

Fully Hierarchical CDC Analysis Using Comprehensive CDC Meta-Database

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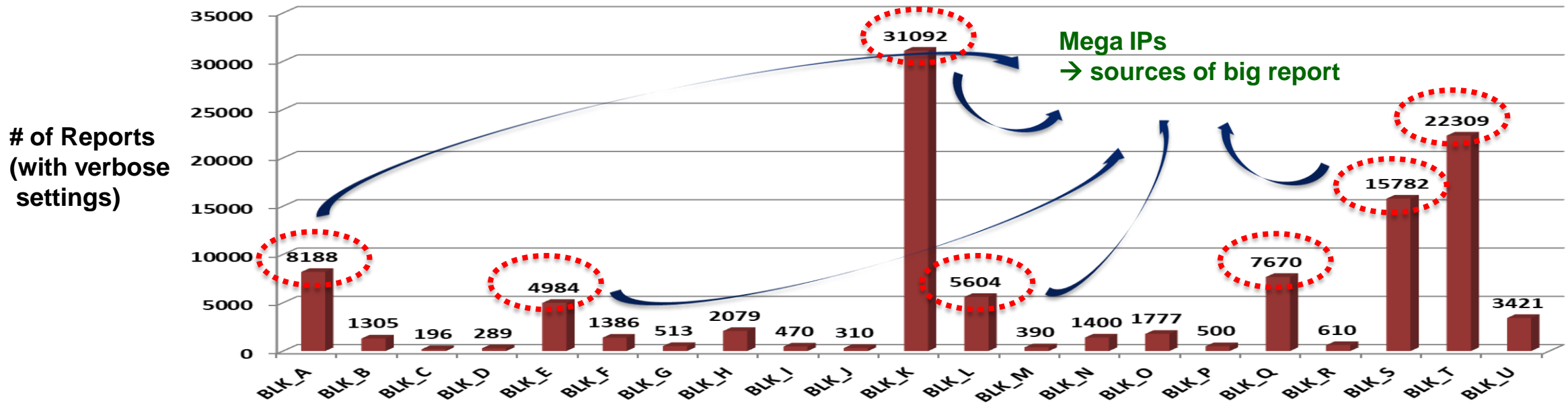


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Background and Challenges

- Example of premium-sized SOC CDC results – Flattened analysis



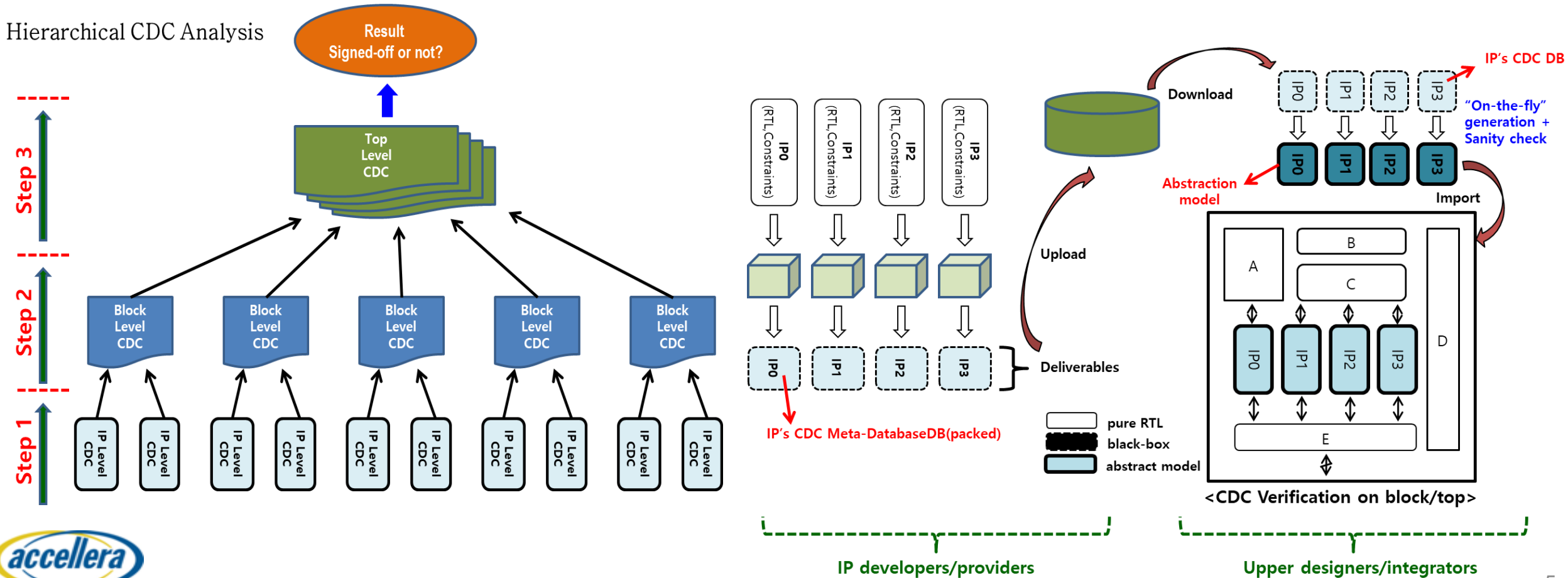
- Report on unsync-path with 'verbose' option enabled(all src-dst path listing)
- Major culprits of high-volume: external & internal mega-IPs
- Painful review & waive: crucial to sign-off TAT

