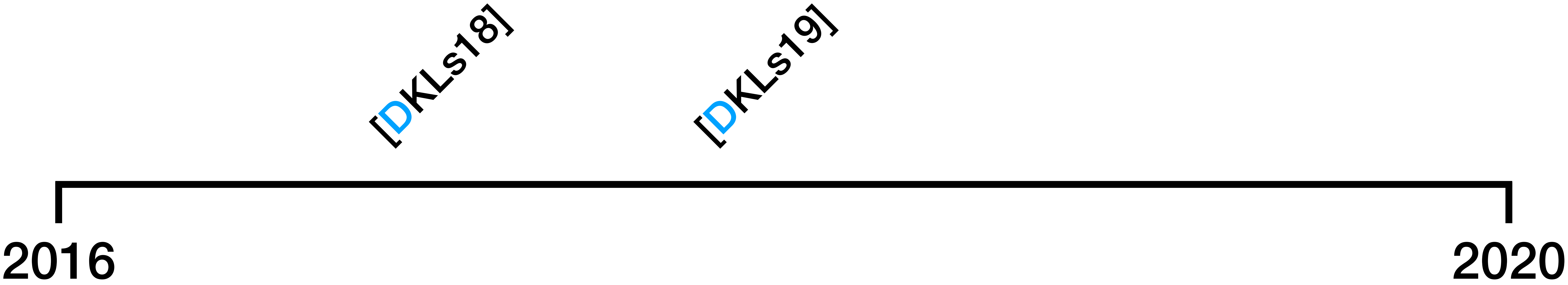
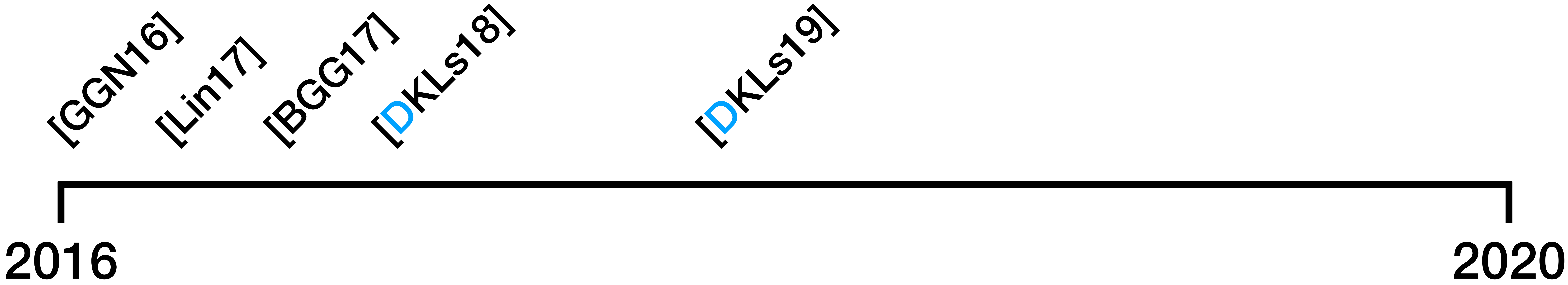
Double Feature:

Secure Two-Party Threshold ECDSA from ECDSA Assumptions

Threshold ECDSA from ECDSA Assumptions: the Multiparty Case

Jack Doerner • Yashvanth Kondi • Eysa Lee • abhi shelat


[DKLs18]
[DKLs19]
2016
2020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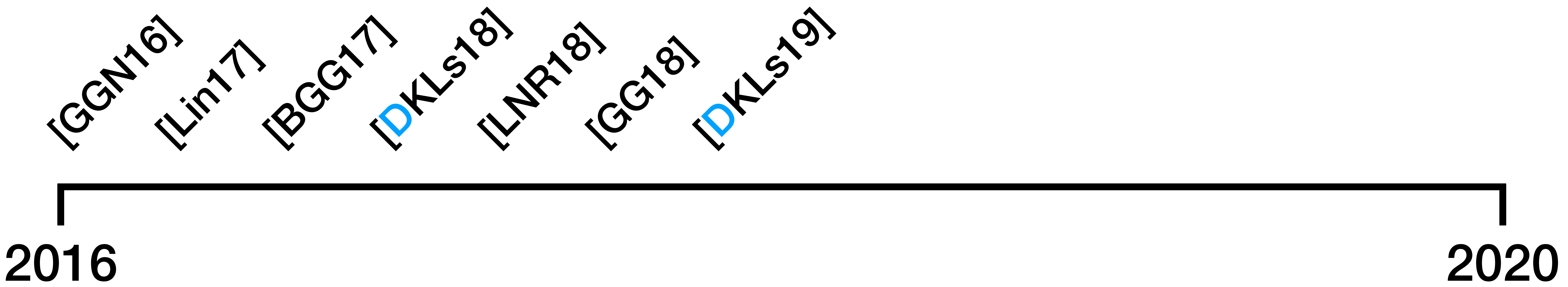

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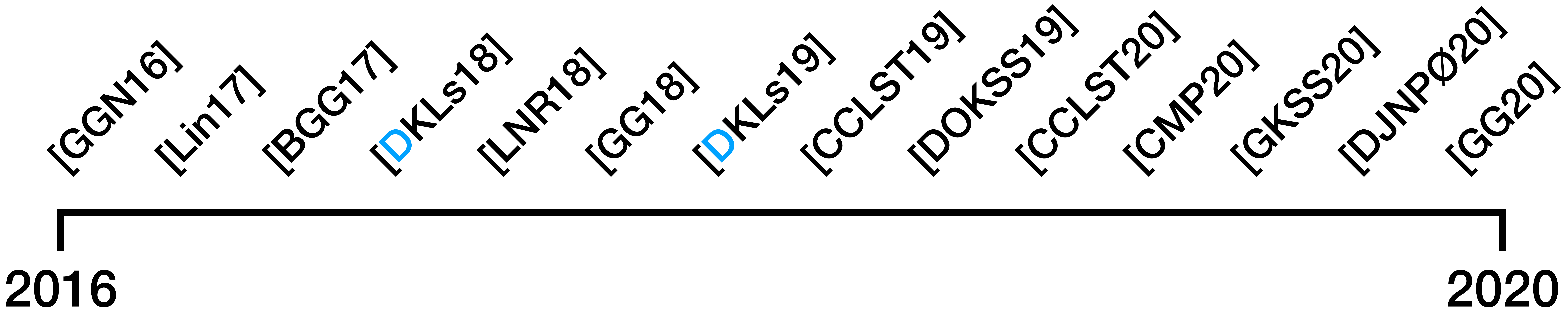

