

Coupling Technology Overview and Planning

What's the right stuff for me?

SHARE Orlando

EWCP

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IBM

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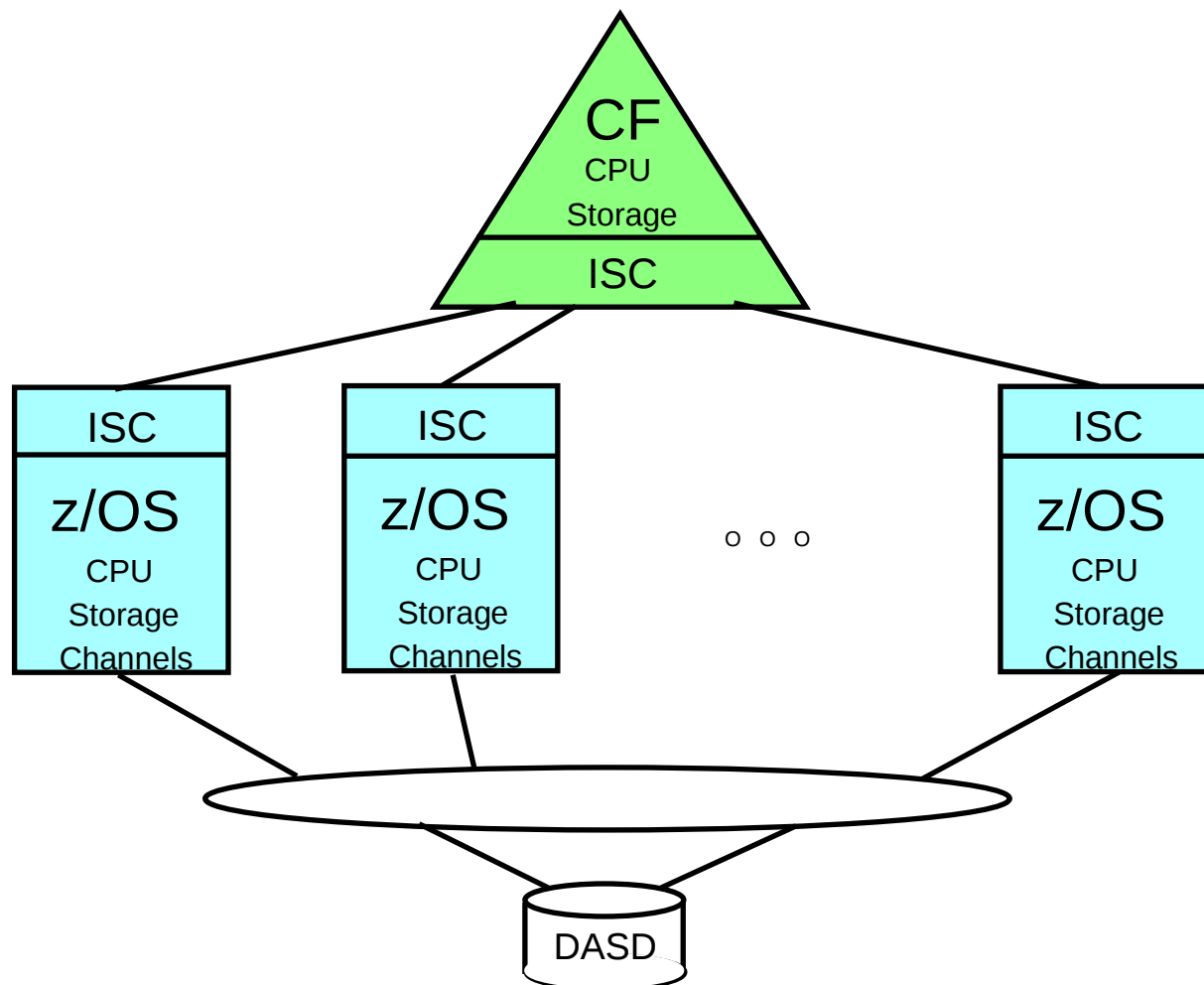
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Parallel Sysplex

