

IIC3253

Criptomonedas

Bitcoin: A Peer-to-Peer Electronic Cash System

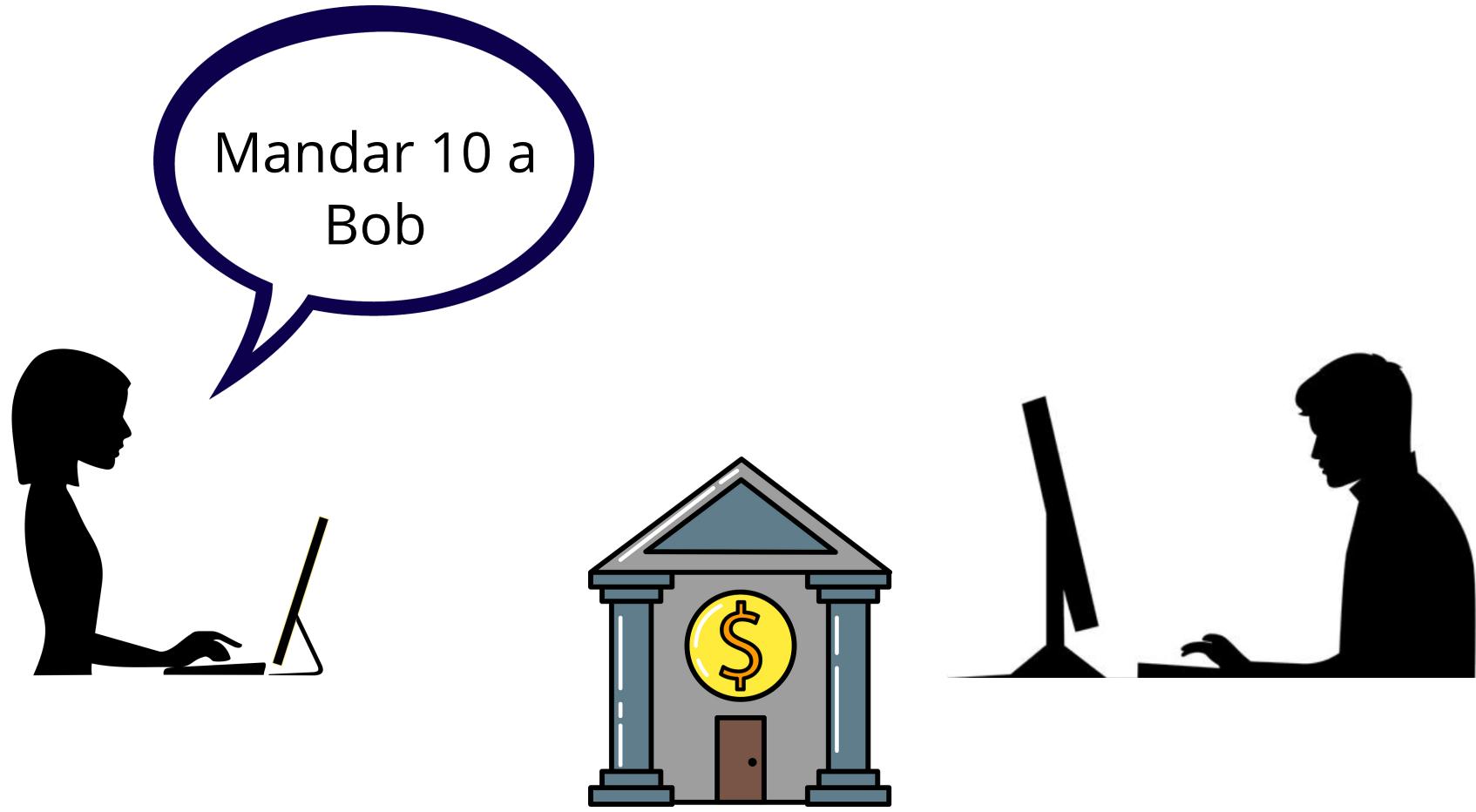
Satoshi Nakamoto
satoshin@gmx.com
www.bitcoin.org

Abstract. A purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main benefits are lost if a trusted third party is still required to prevent double-spending. We propose a solution to the double-spending problem using a peer-to-peer network. The network timestamps transactions by hashing them into an ongoing chain of hash-based proof-of-work, forming a record that cannot be changed without redoing the proof-of-work. The longest chain not only serves as proof of the sequence of events witnessed, but proof that it came from the largest pool of CPU power. As long as a majority of CPU power is controlled by nodes that are not cooperating to attack the network, they'll generate the longest chain and outpace attackers. The network itself requires minimal structure. Messages are broadcast on a best effort basis, and nodes can leave and rejoin the network at will, accepting the longest proof-of-work chain as proof of what happened while they were gone.

1. Introduction

Commerce on the Internet has come to rely almost exclusively on financial institutions serving as trusted third parties to process electronic payments. While the system works well enough for most transactions, it still suffers from the inherent weaknesses of the trust based model. Completely non-reversible transactions are not really possible, since financial institutions cannot avoid mediating disputes. The cost of mediation increases transaction costs, limiting the minimum practical transaction size and cutting off the possibility for small casual transactions, and there is a broader cost in the loss of ability to make non-reversible payments for non-reversible services. With the possibility of reversal, the need for trust spreads. Merchants must be wary of their customers, hassling them for more information than they would otherwise need. A certain percentage of fraud is accepted as unavoidable. These costs and payment uncertainties can be avoided in person by using physical currency, but no mechanism exists to make payments over a communications channel without a trusted party.

What is needed is an electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted



Name	Balance
Alice	100
Bob	100

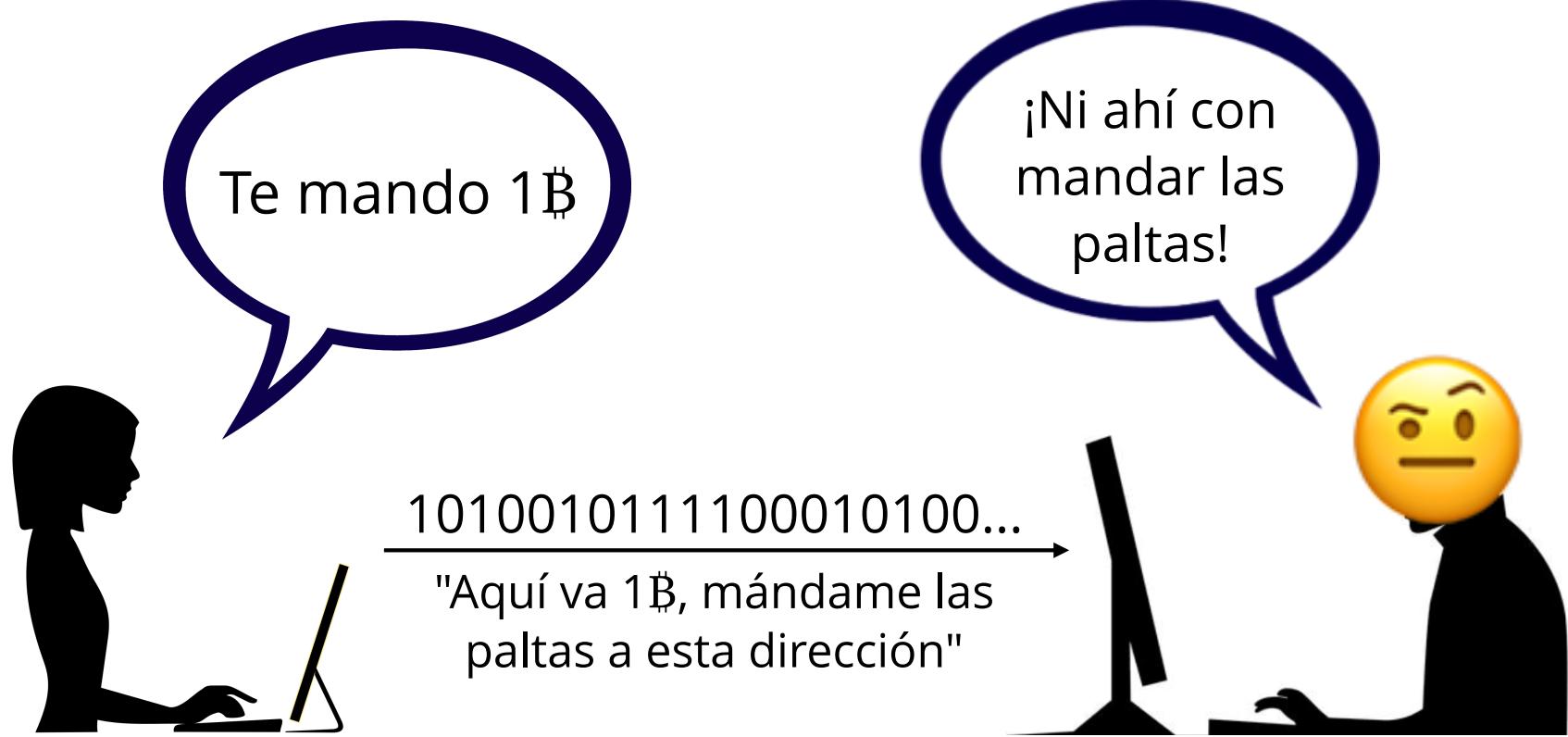


Alice te
mandó 10



Name	Balance
Alice	90
Bob	110

Perfect👌
mando las
paltas



¿Cómo sé que estoy hablando con alguien que tiene 1฿?

¿Cómo sé que me está transfiriendo 1฿?

¿Cómo sé que no se lo está gastando en otro lado?

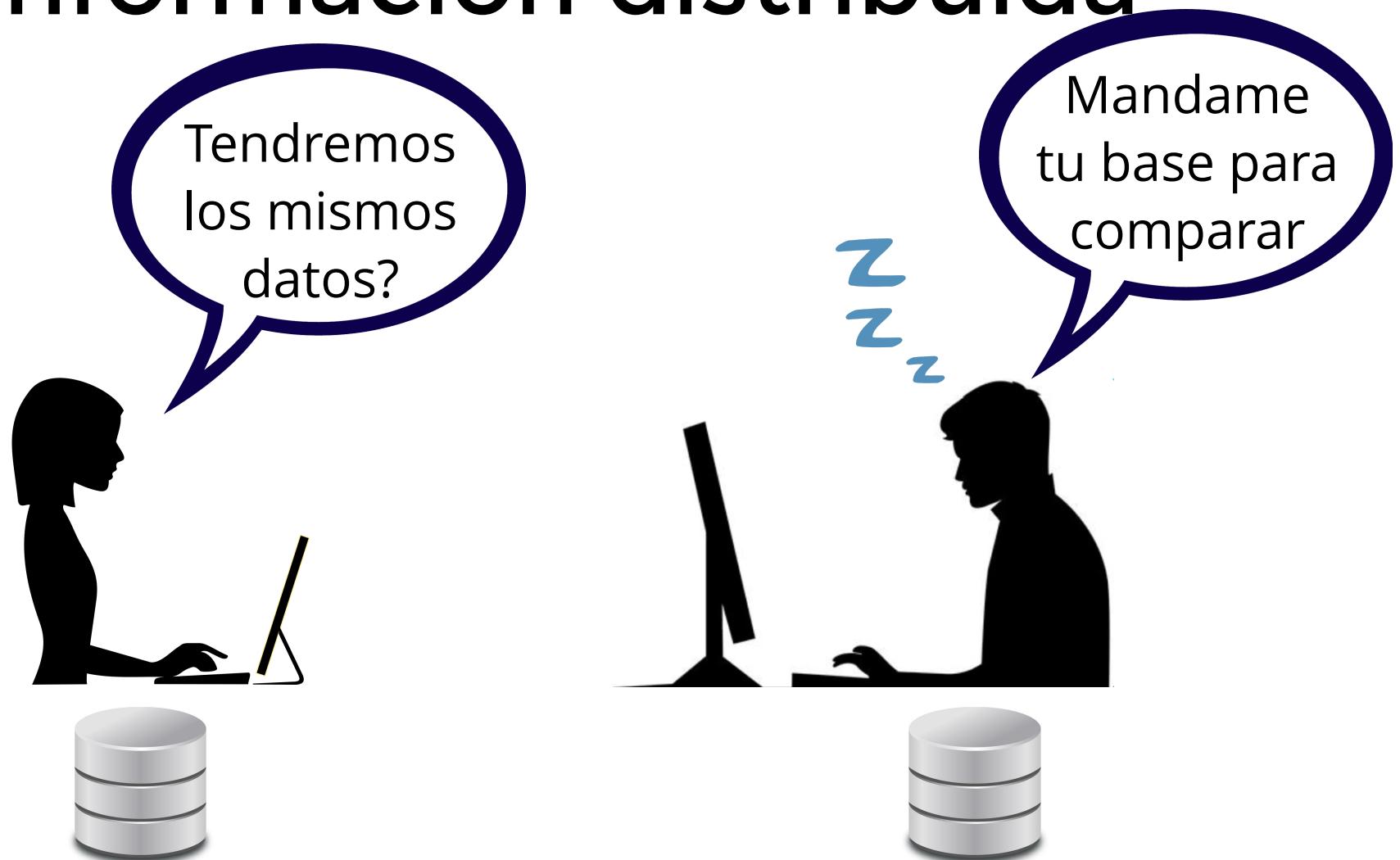
¿De dónde salió ese bitcoin, quién lo creó?