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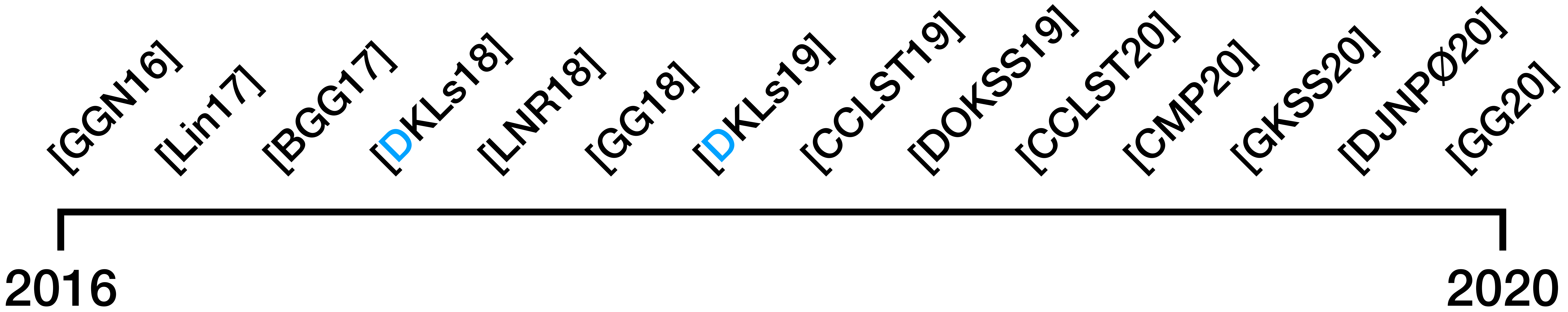
14 Papers!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14 Papers!

After 7 followups, we still stand out

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2016 2020

Threshold ECDSA
From ECDSA Assumptions

[DKLs18] [DKLs19]

OT-Based

Preproc All But Last Msg

Securing DNSSEC Keys
via Threshold ECDSA
From Generic MPC

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Good 2P Perf

Threshold ECDSA From ECDSA Assumptions	Securing DNSSEC Keys via Threshold ECDSA From Generic MPC
[DKLs18] [DKLs19]	[DOKSS19]
OT-Based	OT-Based
Preproc All But Last Msg	Preproc All But Last Msg
No EC Abstraction	Nice EC Abstraction
2 Msgs for 2 Parties	
Many Optimizations	
Better 2P Perf	Good 2P Perf
More Complex Proof	Simpler Proof

OT vs HE

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OT vs HE

Paillier + ZK: [GGN16] [Lin17] [BGG17] [LNR18] [GG18] [CMP20] [GKSS20] [GG20]

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Paillier + ZK

OT

Paillier + ZK

Low Communication

OT

Paillier + ZK

Low Communication

Extra Assumptions

OT

Paillier + ZK

Low Communication

Extra Assumptions

Very High Computation

OT

Paillier + ZK

Low Communication

Extra Assumptions

Very High Computation

NIZK over Crypto

OT

Paillier + ZK	OT
Low Communication	High Communication
Extra Assumptions	Native Assumptions
Very High Computation	Low Computation
NIZK over Crypto	No ZK

OT

High Communication

Native Assumptions

Low Computation

No ZK

Not so bad, actually

Example 1: Mobile Wallet

Multiplier: OT-based
Parties: 4
Curve: 256-bit

2 Mbits
sent per party

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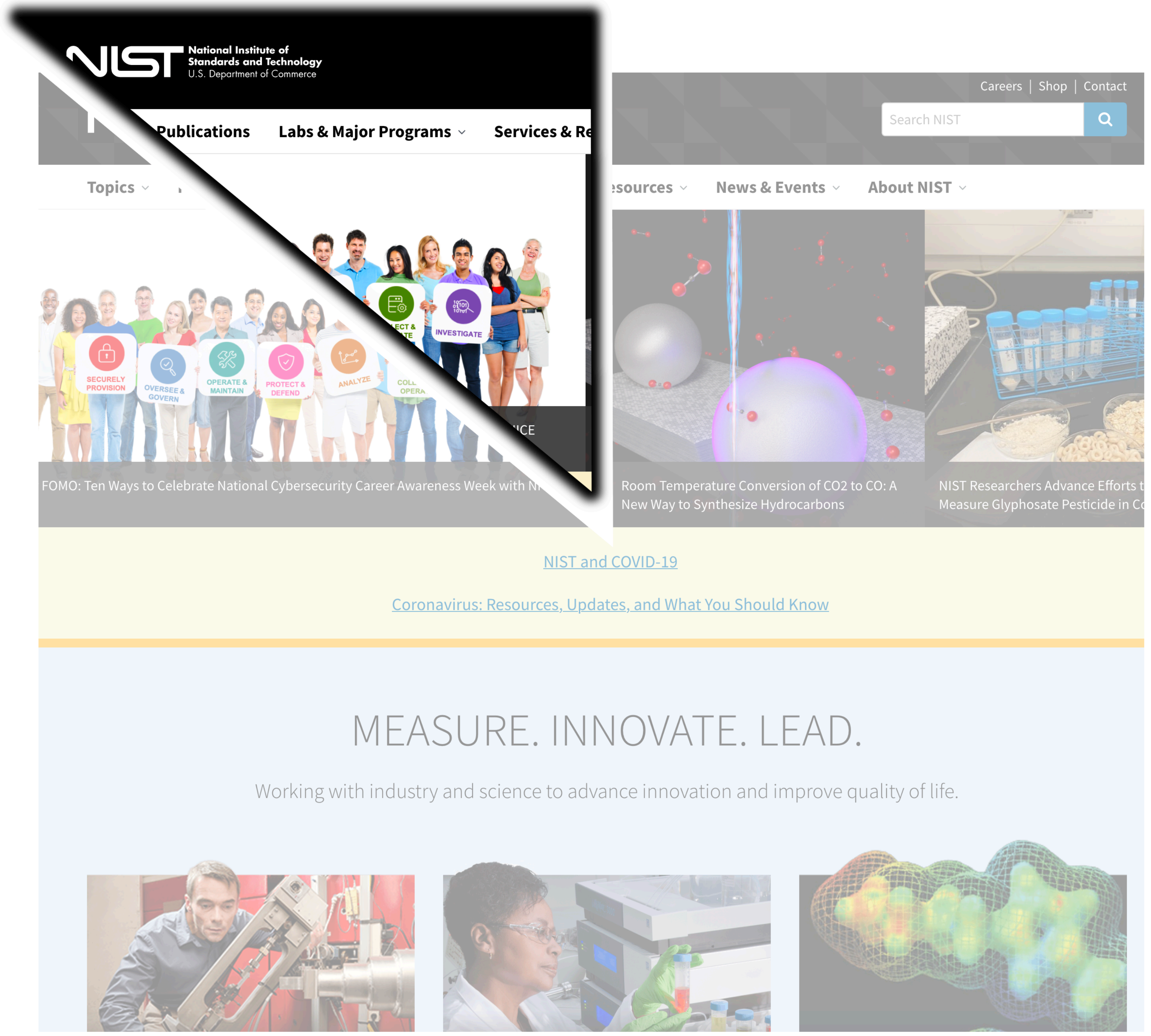
$\approx$