Traditional CDC Analysis Flow on SOC

- CDC challenges on premium-sized SOC
 - Many false-alarms and high review effort
 - Review effort is more critical than H/W limitations
 - Many IPs are re-used on several projects
 - IP's internal report reproduced repeatedly → managing headaches
 - Still run-time & H/W limitations due to continuously increasing design size
- Why hierarchical CDC analysis?
 - Review efforts are more critical than H/W limitations
 - Good for 'Divide-and-conquer' strategies
 - CDC info. encapsulation for small-volumed results

Suggested Hierarchical CDC Flow

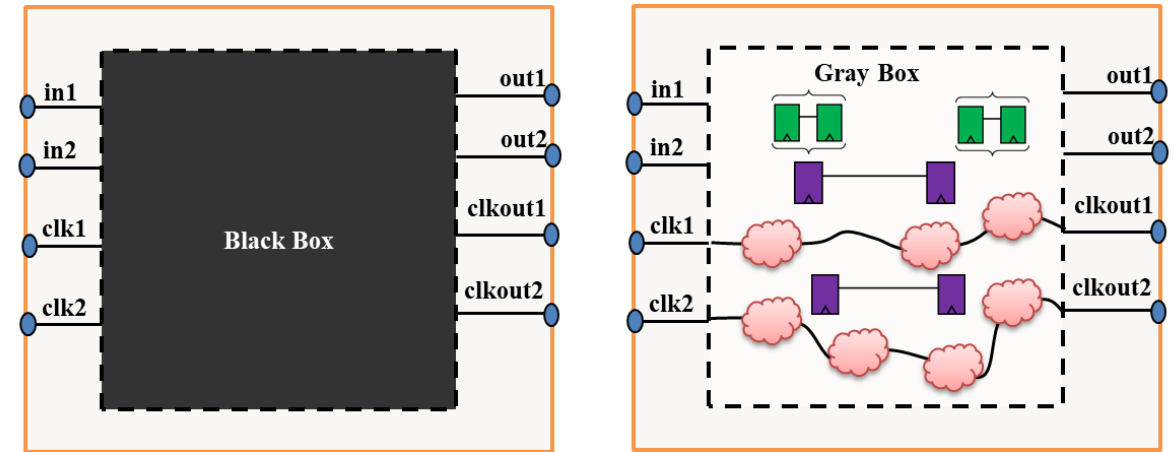
- Multi-way abstraction using IP/Block CDC “meta-database”



CDC Meta-Database(1/2)

- CDC quality depends on the information saved in the model
→ simple boundary model not enough
- Trade-off between accuracy and performance → Balanced database for minimal & sufficient information

