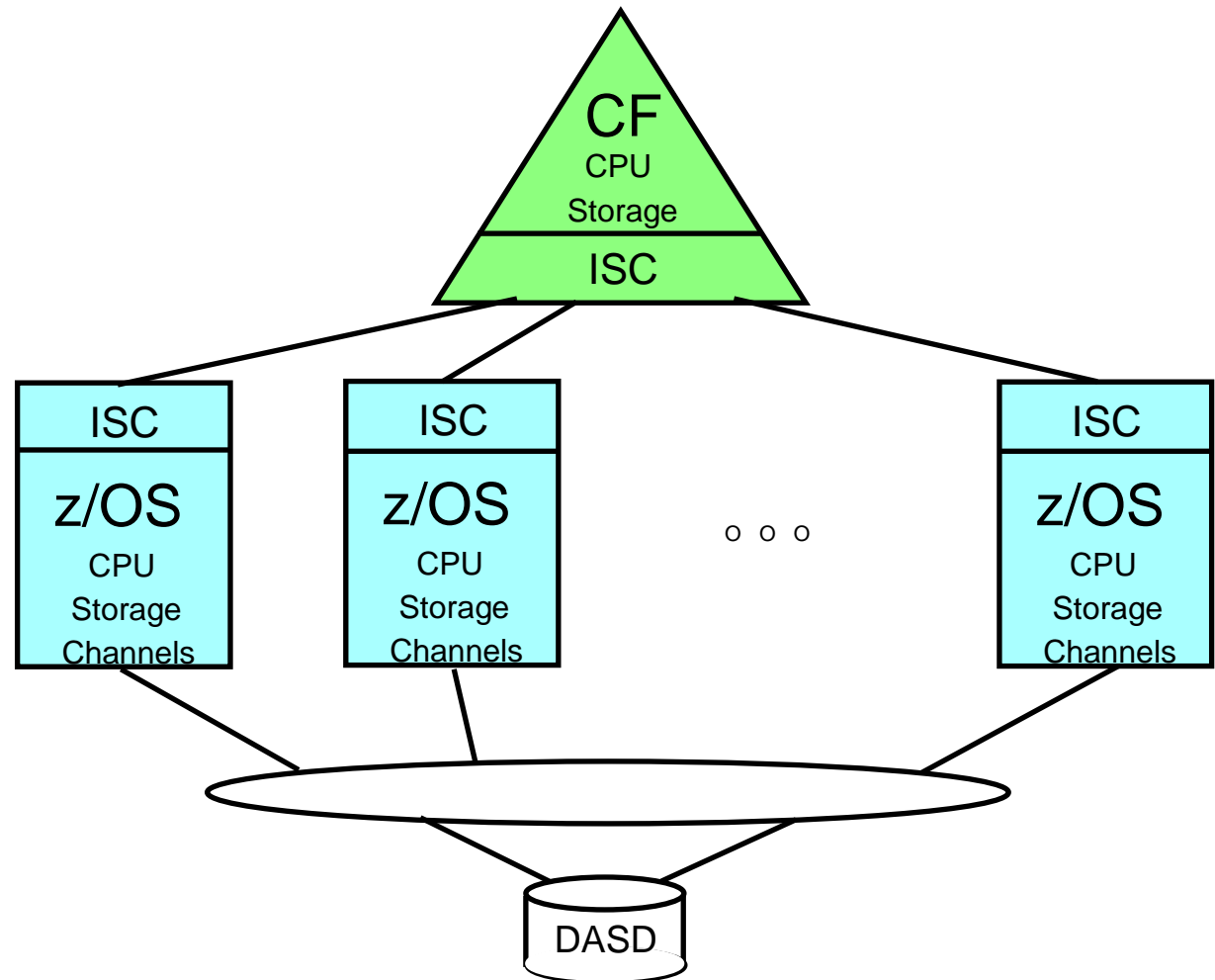Information about non-IBM products is obtained from the manufacturers of those products or their published announcements. IBM has not tested those products and cannot confirm the performance, compatibility, or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.
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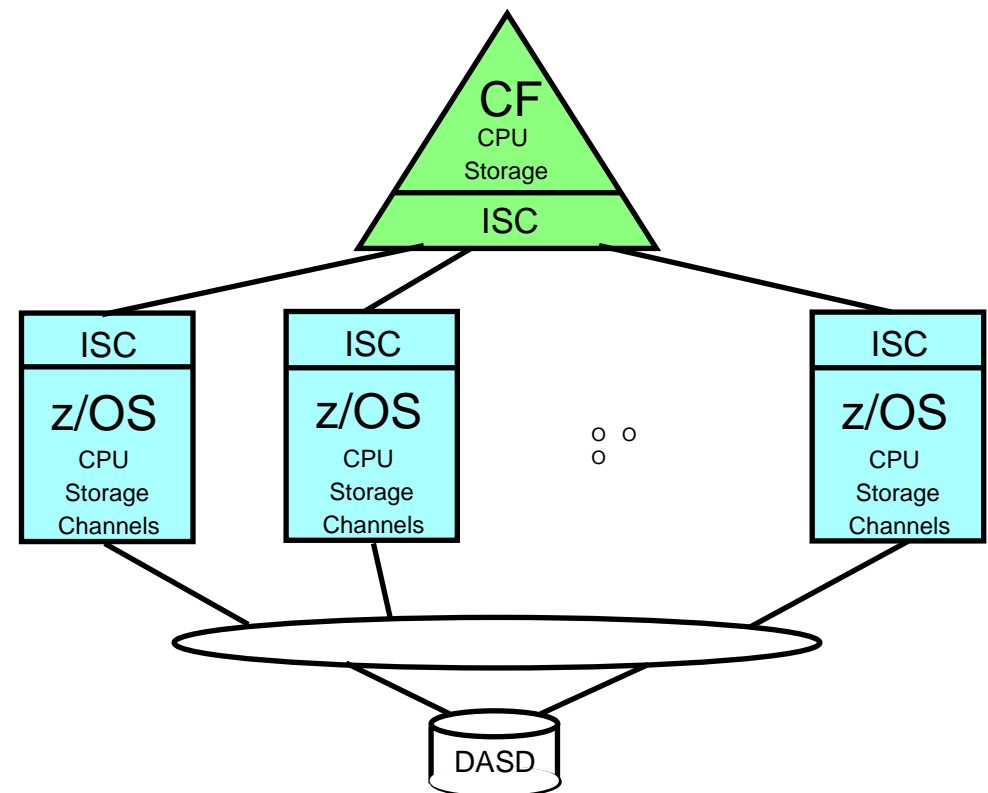
Parallel Sysplex
Overview and hottest players

► Resource Sharing

– XCF

– GRS Star

– logs

► Data sharing

– locking

– global buffer pool

► Workload management

– VTAM

– CICS TS

– IMS SMQ

– MQ shared queues

CF
CPU
Storage
ISC

ISC
z/OS
CPU
Storage
Channels

ISC
z/OS
CPU
Storage
Channels

o o o

ISC
z/OS
CPU
Storage
Channels

DASD

What coupling technology is right for me?