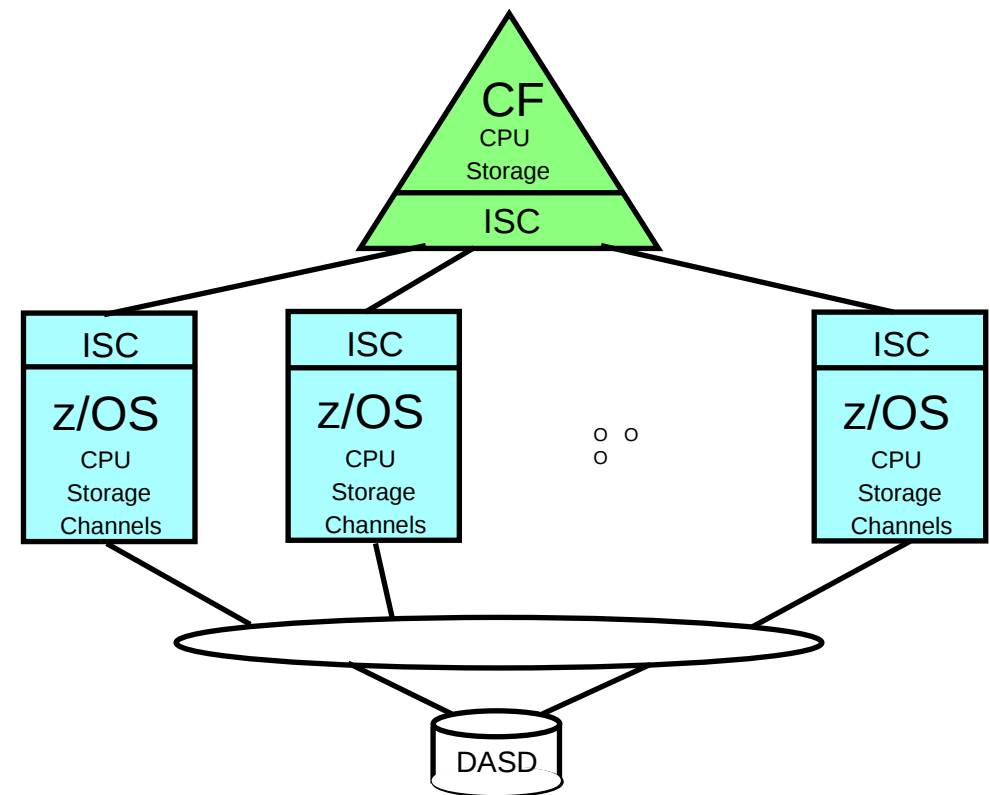
Overview and hottest players

- ▶ Resource Sharing
 - XCF
 - GRS Star
 - logs
- ▶ Data sharing
 - locking
 - global buffer pool
- ▶ Workload management
 - VTAM
 - CICS TS
 - IMS SMQ
 - MQ shared queues



What coupling technology is right for me?

- CF Functionality
- CF Capacity
- CF Service Time



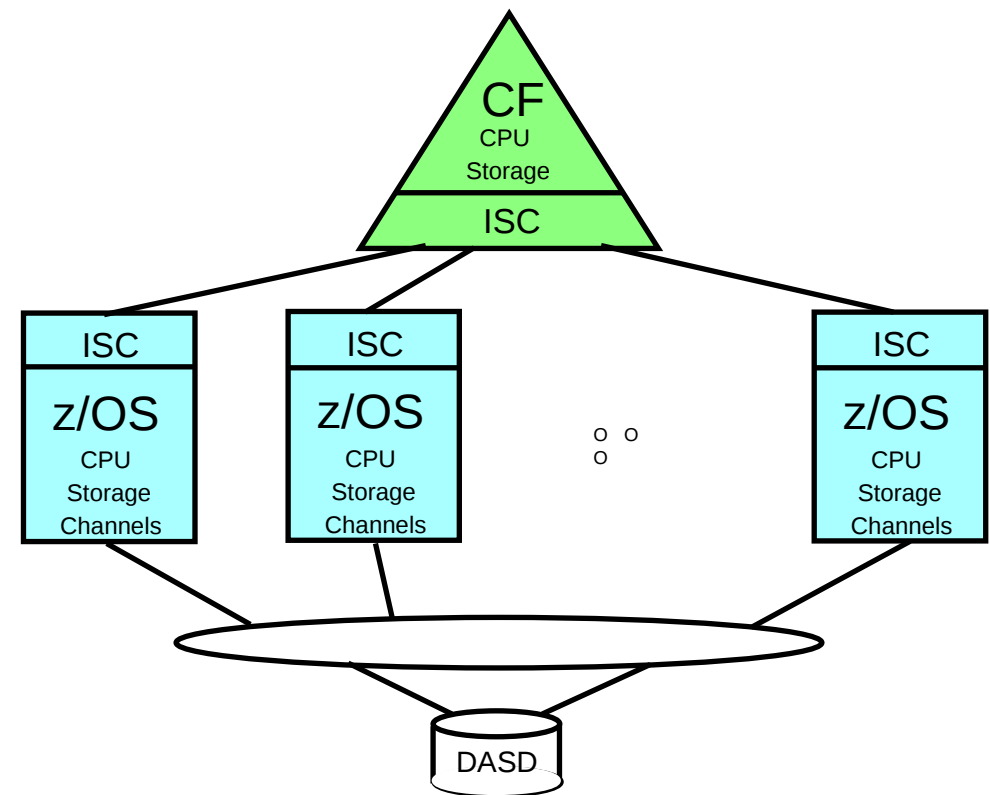
What coupling technology is right for me?

- 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/z114
 - ▶ CF level 17: 2047 structures, enhanced serviceability

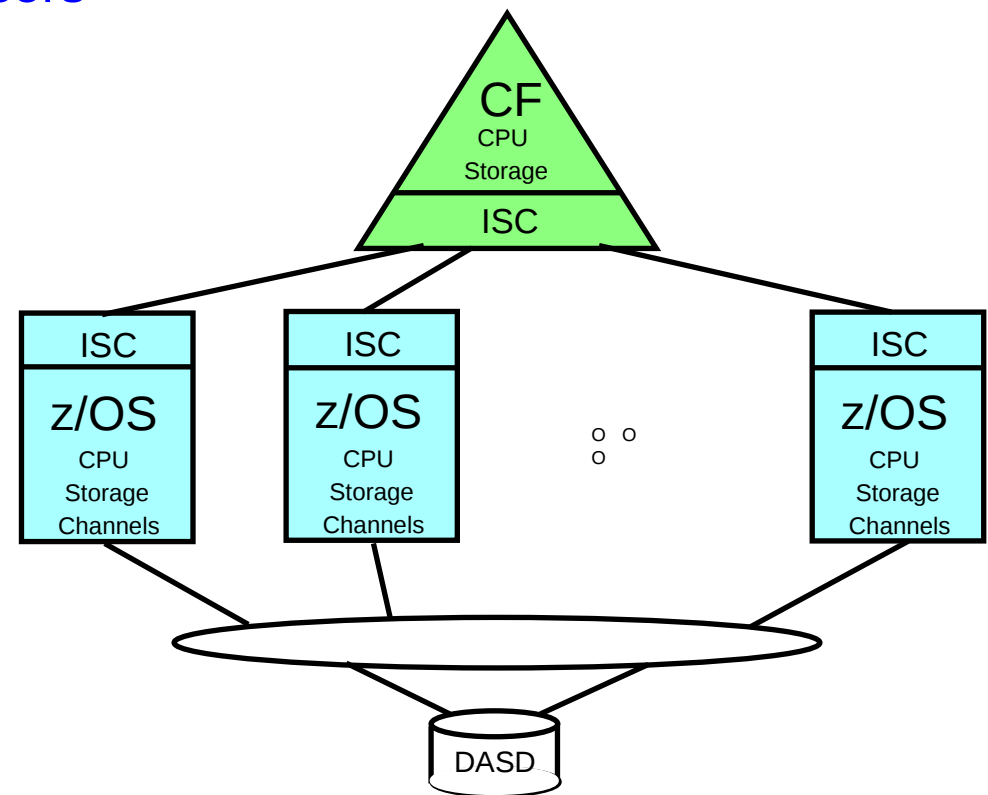
What coupling technology is right for me?

