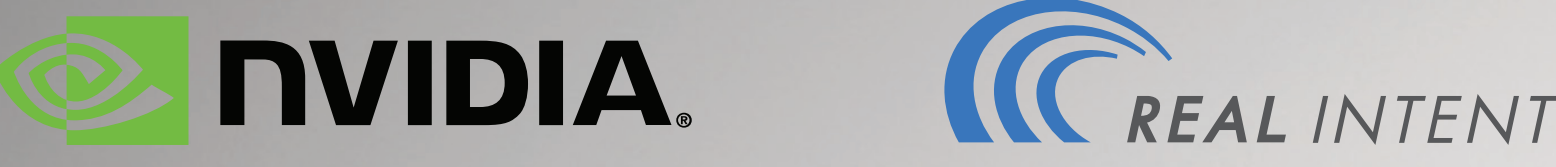
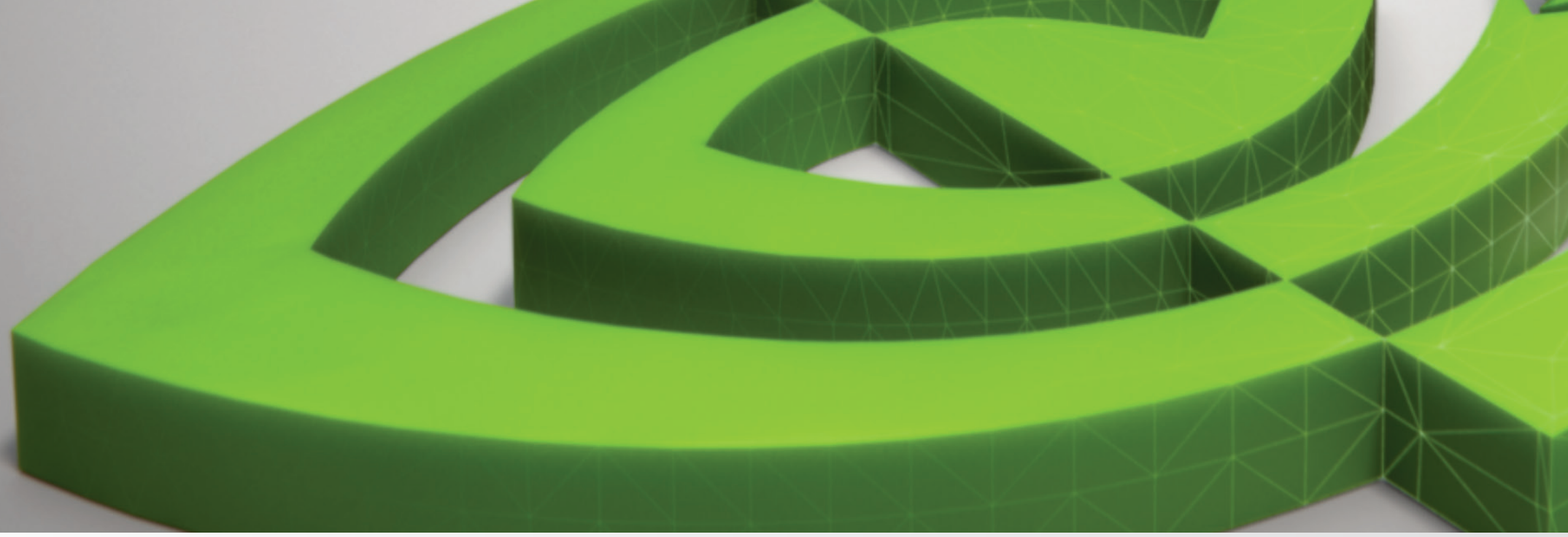