- CF Functionality

- CF Capacity

- CF Service Time

What coupling technology is right for me?

- CF Functionality

  ► CFCC levels

- CF Capacity

- CF Service Time
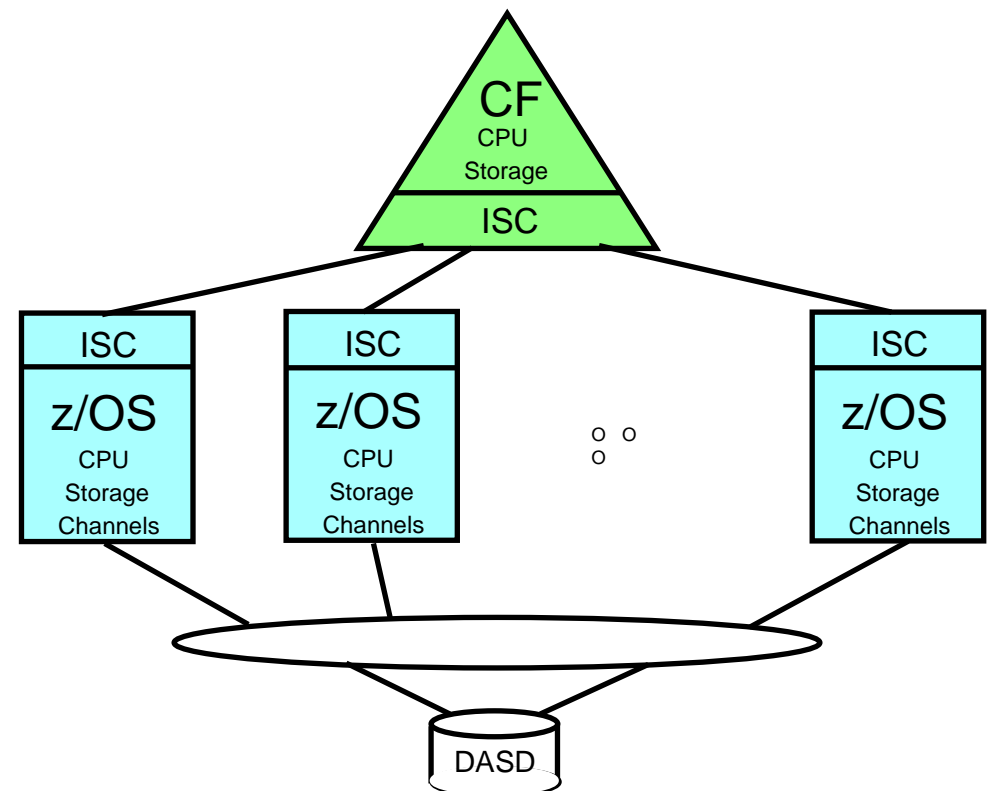
CFCC Level Functional Highlights

- **z990/z900/z890/z800**
  - ►CF level 1-9 functions plus ...
  - ►CF level 10: 64 bit toleration
  - ►CF level 12: 64 bit exploitation, 48 tasks, SM structure duplexing
  - ►CF level 13: DB2 castout improvements

- **z9EC/z9BC/z990/z890**
  - ►CF level 14: CFCC dispatcher enhancements

- **z9EC/z9BC/z10EC/z10BC**
  - ►CF level 15: 112 tasks, CPU % by structure

- **z10EC/z10BC**
  - ►CF level 16: improved SM duplexing, improved LN for IMS and MQ

- **z196**
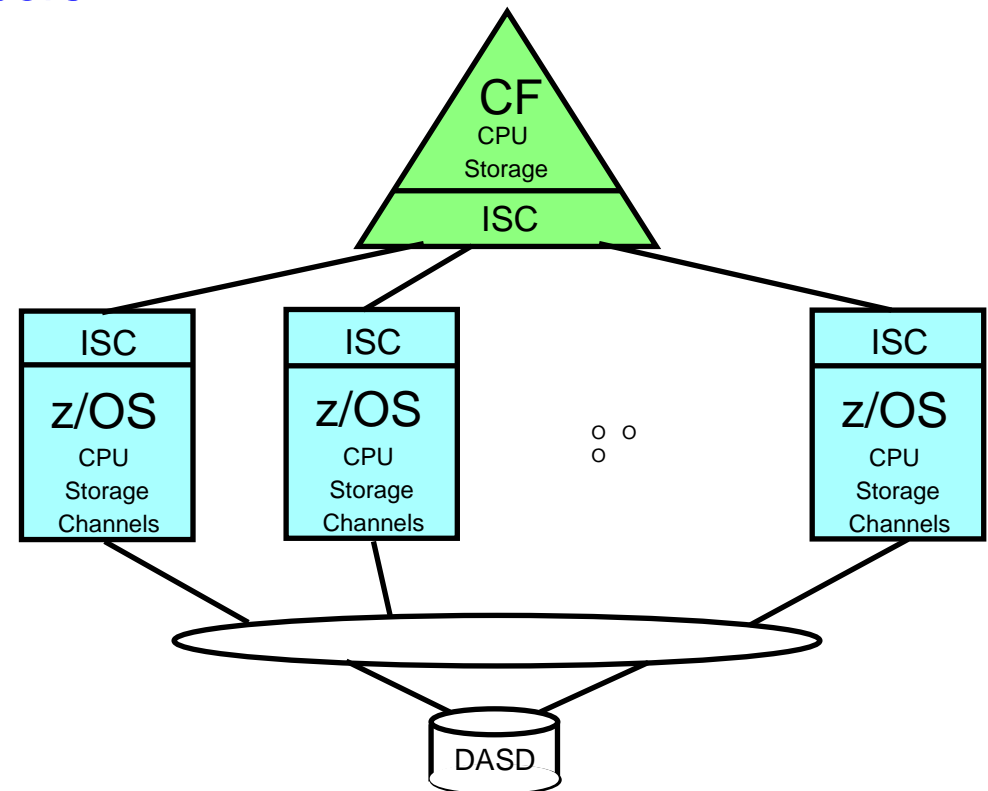 - ►CF level 17: 2047 structures, enhanced serviceability

What coupling technology is right for me?