■ CF Functionality

- ▶ CFCC levels
- ▶ CF Partitions
 - dedicated versus shared processors
 - standalone versus internal
 - CF Duplexing

■ CF Capacity

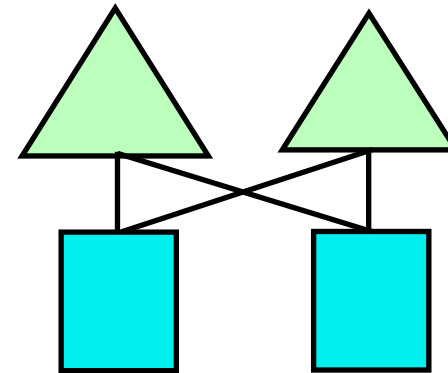
■ CF Service Time



CF Partition Options - what are the differences?

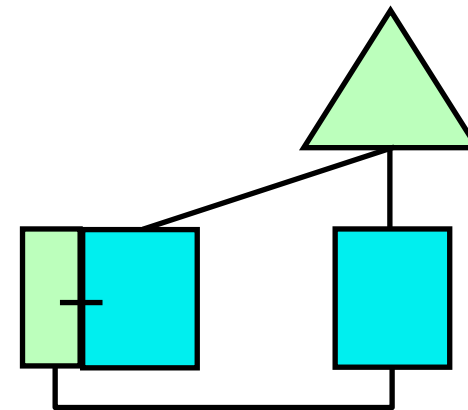
■ Standalone CF

- ▶ 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)

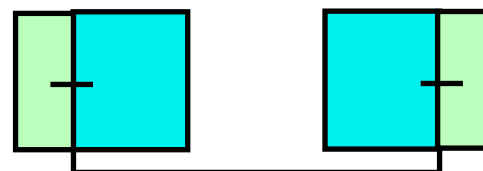
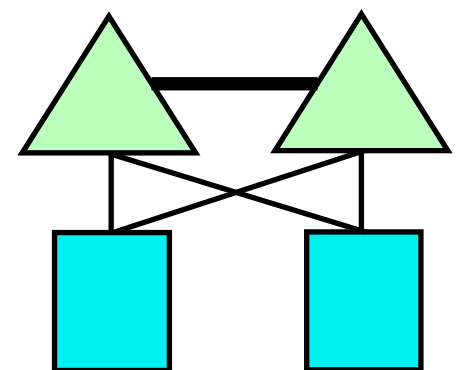
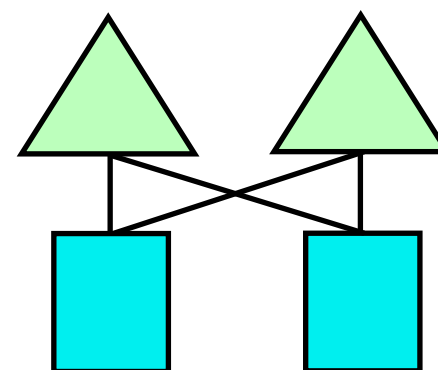
- ▶ dedicated or shared processor(s)
 - see above
- ▶ **availability considerations**
 - addressed by CF duplexing



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 and VSO 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

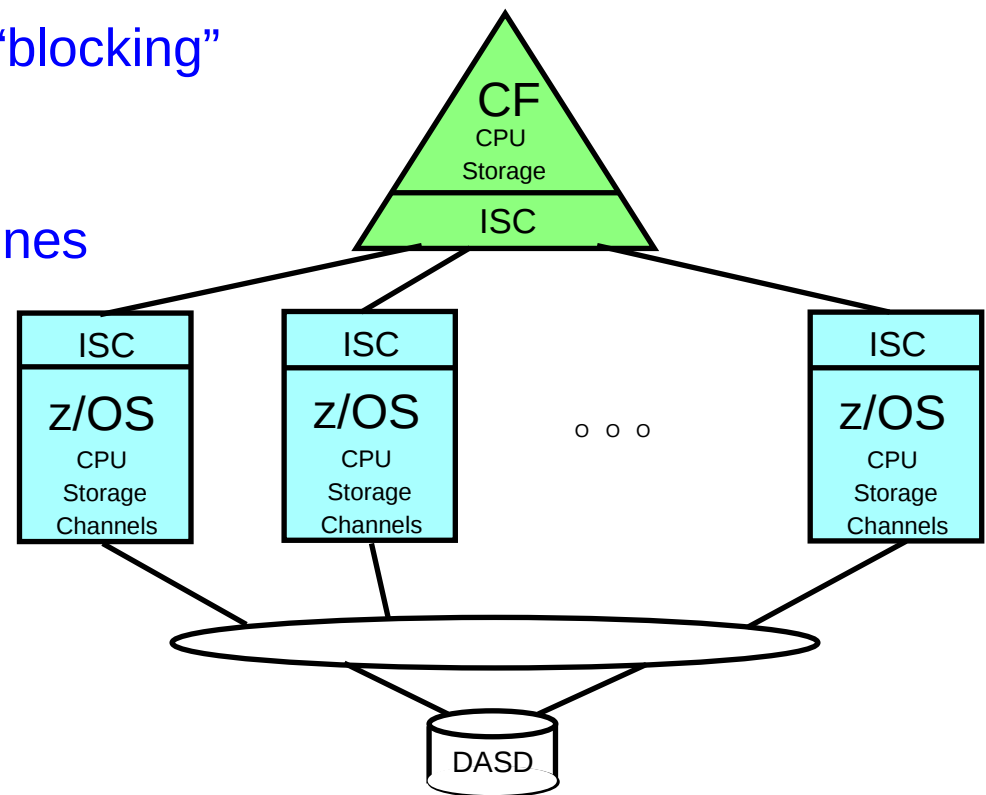
What coupling technology is right for me?

