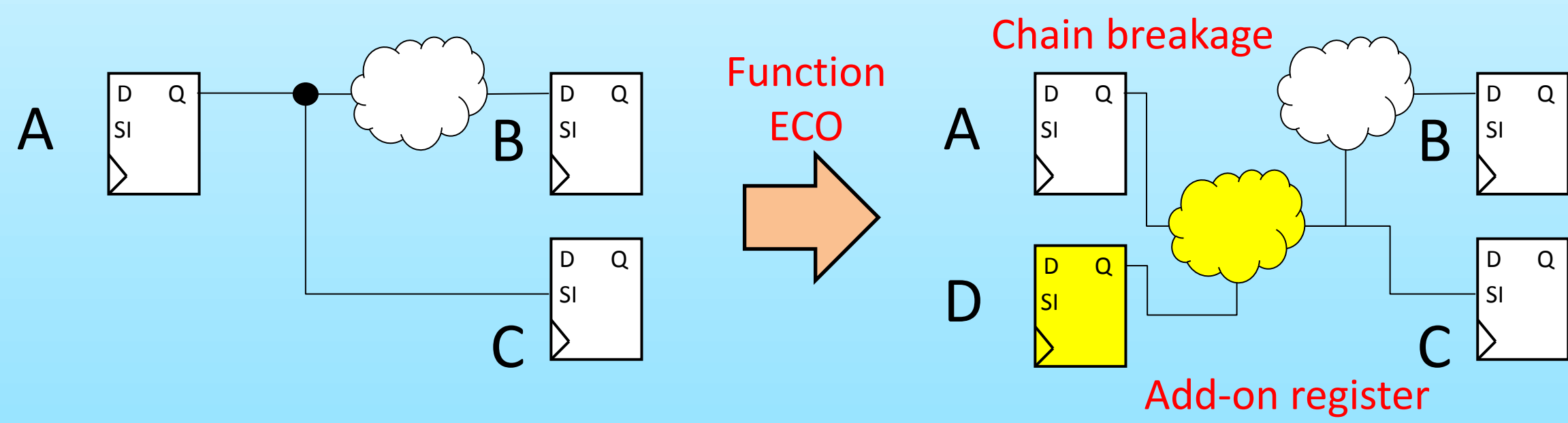


Introduction & Motivation

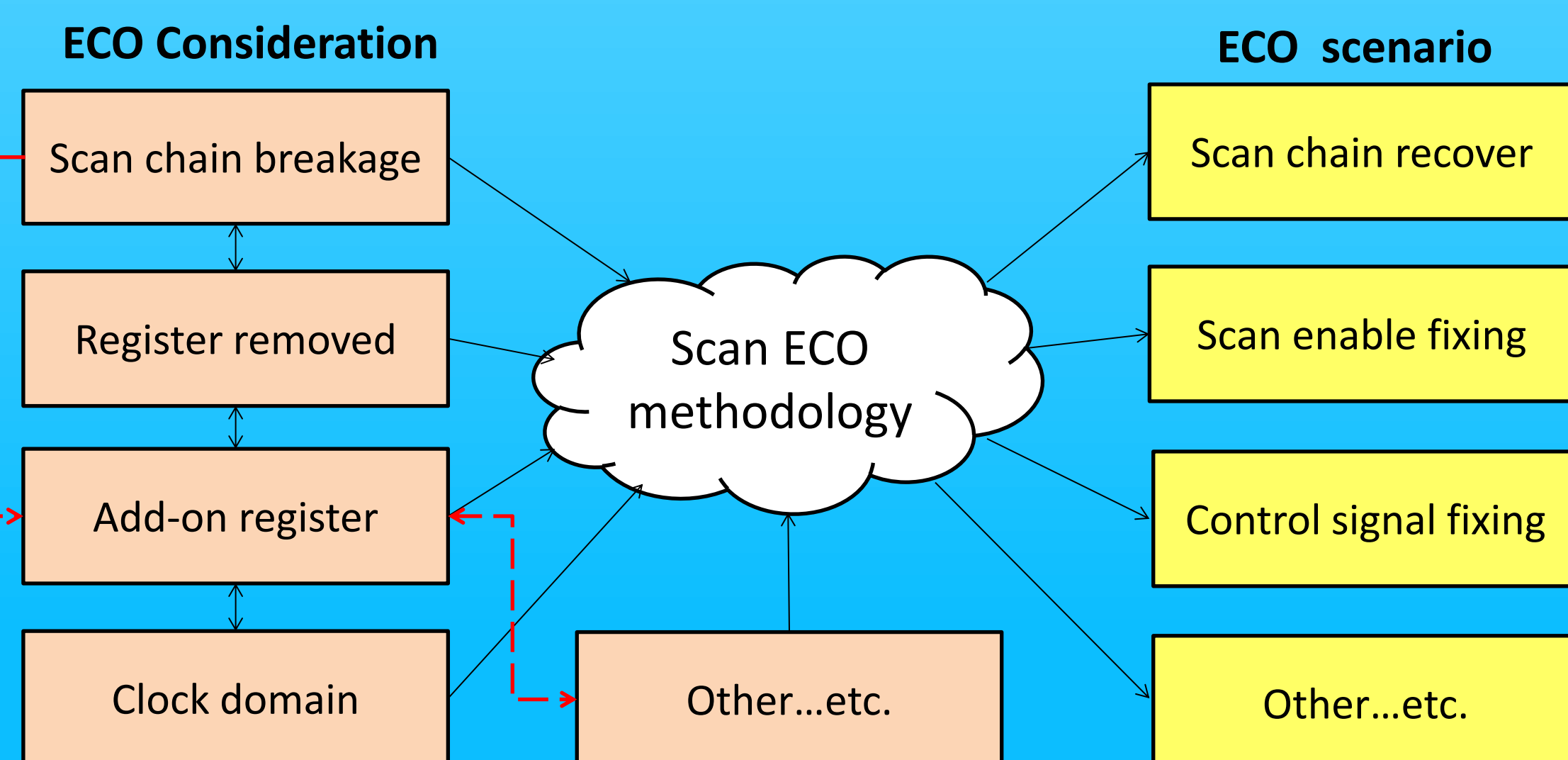
Function ECO induces Scan fail and impacts ECO schedule