- **CF Functionality**

  - ► CFCC levels

  - ► CF Partitions

    - – dedicated versus shared processors

    - – standalone versus internal

      - • CF Duplexing
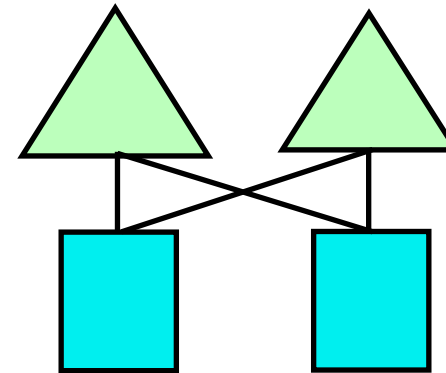
- **CF Capacity**

- **CF Service Time**

CF Partition Options - what are the differences?
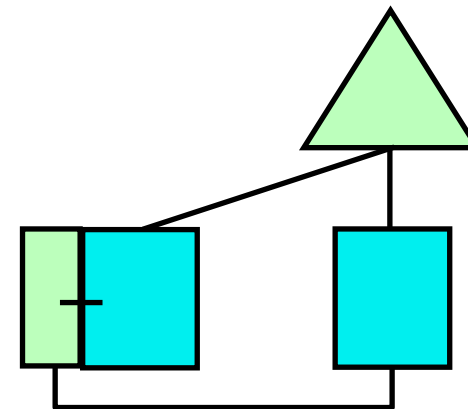
- **Standalone CF**
  - ► dedicated processor(s)
    - – best for production
  - ► shared processor(s)
    - – test or non-data-sharing production
    - – dynamic CF dispatching
    - – competition from other partitions

- **ICF (Internal Coupling Facility)**
  - ► dedicated or shared processor(s)
    - – see above
  - ► availability considerations
    - – addressed by CF duplexing

What is CF duplexing?

- User Managed CF structure duplexing
  - ► Available only for DB2 GBPs and VSO
  - ► User (DB2 or IMS shared VSO)
    - asks for primary/secondary structures
    - writes updates to both
    - synchronizes via already held locks

- System Managed CF structure duplexing
  - ► Installation selects duplexing option
    - for specific exploiters/structures
  - ► System
    - creates primary/secondary structures
    - writes updates to both
    - synchronizes via 2 CF-to-CF ops
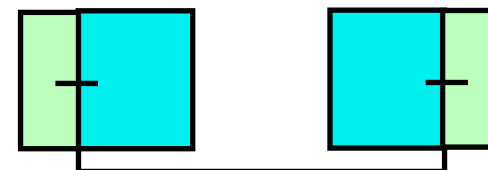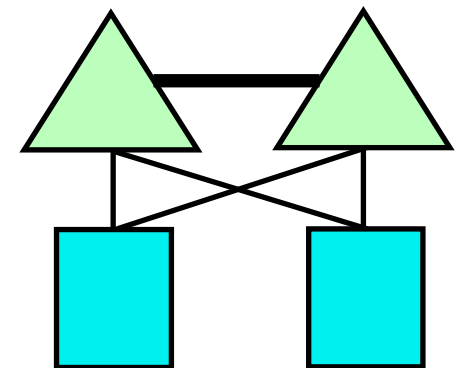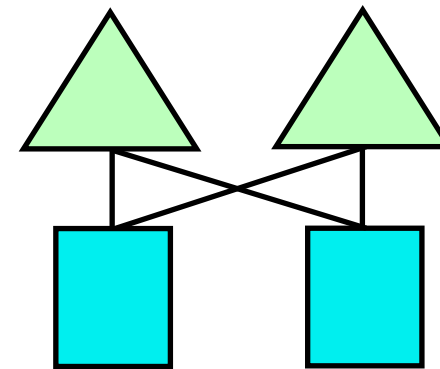
CF duplexing: value vs. cost

- Value
  - ►Faster recovery from CF failures
    - –much, much faster compared to log recovery (40x)
    - –faster compared to rebuild (4x)
 - ►Provides failure isolation
    - –fully exploit ICFs

- Cost
  - ►Increased resource requirements: host CPU, CF CPU, CF links
  - ►User Managed (DB2 GBP structures)
    - –2x times 1% to 100% (typically 20%) of simplex cost
  - ►System Managed (list and lock structures)
    - –3x to 5x times near 100% of simplex cost

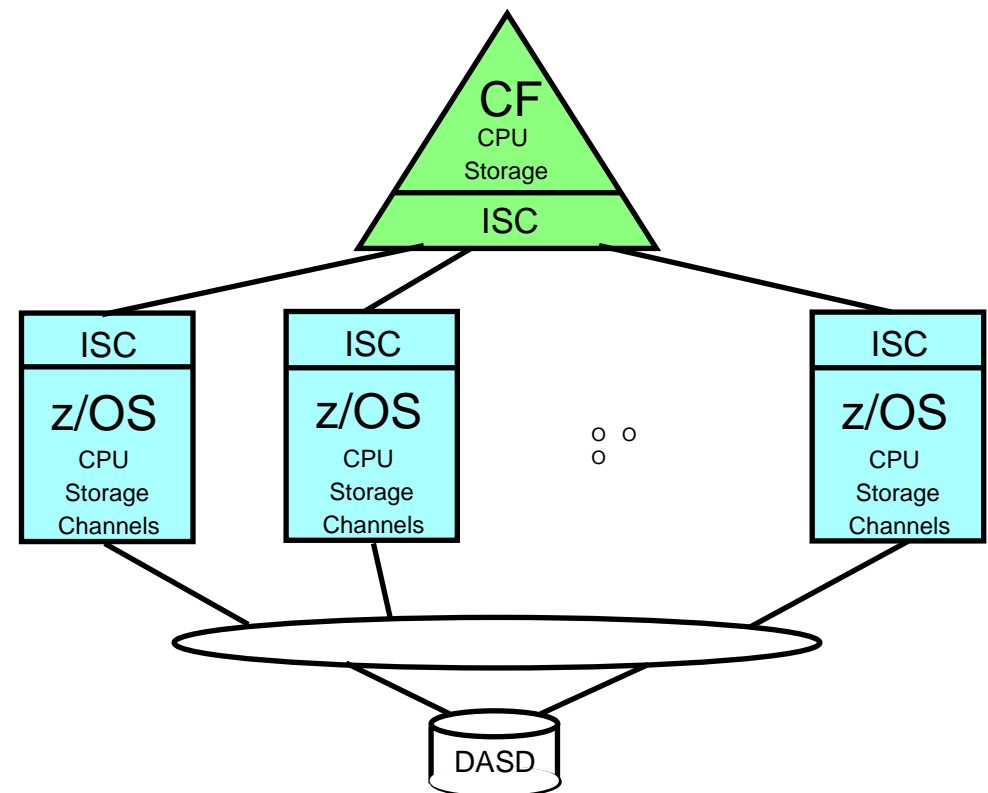- Selectively enable when value > cost

What coupling technology is right for me?