Ingredientes necesarios

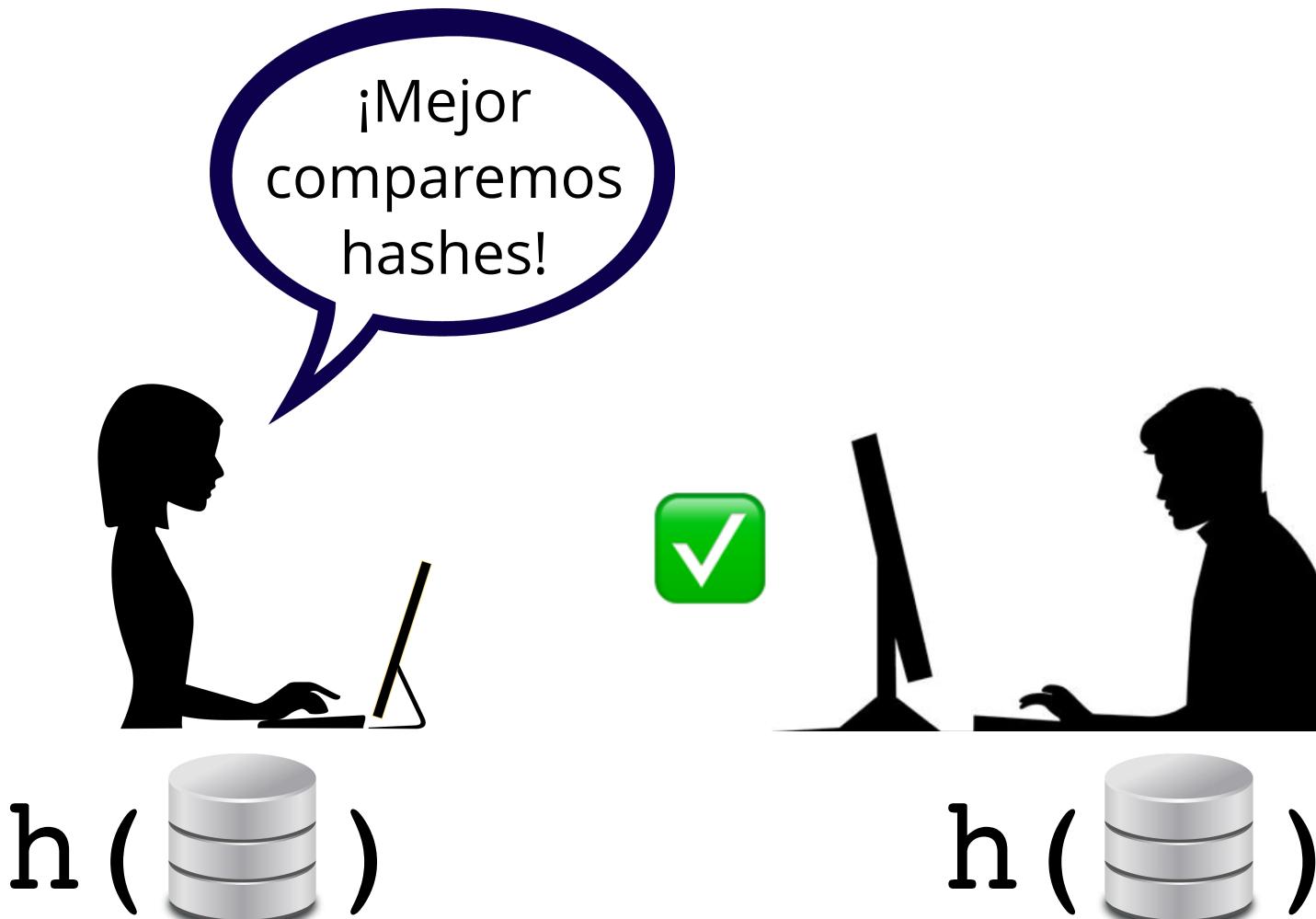
Funciones de hash

Firmas digitales

Funciones de Hash e información distribuida



Funciones de Hash e información distribuida



Funciones de Hash e información distribuida



$h(1 \ 2 \ 3)$



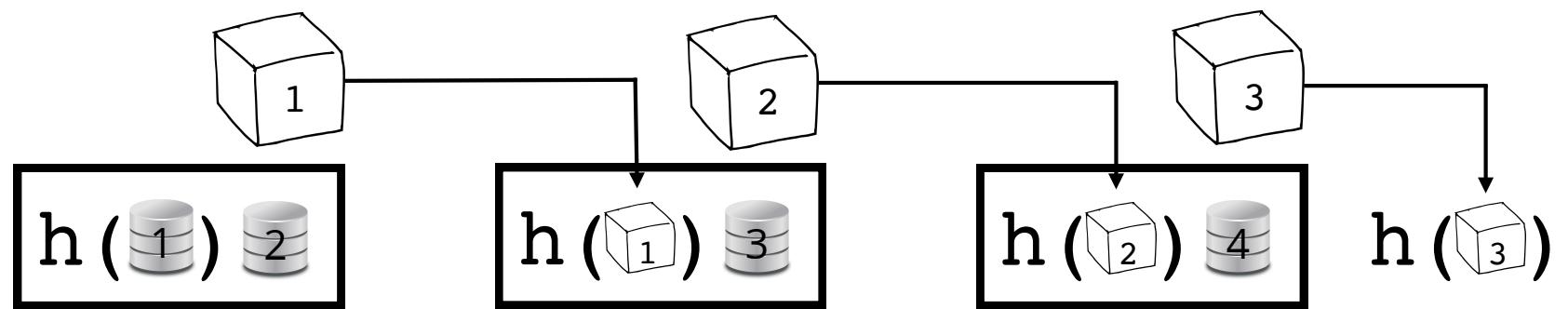
$h(1 \ 2 \ 3)$

Funciones de Hash e información distribuida



$$h(h(h(1) h(2) h(3)))$$

$$h(h(h(1) h(2) h(3)))$$



Nos basta con compartir $h(3)$

¡EL FUTURO ES HOY!

Dude...
seriously?



¿Qué es lo nuevo?

¿Funciones de hash criptográficas?

1973

¿Firmas digitales?

1978



¿El ✨Blockchain✨?

1970s

**iHagamos una
criptomoneda!**

Alice



SK_A

PK_A

Bob



SK_B

PK_B

Carol



SK_C

PK_C

Dan



SK_D

PK_D

Eve



SK_E

PK_E

Frank



SK_F

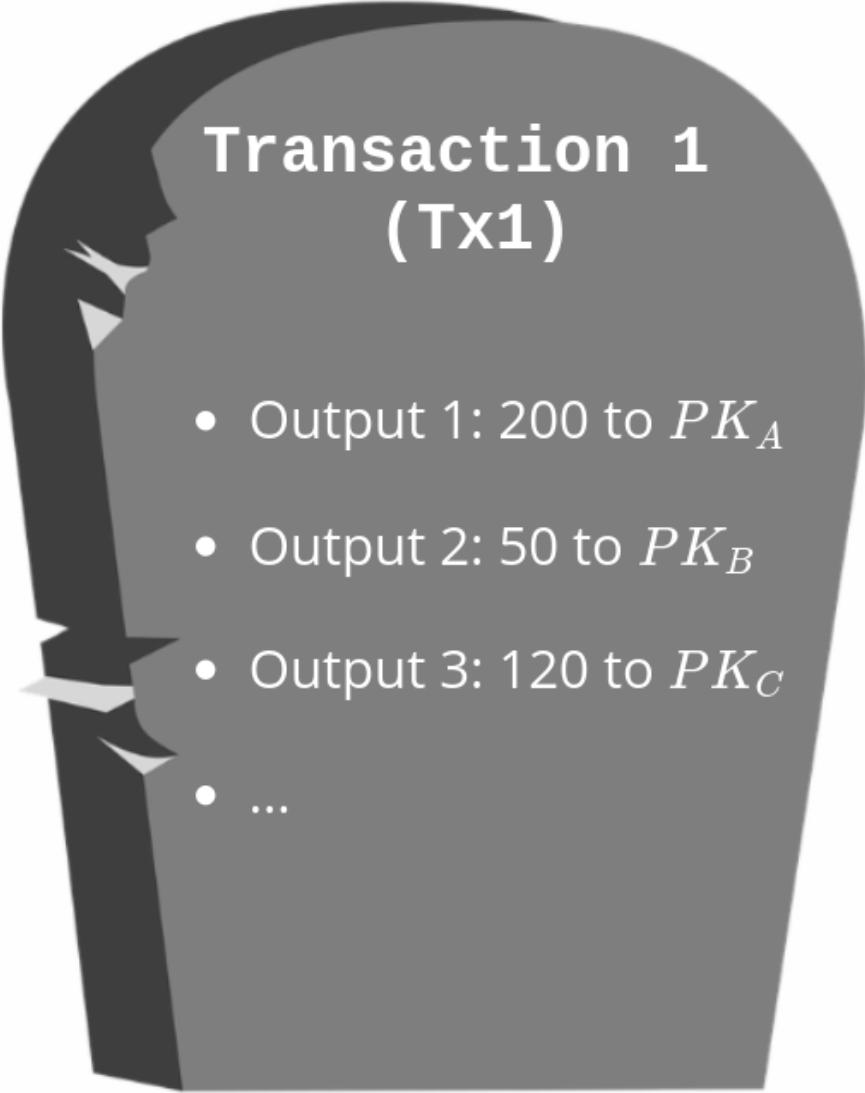
PK_F



$= SK$



$= PK$



Transaction 1 (Tx1)

- Output 1: 200 to PK_A
- Output 2: 50 to PK_B
- Output 3: 120 to PK_C
- ...

¡Bacán,
tengo 320!



Transaction 1 (Tx1)

- Output 1: 200 to PK_A
- Output 2: 50 to PK_B
- Output 3: 120 to PK_C
- ...

Tx3

Input 1: Tx2, Output 1

Output 1: 200 to PK_C


(Firmado con SK_B)



Tx2

Input 1: Tx1, Output 1

Output 1: 200 to PK_B


(Firmado con SK_A)

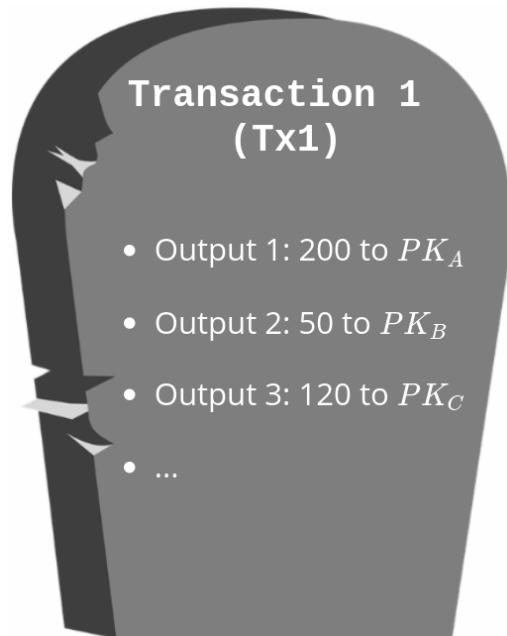




Toda la plata es una cadena
originada en la Transacción 1

¿Siempre tengo que gastar
outputs completos?

¿Qué pasa si quiero combinar
outputs o gastar sólo una parte?





¿Cómo
pago 210?



Tx3

Input 1: Tx1, Output 2

Input 2: Tx2, Output 1

Output 1: 210 to PK_C

Output 2: 40 to PK_B

A handwritten-style signature of the letter 'B'.

(Firmado con SK_B)



Tx2

Input 1: Tx1, Output 1

Output 1: 200 to PK_B

A handwritten-style signature of the letter 'A'.

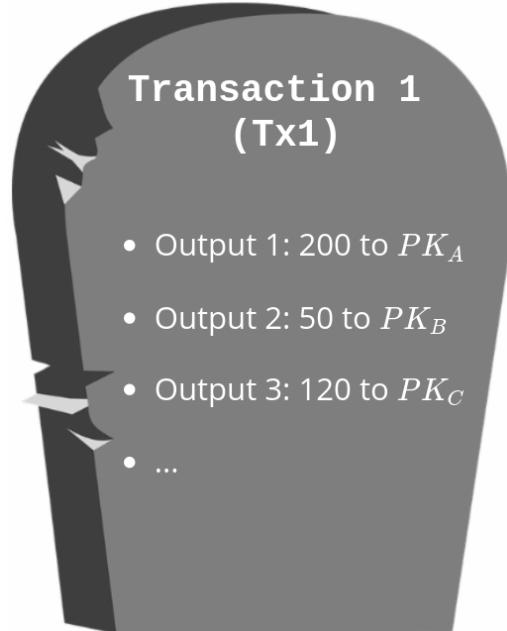
(Firmado con SK_A)

Transaction 1
(Tx1)

- Output 1: 200 to PK_A
- Output 2: 50 to PK_B
- Output 3: 120 to PK_C
- ...



Una transacción puede tener tantos inputs y outputs como queramos



Los outputs siempre se gastan completos



¿Cómo lo
arreglamos?



Transaction 1 (Tx1)

- Output 1: 200 to PK_A
- Output 2: 50 to PK_B
- Output 3: 120 to PK_C
- ...

Tx2

Input 1: Tx1, Output 1

Output 1: 200 to PK_C

J. K.
(Firmado con SK_A)

¡Me
marcho!



¡Yo puedo
ayudar!

Tx2

Input 1: Tx1, Output 1

Output 1: 200 to PK_B

J. K.
(Firmado con SK_A)





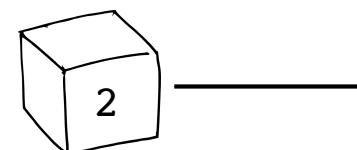
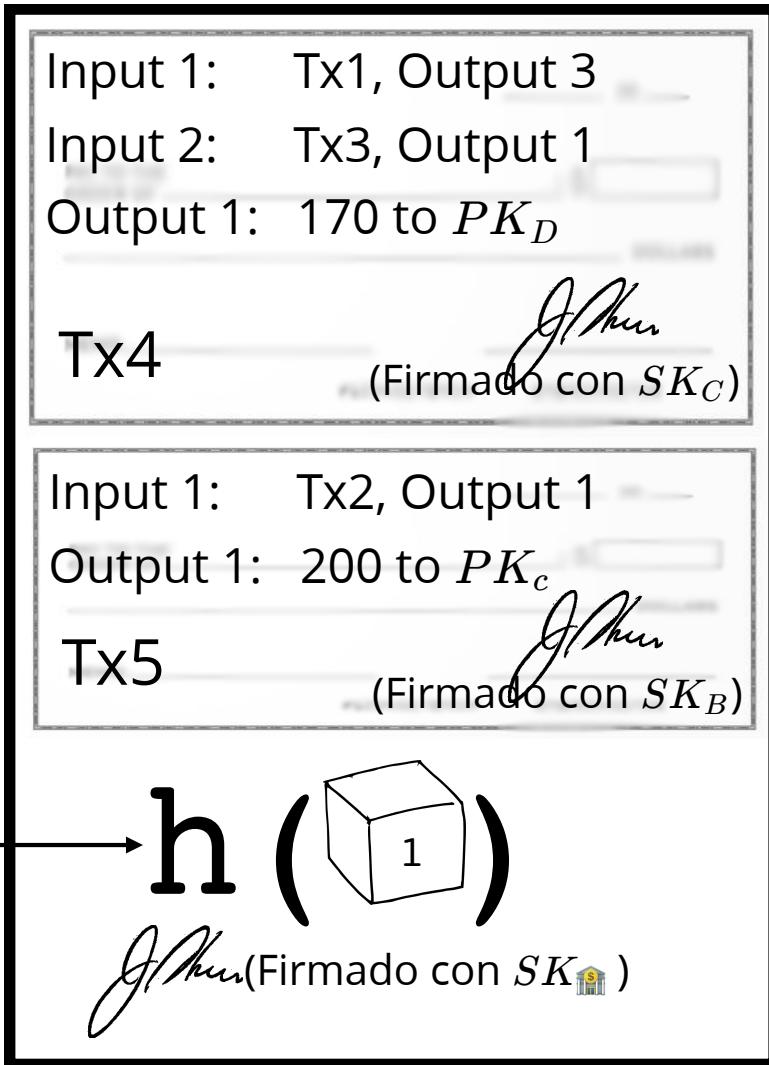
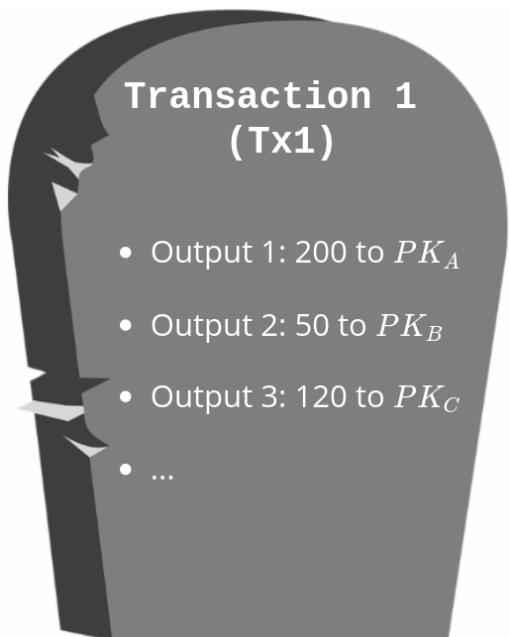
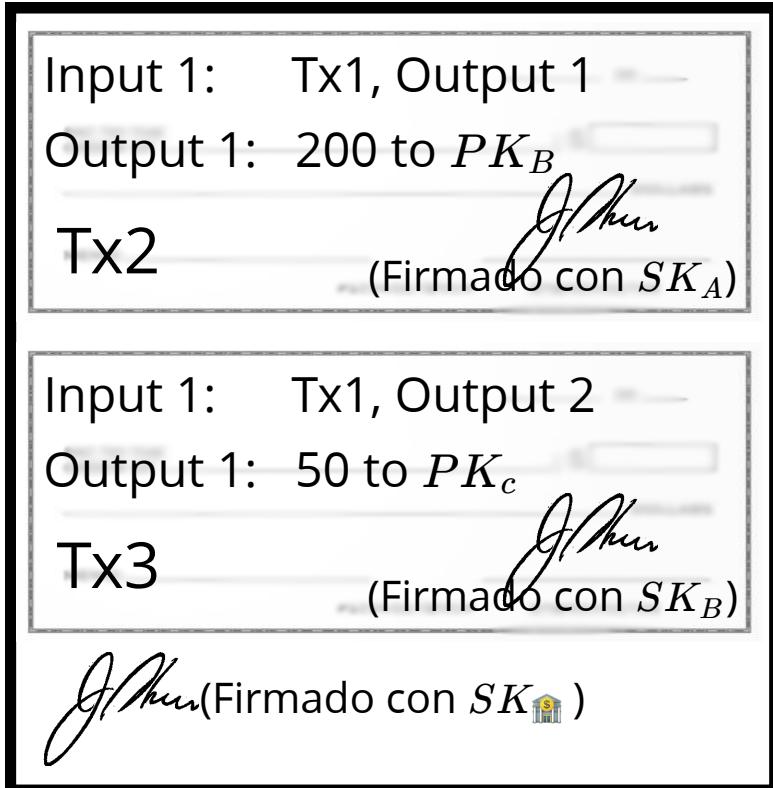
BankCoin

