CBP2025
Opening Remarks

Sixth Championship Branch Prediction (CBP)

Co-located with ISCA 2025 – Tokyo, Japan

Rami Sheikh
Organizing Committee Chair

June 21, 2025

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Acknowledgement

- Organizing Committee
  - Rami Sheikh (ARM), Chair
  - Saransh Jain (ARM)
- Program Chair
  - Eric Rotenberg (NC State University)
- Program Committee
  - Alaa Alameldeen (Simon Fraser University)
  - Muawya Al-Otoom (Apple)
  - Saransh Jain (ARM)
  - Gabriel Loh (AMD)
  - Pierre Michaud (Inria)
  - Eric Rotenberg (NC State University), Chair
  - Rami Sheikh (ARM)
  - Dam Sunwoo (ARM)
  - Chris Wilkerson (Intel)

BIG THANK YOU
to Our Participants and Authors

Special Thanks to arm

Traces, resources, sponsorship, and more …

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Why Do Another CBP?

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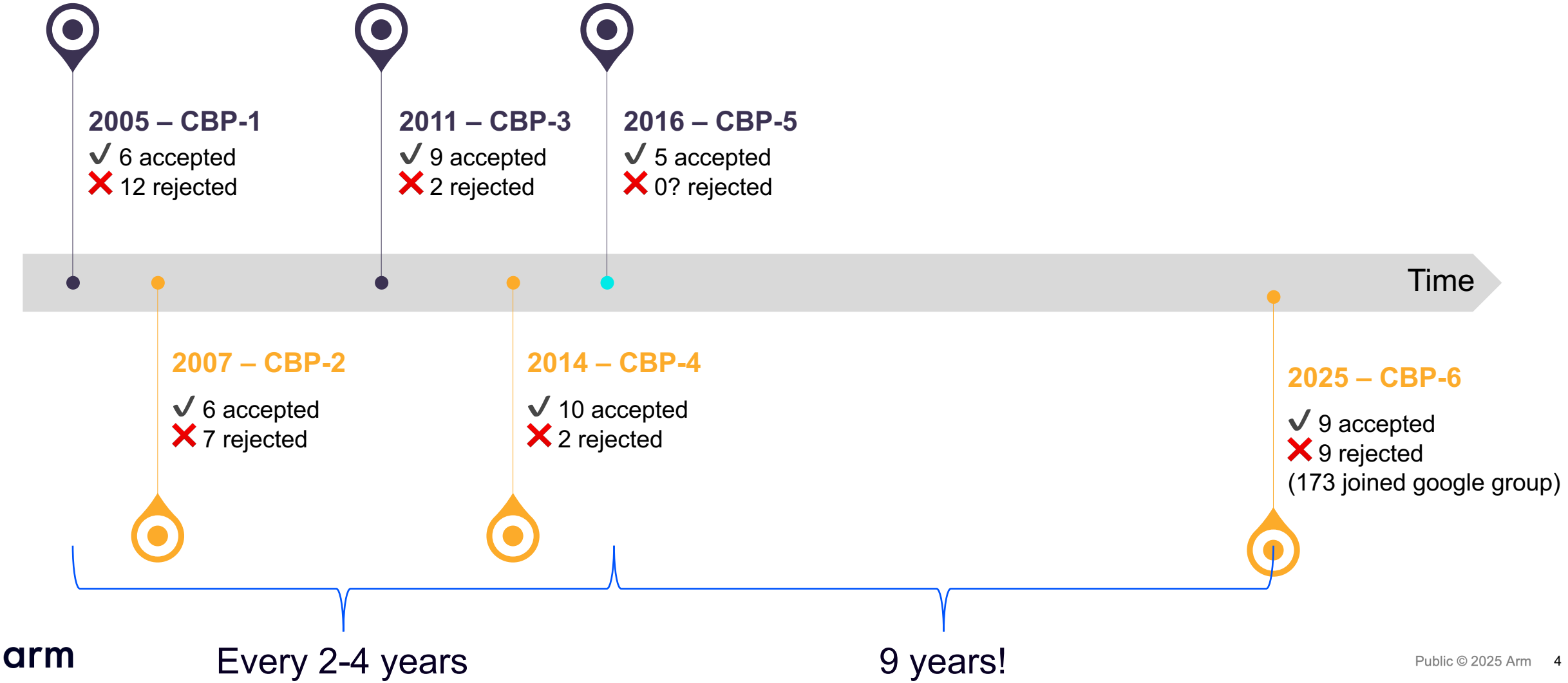
Why Now?