CDC HANDSHAKE ADVANCED SIGNOFF METHDOLOGY

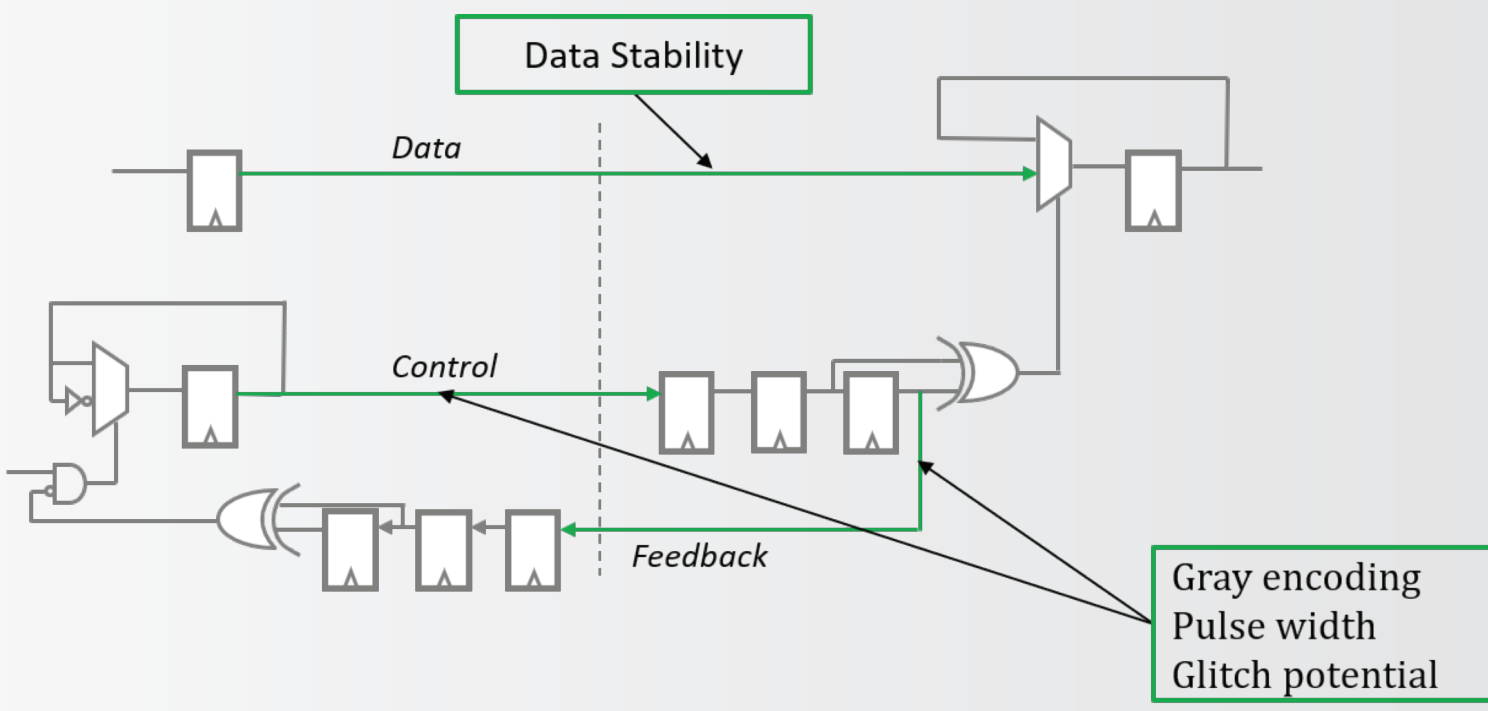


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FORMAL SIGNOFF— METHODOLOGY CHALLENGES