1. La transacción inicial Tx1, se respeta igual que antes
2. Una transacción es una secuencia de pagos que llega a Tx1, igual que antes
3. El banco publicará en un blockchain firmado todas las transacciones válidas



SK

PK





¿Ha estado como lento el sistema los últimos días o no?

Vale, tranqui
estamos
empezando

Sorry, problema
técnico...



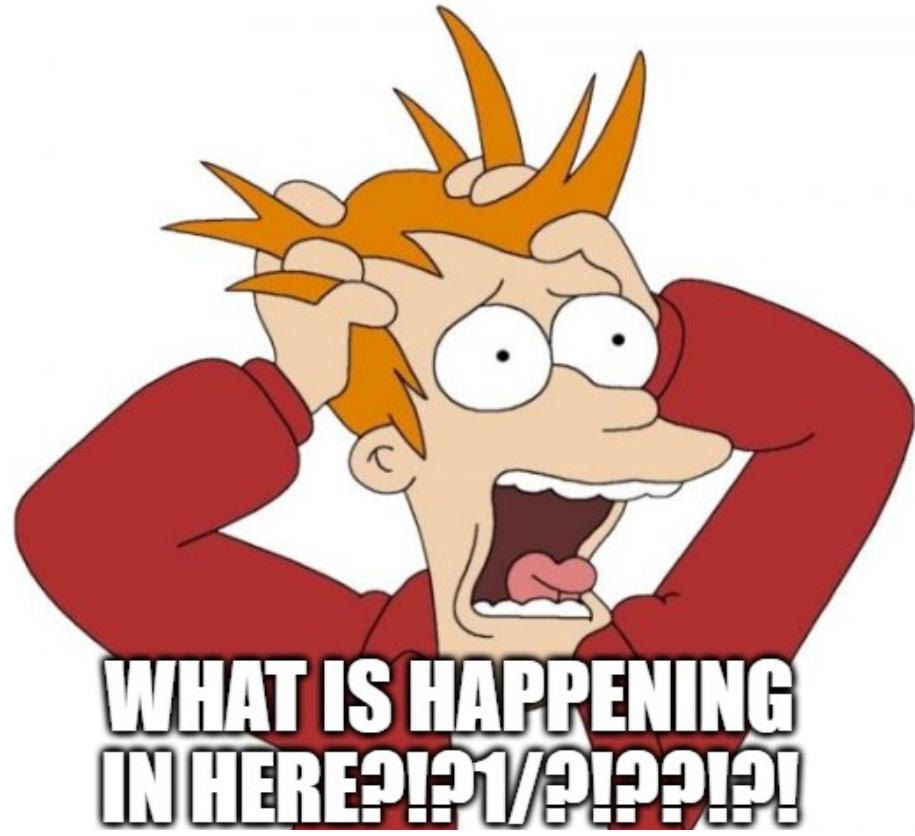


Qué raro, como hace una semana que no logro meter transacciones

Sí, es que no me caes tan bien...

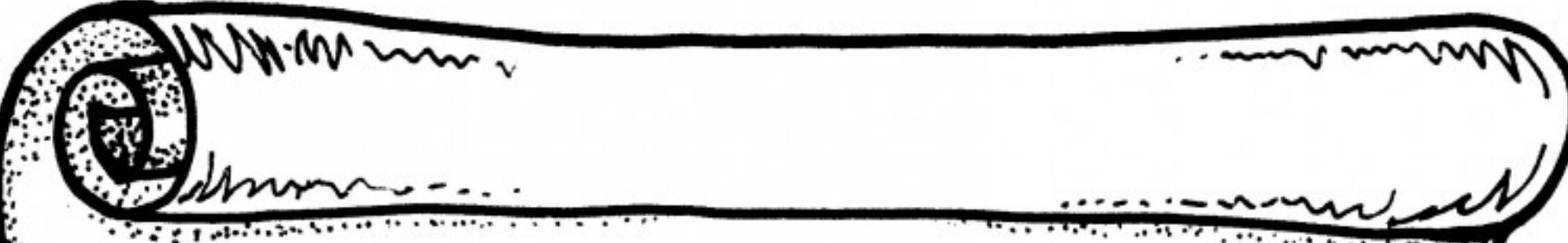
Pero por un pago se todo se puede





💥 jjMe hackearon
y me robaron mi
llave privada!! 💥





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1. Introduction

¿A quién le mando mis transacciones?



Acabo de llegar, ¿qué hago?



¿Quién creará los bloques ahora?