- It’s been a while …



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Why is This Important?

- Branch prediction research has slowed
  - State-of-art remained largely stagnant
  - Reignite the community's interest for pushing the envelop
- Highlight real-world challenges faced by the industry
  - ARM has a rich set of workloads covering many market segments (client, infra …etc.)
  - Give back to the architecture community
- Emphasize how crucial it is to keep advancing branch prediction
  - Industry-academia collaboration is a necessity to fuel innovation

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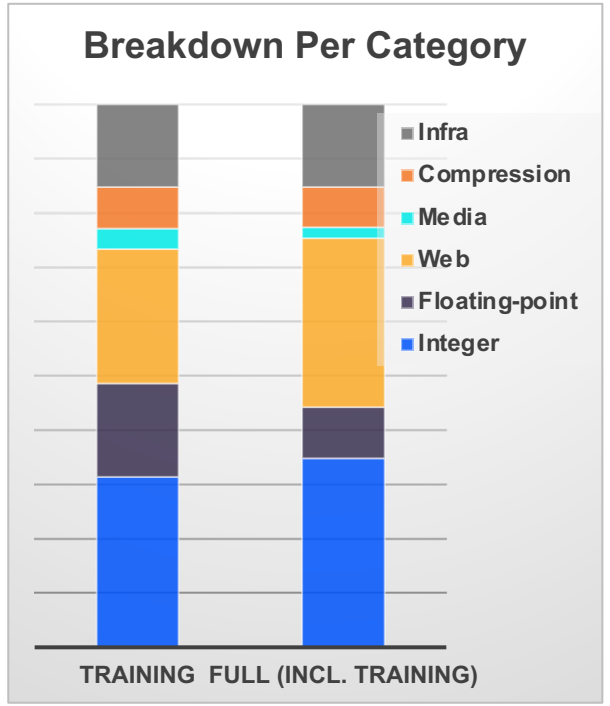
What's New About CBP2025?

Our Traces

- Extracted from a wide spectrum of industry-relevant workloads
- Include key information
  - Basic instruction information
  - Execution information (memory addresses, register values and dependencies …etc.)
- Selection criteria
  - High branch mispredictions per 1K instructions (MPKI)
  - Performance scaled with MPKI reduction
- Two data sets
  - Training
  - Full (includes training)

Includes Training

	Training (BrMisPKI_64KB)	Full (BrMisPKI_64KB)
Integer	33 (4.7)	234 (3.4)
Floating-point	18 (4.2)	64 (2.3)
Web	26 (3.7)	209 (3.2)
Media	4 (0.9)	14 (0.9)
Compression	8 (2.8)	50 (4.2)
Infra	16 (2.5)	102 (1.7)
Total	105 (3.8)	673 (3.0)



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Other Aspects of CBP2025

- Simulator
  - Superscalar with large out-of-order window
  - Visibility into instructions' state at strategic points in the pipeline (predict, decode, AGEN, execute, commit)

- Guidelines
  - Budget: 192KB (option: reference 64KB CBP5 winner TAGE-SC-L + 128KB to spare)
  - Optimization criterion
    - BrMisPKI: Conditional branch mispredictions PKI
    - CycWpPKI: Cycles on the wrong path PKI

- Limitations
  - Lack of visibility into some of the microarchitectural state (e.g., BTB, L1D)
  - Missing some of the instruction details (e.g., precise instruction operation, immediate values)

May address these in the future

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Did We Accomplish Our Mission?