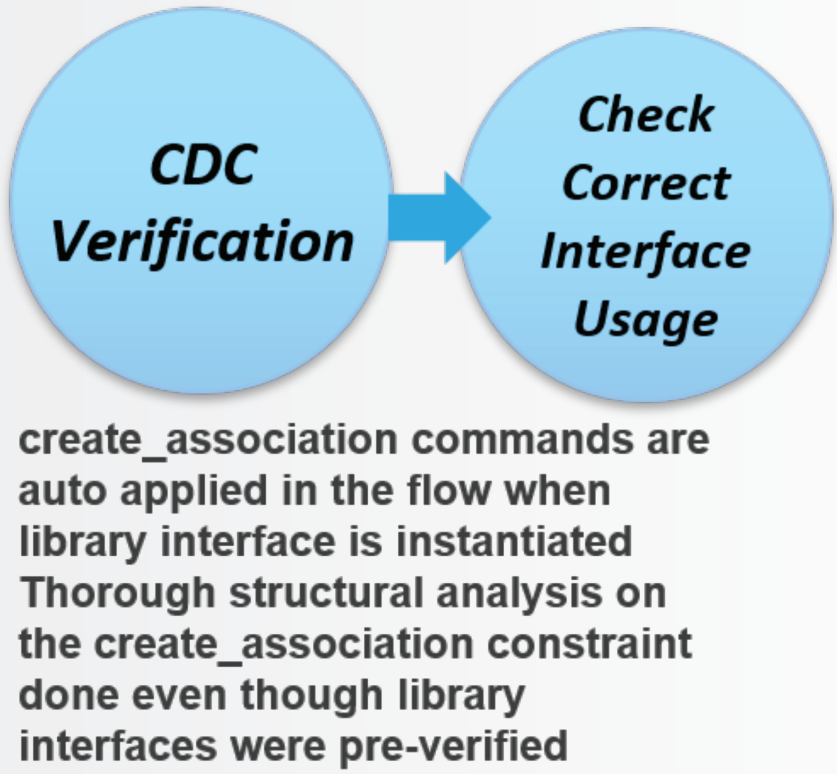
- To strengthen structural signoff, formal signoff is used
- Formal Sign-off
 - Based on sequential proof that control path qualification is always safe
- Formal sign-off removes limitations of structural sign-off
- Involves huge effort for 100% signoff



