CrypTO Cars

IXH25 - Italian XRPL Hackathon

Group ”PoliTO 1”

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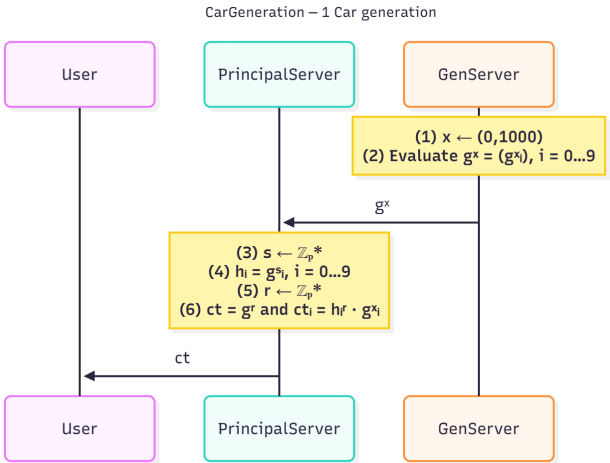
Setting

In our analysis, we modeled four distinct entities involved in the system:

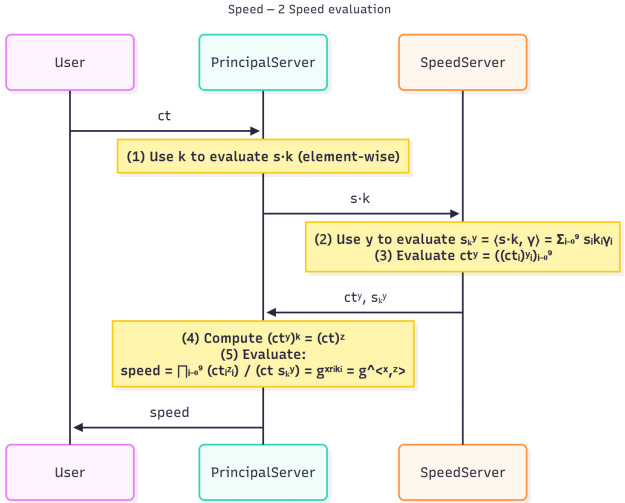
1. User
2. Principal Server
3. Generation Server
4. Speed Server

We employ a **multi-party functional homomorphic encryption scheme**, inspired by the paper *"Simple Functional Encryption Schemes for Inner Products" (2015, École Normale Supérieure)*. The speed function used is defined as $g^{\langle x,z \rangle}$, where $z = k \cdot y$ element-wise. Importantly, the vector z remains individually unknown to each server.
Our security model relies on the **Discrete Logarithm Assumption** and the premise that the **servers do not collude**.

CarGeneration



Speed Computation



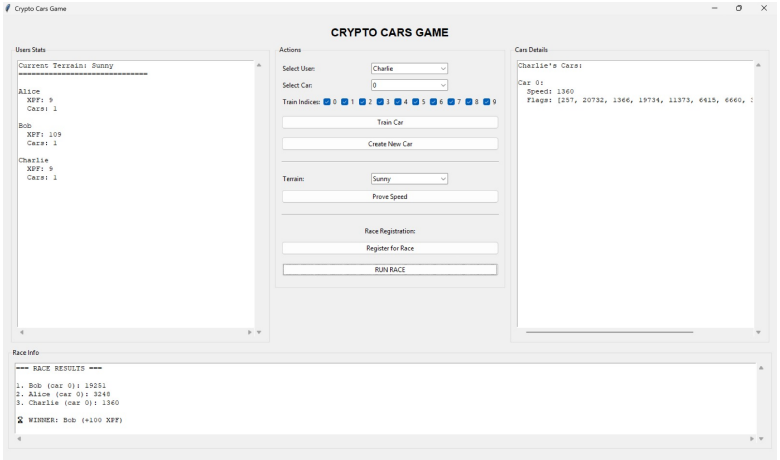
Homomorphic Encryption - Training

At this point the user owns a **car** with a defined **speed**. By spending **1 XPF**, the user can either train the car, or join the next race directly. The user can also input the **weather** on which the race takes place.
The training process is made possible by the use of a **homomorphic encryption scheme**. Thanks to its properties, operations such as adding or subtracting up to 20 from a flag can be performed directly on the encrypted data, without the need for decryption.

Game

Races occur every 10 minutes, following a blockchain-like structure. The winner earns **100 XPF** by adding the new block and other users can verify the result via a **modified version** of the **BLS protocol** on the single $ctx_i^{z_i}$.

Demo


Crypto Cars Game
CRYPTO CARS GAME
Users Stats
Current Terrain: Sunny
Alice
XPF: 9
Cars: 1
Bob
XPF: 109
Cars: 1
Charlie
XPF: 9
Cars: 1
Actions
Select User:
Charlie
Select Car:
0
Train Indices: 0 1 2 3 4 5 6 7 8 9
Train Car
Create New Car
Terrain:
Sunny
Prove Speed
Race Registration:
Register for Race
RUN RACE
Cars Details
Charlie's Cars:
Car 0:
Speed: 1360
Flags: [257, 20732, 1366, 19734, 11373, 6415, 6660,
Race Info
=== RACE RESULTS ===
1. Bob (car 0): 19251
2. Alice (car 0): 3240
3. Charlie (car 0): 1360
WINNER: Bob (+100 XPF)

AI disclaimer

We used Generative AI (ChatGPT-5) to:

- Assist in programming the system's infrastructure, excluding any cryptographic components
- Draft and refine the `README` documentation
- Proofread and improve the presentation slides
- This paragraph! :)

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Thank you for listening!
Any questions?