Boundary-model vs. CDC Meta-database



“Waivers” also added
→ For sanity check during “on-the-fly” DB generation

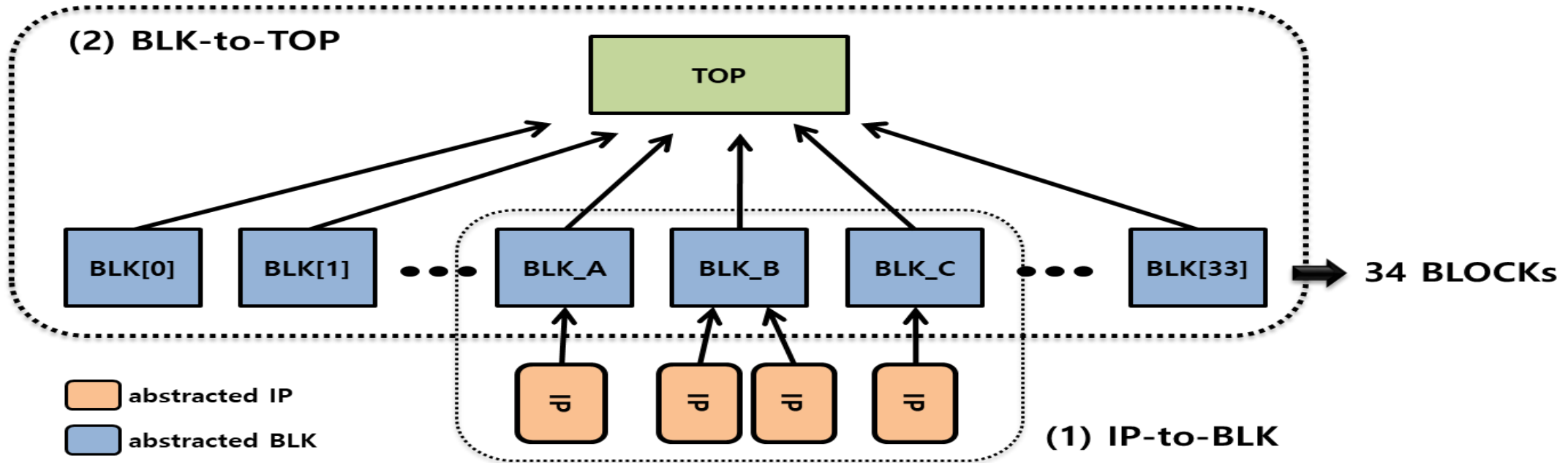
CDC Meta-Database(2/2)

- Advantages
 - Significantly reduced volume of data to be reviewed on blocks or top
 - Accurate inter-block crossings with advanced rule-checks
 - Better sign-off coverage(vs. boundary-modeling)
 - More complete and less-noisy results
 - Better debugging

Methodology Changes for Hierarchical Flow

- Simplified IP deliverables
 - Constraints + waivers → Unified meta.db
- Strengthened IP sign-off quality
 - IP owners' more responsibilities on the boundary constraints
- Strategies for selecting IPs for abstraction
 - Excluding value-less IPs from CDC abstraction
- On-the-fly sanity check & generation of DBs
 - For parameterized IPs and the overhead of DB size for version control system
- IP assumptions
 - IP designers motivated to add more assumptions for less iterations & saving time

Results(1/3) – SOC Verification Hierarchy



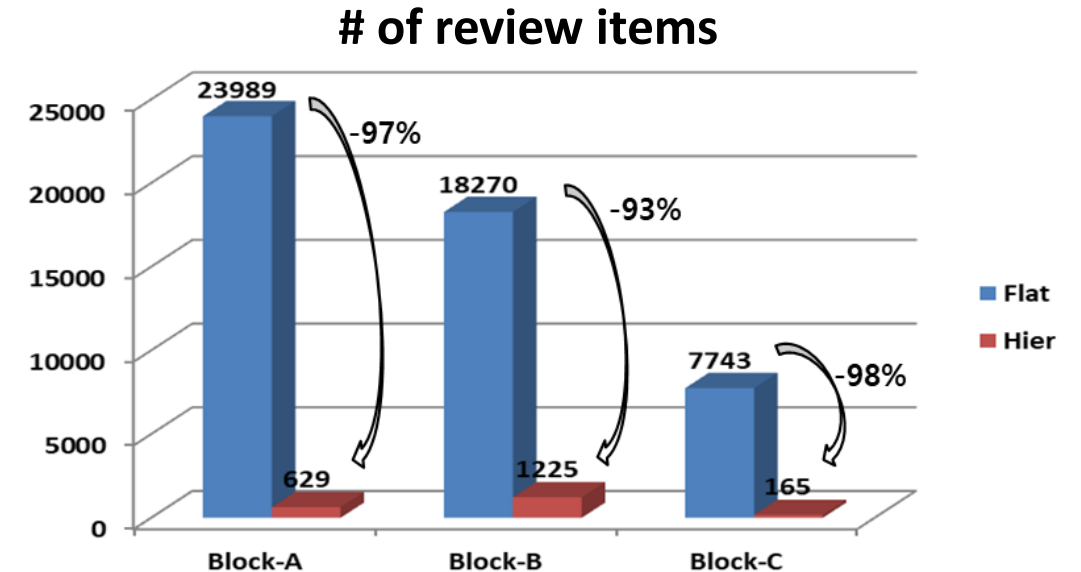
- 2-way hierarchical abstraction
 - IP-to-Block – (1)
 - Block-to-Top – (2)
- IP/Block deliverables imported on the upper design units.