CDC HANDSHAKE SIGN-OFF— NEW METHODOLOGY

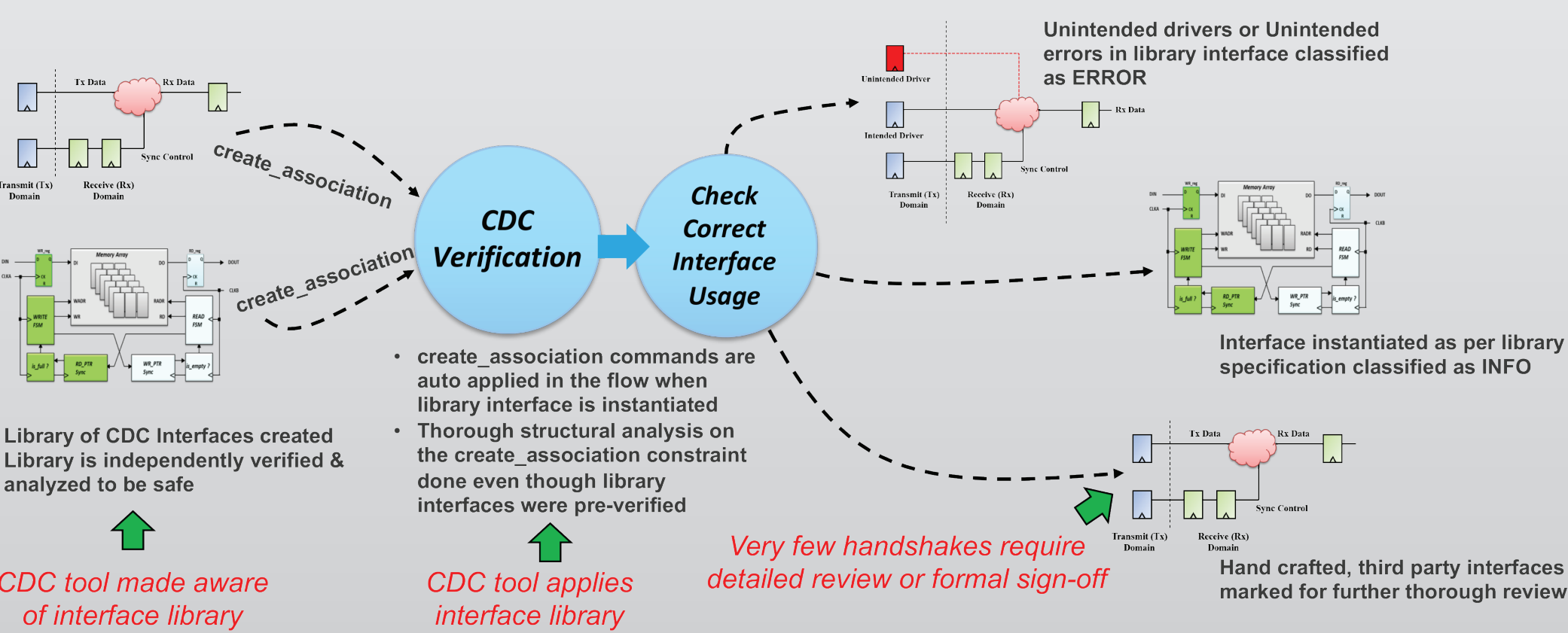
INTERFACE VERIFICATION

- Flow auto-applies create_association commands for these known structures in Meridian CDC
- Assumptions:
 - Detailed interface verification is done at interface library level
 - Top level only needs to verify structural instantiation
- Meridian CDC verifies create_association:
 - All handshake (TX, RX, Feedback) components
 - No issues in structural associations of components
 - Any unintended drivers or receivers in the interface
 - Any unintended parts, synchronizers which differ from library specification



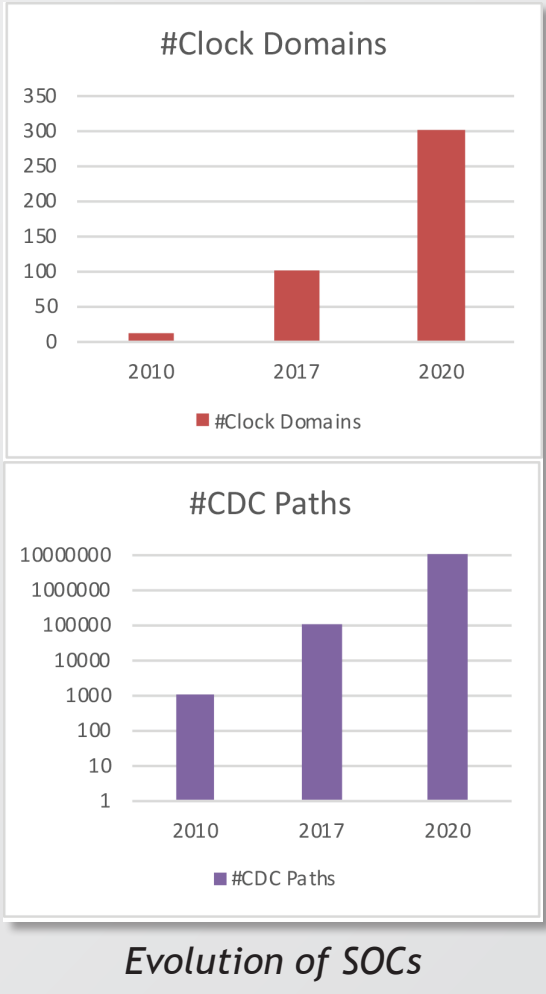
CDC HANDSHAKE SIGN-OFF— NEW METHODOLOGY

COMPLETE FLOW



MOTIVATION

- SOCs are extremely complex
 - Numerous (> 100!) asynchronous clock domains
 - Millions of clock-domain crossing paths
- Handshake Mechanisms (CDC Interfaces) are common design patterns for faithful data transfer across domains
 - Typical SOC contains thousands of such interfaces
- Every single interface *must be* reviewed for sign-off
 - Reviewing each interface is a colossal sign-off effort
 - Not reviewing all may cause CDC issues to be missed
- All the effort notwithstanding, today's interface review process is not entirely flawless
 - CDC tools miss bugs