- **Unintended scan breakage** and **unstitched add-on registers**
- Commercial ECO tools only focus on function and not repair scan breakage and coverage loss



Complexity: should satisfy various considerations and scenarios

- Bad ECO methodology will result in conflict between considerations
- Require efficient “Scan ECO” methodology to **ensure testability and quality of Scan** within a limited schedule
- Rely on designer/DFT engineer’s manual effort to recover scan quality traditionally
 - Without systematic methodology
 - ECO complexity



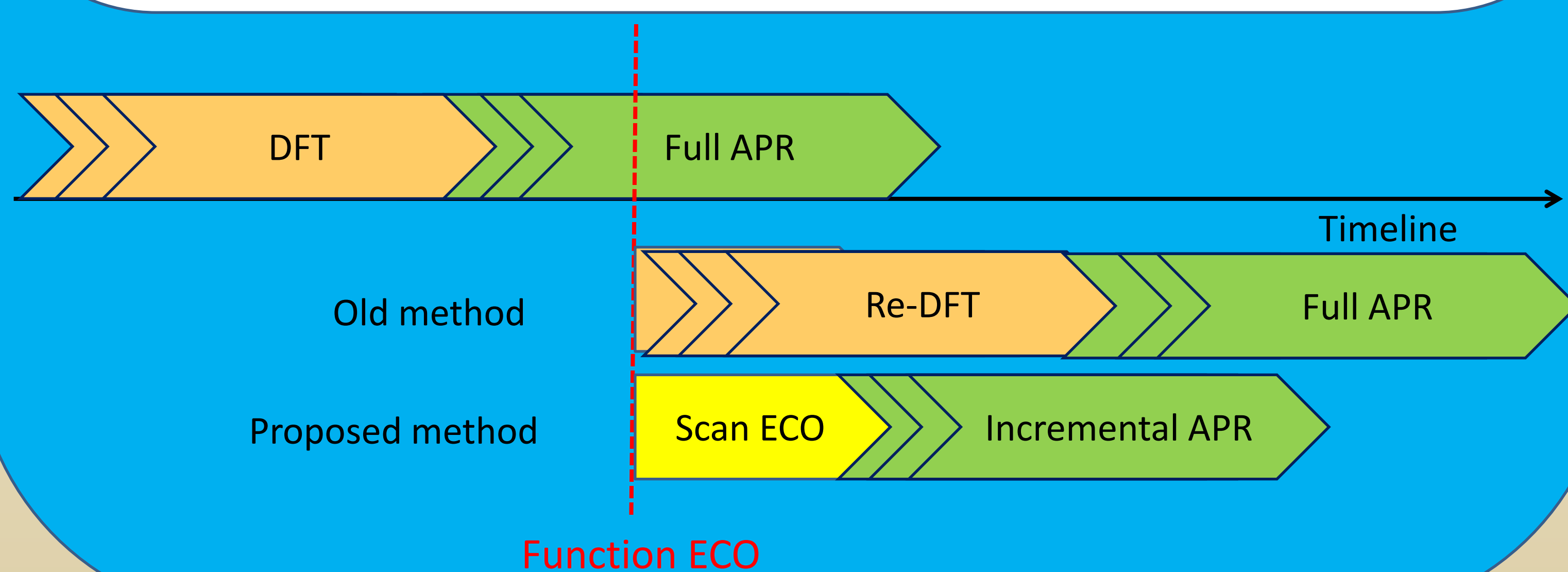
Results

Case Details

- Case M1: 9.2M gate count, process: 12FFC
- Case M2: 12M gate count, process: 16FFGL
- Case R1: 15.1M gate count, process: 7FF
- Case R2: 52.3M gate count, process: 28HPCPLUS
- Case R3: 9.4M gate count, process: 16FFGL

Case Summary

Case	Case M1	Case M2	Case R1	Case R2	Case R3
Case Policy	Case M1	Case M2	Case R1	Case R2	Case R3
Scan data recovery	156	2	114	0	0
Add-on register	5	0	0	673	8
Scan Clock	0	1	0	0	0
Scan ECO Flow Runtime	1.5 hours	1.5 hours	1 hour	2 hours	0.5 hour
*Old Method Runtime	6 hours	4.5 hours	7.5 hours	14.5 hours	4 hours
Time saved	75.0%	66.7%	86.7%	86.2%	87.5%