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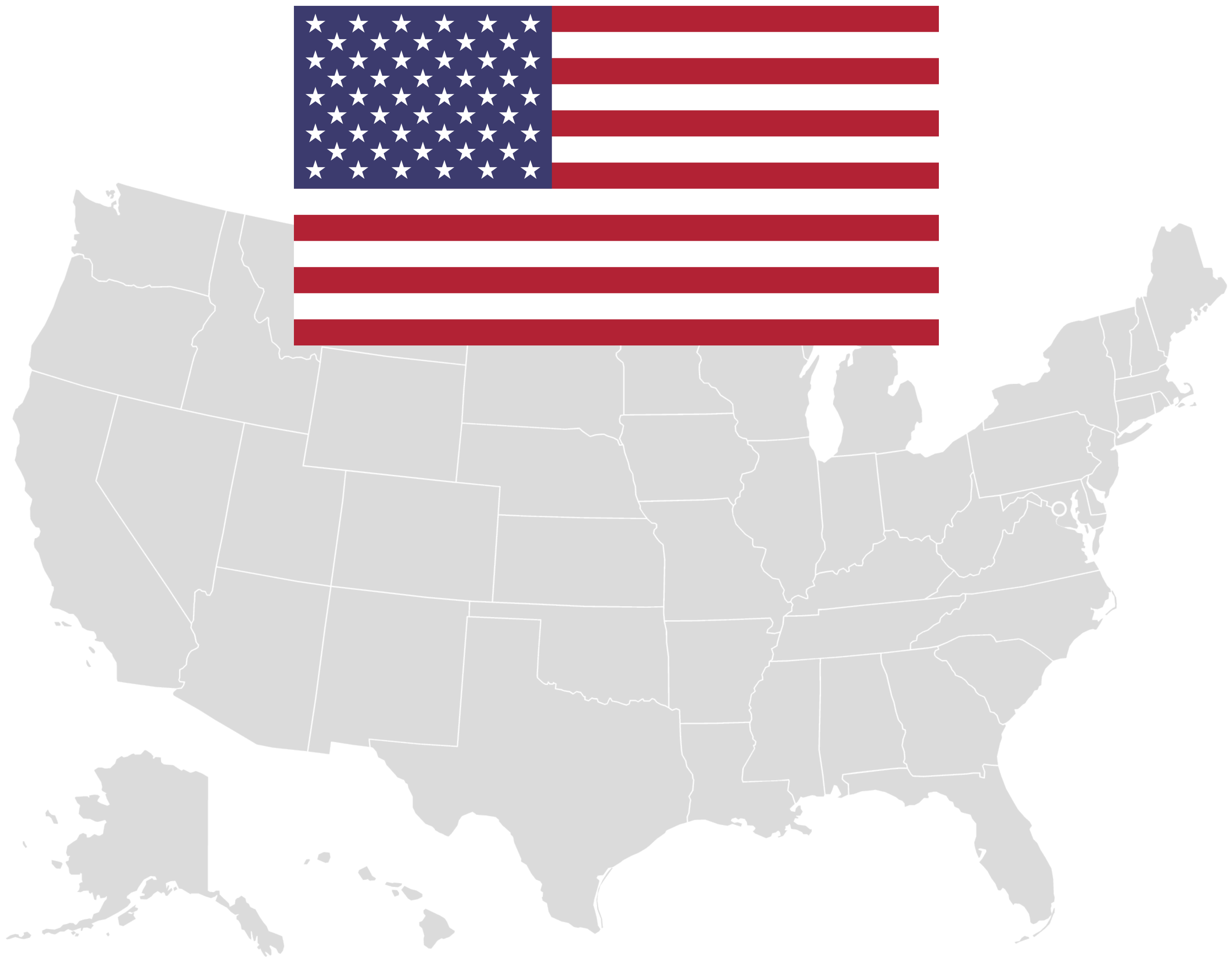