■ CF Functionality

■ CF Capacity

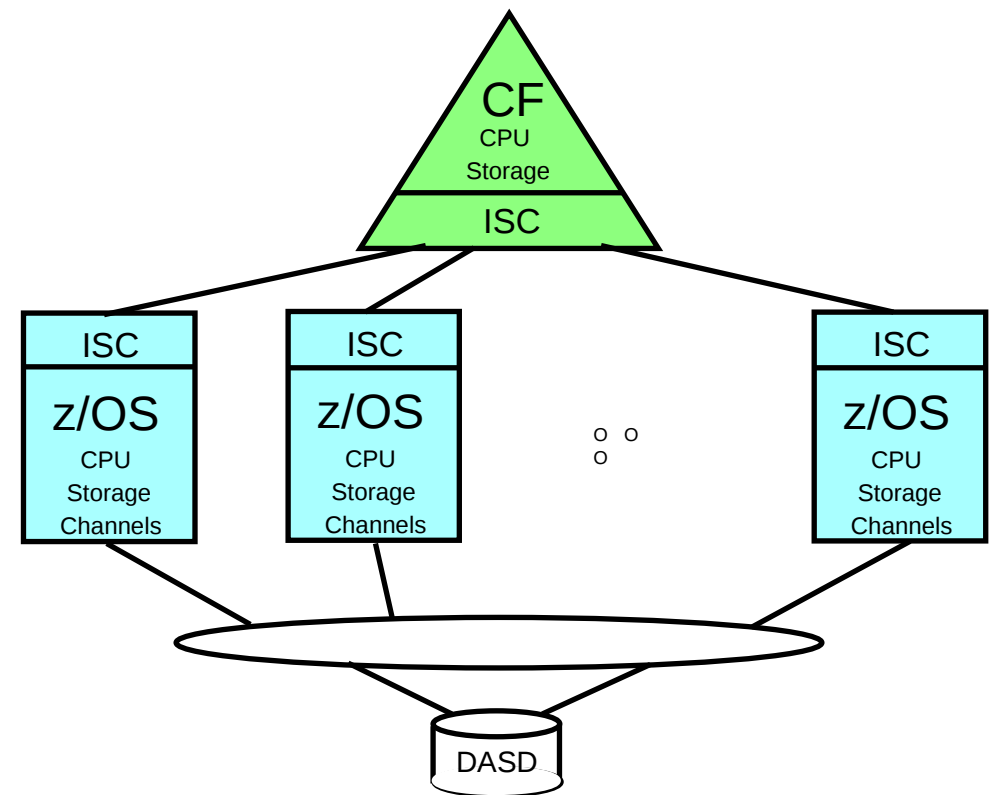
- ▶ Need enough to handle the request rate (keep utilization < 50%)
 - ▶ Note 1way CFs < 30% due to
 - ▶ Single server queuing
 - ▶ Long running commands “blocking” short commands
- ▶ Add engines or move to faster engines

■ 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

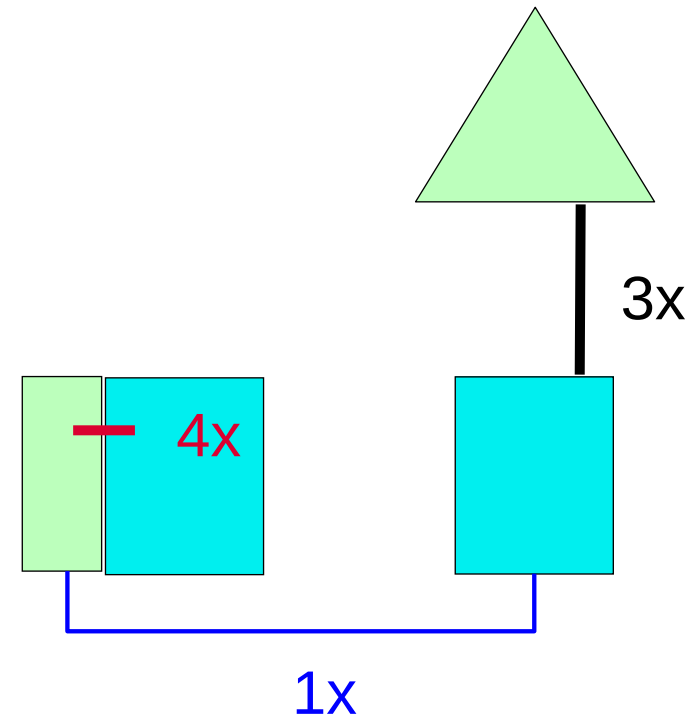
■ ICB (Integrated Cluster Bus)

- Copper cable plugs close to memory bus
- 10 meter max length
- **Not available on z196**

■ IC (Internal Coupling Channel)