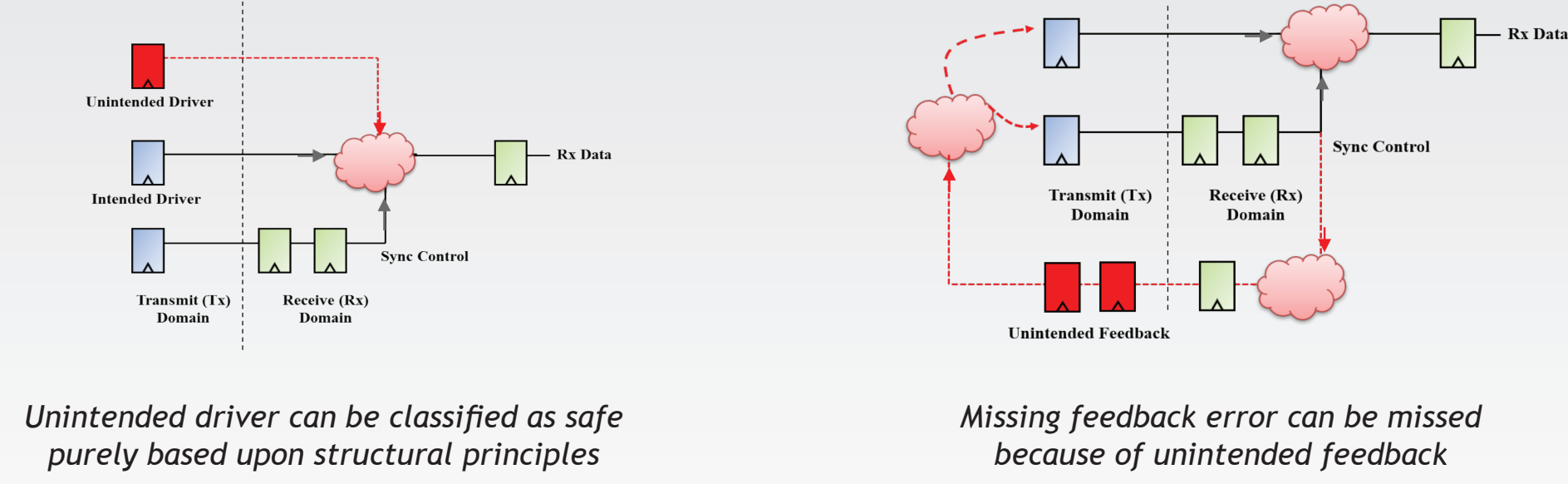
ADVANCED CDC HANDSHAKE SIGN-OFF

NEW METHODOLOGY REQUIREMENTS

- Should supplement the current structural sign-off flow
- Should be conservative enough not to hide any potential CDC issues
- Able to guarantee 100% sign-off
- Intelligent enough to not increase sign-off effort
- Portable across multiple designs
- Ease of implementation and integration

STRUCTURAL SIGNOFF—CURRENT METHODOLOGY LIMITATIONS

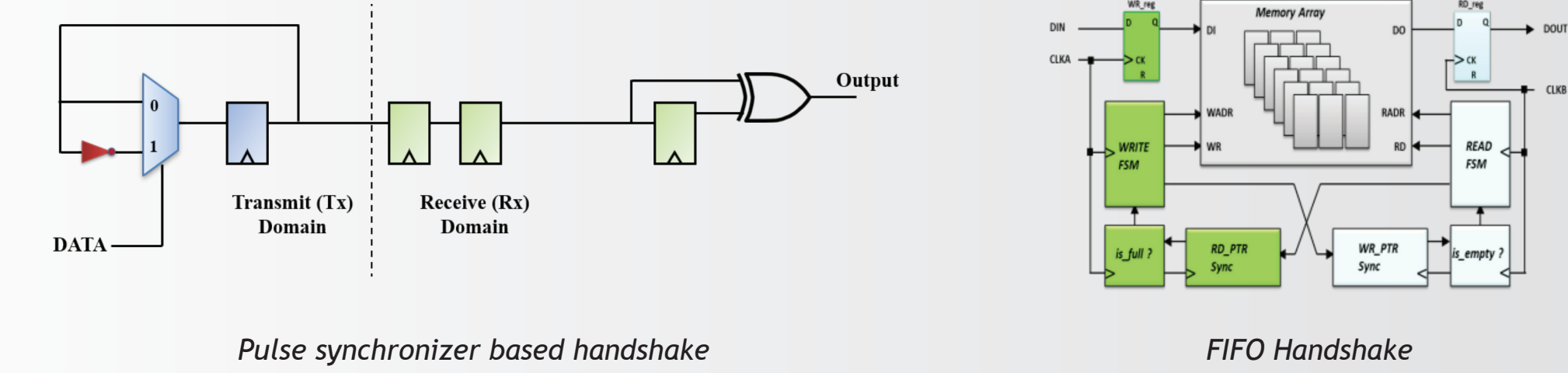
- Imperfect Sign-Off In State-of-Art Tools
- Most of current flows rely on Structural
- Signoff Structural Sign-off
 - Based on Control/Qualifier signal associated with driver data-signal and feedback
- Flows can miss CDC errors in complex handshake scenarios
 - Signals might get classified *incorrectly* as safe purely based upon structural principles
 - Unintended feedback associations can be made for closed loop CDC transfers