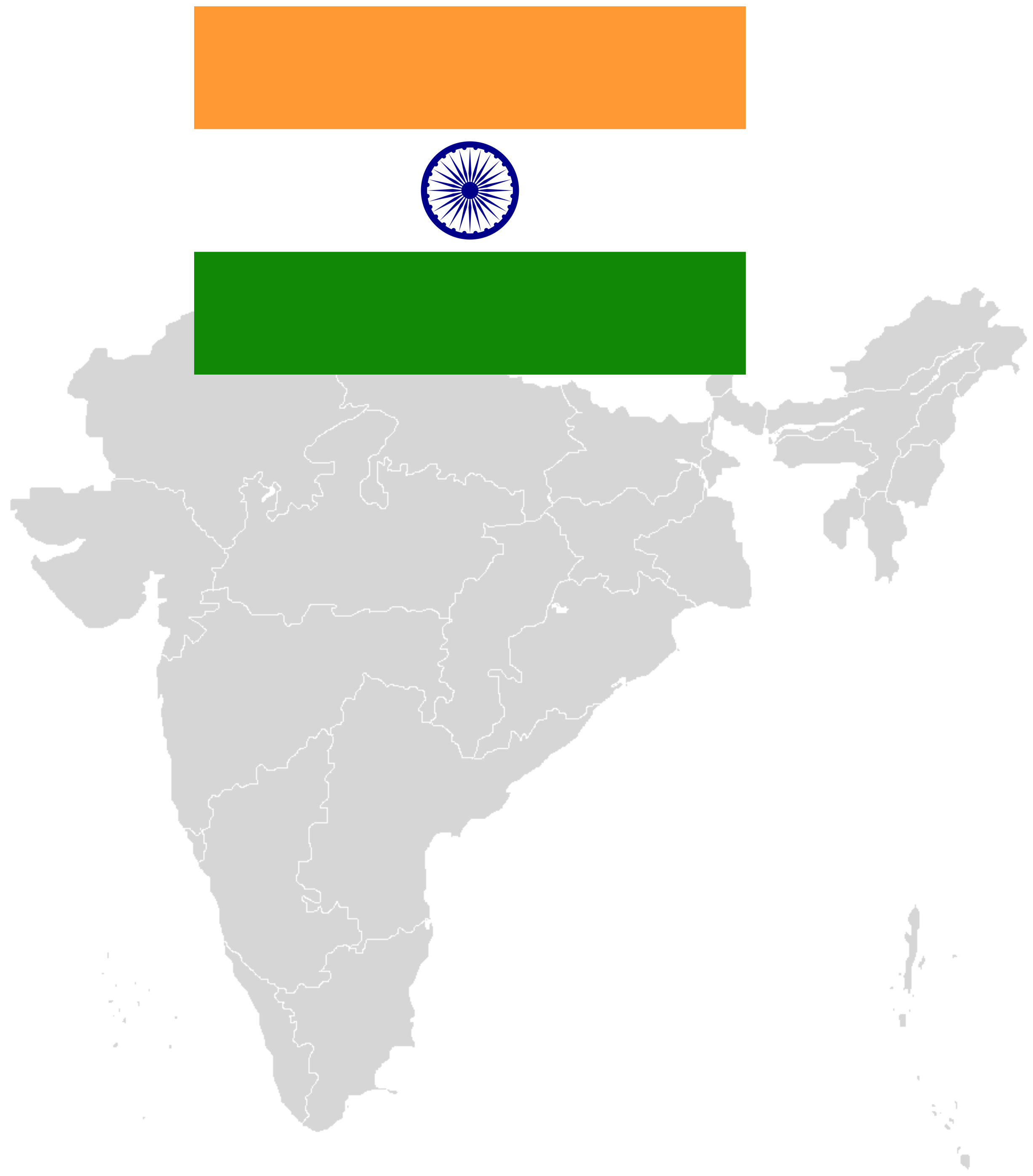

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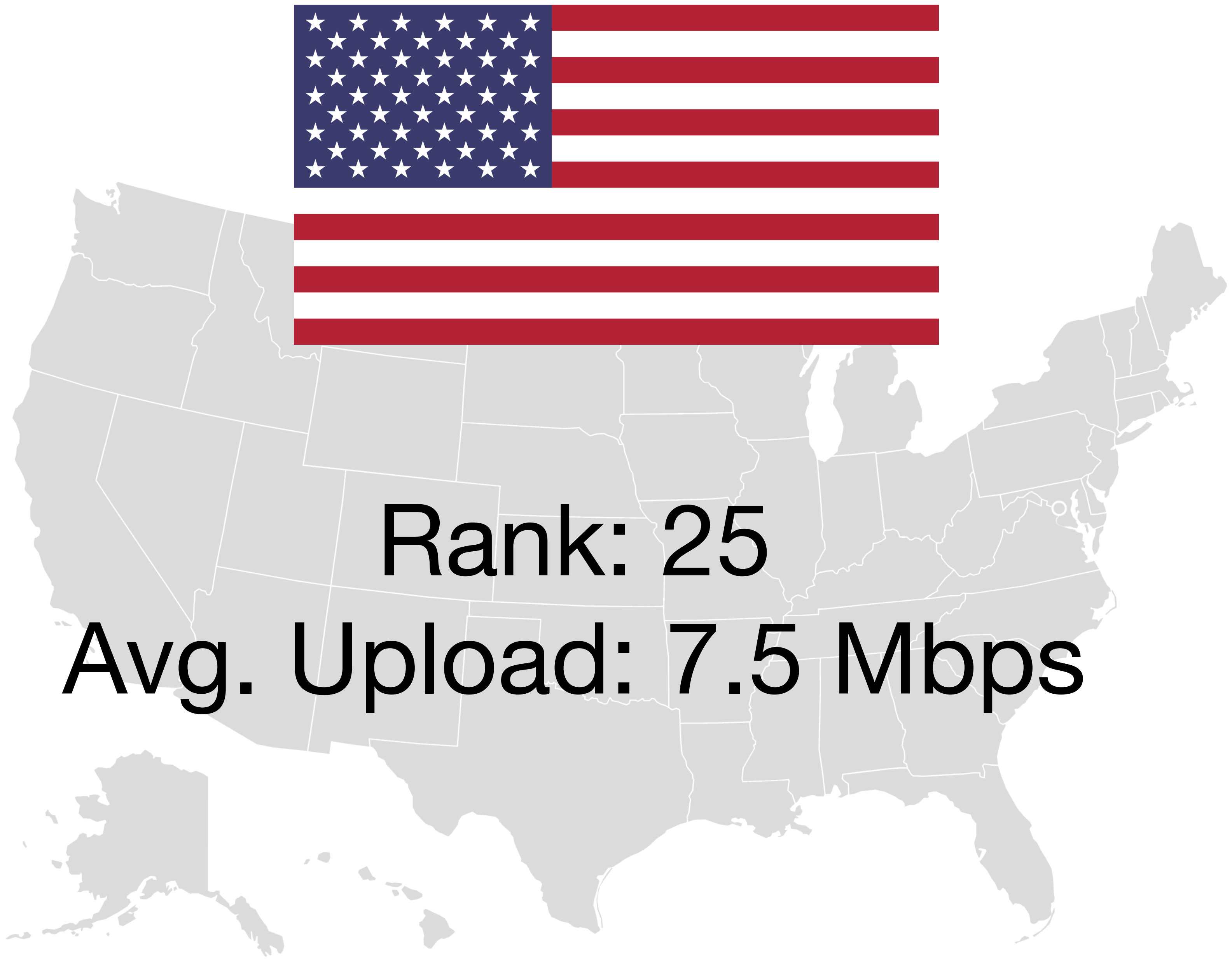
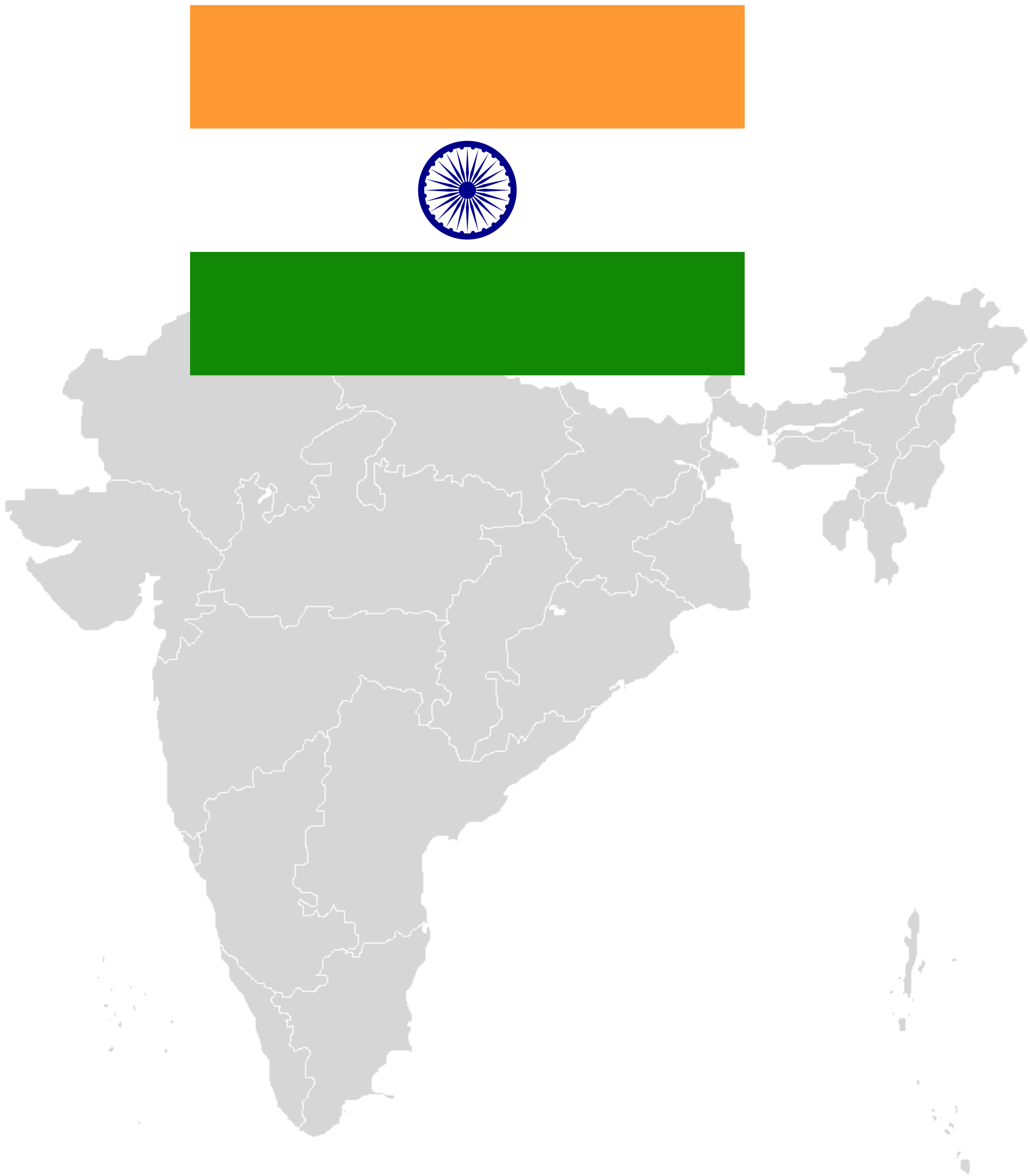