- Millicode - no external connection
- Only between partitions on same processor

Relative Performance
Based on avg data xfer size



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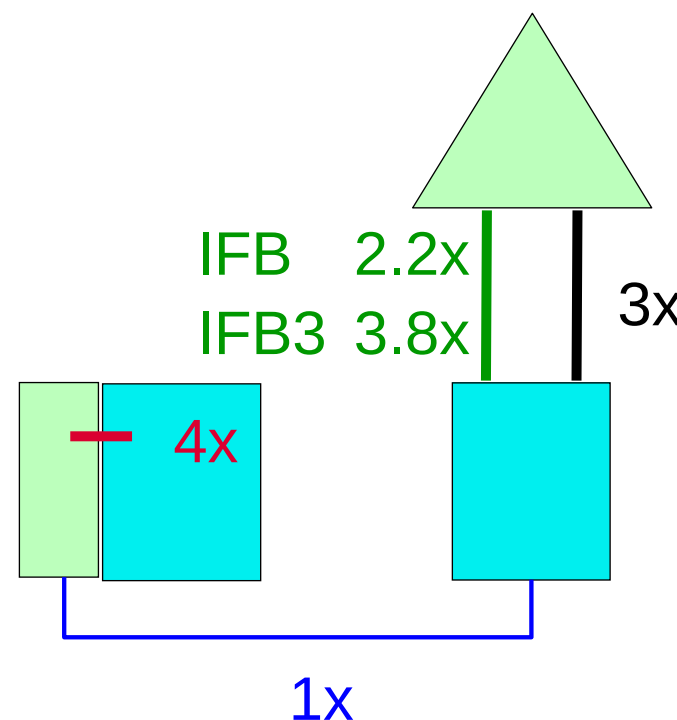
■ IC (Internal Coupling Channel)

- Microcode - no external connection
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■ 12X IFB and 12X IFB3 (intro z196 GA2)

- 150 meter max distance optical cabling
- Supports multiple CHPIDs per physical link
- Multiple CF partitions can share physical link

Relative Performance
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Coupling Link Choices - Overview

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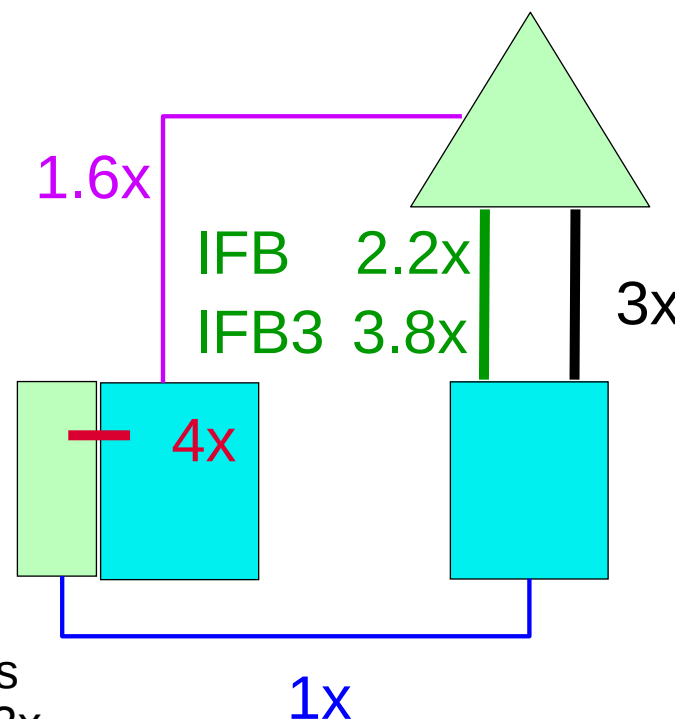
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■1x IFB

10km and longer distances with qualified WDM solutions

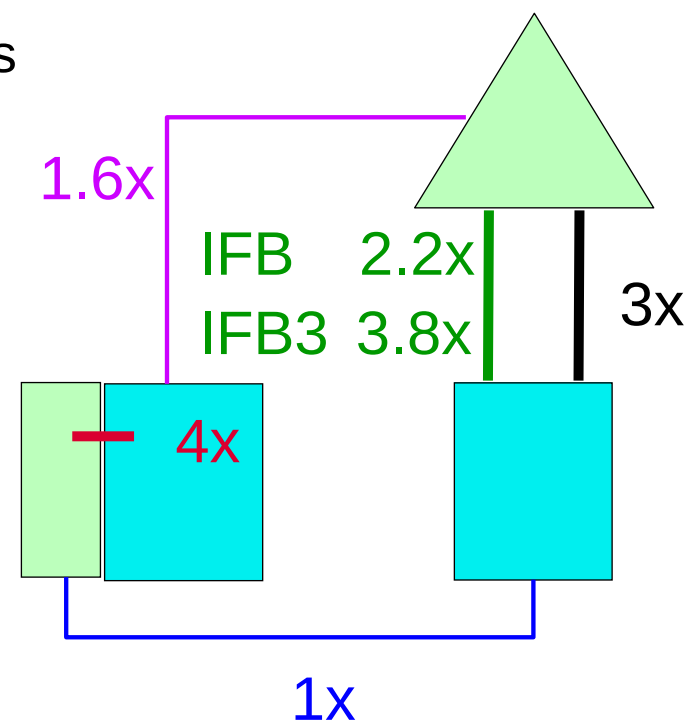
- Same multiple CHPIDs and sharing flexibility as 12x
- 32 subchannels (up from 7) per CHPID (intro z196 GA2)

Relative Performance
Based on avg data xfer size



IFB Configuration Advantages

- **Pure Capacity**
 - 1 12x IFB(3) replaces 1 ICB4
 - 1 12x IFB(3) 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 IFB(3) 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 IFB(3) 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



What coupling technology is right for me?