CDC HANDSHAKE SIGN-OFF— NEW METHODOLOGY

NEW METHODOLOGY REQUIREMENTS

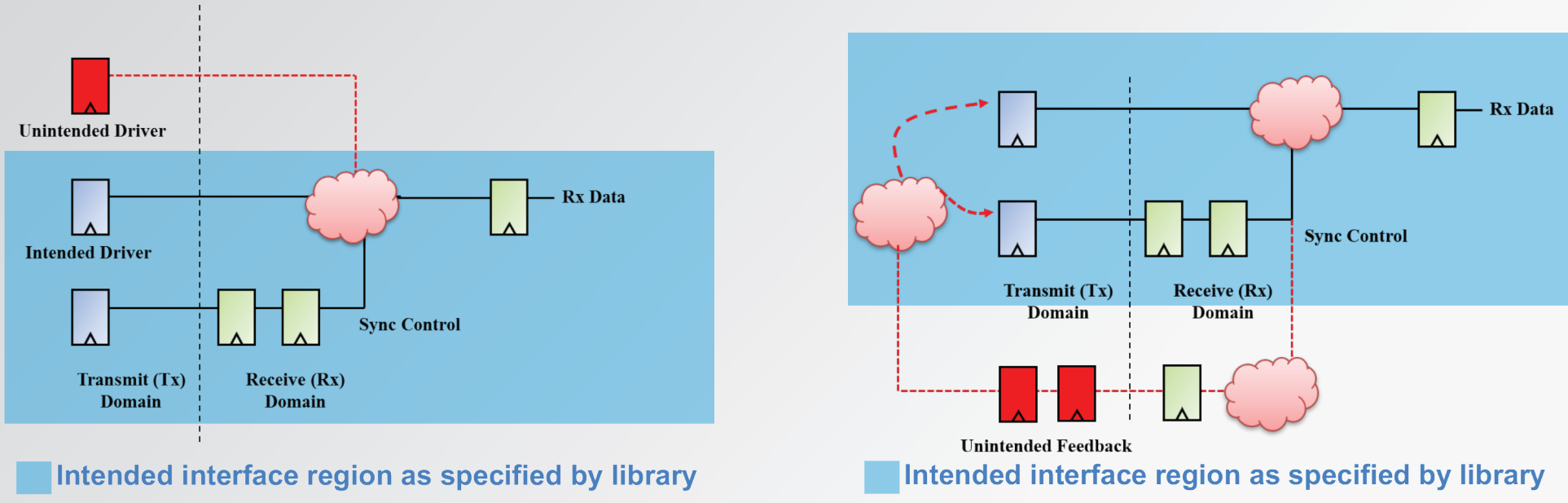
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CDC HANDSHAKE SIGN-OFF— NEW METHODOLOGY