- CF Functionality

- CF Capacity
  - ► Need enough to handle the request rate (keep utilization < 50%)
    - ► Note 1way CFs <30% due to
      - ► Single server queuing
      - ► Long running commands "blocking" short commands
  - ► Add engines or move to faster engines
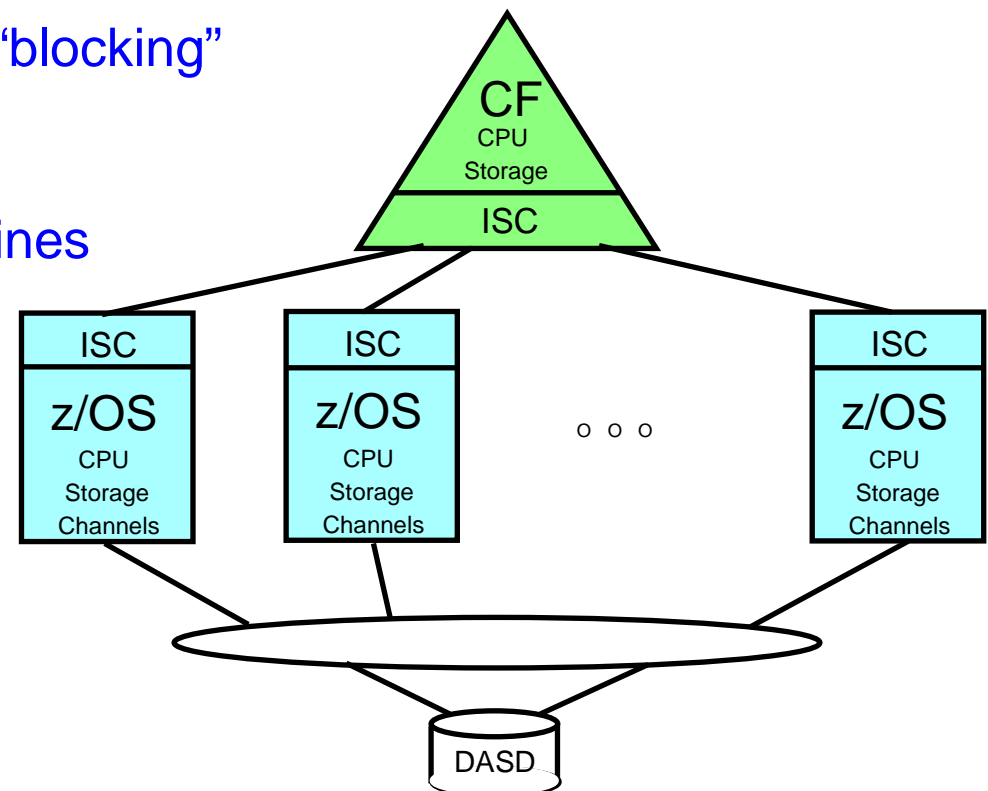
- CF Service Time

What coupling technology is right for me?

- CF Functionality

- CF Capacity

- CF Service Time
  - ► Affected by
    - –speed of CF engine
    - –link technology

Coupling Link Choices - Overview

- **ISC (Inter-System Channel)**
  - Fiber optics
  - I/O Adapter card
  - 10km and longer distances with qualified WDM solutions

- **ICB (Integrated Cluster Bus)**
  - Copper cable plugs close to memory bus
  - 10 meter max length
  - Not available on z196

- **IC (Internal Coupling Channel)**
  - Microcode - no external connection
  - Only between partitions on same processor

Relative Performance
Based on avg data xfer size

3x

4x

1x

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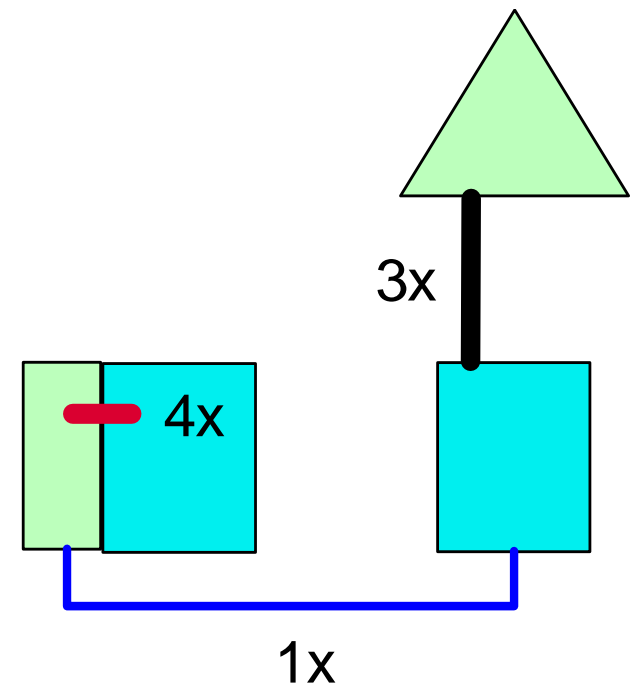
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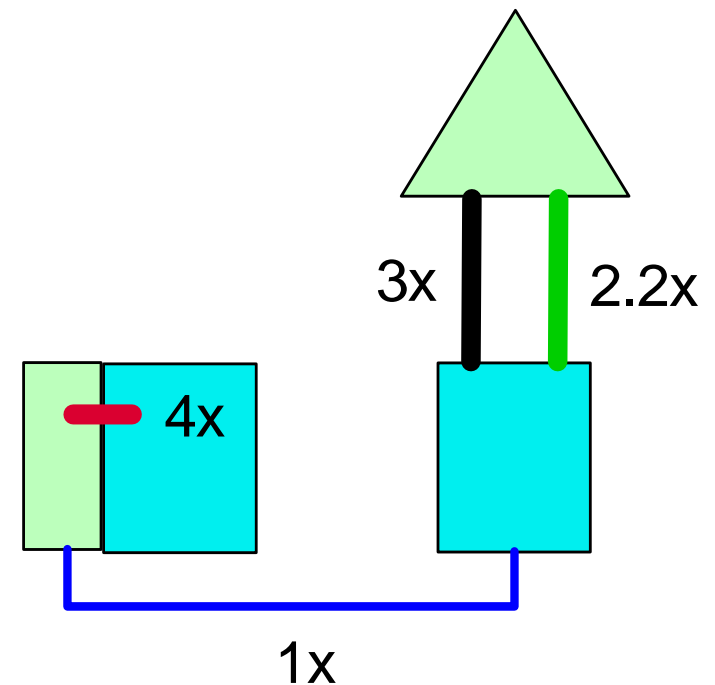 - Only between partitions on same processor