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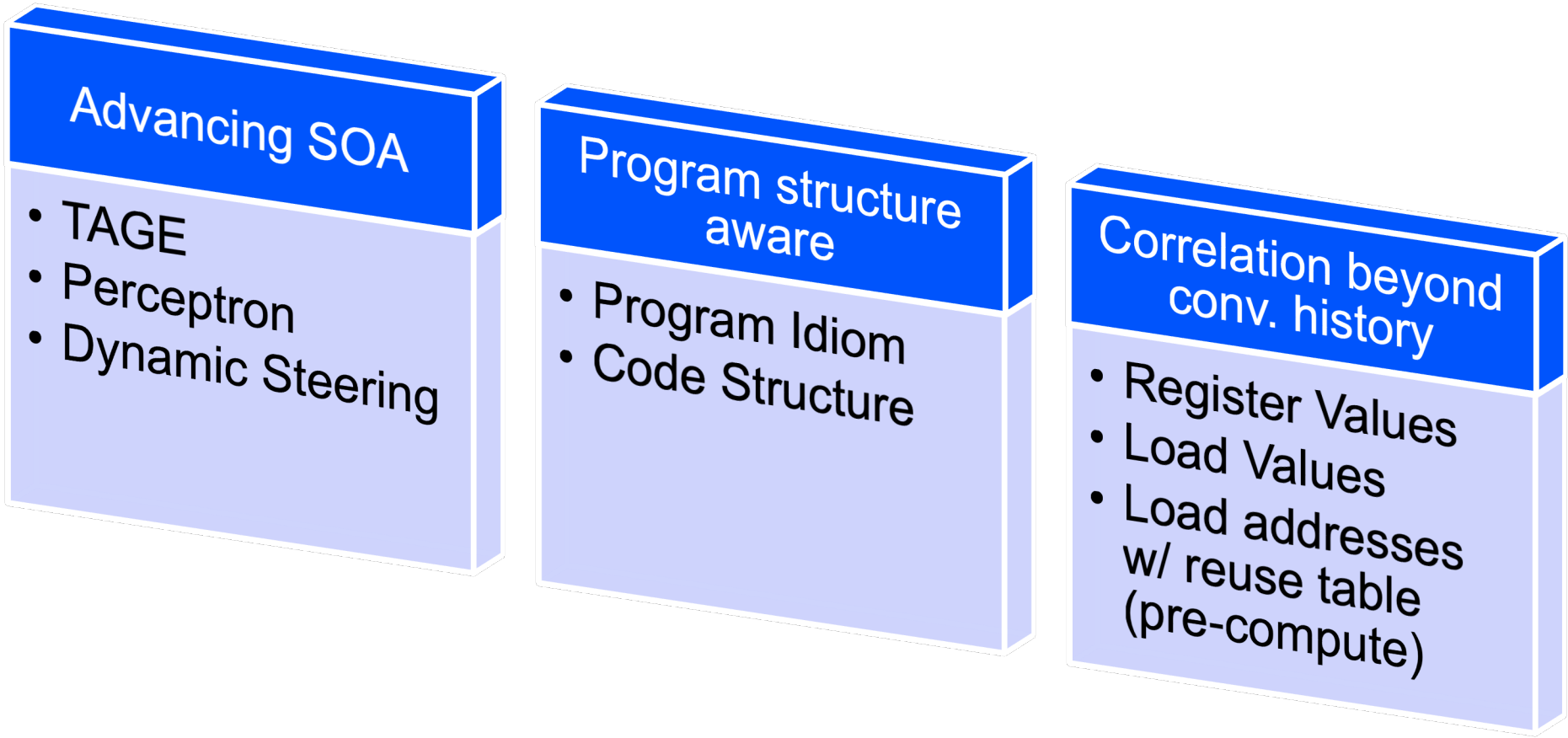
CBP2025 Delivers A Rich, Diverse Program!



