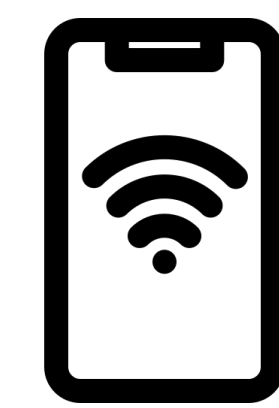


**Temporal patterns in Wi-Fi packet bursts exist during network discovery**

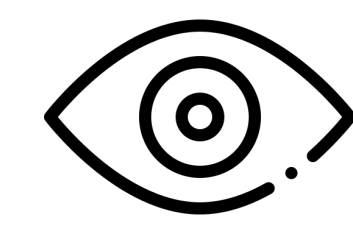
**Our new passive identification method exploits predictable transmission timing between those bursts**

# Passive Device Identification with Packet Timing Analysis

## MAC Address Randomization



Wi-Fi devices search for Access Points by broadcasting *probe requests* with a *random* MAC address in the clear.

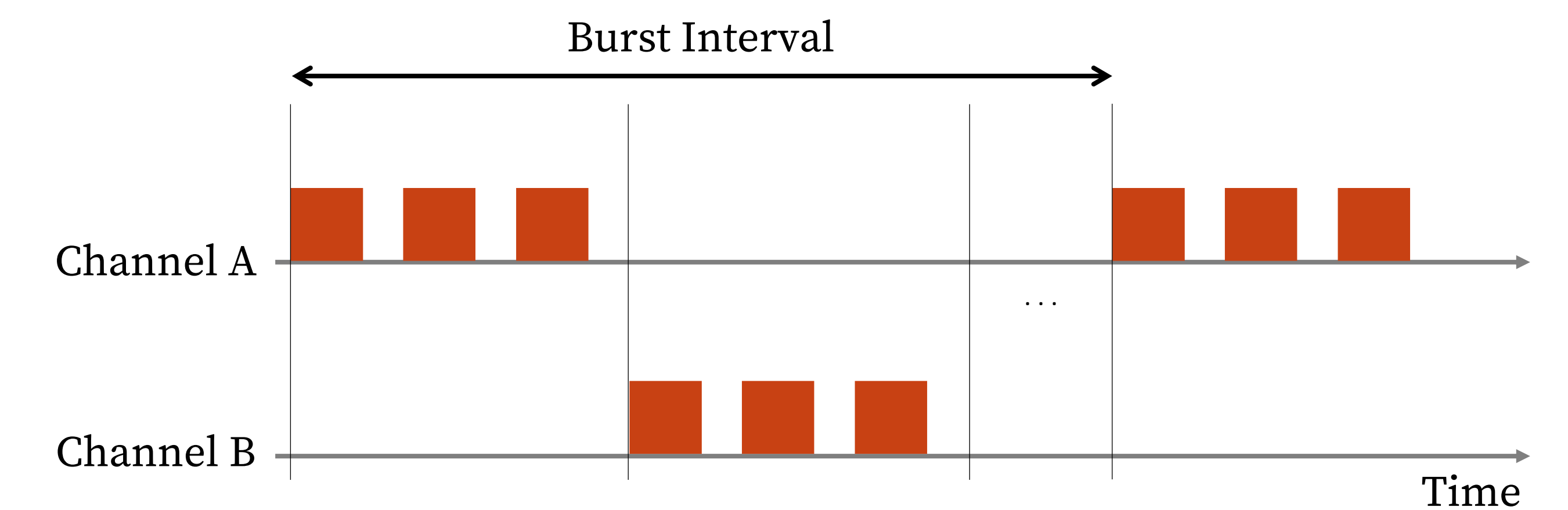


Even with MAC randomization activated, **predictable patterns in network discovery enable other threats** to user privacy:

- Unwanted surveillance across networks
- Learning people's locations and movements across space
- Compromising personal safety