- CF Functionality

- CF Capacity

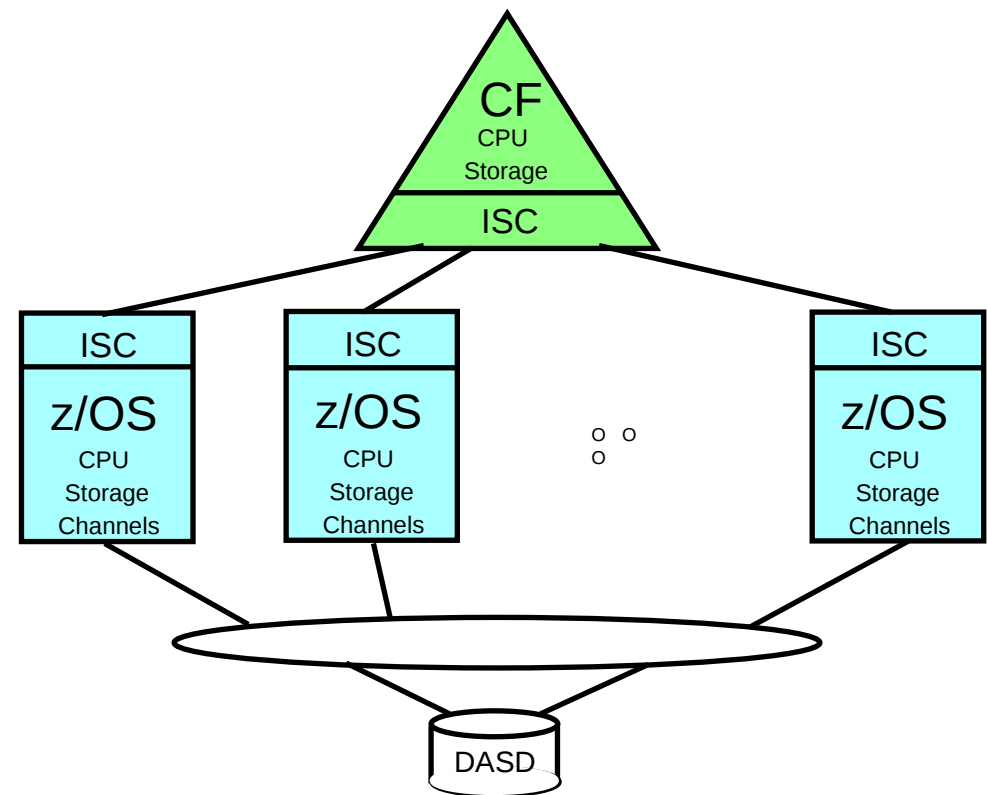
- CF Service Time

- ▶ Affected by

- speed of CF engine
 - link technology

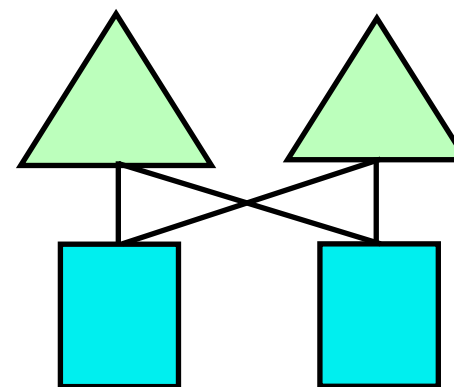
- ▶ Affects cost of data sharing

- host processor dwells
for synchronous requests



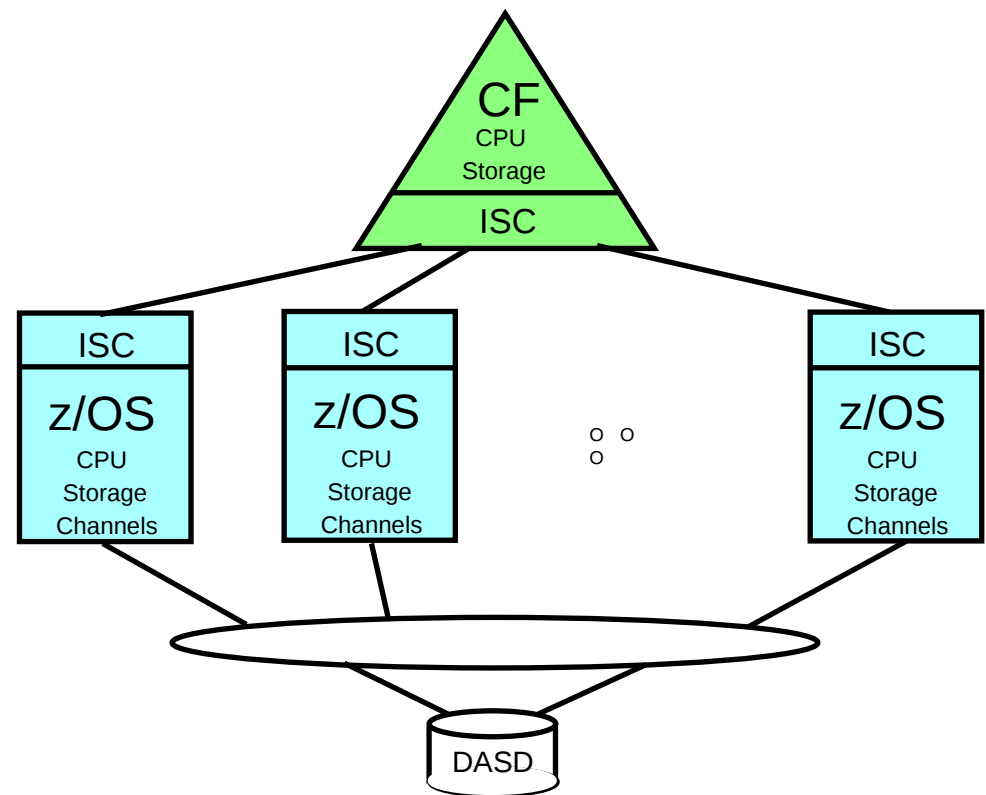
CF Operations: synchronous or asynchronous