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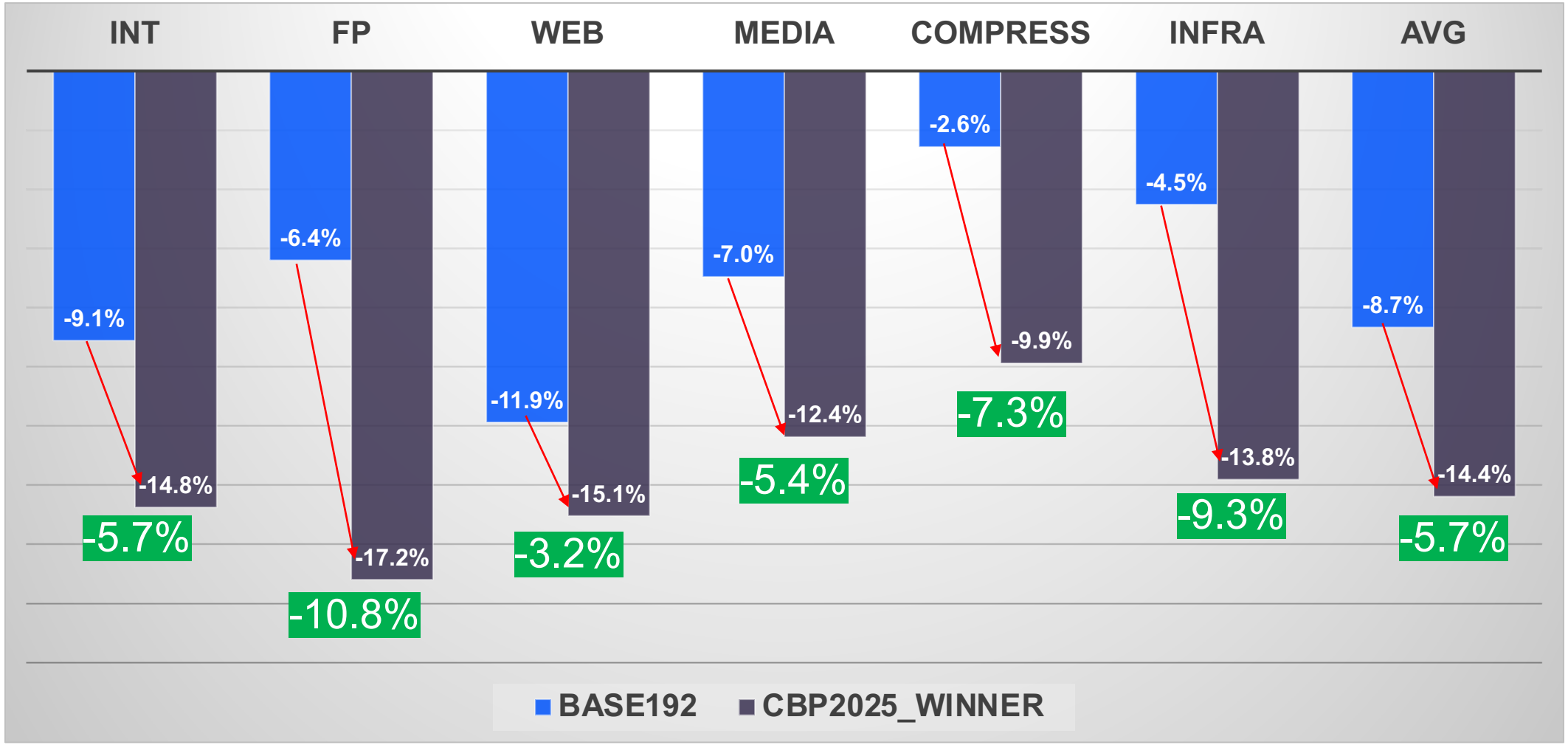
CBP2025 Advances State-of-The-Art!