## Exploiting Inter-burst Timing

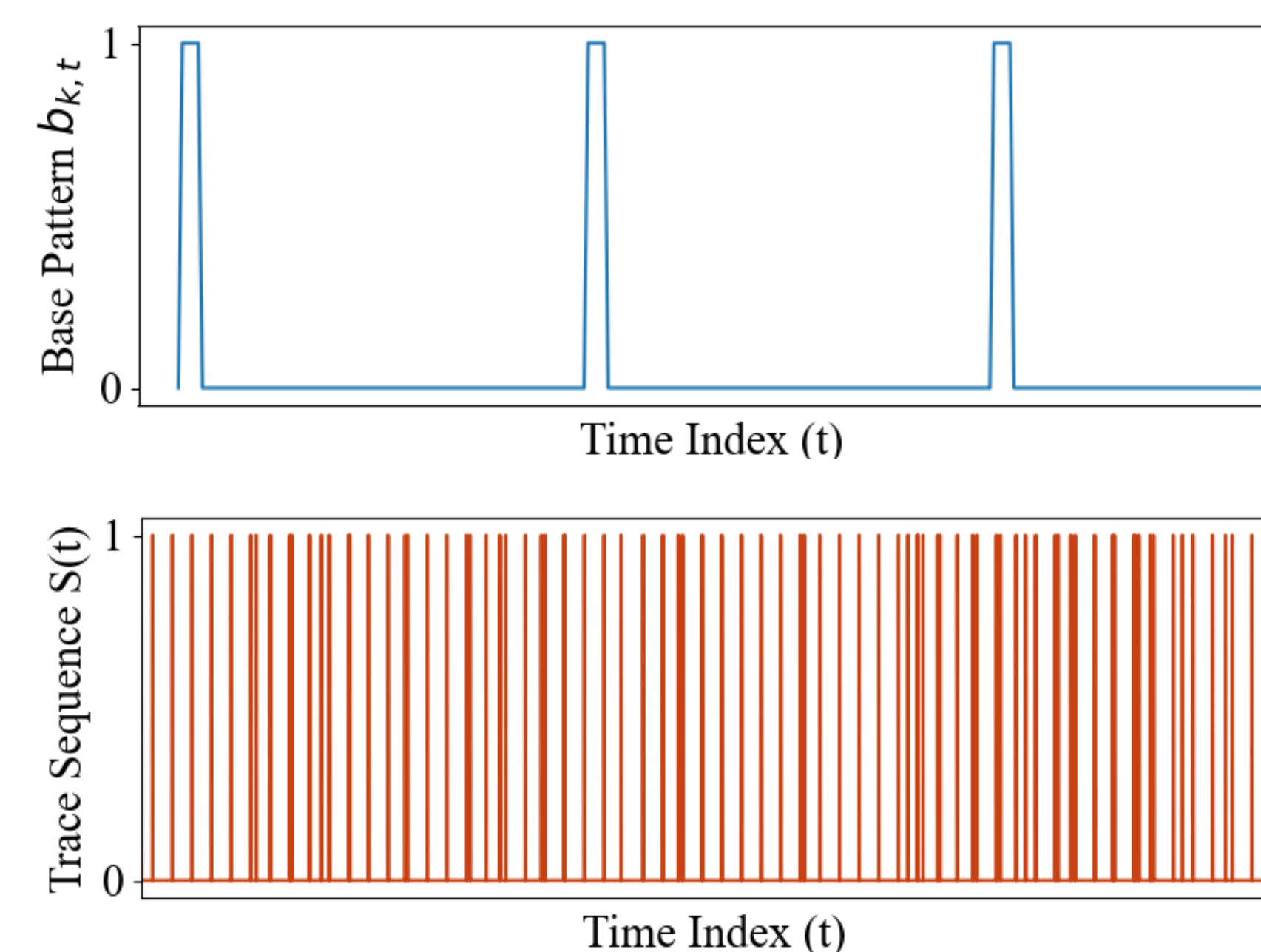
As devices broadcast probe requests, they embed *predictable temporal patterns in transmission bursts*.



The *burst interval* measurement serves as an identifier.