Rank: 25
Avg. Upload: 7.5 Mbps



source: opensignal

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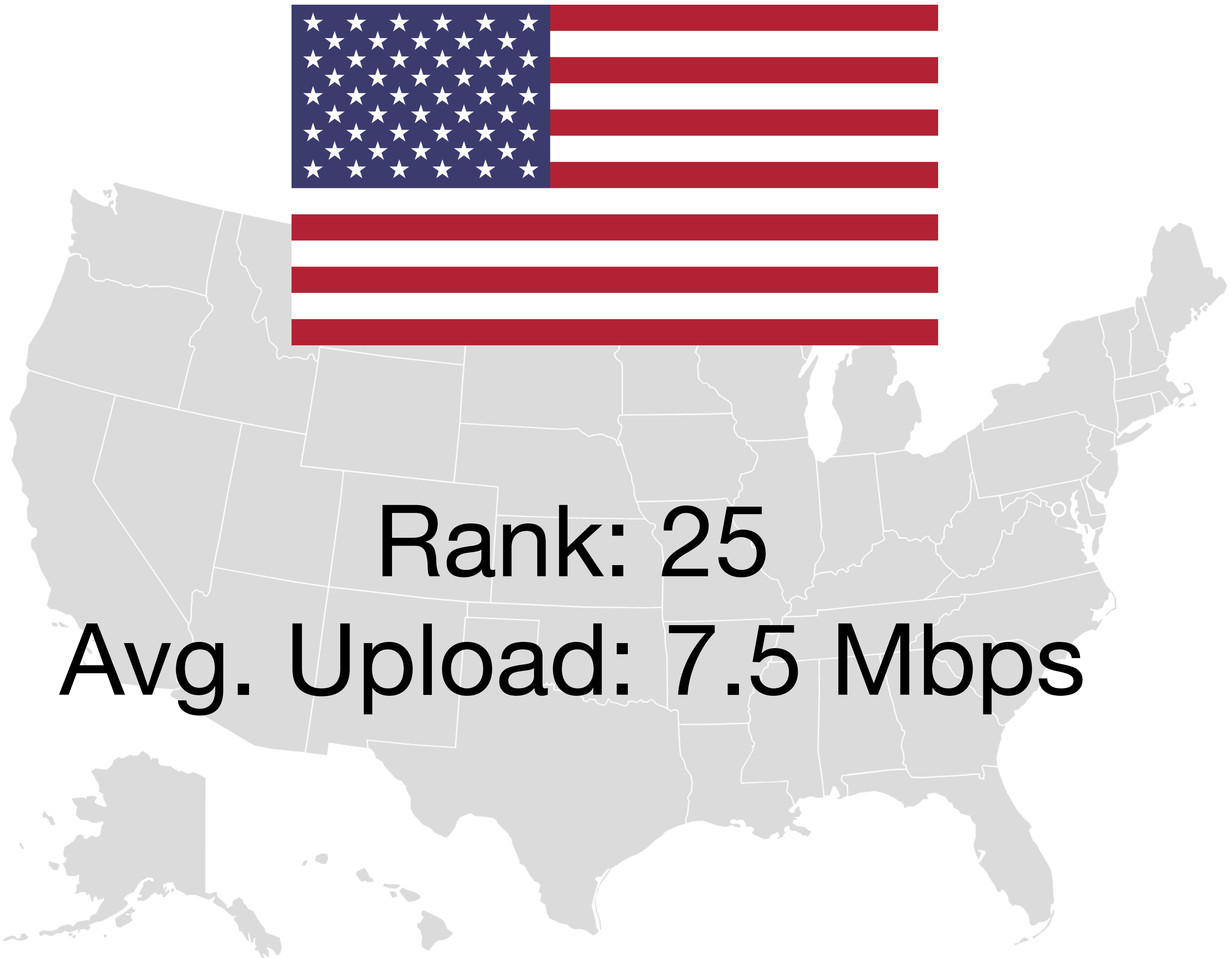