INTERFACE REVIEW

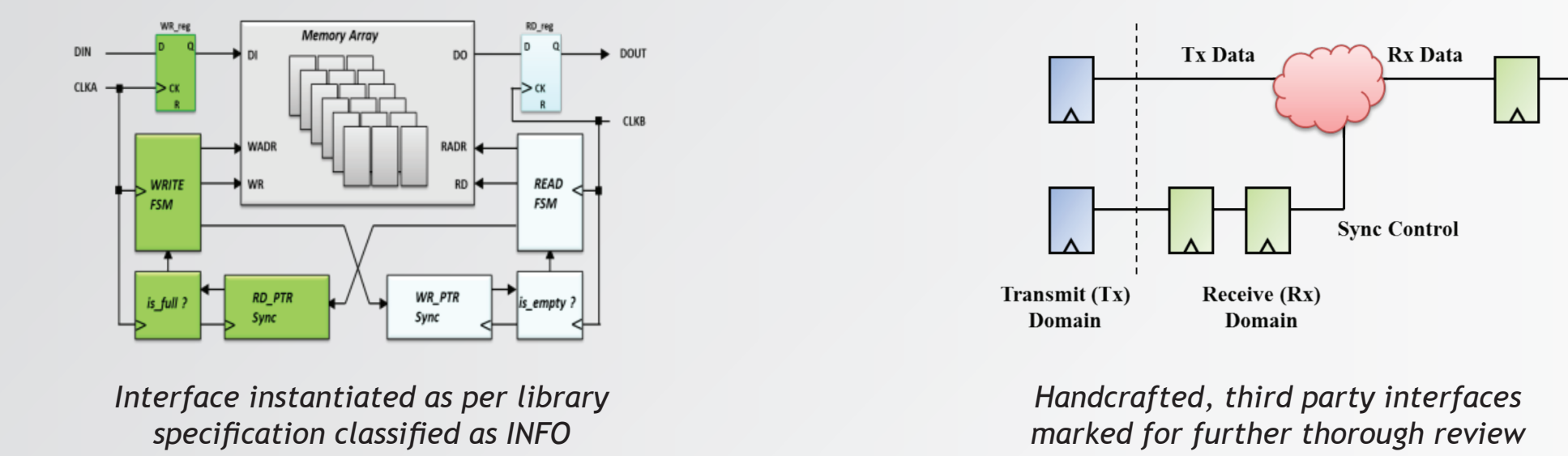
- After tool's analysis
 - Unintended drivers are classified as Errors in handshake
 - Unintended feedback or unintended flops are also classified as Errors
- Users need to review the Errors and
 - Fix the design interface
 - Add appropriate constraints in the tool if unintended parts are deemed to be safe



CDC HANDSHAKE SIGN-OFF— NEW METHODOLOGY

INTERFACE REVIEW

- After tool has completed analysis
 - Interfaces instantiated as per library specification and are accepted by the tool are classified as INFO
 - No further action needed from user
 - Hand crafted or IP-specific interfaces are classified as Warning
 - Users need to run additional checks (formal CDC, simulation etc.) on these
 - After verification, users should add create_association commands so they become part of IP-specific local interface library



RESULTS

- Initial results showed
 - >85% coverage on smaller IPs
 - >50% coverage bigger IPs
- Some IPs have < 50% coverage
- Future work
 - Add more library components to improve the coverage
 - Analyze if some IPs are exceptions to interface principles

Units with good (>=50%) coverage: 25/55				
Design	Total # of Interfaces	#of library interfaces	#of non-library interfaces	%ge coverage
IP1	11	11	0	100
IP2	14	14	0	100
IP3	9	8	1	88.8
IP4	347	296	51	85.3
IP5	735	609	126	82.8
IP6	12	9	3	75.0
IP7	23	17	6	73.9
IP8	173	120	53	69.3
Future work: Sample Units for which coverage can be improved				
IP9	127	24	103	18.9
IP10	371	59	312	15.9
IP11	91	6	85	6.6
IP12	38	1	37	2.6
IP13	88	2	86	2.2
IP14	16	16	0	0.00

SUMMARY

- Handshake mechanism (Interfaces) sign-off is one of the most important aspects of CDC verification.
- Structural Sign-off in state-of-art tools is imperfect and can generate false positives
- Formal sign-off requires huge sign-off effort
- New Interfaces sign-off methodology provides scale and accuracy
 - Is conservative to avoid any potential CDC issues
 - Able to guarantee 100% sign-off
 - Intelligent enough to not increase sign-off effort