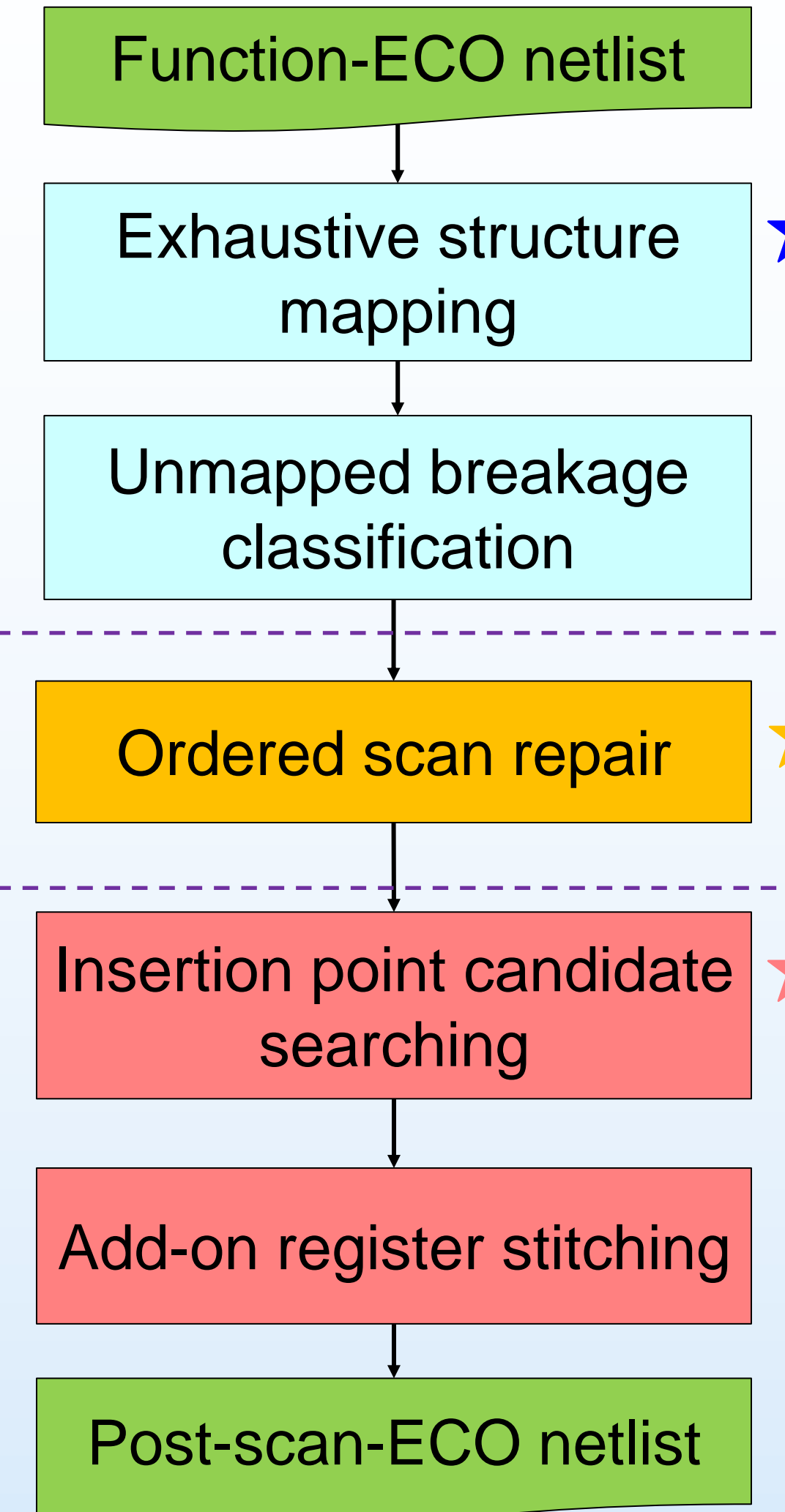
Proposed Methodology

Main Idea

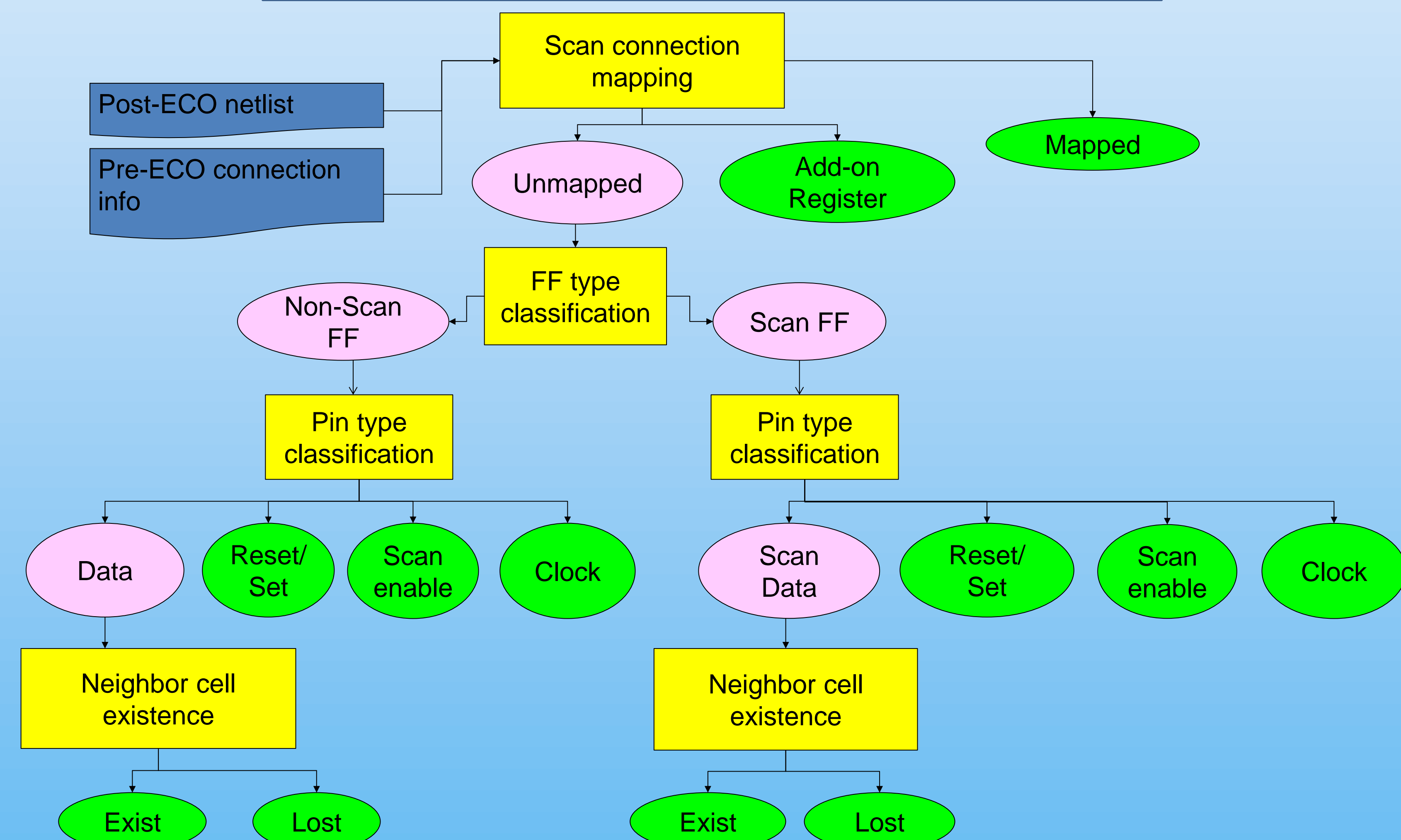
Provide systematic scan ECO methodology to deal with complex scan breakage scenarios and add-on registers