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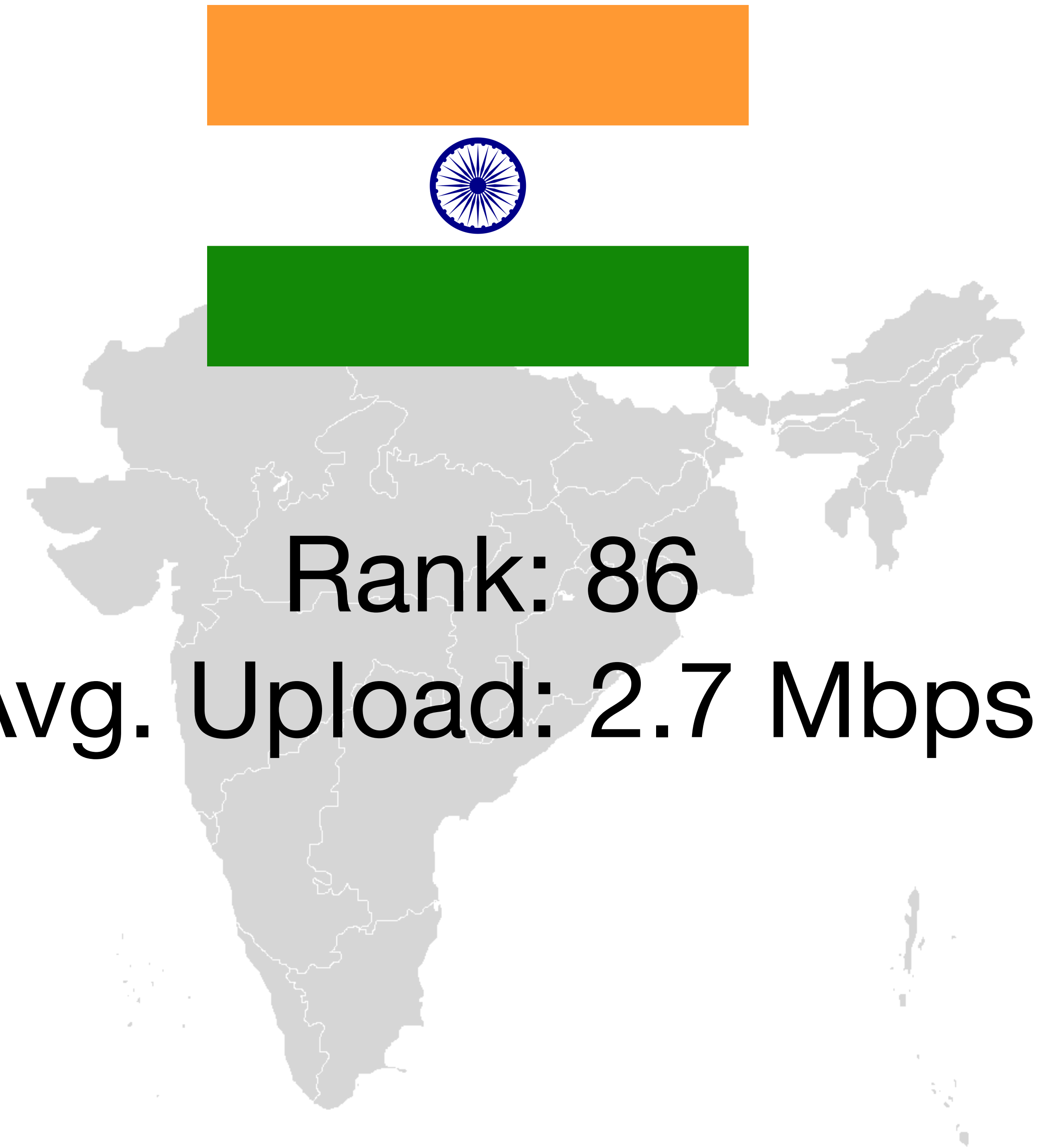

Rank: 86
Avg. Upload: 2.7 Mbps

source: opensignal

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Rank: 25
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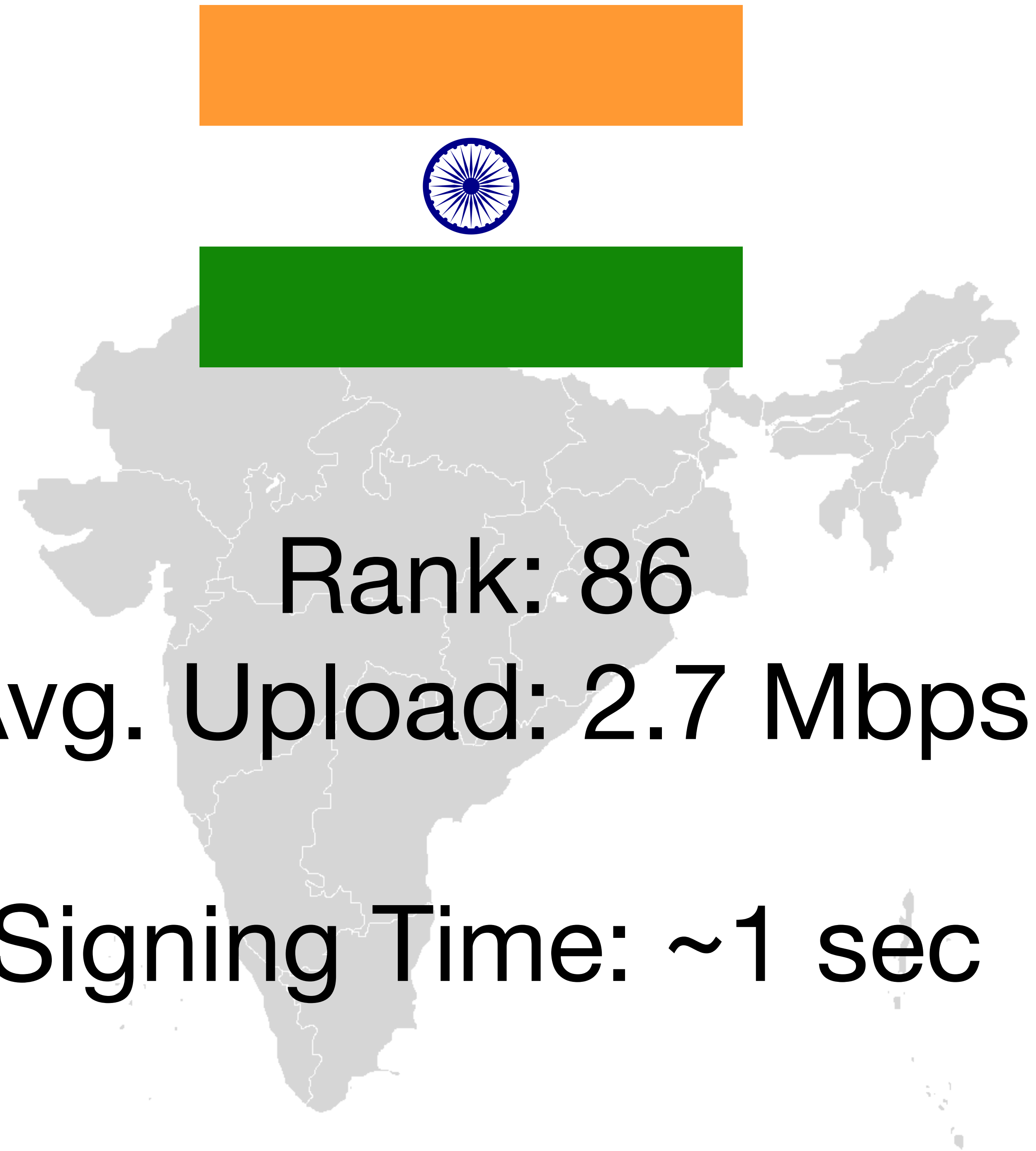
Signing Time: ~1/3 sec