Yo puedo ayudar

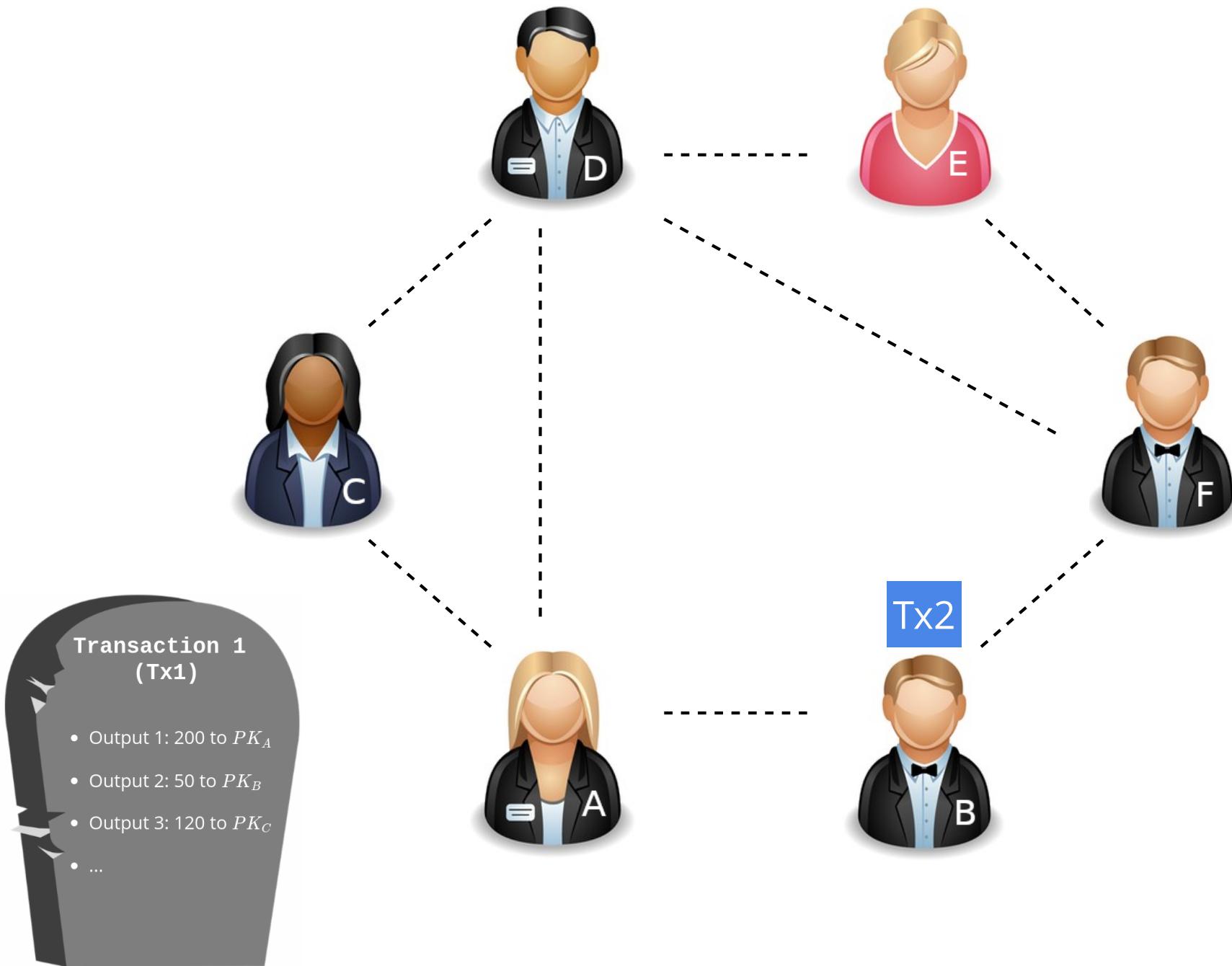


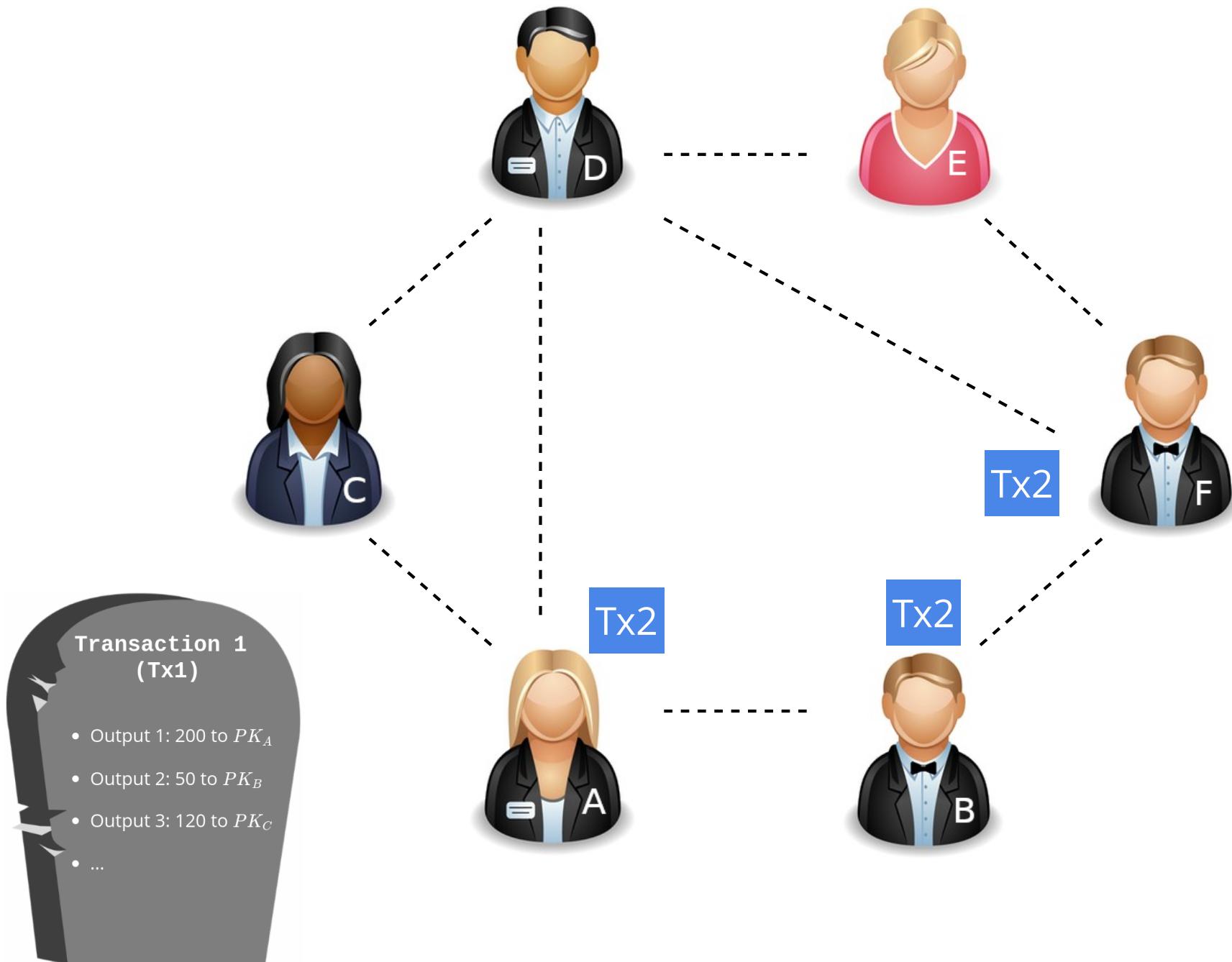
bitcoin

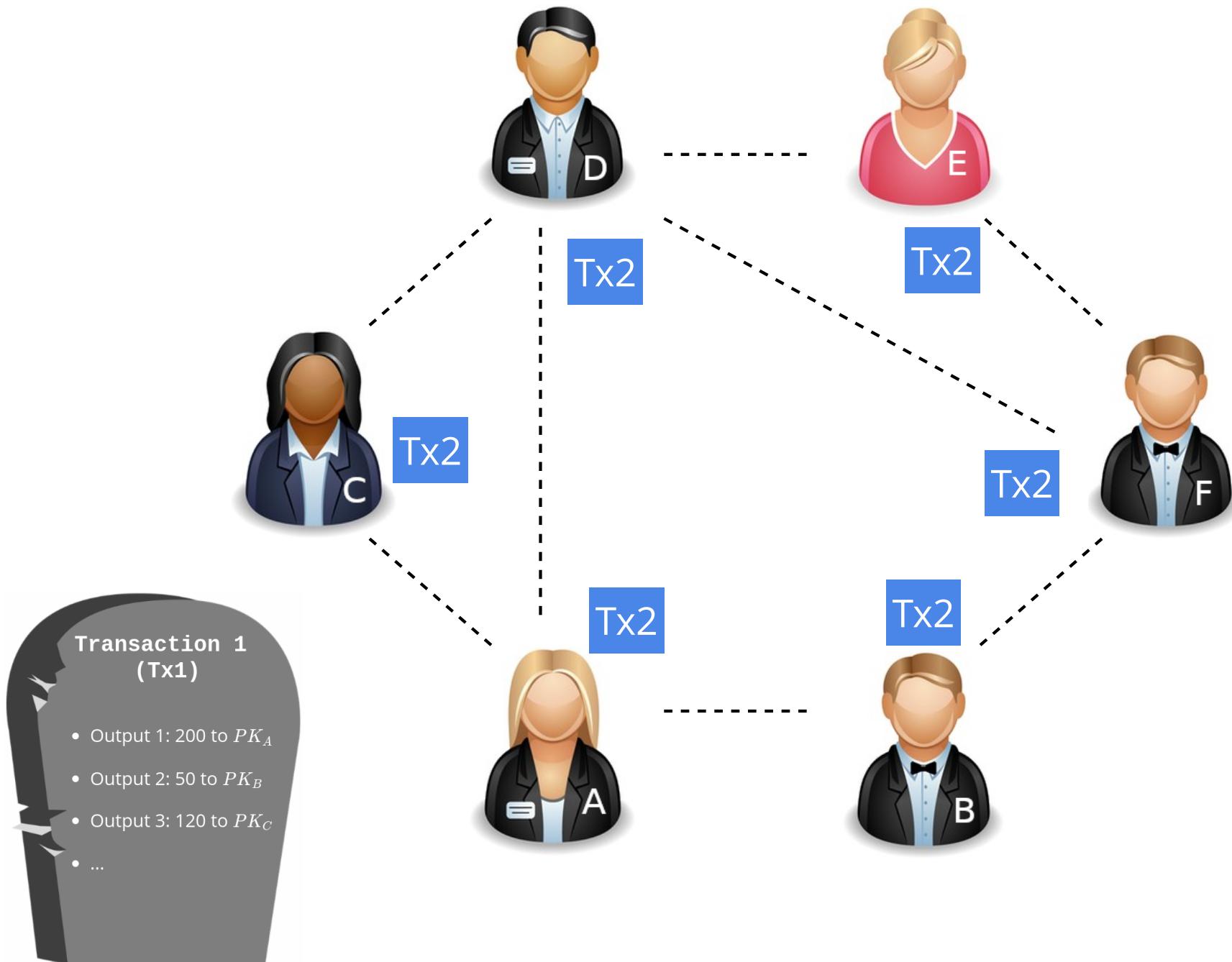
- La transacción inicial se respeta igual que antes, y le llamaremos bloque 0
- Si quieres pagar, mandale transacciones a tus vecinos
- Si recibes una nueva transacción, mándasela a tus vecinos

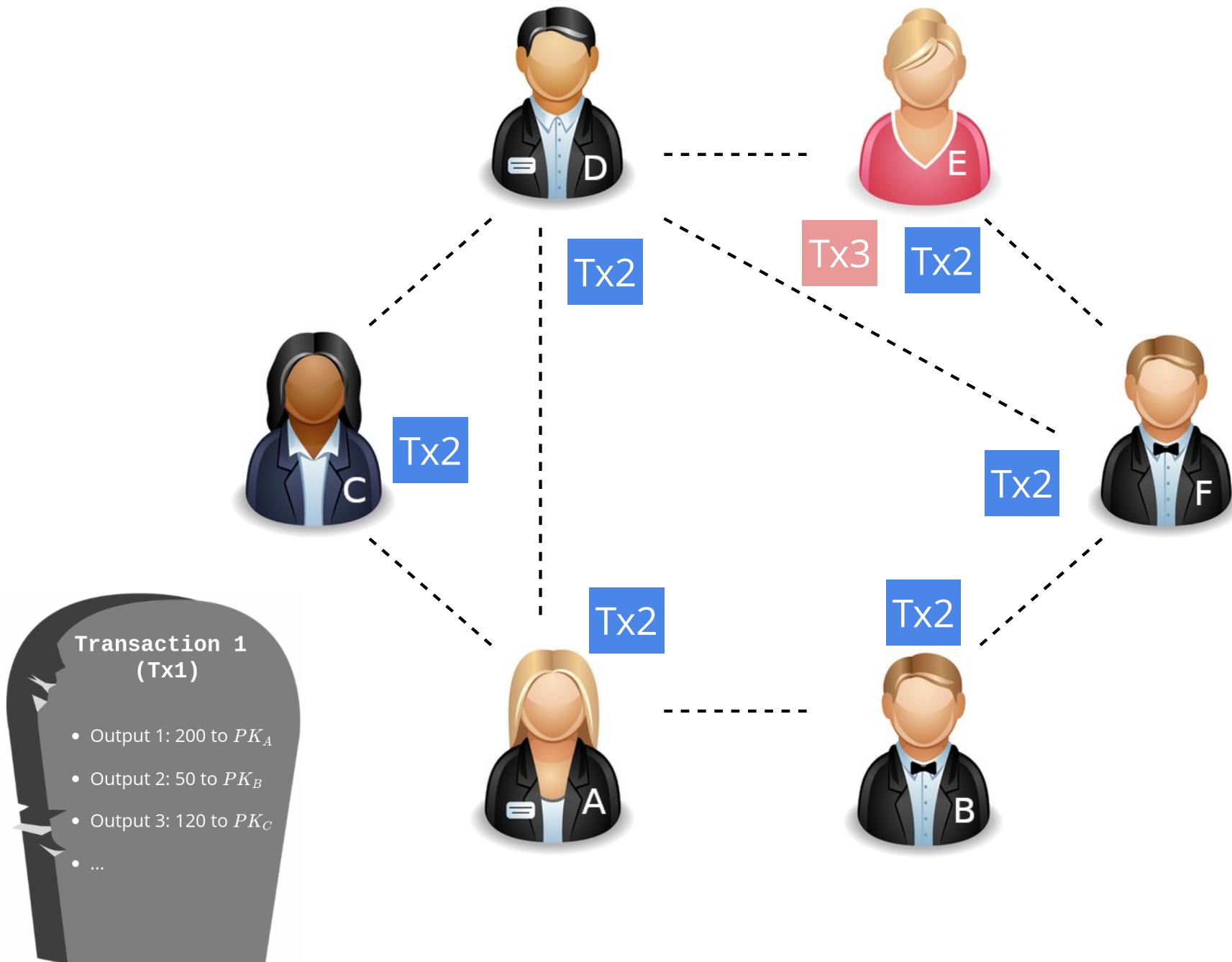
Nada complicado por ahora...



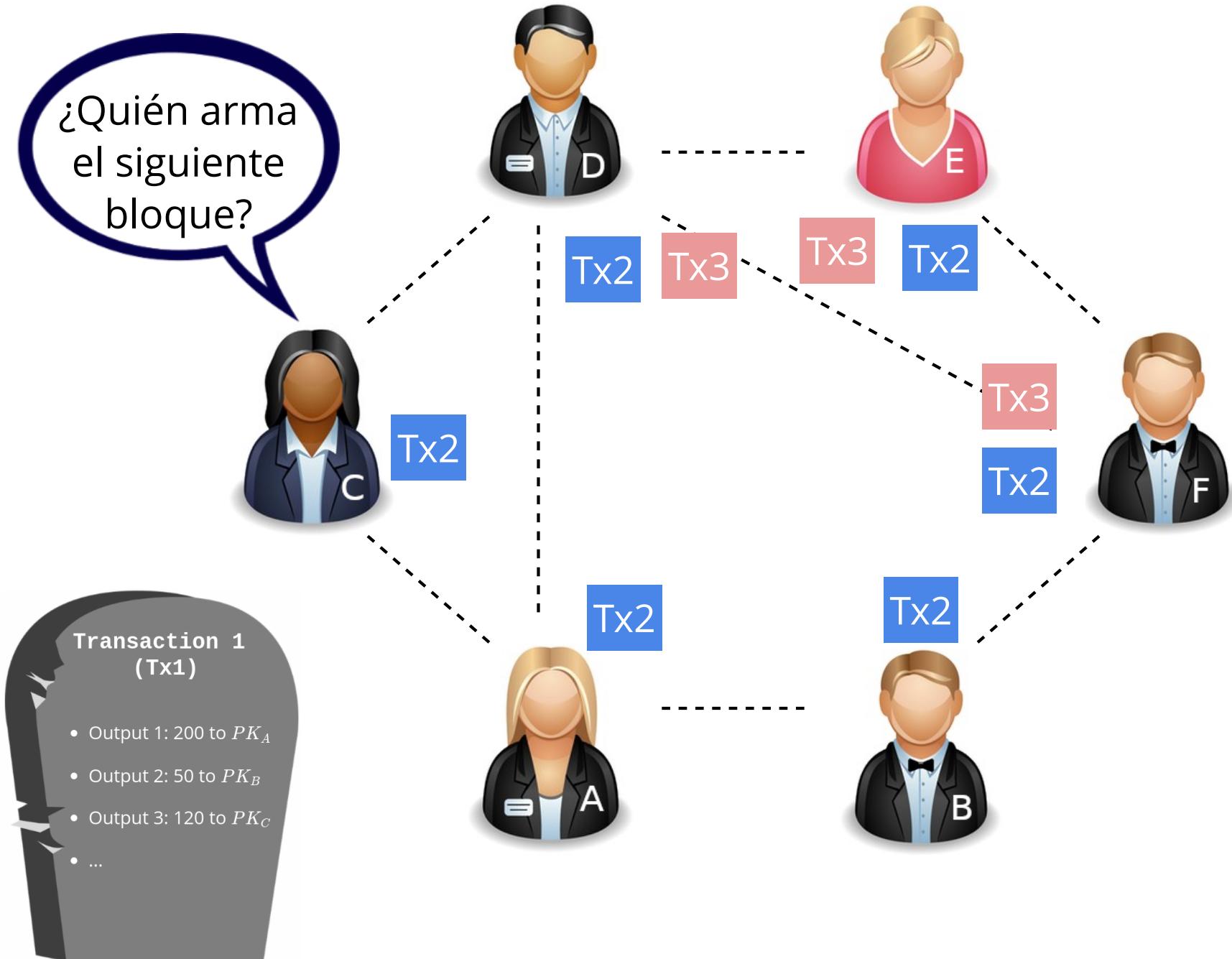






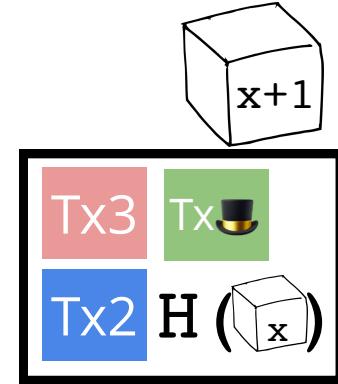


¿Quién arma el siguiente bloque?



- Cuando te elijan, forma un bloque con lo que tengas y mándalo a tus vecinos
- Si recibes un bloque, verifica que sea correcto y mándalo a tus vecinos
- ...

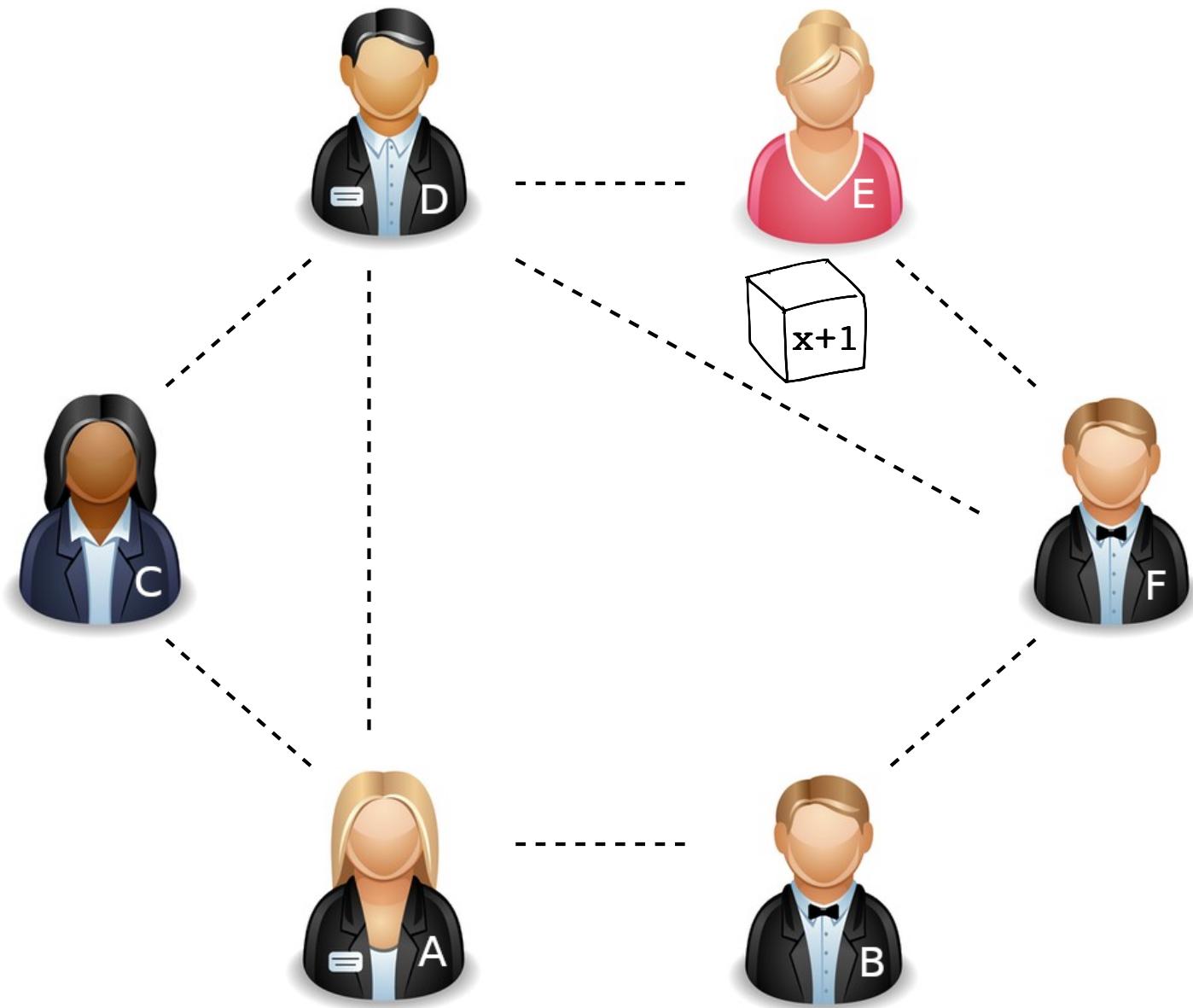
¿Por qué haría yo esto bien?