- **PSIFB (12x IB)**
  - 150 meter max distance optical cabling
  - Supports multiple CHPIDs per physical link
  - Multiple CF partitions can share physical link

Relative Performance
Based on avg data xfer size

3x   2.2x

4x

1x

Coupling Link Choices - Overview

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- **PSIFB (12x IB)**
  - 150 meter max distance optical cabling
  - Supports multiple CHPIDs per physical link
  - Multiple CF partitions can share physical link

- **PSIFB (1x IB)**
  - 10km and longer distances with qualified WDM solutions
  - Same multiple CHPIDs and sharing flexibility as 12x

Relative Performance
Based on avg data xfer size

1.6x

3x   2.2x

4x

1x
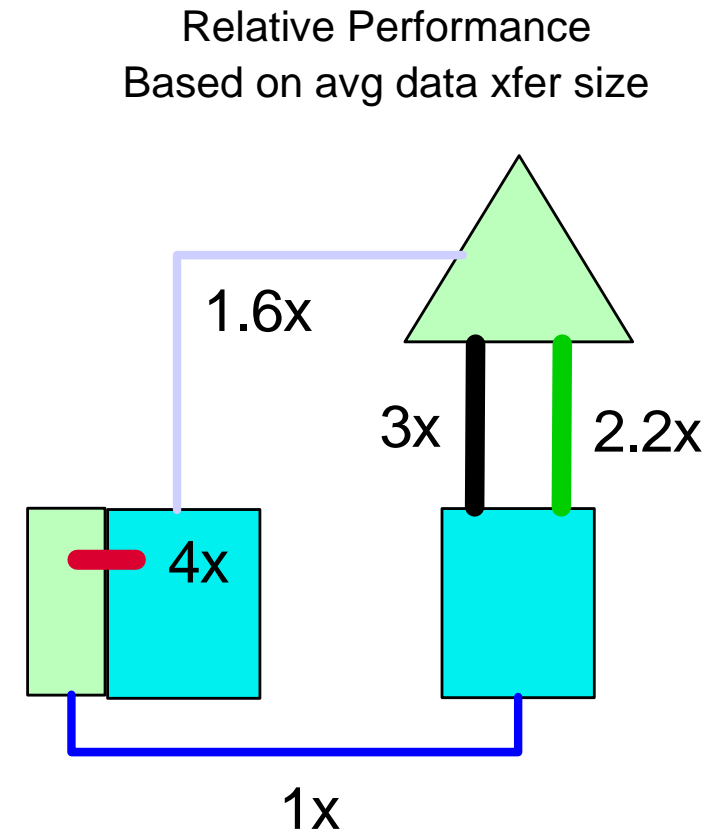
PSIFB Configuration Advantages

- **Pure Capacity**
  - 1 12x PSIFB replaces 1 ICB4
  - 1 12x PSIFB replaces 4 ISC3s
- **Eliminating subchannel and path delays**
  - Often >2 ICB4s configured not for capacity but for extra subchannels/paths to eliminate delays
  - 2 12x PSIFB links with multiple CHPIDs can replace >2 ICB4s in this case
- **Multiple sysplexes sharing hardware**
  - Production, development, test sysplexes may share hardware – each needs own ICB4 or ISC3 links
  - 2 PSIFB links with multiple CHPIDs can replace >2 ICB4s or ISC3s in this case
- Multiple CHPID recommendations
  - Max 16 per HCA (2 ports per HCA)
    - Use up to all 16 for lightly loaded connectivity
    - Limit to use up to 8 per HCA for heavy loads
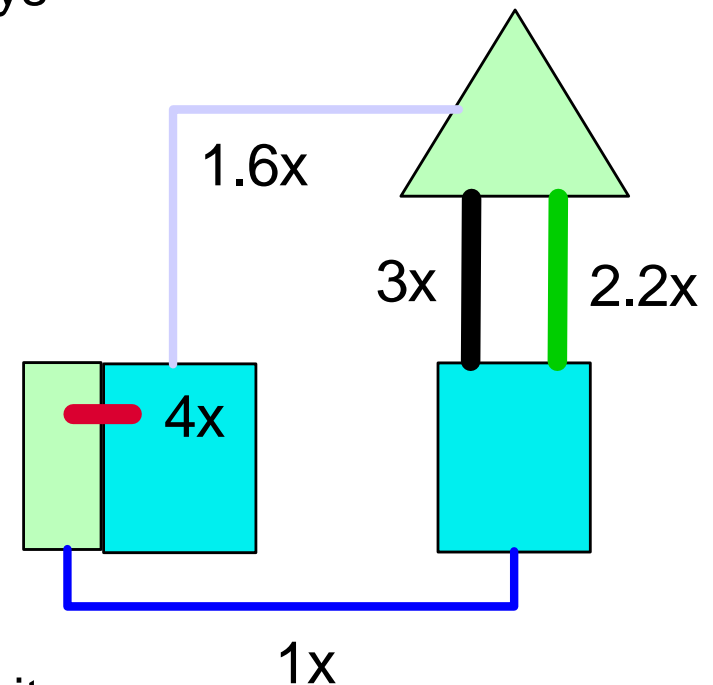
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1x

What coupling technology is right for me?