- **BrMisPKI** Reduction on Full traces w.r.t. BASE (64KB TAGE-SC-L)



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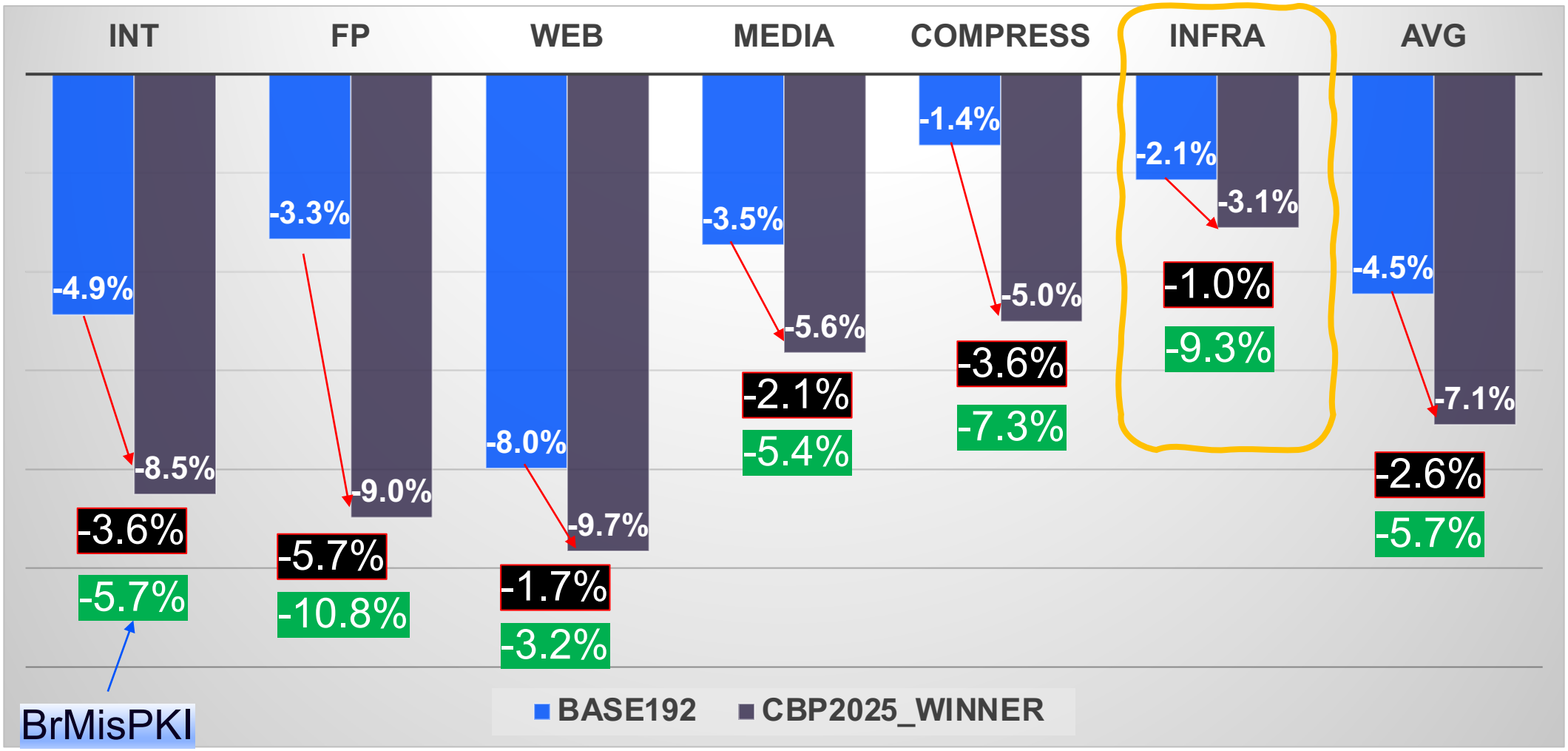
CBP2025 Advances State-of-The-Art!

- **CycWpPKI** Reduction on Full traces w.r.t. BASE (64KB TAGE-SC-L)



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Surprise Announcement

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Cash Prizes for Top 3 Predictors:

- 1st Place: $1,000
- 2nd Place: $500
- 3rd Place: $250

We have an exciting announcement...