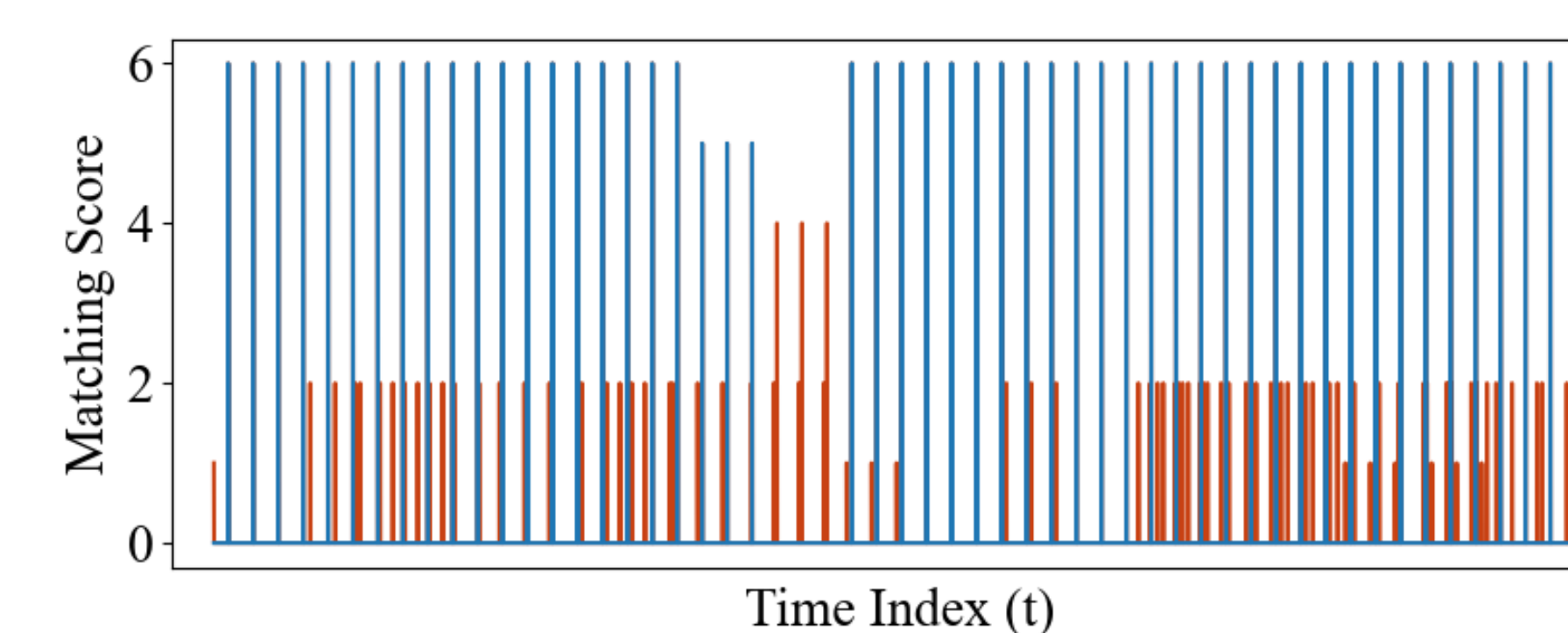
## How We Track Devices

Time-shifted copies of a *base pattern* (top) for a sequence of bursts is correlated with the *packet trace sequence* (bottom).



$S(t) = 1$  if there is a probe in time window  $t$

The correlation outputs scores for time windows where probe requests in the sequence match the pattern.



The set of MAC addresses in those time windows are considered belonging to the same device.

```
16:67:c1:04:39:bf
54:8a:53:be:1d:df
c6:b8:d1:2a:a9:a5
9c:99:c4:cb:84:ea
8a:46:2b:f2:db:8d
36:74:9e:6c:f2:9c
b6:1a:e9:06:f1:c4
a2:f1:dd:3b:32:82
2a:a0:d5:3b:53:72
```

Results from the burst interval attack

Device	Detection Rate	Burst Interval
Windows 10 Laptop	85.7%	59.7s ± 20ms
Raspberry Pi 3B+	96.8%	60.0s ± 25ms
Ubuntu 20.04 Laptop	100%	63.0s ± 30ms

## References

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J. Pang, B. Greenstein, R. Gummadi, S. Seshan, and D. Wetherall. 802.11 User Fingerprinting. In *MobiCom '07*. DOI: 10.1145/1287853.1287866



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