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  - ►Affected by
    - –speed of CF engine
    - –link technology
  - ►Affects cost of data sharing
    - –host processor dwells
      for synchronous requests
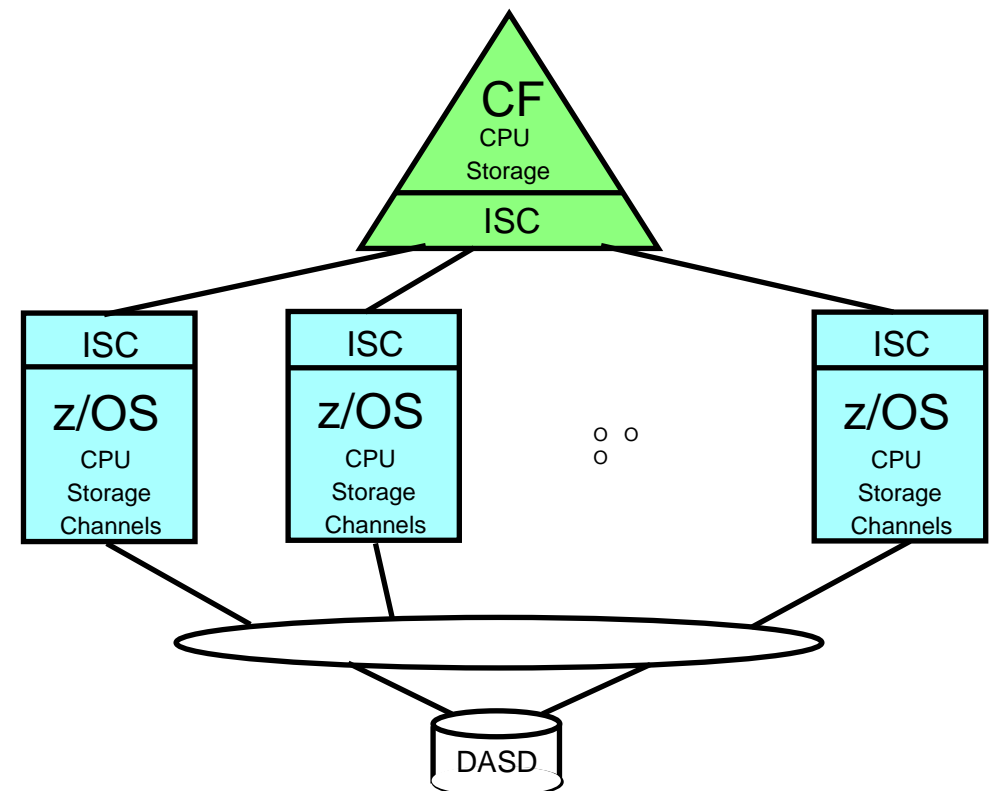
CF Operations: synchronous or asynchronous

- Describes state of host processor engine issuing CF operation

- Synchronous operation
  - ► SW cost: exploiter+XES
  - ► HW cost ("dwelling time")

- Asynchronous operation
  - ► SW cost
    - – exploiter+XES+SRBs
    - – task switching impact on HW
  - ► HW cost - virtually none (no dwelling)
  - ► CF service time elongation
    - – added latency for XES to recognize completion of operation

- Which when?
  - ► Exploiter can specify synch or asynch
  - ► If synch, XES heuristic can override and issue it asynch
    - – based on measured synch service time versus "breakeven" cost of asynch
 - ► If issued synch and encounter subchannel busy, will change to asynch

What coupling technology is right for me?

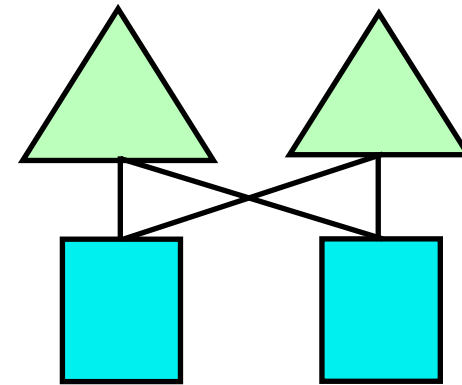- CF Functionality

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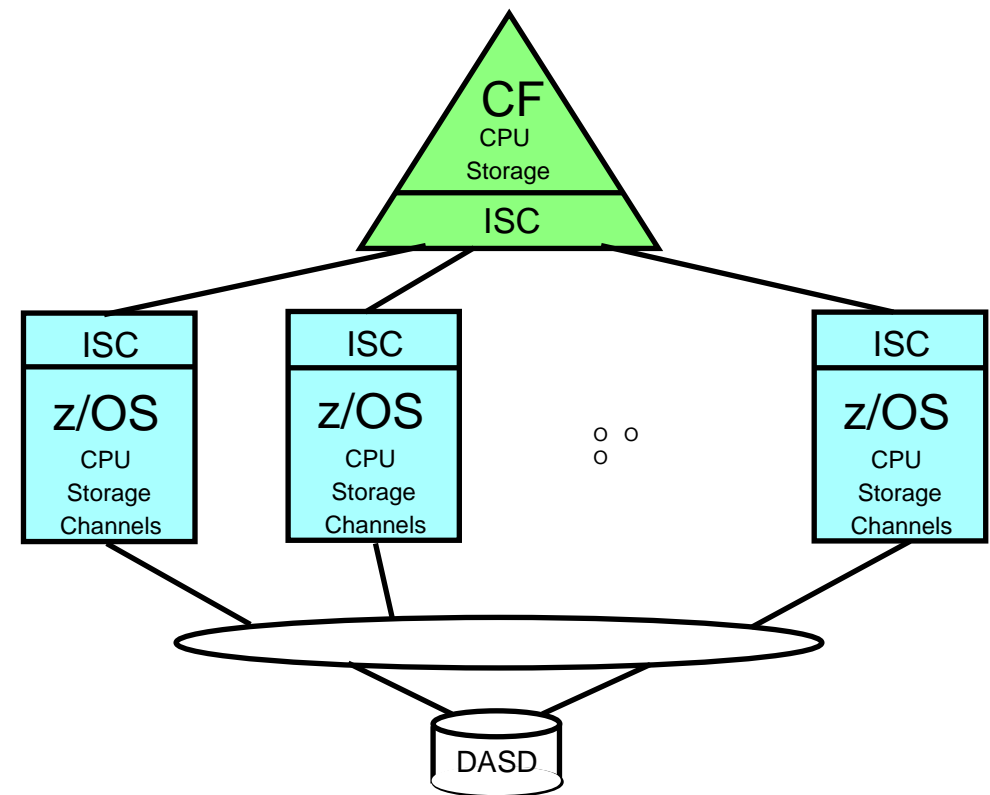   - –host processor dwells
       for synchronous requests
  - ► Impact relative to ...
    - –Rate of requests to the CF
    - –Speed of the host processor

Host Capacity Effect

- Directly related to activity to CF
  - ►CF request rate x SW+HW cost

- Varies based on
  - ►Portion of workload involved in data sharing
  - ►Access rate to shared data
  - ►Type of hardware for Host, CF and CF links

- Typical system-level effects
  - ►Resource Sharing: 2-3% versus single image
  - ►Data sharing primary production application: 5-10%

- Individual Transaction/Job effects - can have wide variation

Production Examples

Host Effect with primary application involved in data sharing

Industry	Trx Mgr / DB Mgr	z/OS Images	CF access per Mi	% of used capacity
Banking	CICS/IMS	4	9	11%
Banking	CICS/IMS	8	8	9%
Banking	IMS/IMS	2	5	7%
Pharmacy	CICS/DB2	3	8	10%
Insurance	CICS/IMS+DB2	9	9	10%
Banking	IMS/IMS+DB2	4	8	11%
Transportation	CICS/DB2	3	6	8%
Banking	IMS/IMS+DB2	2	7	9%
Retail	CICS/DB2+IMS	3	4	5%
Shipping	CICS/DB2+IMS	2	8	9%