The Fine Print: Prize disbursement to 1st–3rd place finishers is subject to a few potential issues. Arm donated the funds to NC State University for CBP2025 (and/or future competitions), but:

1. **Funds Received, Account Pending:** NC State University has received the funds, but the disbursement account is not yet set up. Prize amounts are tentative until that's resolved.
2. **Vendor Setup Required:** Recipients must register as a "vendor" with NC State University and submit an invoice to receive payment.
3. **Bank Restrictions:** NC State University may be unable to process payments to certain non-U.S. banks.
4. **Country Restrictions:** Payments may be blocked for recipients in countries restricted by U.S. federal or state regulations.

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Heads up! We Will Discuss This Later Today

- Should we make CBP a year-round competition?
- What improvements would the community like to see in the infrastructure?
- Are there improvements to traces that would be valuable?

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What’s Today’s Program?

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Today's Program

Session 1 (9:20 – 10:50 AM) – 6 papers
- **TAGE-SC for CBP2025** — André Seznec
- **A Deep Dive Into TAGE-SC-L** — Alberto Ros
- **RUNLTS**: Register-value-aware predictor Utilizing Nested Large TableS — Toru Koizumi, et al.
- **LVCP**: A Load Value Correlated Predictor for TAGE-SC-L — Yang Man, et al.
- **PIP**: An Ensemble of Programming-Idiom Predictors — Karl Mose, et al.
- TAGE-SC-L with **Code Structure Correlator** — Lingzhe Cai, et al.

Break (11:00 – 11:30 AM)

Session 2 (11:30 AM – 12:15 PM) – 3 papers
- **Multiperspective Perceptron Predictor** — Daniel A. Jiménez
- Taming Wild Branches: Overcoming Hard-to-Predict Branches using the **Bullseye Predictor** — Emet Behrendt, et al.
- **Branch Prediction via Load Value Prediction**: A Case of BALL (Branch-ALU-Load-Load) Predictor— Jun Fan

Closing Remarks, Results, and Awards (12:15 – 1:00 PM)