- **Structure mapping stage** ★
 - Exhaustive structure mapping
 - To find scan breakage and add-on registers
 - Unmapped breakage classification
 - Classify scan breakage scenarios
- **Structure repair stage** ★
 - Ordered scan repair
 - Repair scan following ordered scenarios
- **New component insertion stage** ★
 - Insertion point candidate searching
 - Consider routing, timing, and test cycle impact
 - Add-on register stitching

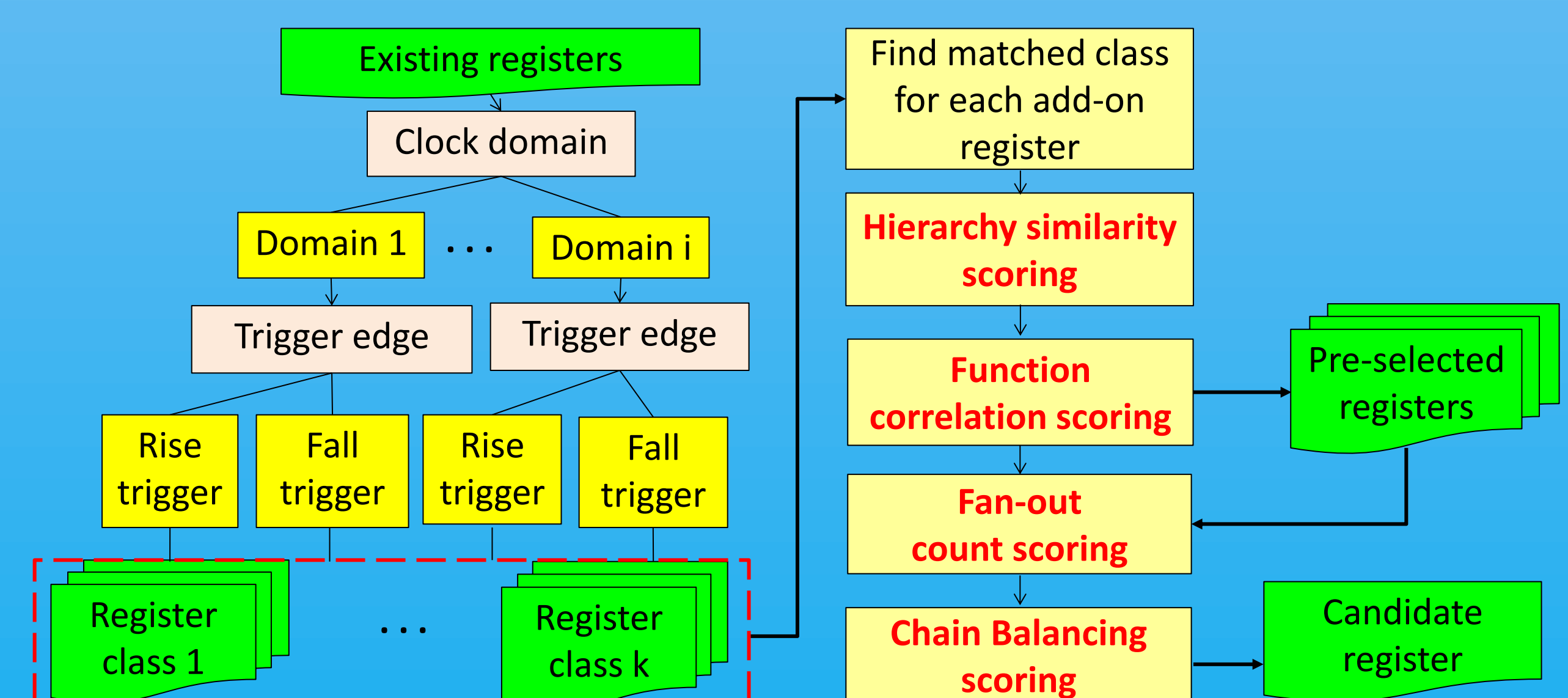
Flow Chart



Scan Structure Mapping and Classification



Insertion Point Candidate Searching



Summary

- Function ECO easily causes scan structure breakage and unstitched add-on registers
- Function ECO’s impact on scan structure is complex
- Proposed methodology contains
 - Structure mapping
 - Structure repair
 - New component insertion
- Experiment shows proposed methodology can reduce
 - 66.7%~75% ECO time compared to manual ECO
 - 86.2%~87.5% ECO time compared to scan re-implementation