Results(2/3) – IP-to-Block

- Flat vs. Hierarchical

CDC rule categories / Measured Performance	Block-A		Block-B		Block-C	
	Flat Analysis	Hierarchical Analysis	Flat Analysis	Hierarchical Analysis	Flat Analysis	Hierarchical Analysis
Rough size [Gate-count]	23M	-	40M	-	16M	-
Number of Mega-IPs Bstracted	-	2	-	2	-	1
Setup rule Check	86	53	166	144	44	36
Boundary Consistency Check	N/A	243	N/A	8	N/A	8
Glitch check	110	39	248	131	71	29
Synchronization Check	23,445	152	11,627	2817	7,356	23
Reset check	348	142	6239	5091	282	69
Run-time[min]	26	5	32	16	11	2
Memory[GB]	9.5	4.9	17.9	8.3	5.2	3.9
Estimated human effort	100%	27%	100%	34%	100%	28%

- Boundary check rule (available only on hierarchical analysis)
- Tool used : Meridian CDC(Real Intent Inc.), with verbose options fully enabled to count all paths
- Estimated human effort : Calculated based on designers' feedback for review

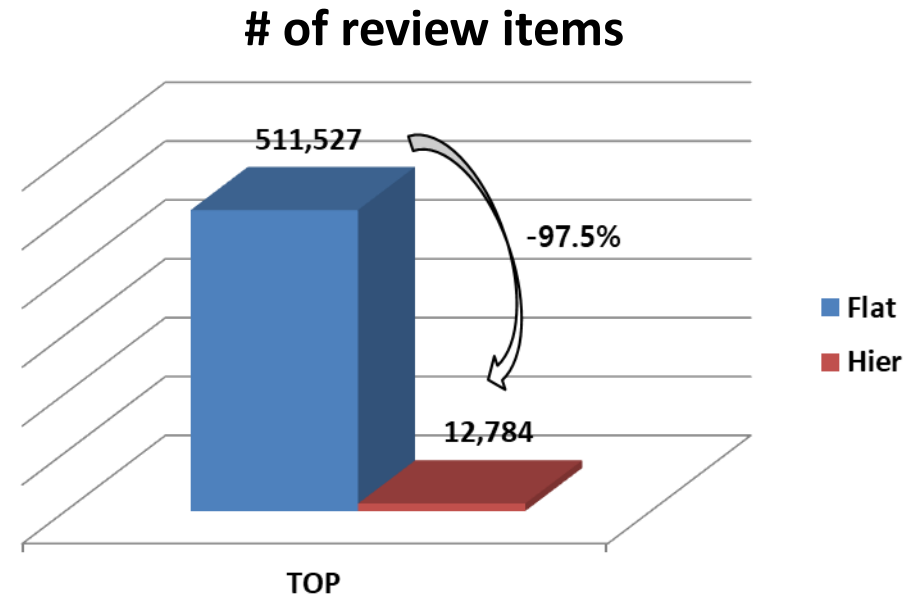


Results(3/3) – Block-to-Top

- Flat vs. Hierarchical

Items for Measurements (Design info., Rule check counts, Performance)	TOP	
	Flat analysis	Hierarchical analysis
Rough area[Gate count]	800M	-
Number of Blocks Abstracted	-	34
Setup rule check	3,223	333
Boundary consistency check ***	N/A	4,220
Glitch check	10,945	947
Synchronization check	474,637	7,209
Reset check	22,722	75
Run-time [min]	1,796	214
Memory consumption [GB]	242	89
Estimated human effort	100%	34%

- Flattened-top analysis not possible(30H)
→ Inevitable hierarchical flow
- 97.5% reduction of review items
→ Substantially 60%~70% human effort saved
* Flat analysis shows lots of repetitions



Effects and Strategies

- Effects
 - Less time-consuming iterations between IP/Block and upper designers
 - Reasonable run-time and H/W resource for SOC top verification
 - Less managing efforts for intra-block/IP crossings
 - Designers can focus on important paths with less false-alarms
- Strategies
 - Selective abstraction of IPs required
 - Careful boundary constraining required for less iterations

Conclusion

- Challenges on premium-sized SOC CDC verification
- A new hierarchical CDC flow using CDC-comprehensive meta-database
- Well-balanced CDC meta-database introduced
- Methodology changes for new hierarchical flow
- Multi-level hierarchical approach on premium-sized SOC designs
- Verification results and comparisons