Coupling Technology versus Host Processor Speed

Host effect with primary application involved in data sharing
Chart below is based on 9 CF ops/Mi - may be scaled linearly for other rates

Host CF	z890	z990	z9 BC	z9 EC	z10 BC	z10 EC	z196
z890 ISC	13%	15%	16%	17%	19%	21%	NA
z890 ICB	9%	10%	10%	11%	12%	13%	NA
z990 ISC	13%	14%	14%	15%	17%	19%	NA
z990 ICB	9%	9%	9%	10%	12%	13%	NA
z9 BC ISC	12%	13%	14%	15%	17%	19%	23%
z9 BC PSIFB 12X	NA	NA	NA	NA	13%	14%	16%
z9 BC ICB	8%	9%	9%	10%	11%	12%	NA
z9 EC ISC	12%	13%	13%	14%	16%	18%	22%
z9 EC PSIFB 12X	NA	NA	NA	NA	13%	14%	16%
z9 EC ICB	8%	8%	8%	9%	10%	11%	NA
z10 BC ISC	12%	13%	13%	14%	16%	18%	22%
z10 BC PSIFB 12X	NA	NA	11%	12%	13%	14%	15%
z10 BC ICB	8%	8%	8%	9%	10%	11%	NA
z10 EC ISC	11%	12%	12%	13%	15%	17%	22%
z10 EC PSIFB 12X	NA	NA	10%	11%	12%	13%	15%
z10 EC ICB	7%	7%	7%	8%	9%	10%	NA
z196 ISC	NA	NA	11%	12%	14%	16%	21%
z196 PSIFB 12X	NA	NA	9%	10%	11%	12%	14%

With z/OS 1.2 and above, synch->asynch conversion caps values in table at about 18%
PSIFB 1X links would fall approximately halfway between PSIFB 12X and ISC links
IC links scale with speed of host technology and would provide an 8% effect in each case

What coupling technology is right for me?
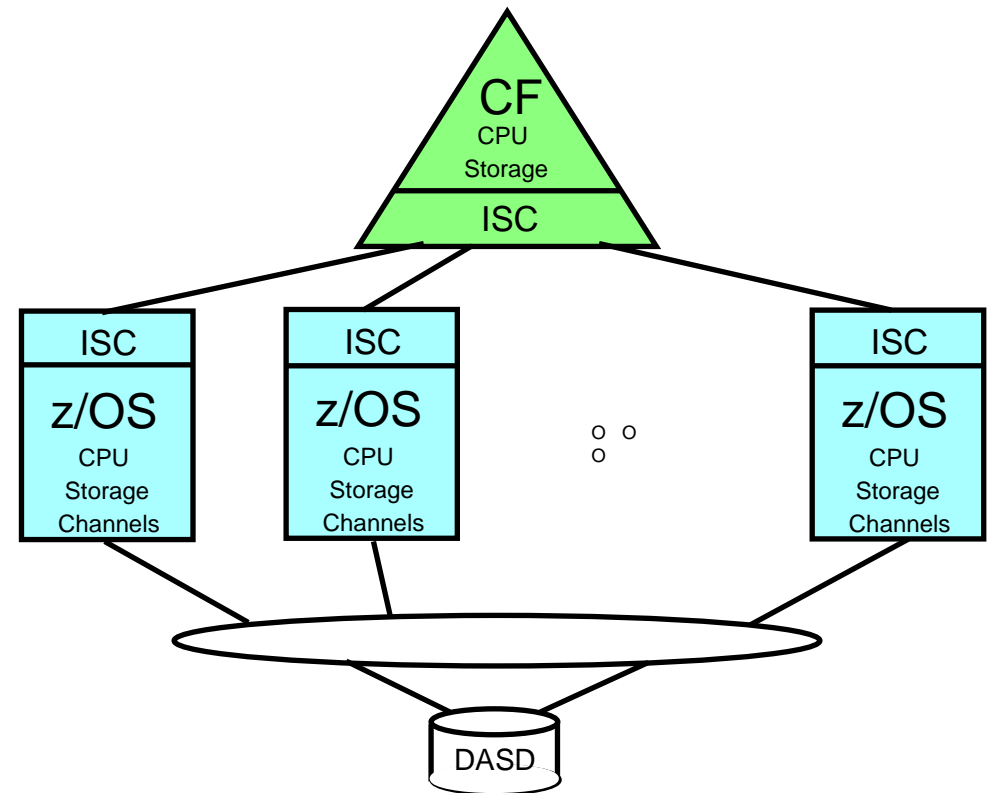## Your Handy Dandy Checklist

- **CF Functionality**
  - ► CFCC level, standalone vs internal, dedicated vs shared

- **CF Capacity**
  - ► Need enough to handle the request rate (keep utilization < 50%)
 - ► Add engines or move to faster engines

- **CF Service Time**
  - ► Affected by
    - – speed of CF engine
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CF
CPU
Storage

ISC

ISC

z/OS
CPU
Storage
Channels

ISC

z/OS
CPU
Storage
Channels

ISC

z/OS
CPU
Storage
Channels

DASD

For those considering data sharing over distance ...