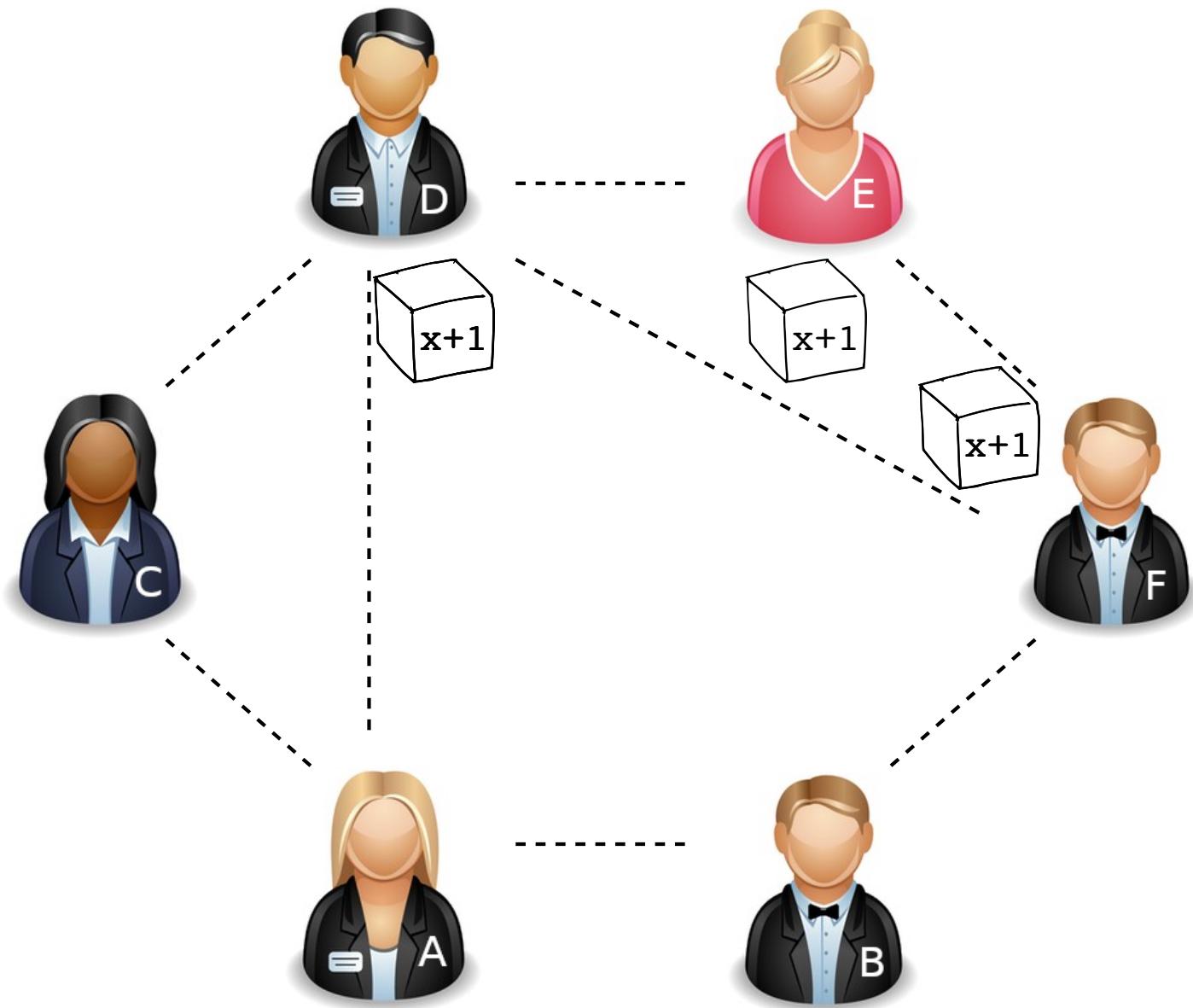


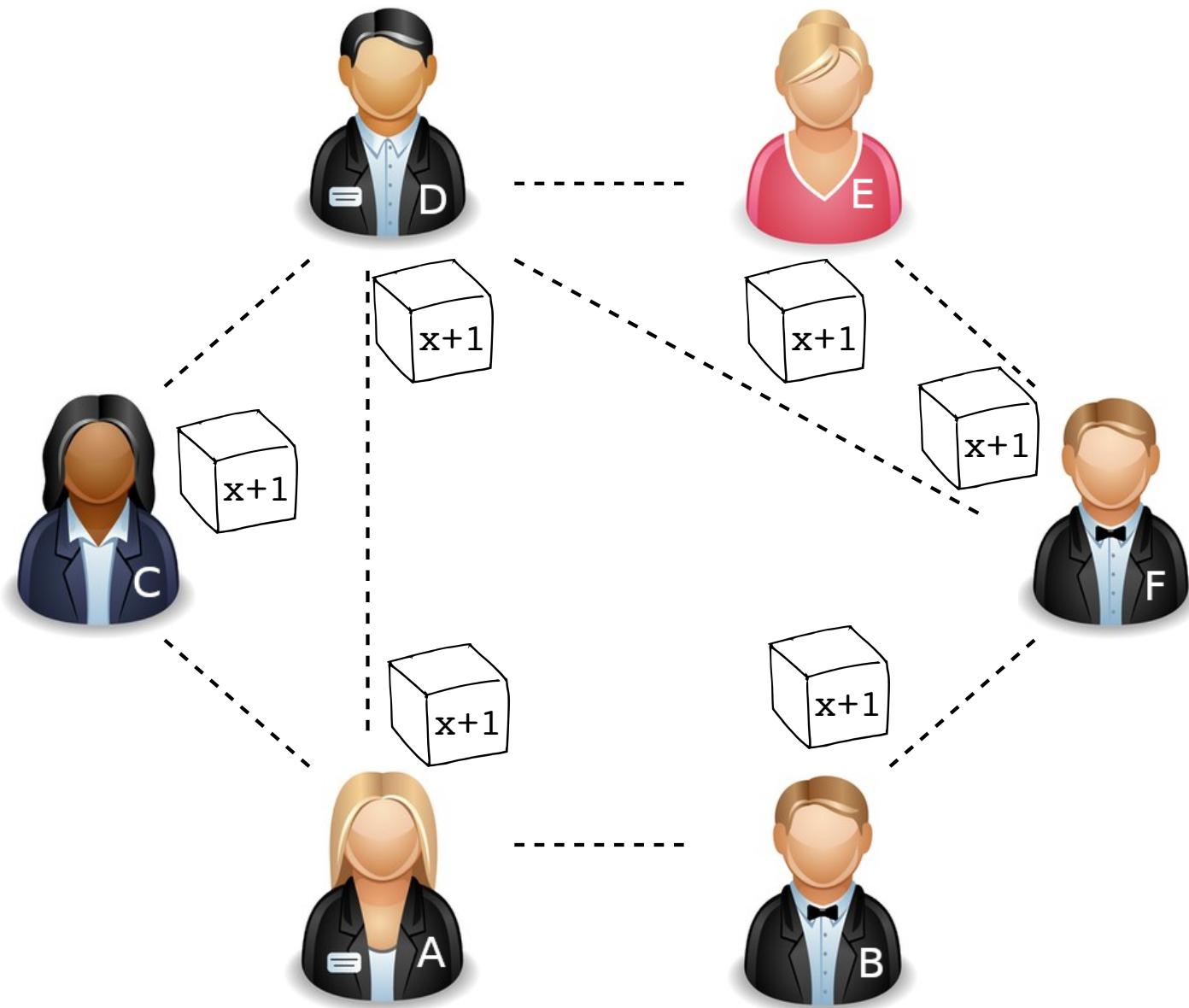
Yo voy a elegir a una persona

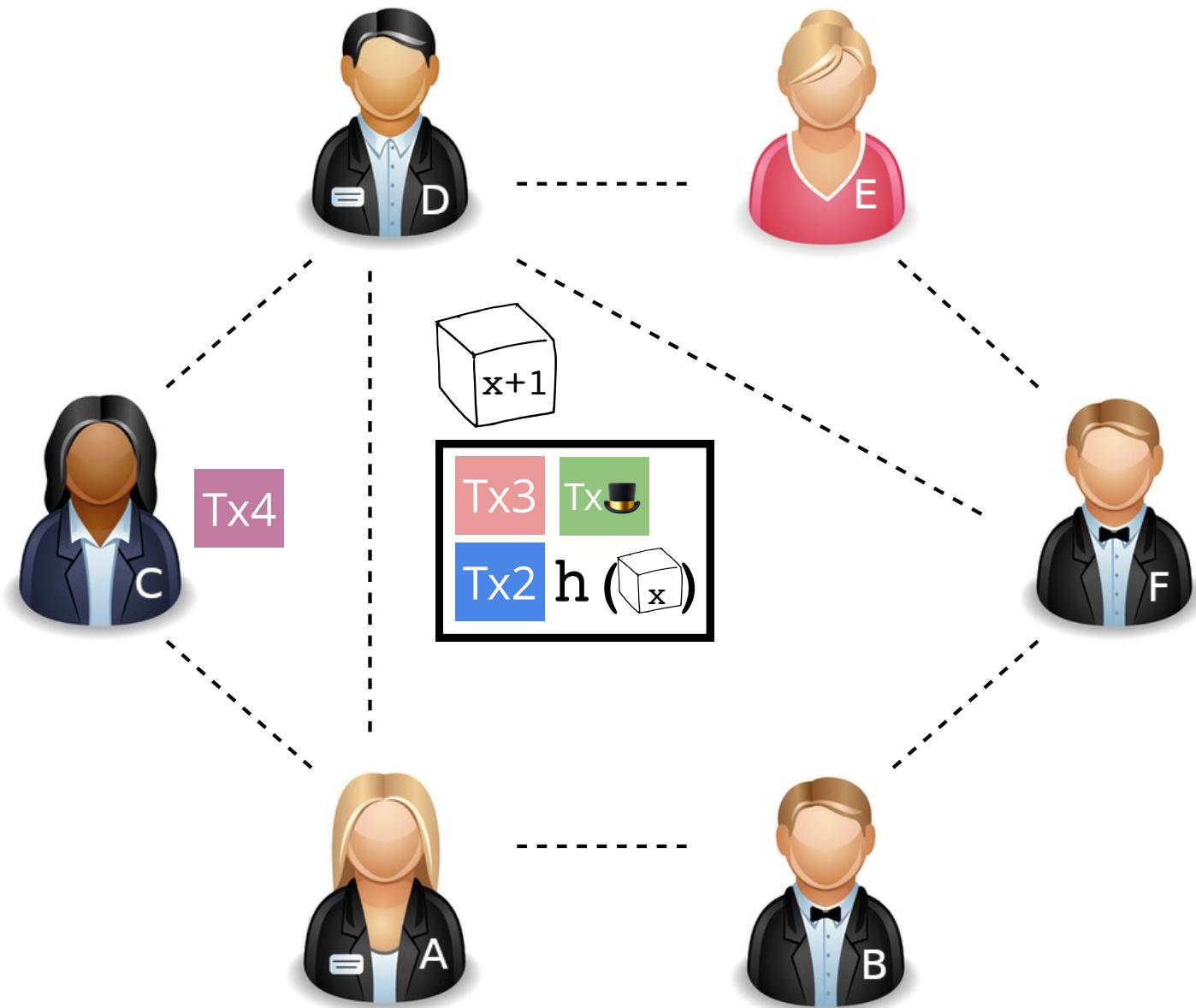


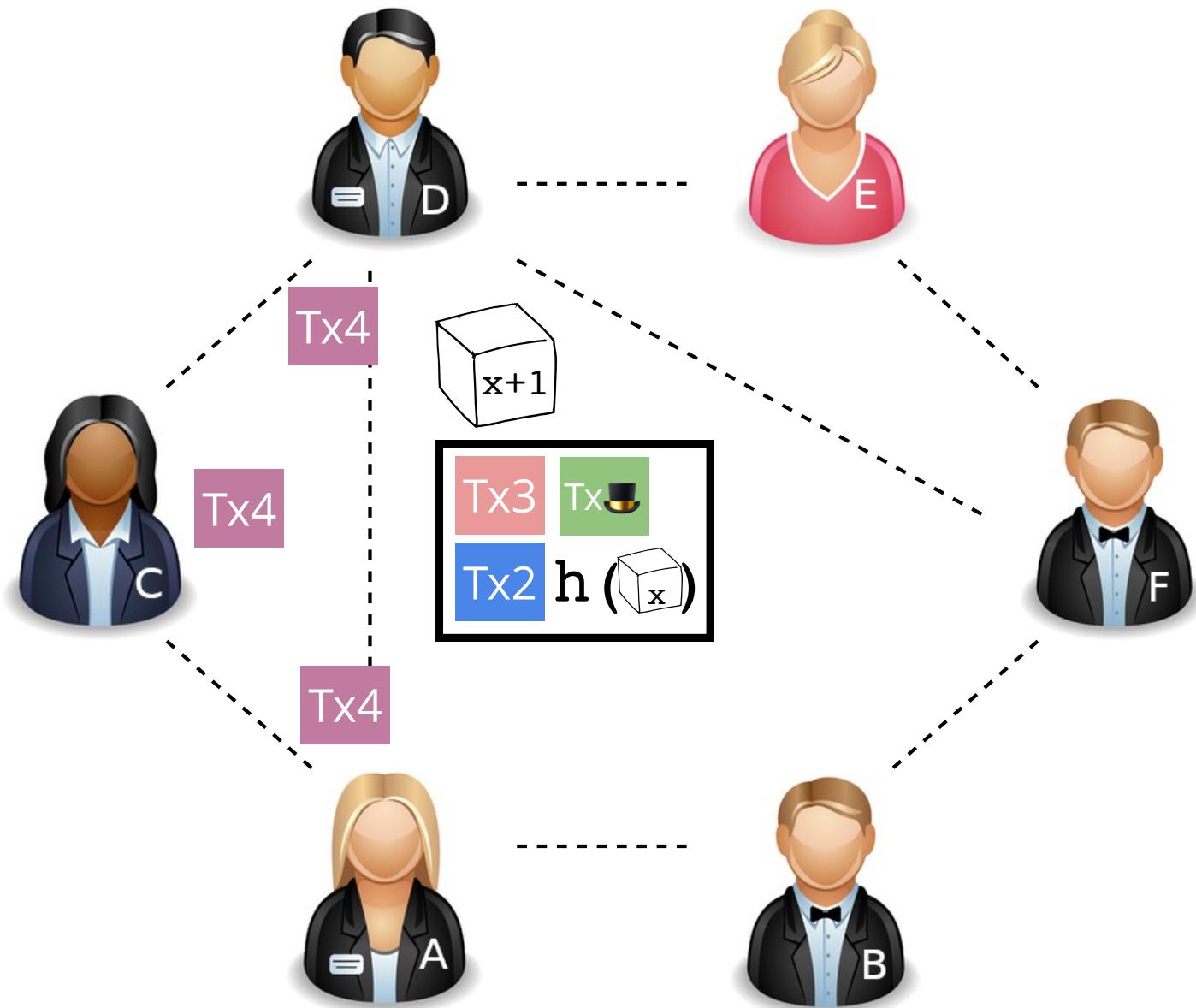
Monto fijo, a quién quieras

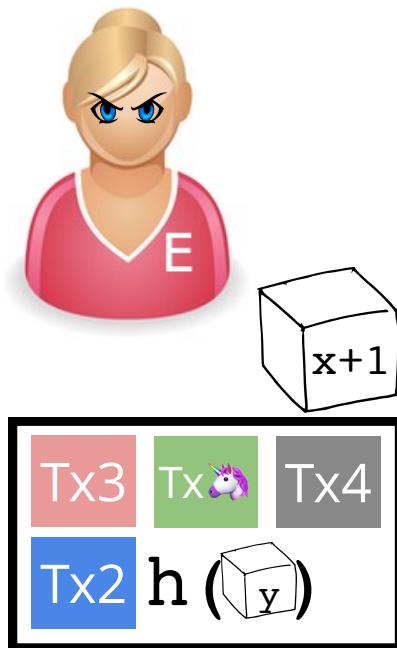