- 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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 - speed of CF engine
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 - ▶ Affects cost of data sharing
 - 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	z9 BC	z9 EC	z10 BC	z10 EC	z114	z196
z9 BC ISC3	14%	15%	17%	19%	18%	23%
z9 BC 12x IFB	NA	NA	13%	14%	13%	16%
z9 BC ICB4	9%	10%	11%	12%	NA	NA
z9 EC ISC3	13%	14%	16%	18%	17%	22%
z9 EC 12x IFB	NA	NA	13%	14%	13%	16%
z9 EC ICB4	8%	9%	10%	11%	NA	NA
z10 BC ISC3	13%	14%	16%	18%	17%	22%
z10 BC 12x IFB	11%	12%	13%	14%	13%	15%
z10 BC ICB4	8%	9%	10%	11%	NA	NA
z10 EC ISC3	12%	13%	15%	17%	17%	22%
z10 EC 12x IFB	10%	11%	12%	13%	12%	15%
z10 EC ICB4	7%	8%	9%	10%	NA	NA
z114 ISC3	14%	14%	16%	18%	17%	21%
z114 12x IFB	10%	10%	12%	13%	12%	15%
z114 12x IFB3	NA	NA	NA	NA	10%	12%
z196 ISC3	11%	12%	14%	16%	17%	21%
z196 12x IFB	9%	10%	11%	12%	11%	14%
z196 12x IFB3	NA	NA	NA	NA	9%	11%

With z/OS 1.2 and above, synch->asynch conversion caps values in table at about 18%
 1X IFB links would fall approximately halfway between 12X IFB and ISC3 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

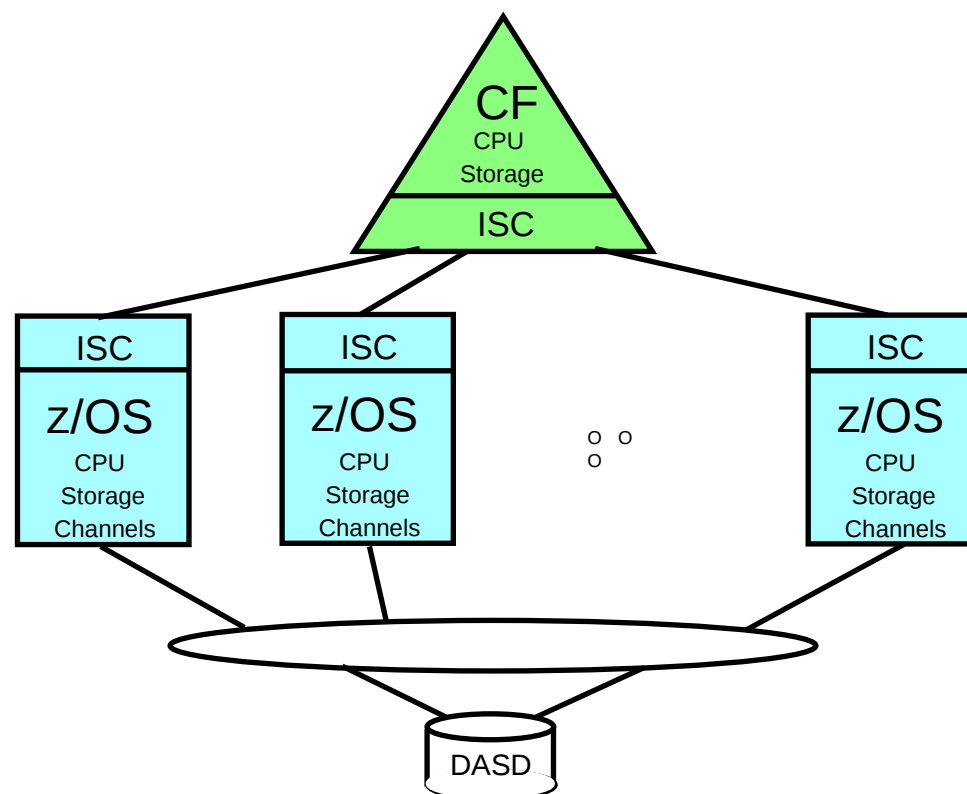
- ▶ CFCC level, standalone vs internal, dedicated vs shared