- CF Functionality

- CF Capacity

- CF Service Time
  - ► Affected by
    - – speed of CF engine
    - – link technology
    - – distance between host and CF
      - • elongates by 10 mics per km due to speed of light thru fiber
  - ► Can affect application performance
    - – transaction waits for synch and asynch requests
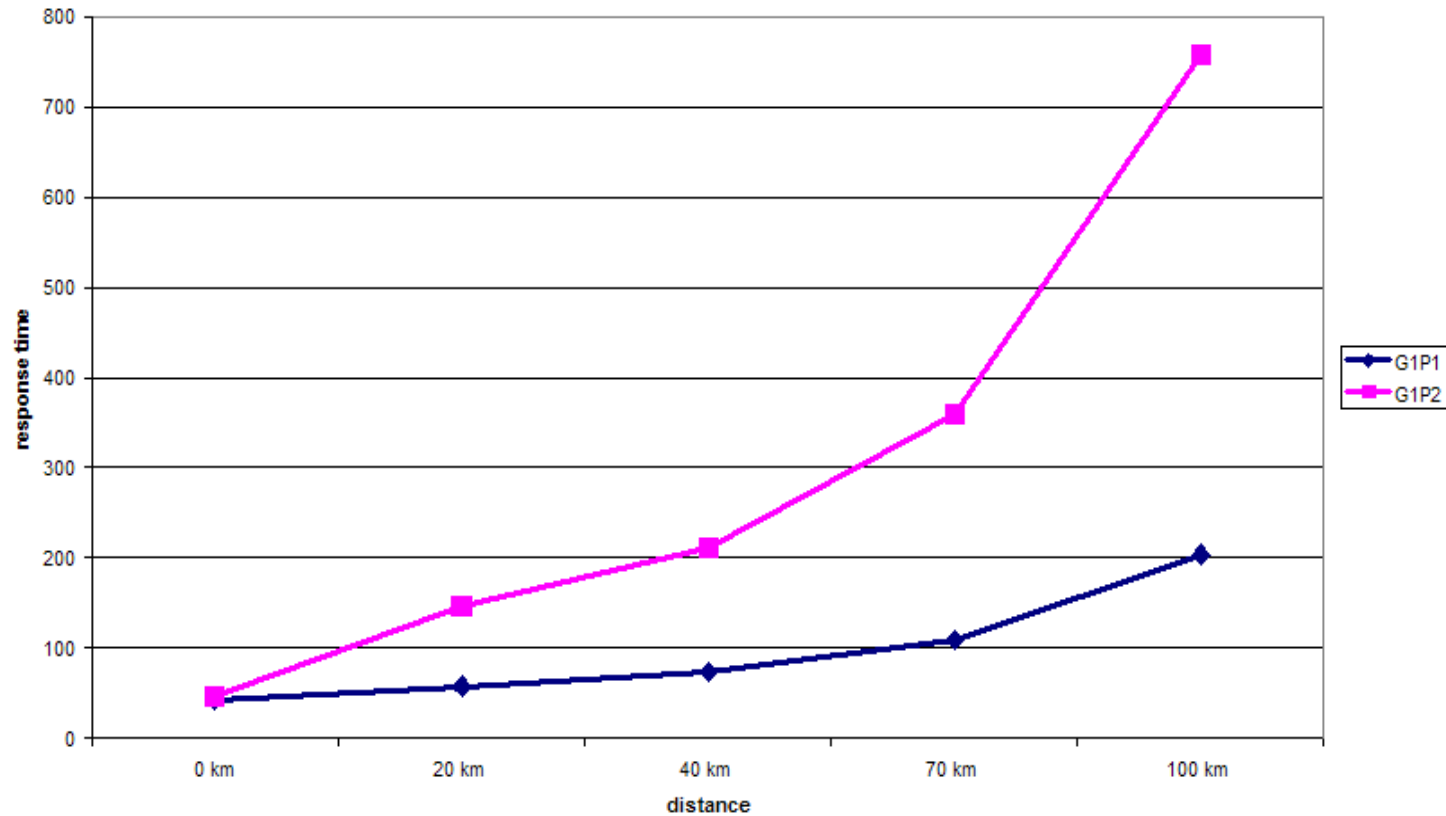   - • potential impact on subsystem queues and lock contention
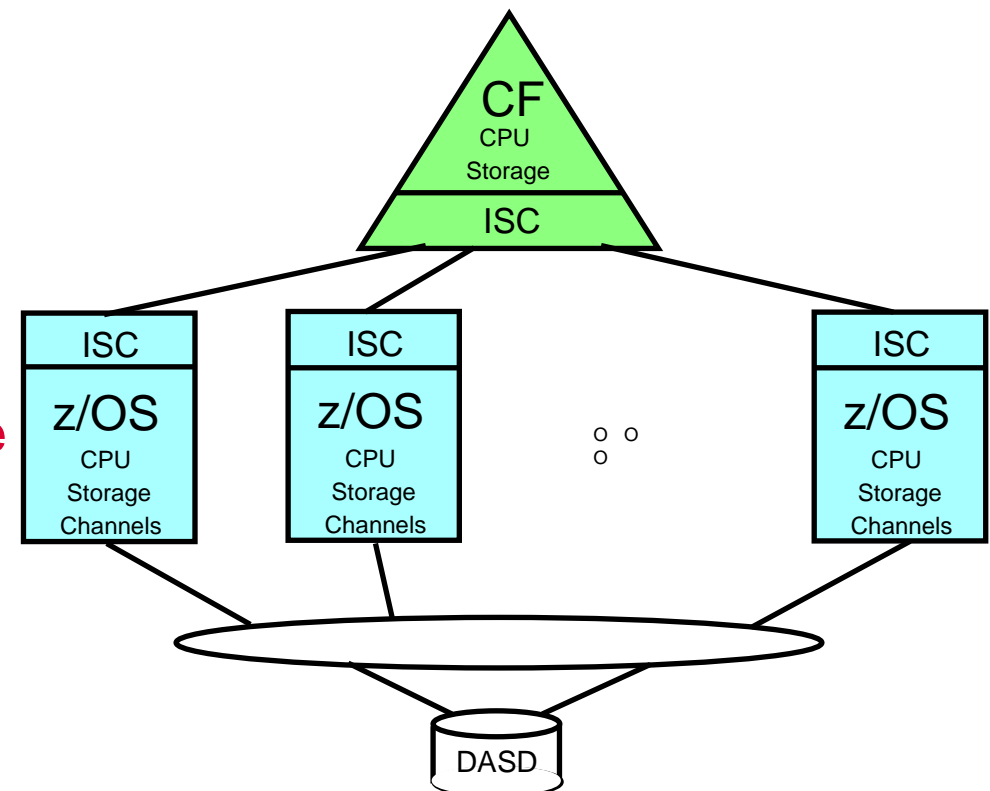
Example Distance Impact

Benchmark CICS/DB2 data sharing application

G1P1 LPAR local to CF with lock structure and primary GBPs

G1P2 LPAR remote to CF with lock structure and primary GBPs

Case 3 : transactions response time (ms)

Data sharing over distance summary

- CF service time elongation (versus synch request)
  - +50 mics due to change to asynch
  - +10 mics per km due to speed of light through fiber (round trip to CF)

- Host impact is capped by synch to asynch conversion

- Will likely need more links between host and remote CF
  - link buffer (subchannel) busy grows linearly with elongated service time
  - PSIFB multiple CHPIDs support helps here

- Potential application performance impact
  - increased transaction response time
    - increased internal subsystem queues
    - increased lock contention

- Each application will react differently

- Difficult to predict impact

- Suggest application stress testing with simultated distance (e.g., fiber suitcases)

References

- http://www-03.ibm.com/systems/z/advantages/pso/whitepaper.html

  - ►CF Configuration Options White Paper
  - ►System Managed CF Structure Duplexing White Paper

- http://www-03.ibm.com/systems/z/advantages/pso/ifb.html

- http://www-03.ibm.com/systems/z/advantages/pso/tools.html

  - ►CF Structure Sizer Tool