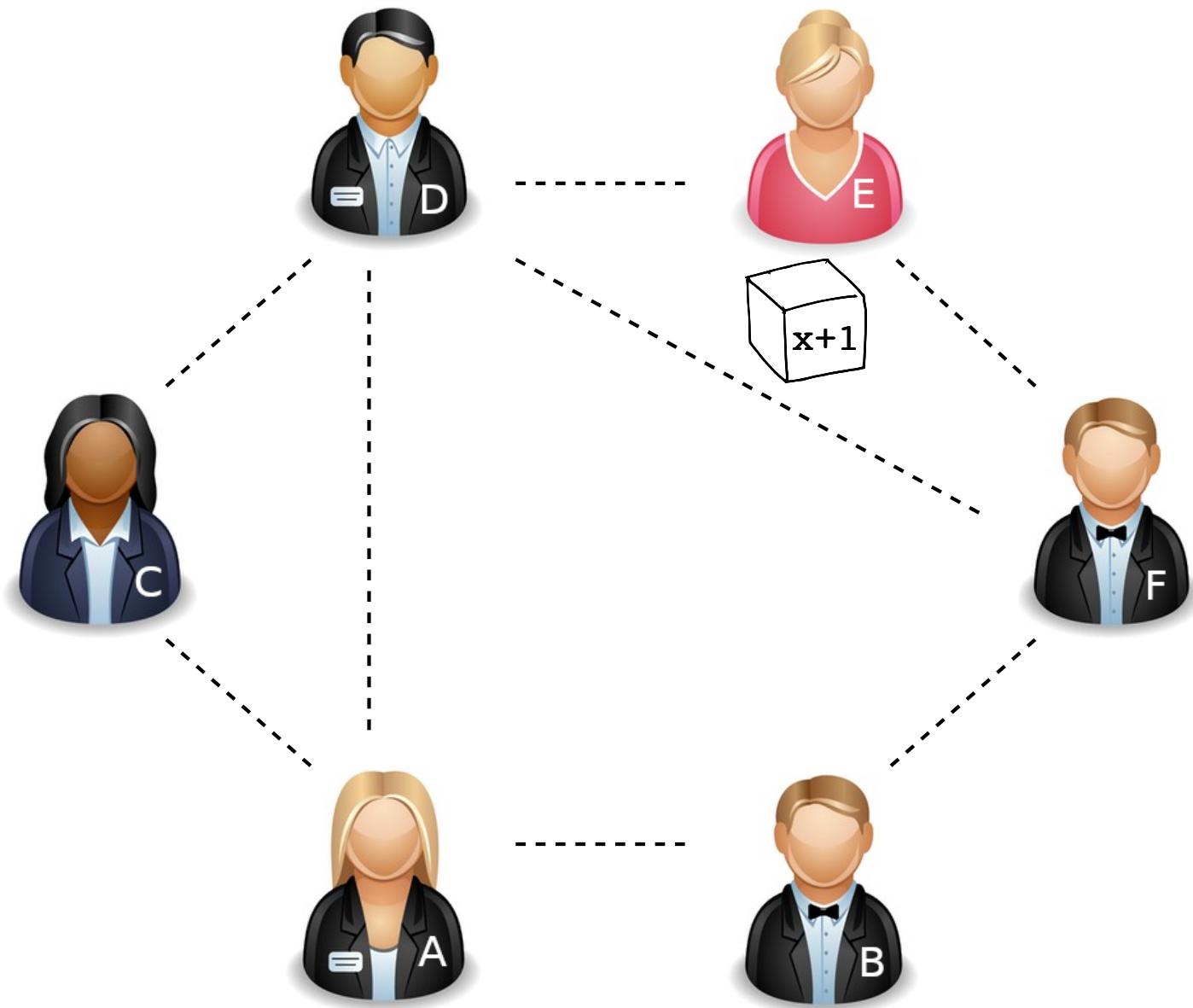


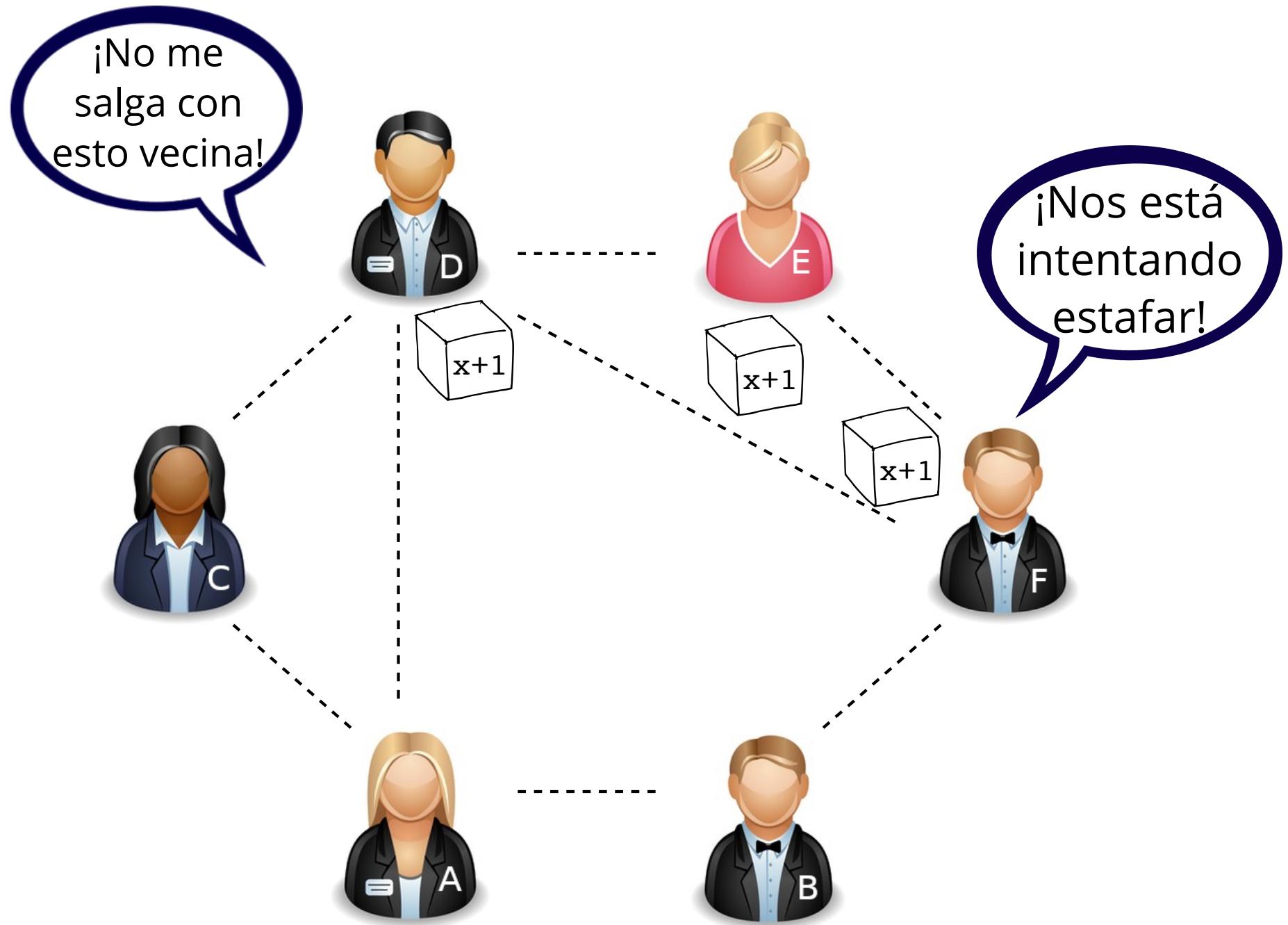


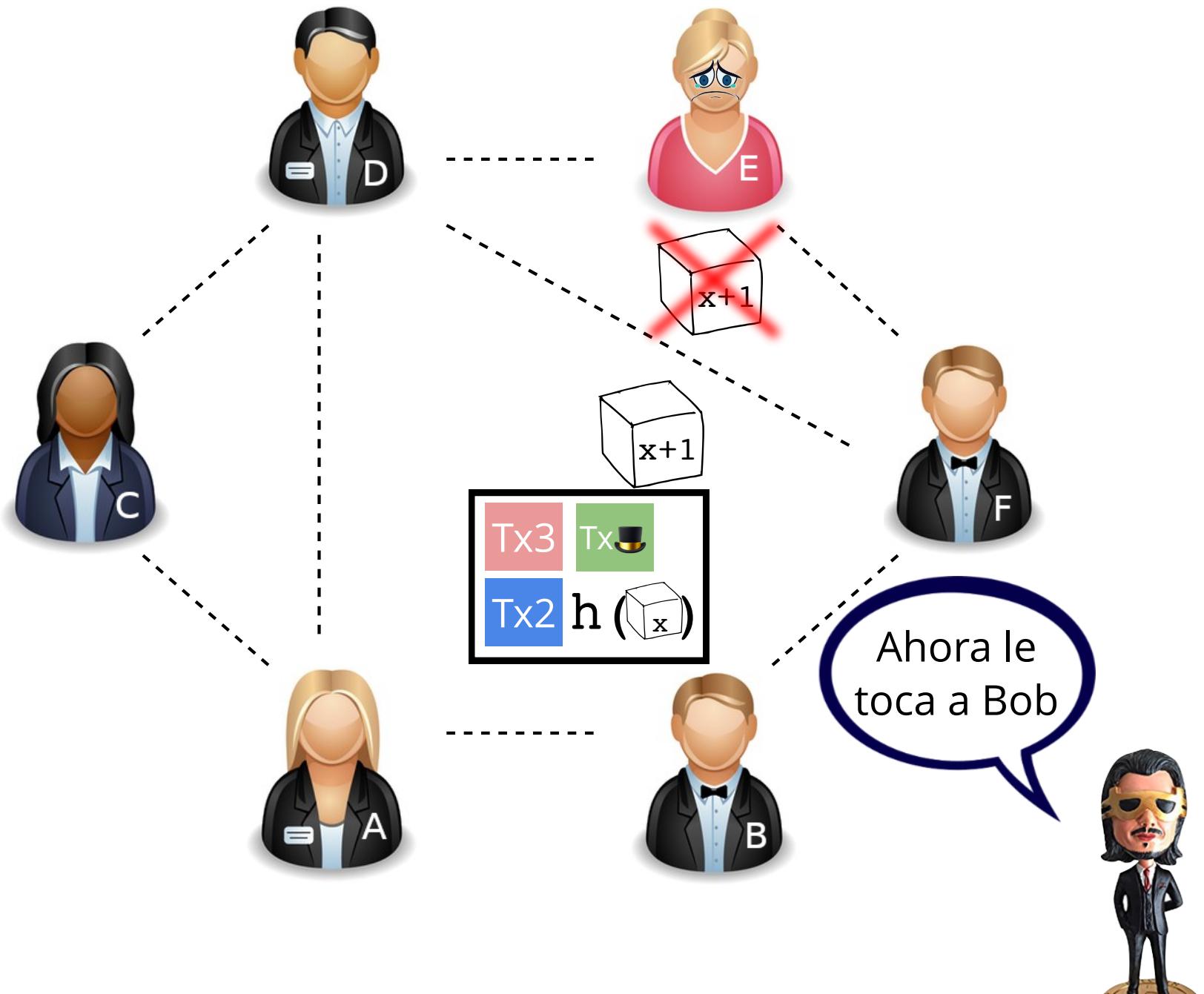
Yo voy a
elegir a una
persona

Monto fijo,
a quién
quieras









Todo bien Satoshi
pero... na que ver que
elijas tanto a tus
amigos



¡Siii a mi nunca
me ha elegido!