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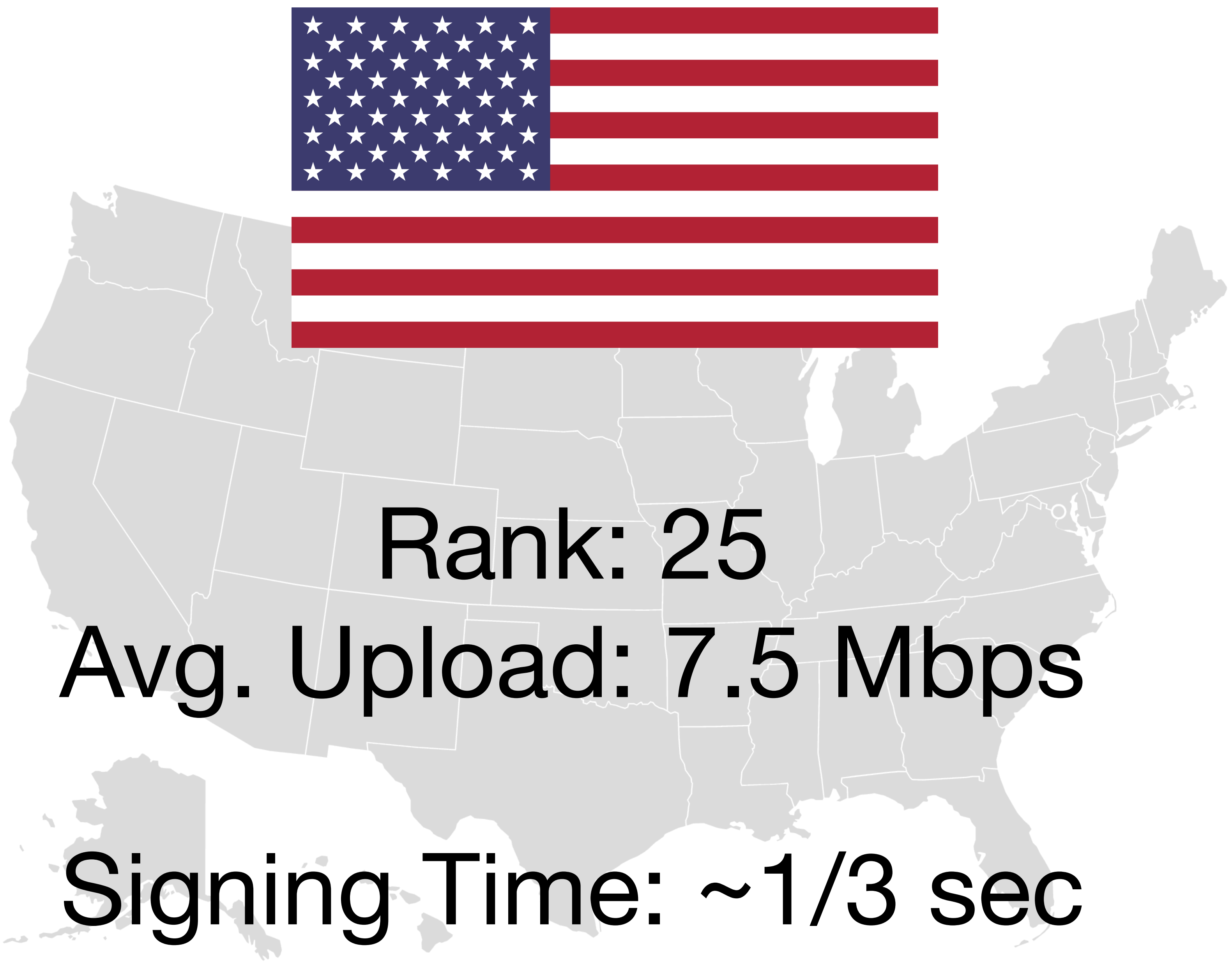