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Merci
Danke
Gracias
Grazie
谢谢
ありがとう
Asante
Thank You
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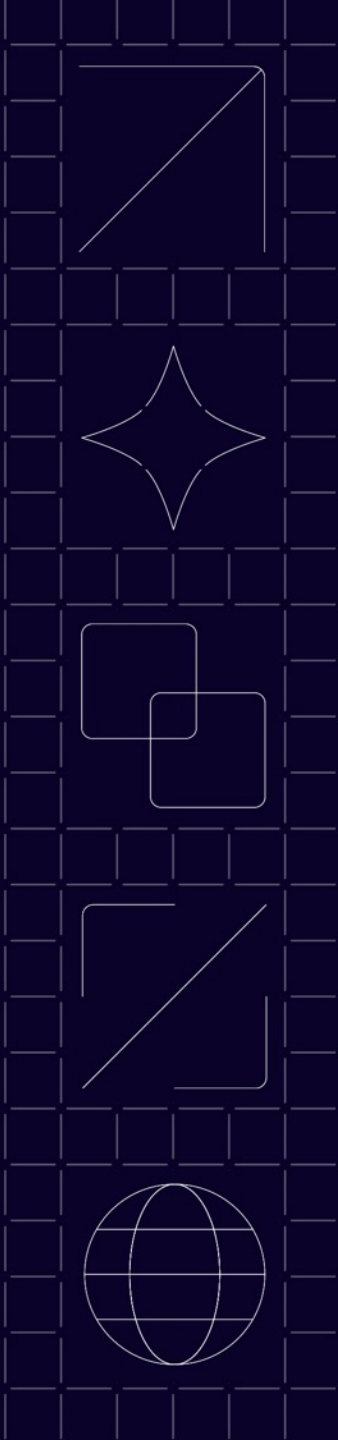
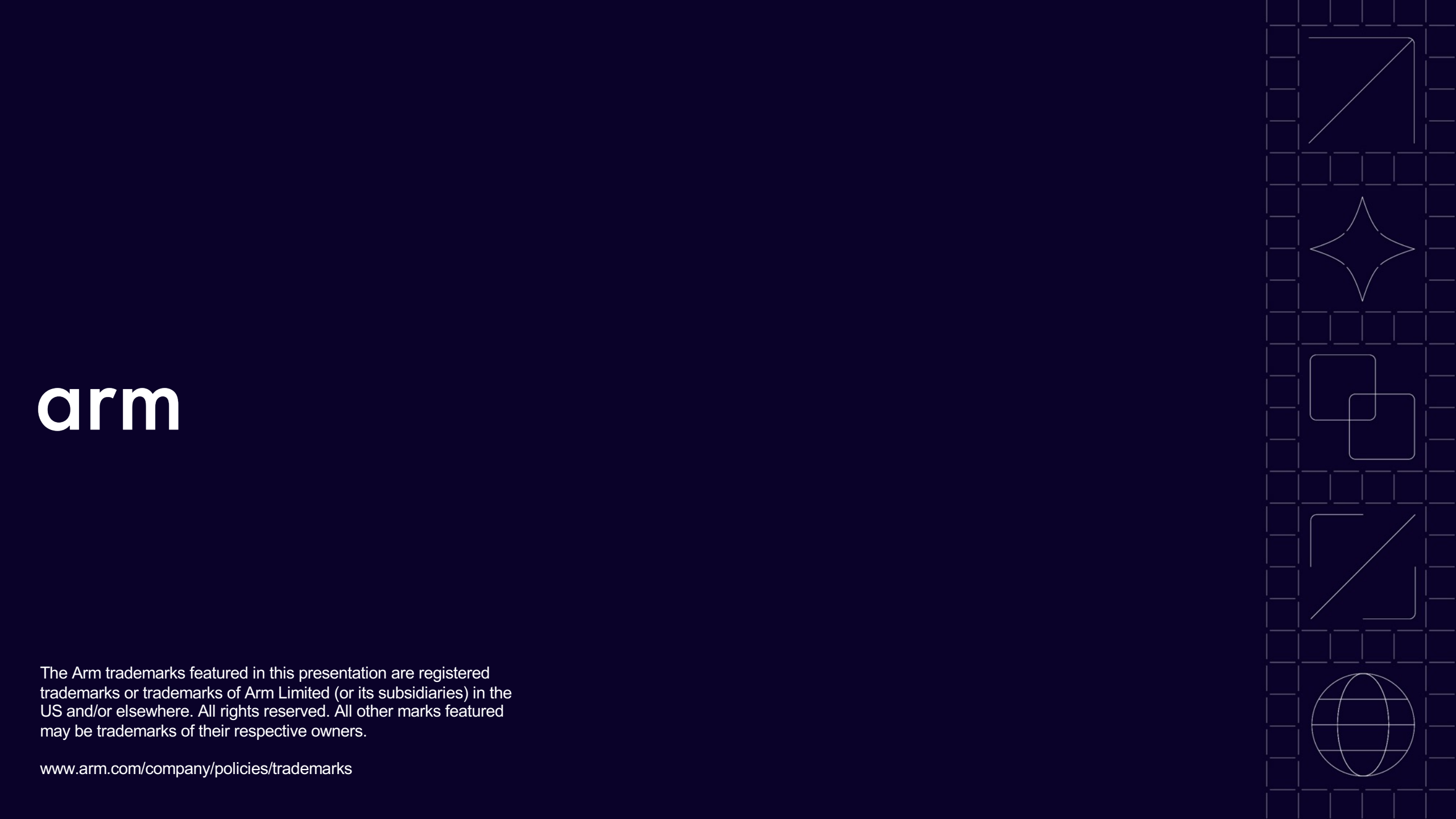
תודה
ధన్యవాదములు
Köszönöm





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