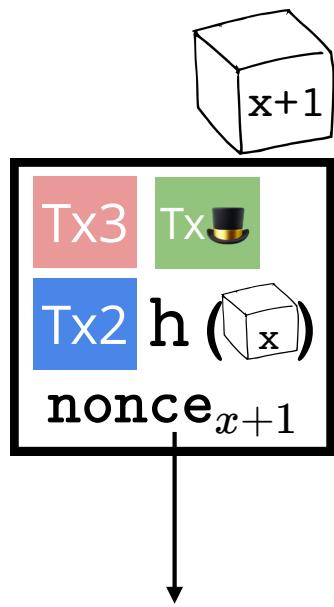
Ya, hagámosla
bien



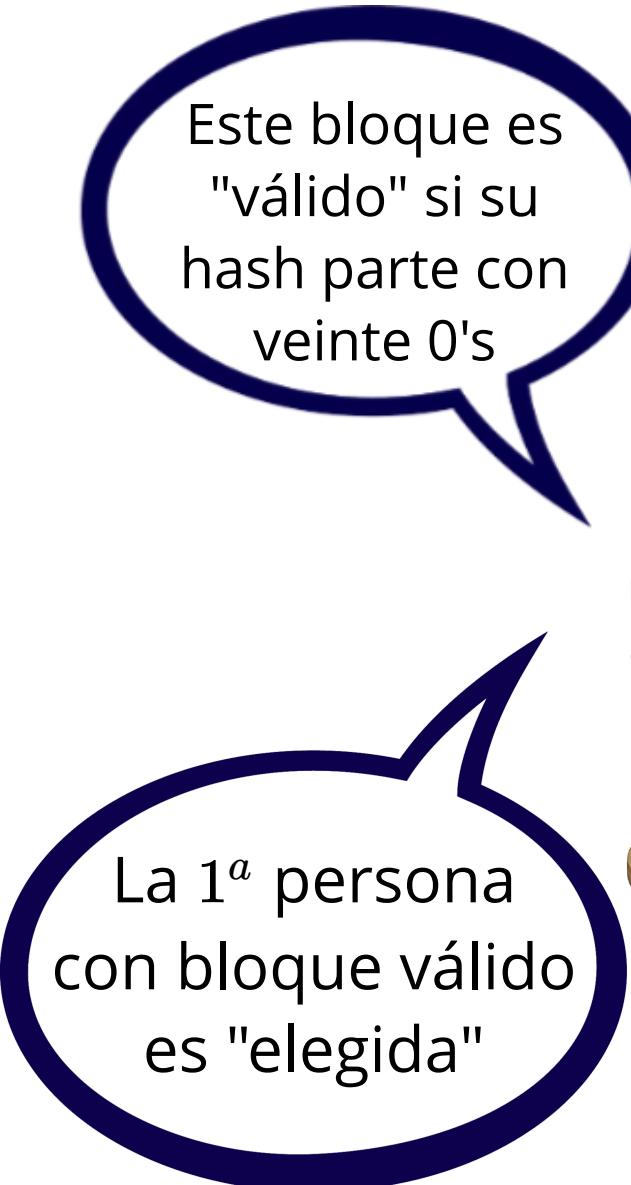
¿Podemos elegir "aleatoriamente" a quien genera el siguiente bloque?

¿Cómo nos aseguramos de que la fuente de aleatoriedad sea justa?

Y aunque pudiésemos
¿Aleatoriedad sobre qué?

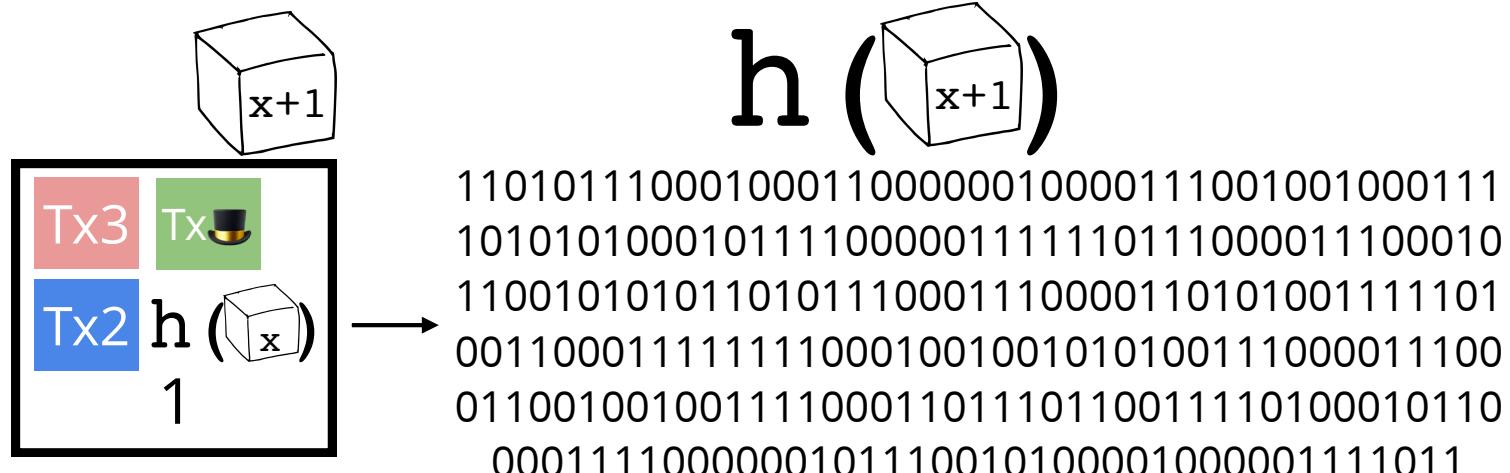


Es un valor *arbitrario*

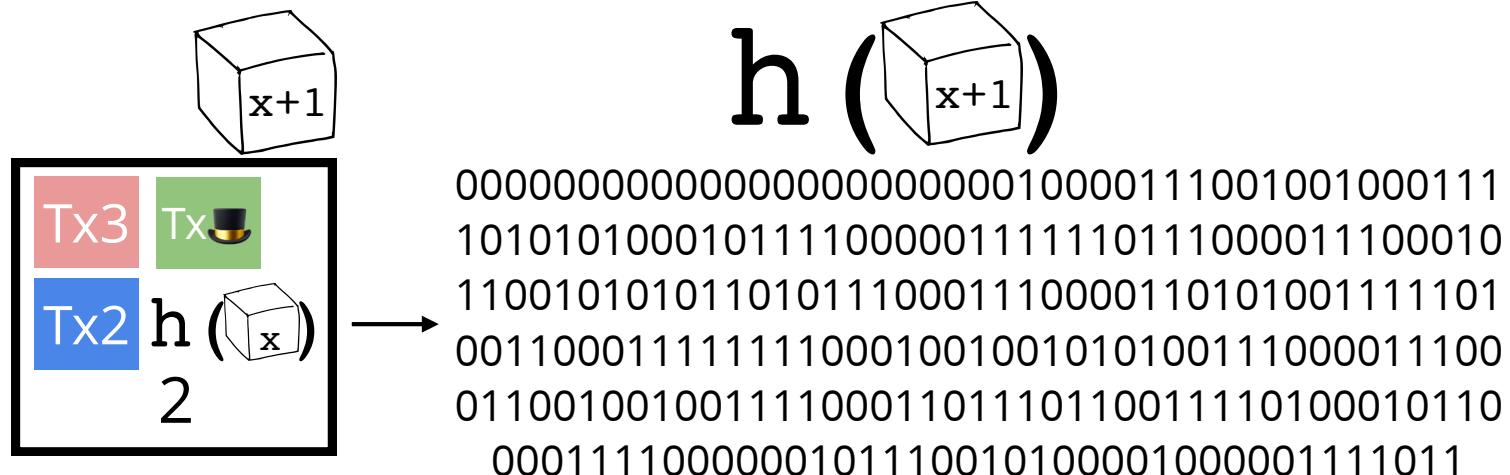


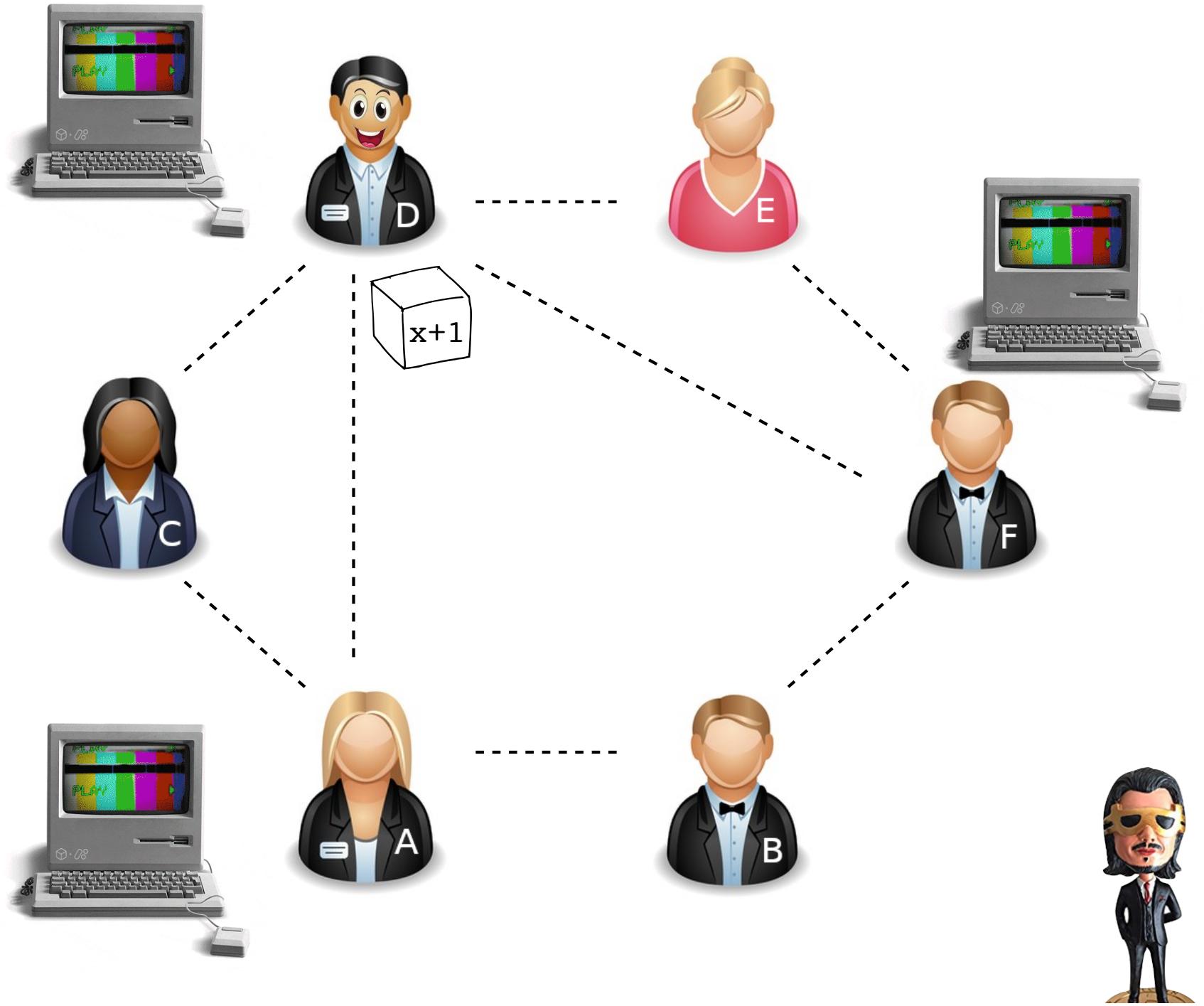
A smaller blue speech bubble contains the text: "La 1^a persona con bloque válido es \"elegida\"". To the right of the bubbles is a small 3D model of a man wearing a mask and sunglasses, standing on a gold-colored circular base that says "SATOCHI".

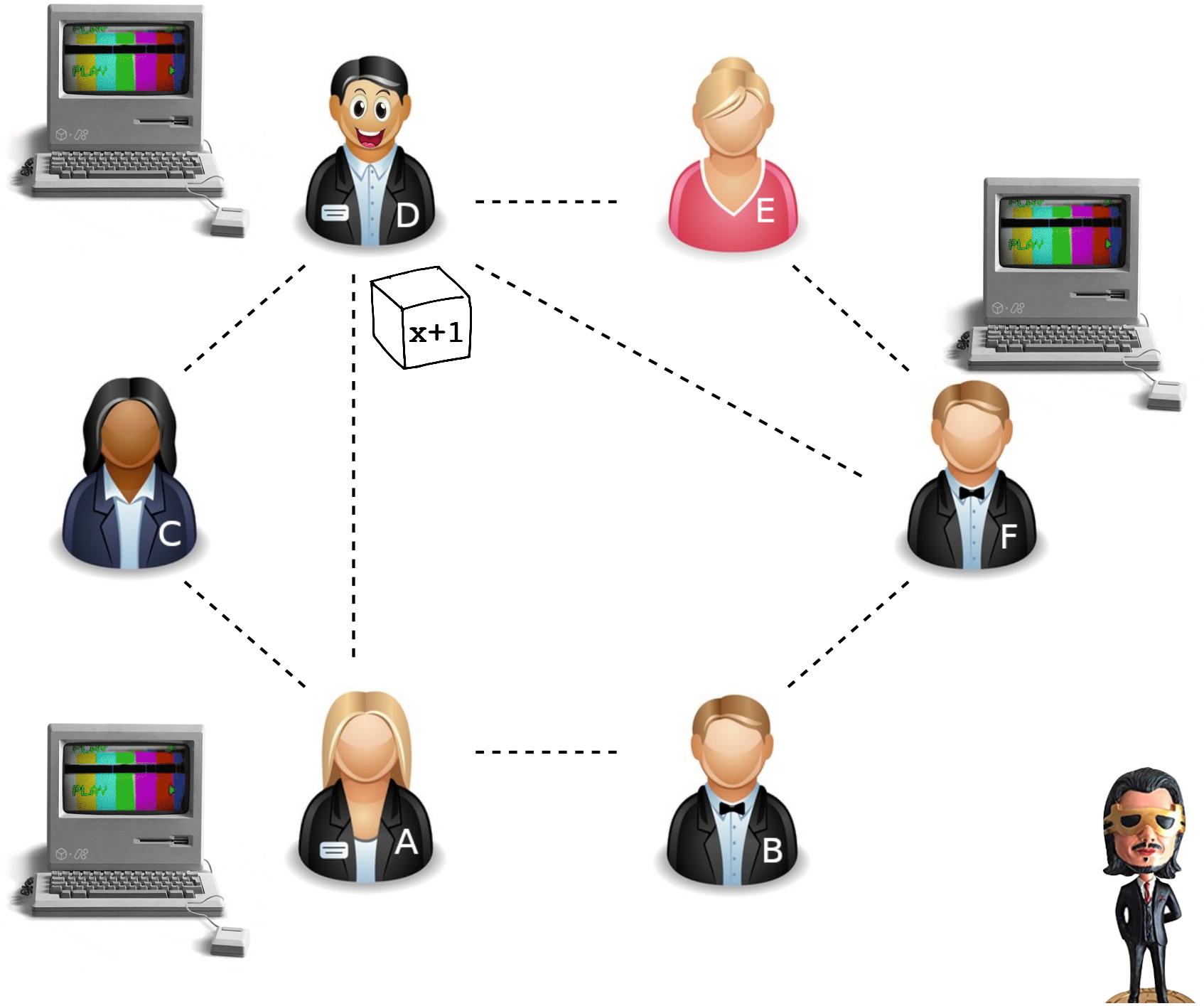
¡Bacán, voy a
tratar de hacer
un bloque válido!