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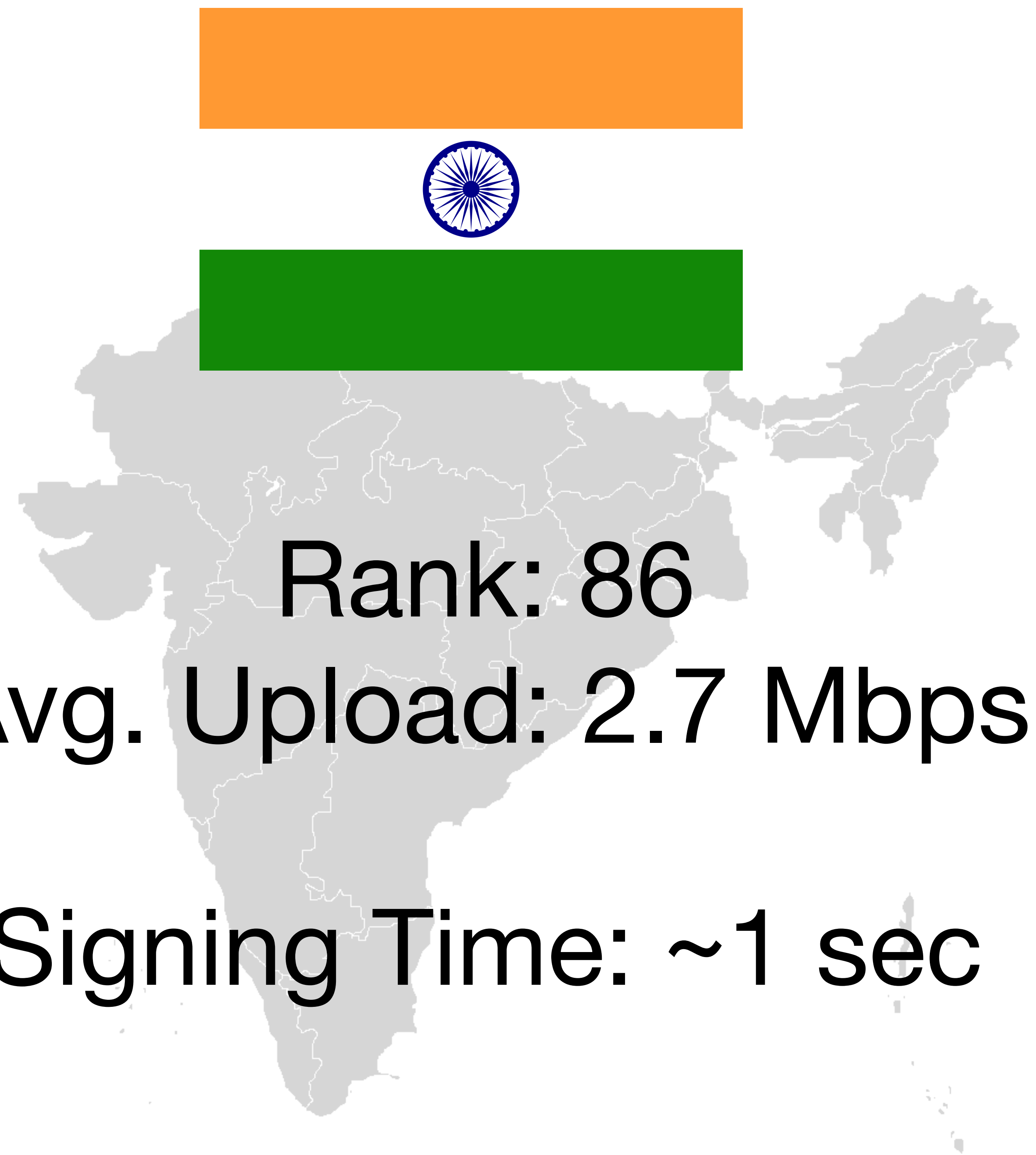

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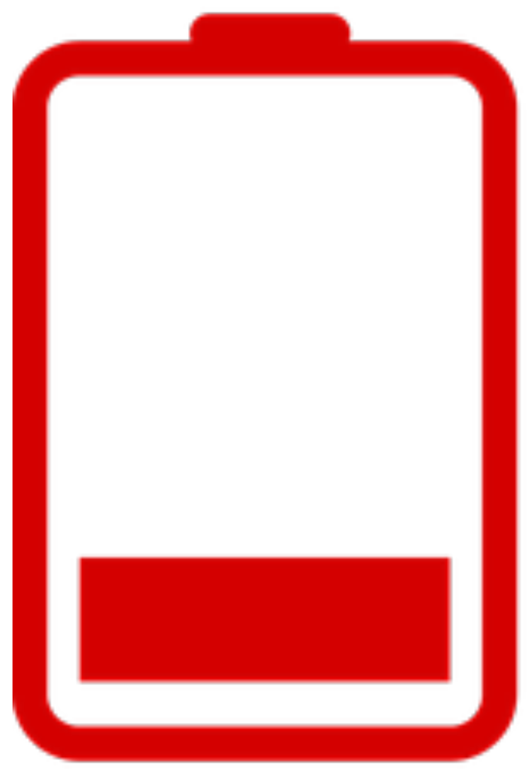
Signing Time: ~1 sec

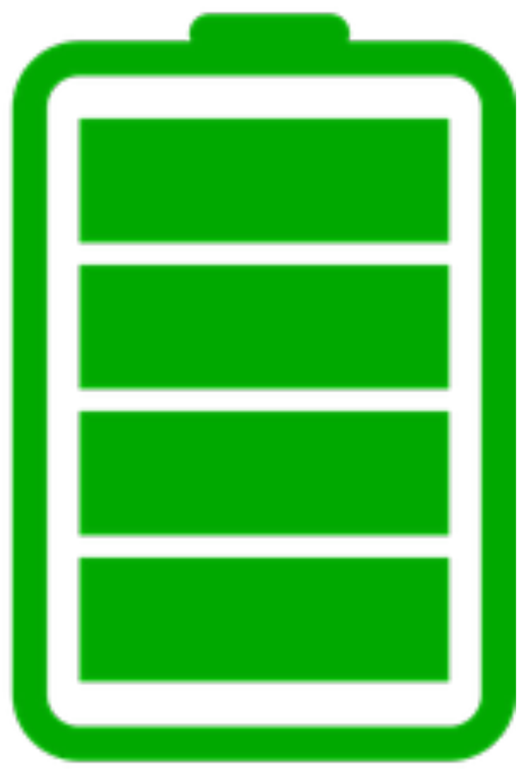
Similar to computation time for Paillier
on powerful hardware!

source: opensignal

On the Other Hand



Paillier + ZK



OT

Example 2: Datacenter Signing

How much bandwidth to be CPU bound?
(including preprocessing)

2 Parties
~250 sigs/second

256 Parties
~3 sigs/second

using GCP n1-highcpu nodes

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How much bandwidth to be CPU bound?
(including preprocessing)

2 Parties
~250 sigs/second

Each party sends:
~700 Kbits per sig

256 Parties
~3 sigs/second

Each party sends:
~185 Mbits per sig

using GCP `n1-highcpu` nodes

Example 2: Datacenter Signing

How much bandwidth to be CPU bound?
(including preprocessing)

2 Parties
~250 sigs/second

Each party sends:
~700 Kbits per sig

Bandwidth required:
~180 Mbps symmetric

256 Parties
~3 sigs/second

Each party sends:
~185 Mbits per sig

Bandwidth required:
~555 Mbps symmetric

using GCP `n1-highcpu` nodes

Summary

Bandwidth isn't always the bottleneck
or the most important cost factor

Guide concrete optimization by
studying real use-cases

We ❤️ OT

Our Protocols

UC Sec From CDH in the ROM

OT-Based

No ZK in Signing

One "Online" Msg

Const or Log Round Preprocessing

2 Msgs for 2 Parties

Secure Two-Party Threshold ECDSA from ECDSA Assumptions

http://ia.cr/2018/499

Threshold ECDSA from ECDSA Assumptions: the Multiparty Case

http://ia.cr/2019/523