■ CF Capacity

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

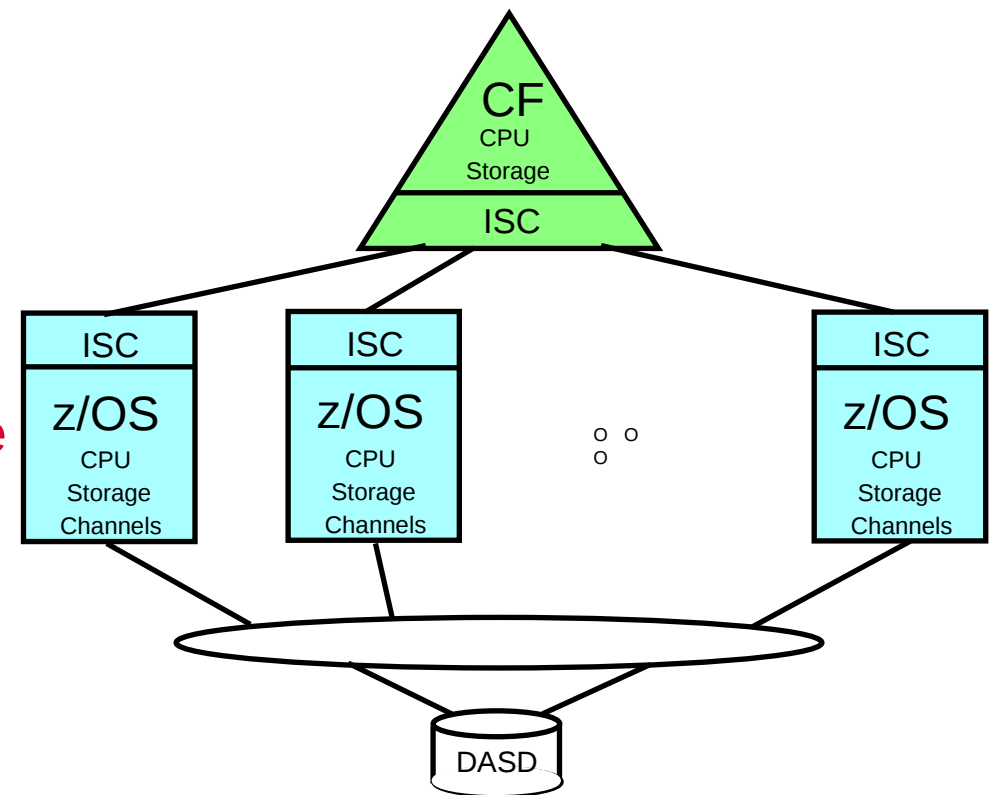
■ CF Service Time

- ▶ Affected by
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- ▶ Impact relative to ...
 - Rate of requests to the CF
 - Speed of the host processor



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



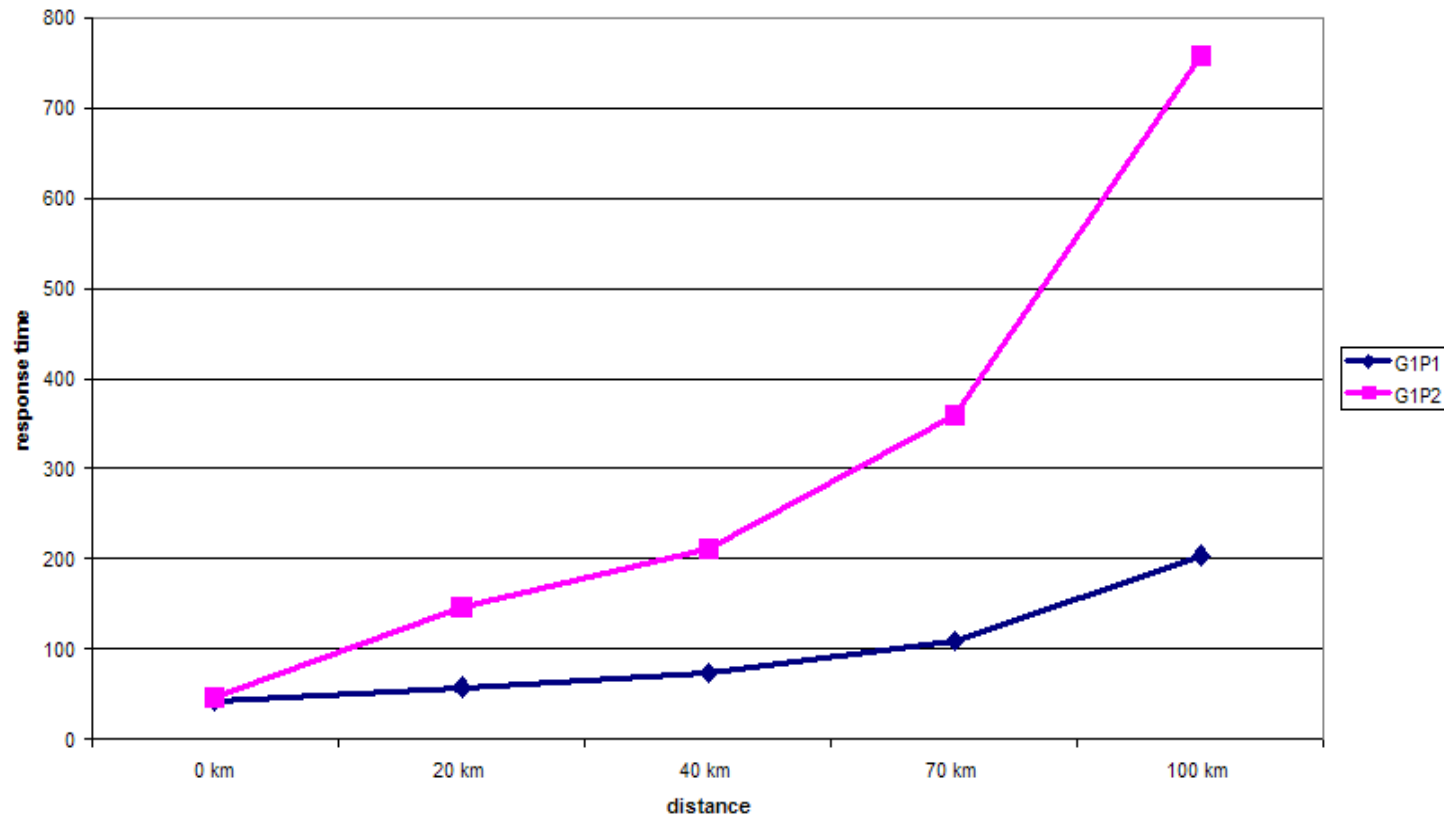
Example Distance Impact

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
 - ▶ IFB multiple CHPIDs and 32 subchannels per CHPID 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 simulated 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://w3.itso.ibm.com/abstracts/sg247817.html>
 - ▶ System z Parallel Sysplex Best Practices

- <http://www-03.ibm.com/systems/z/advantages/pso/tools.html>
 - ▶ CF Structure Sizer Tool