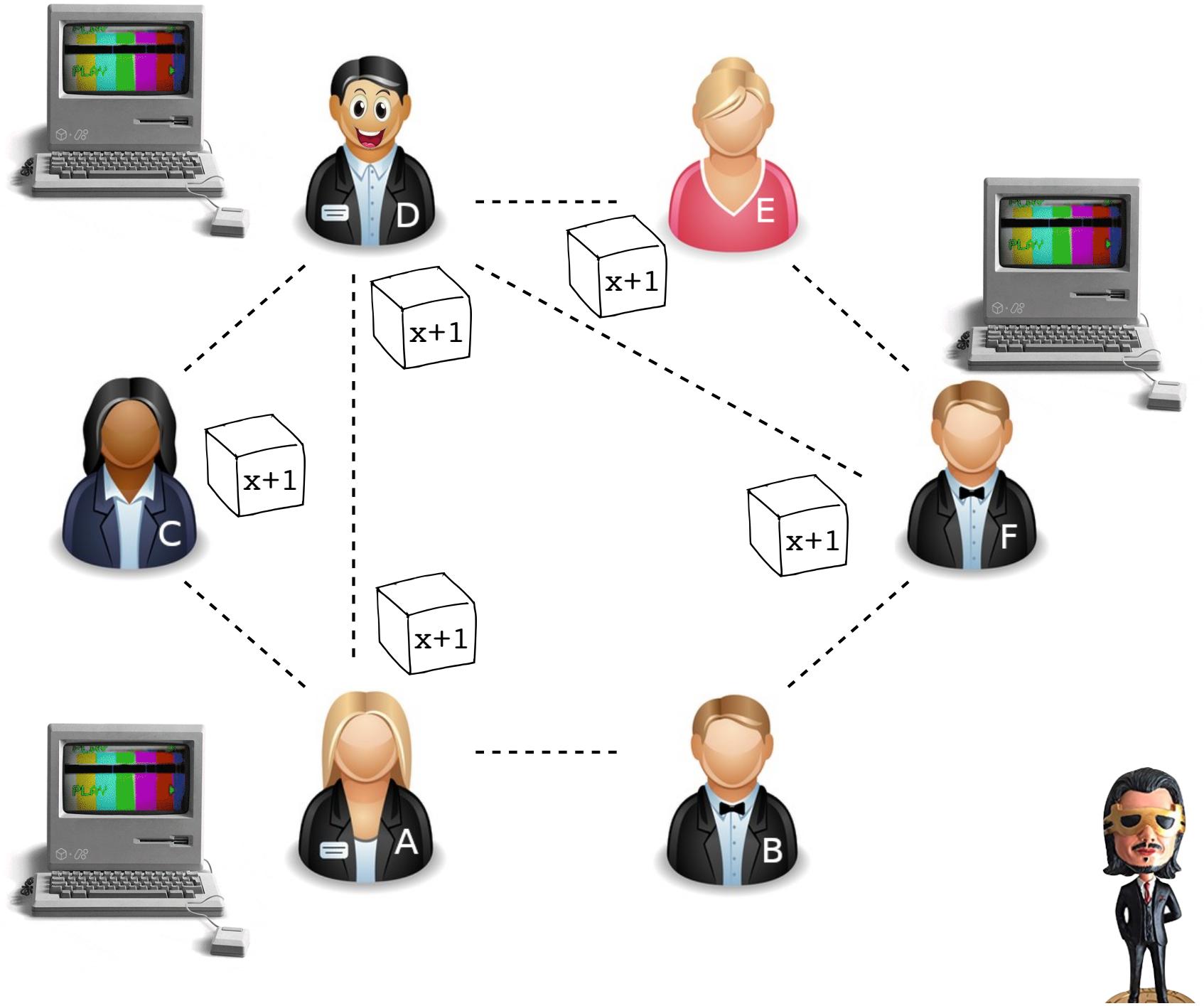


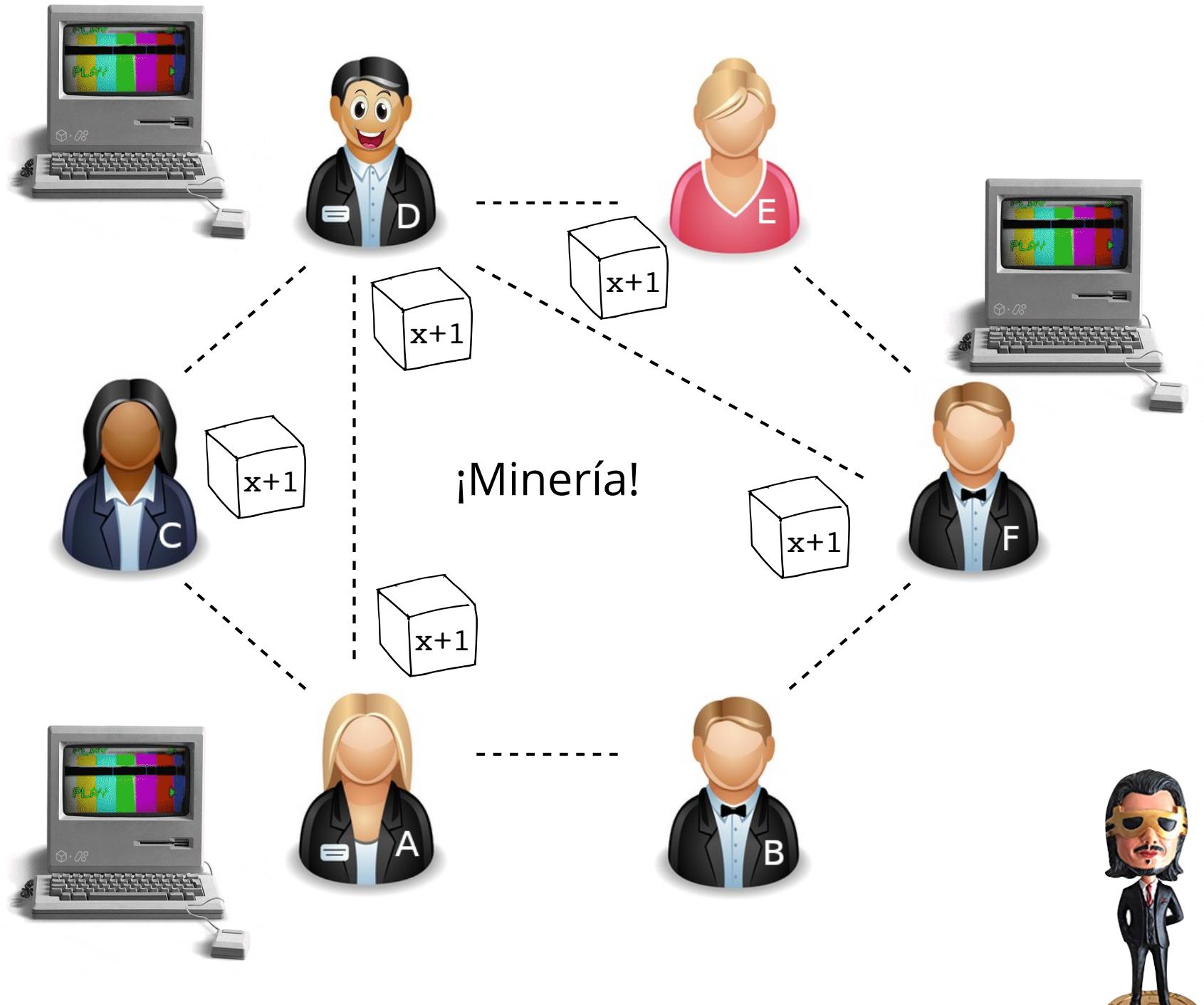
No me funcionó,
¡voy por otro!

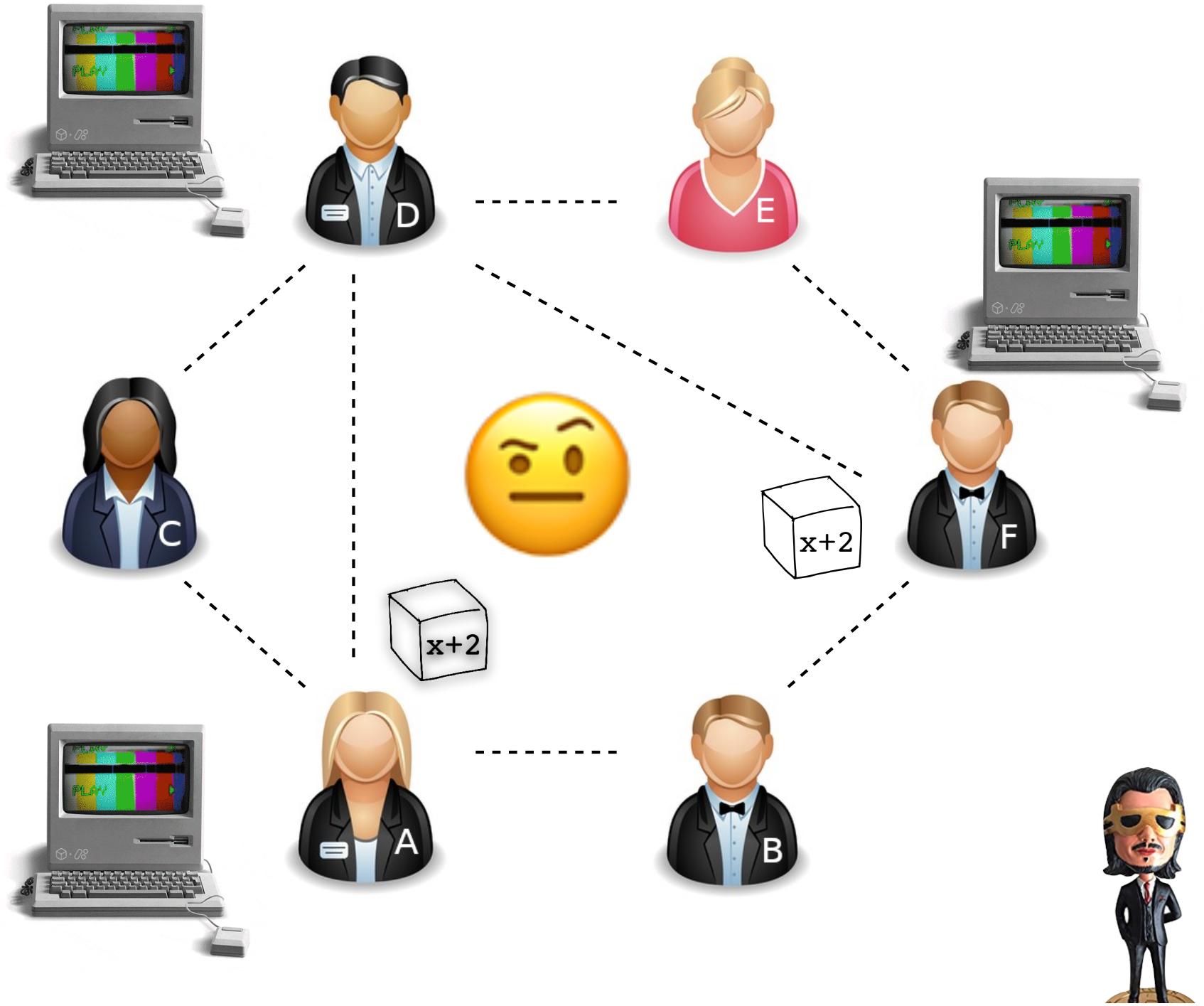








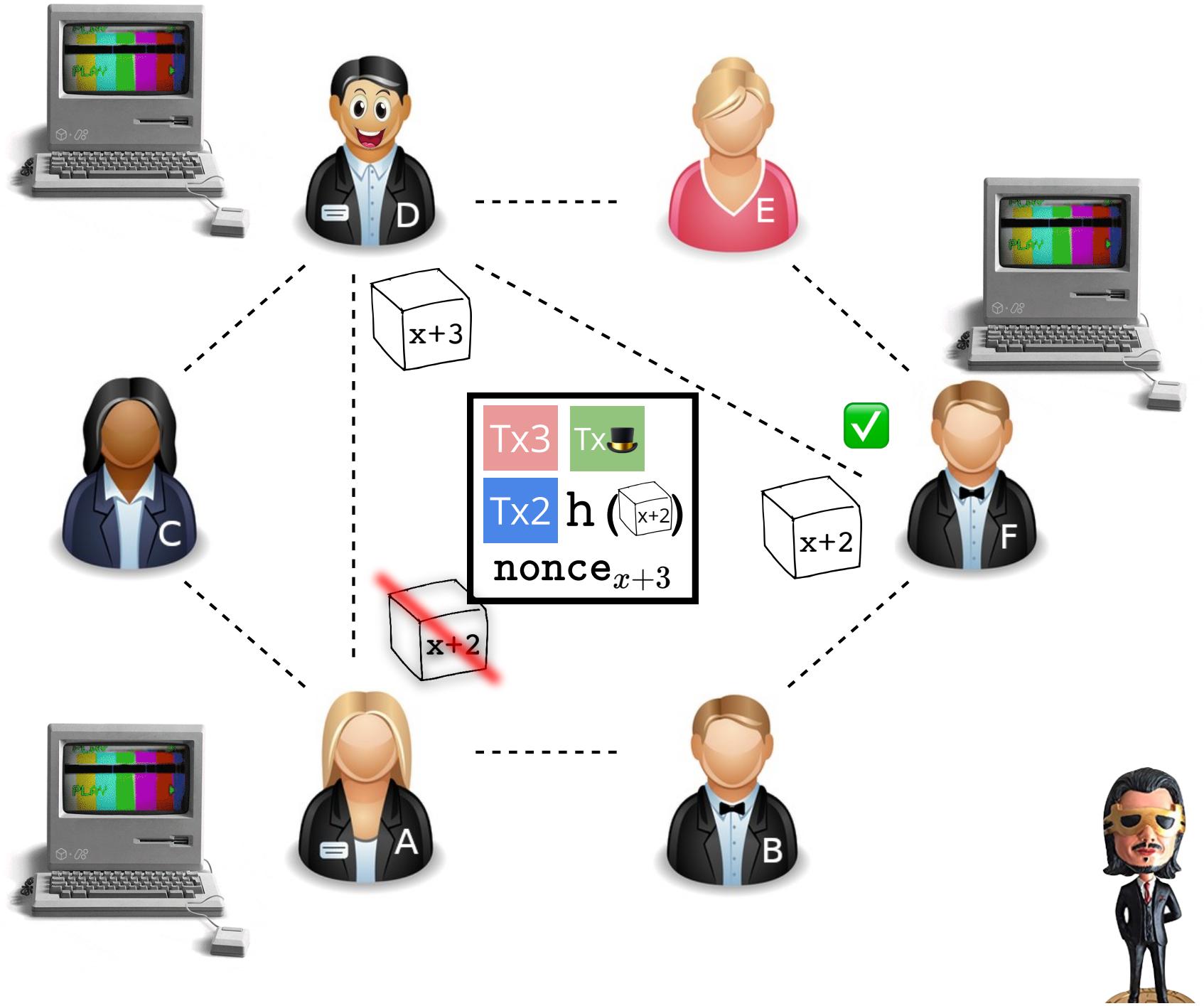




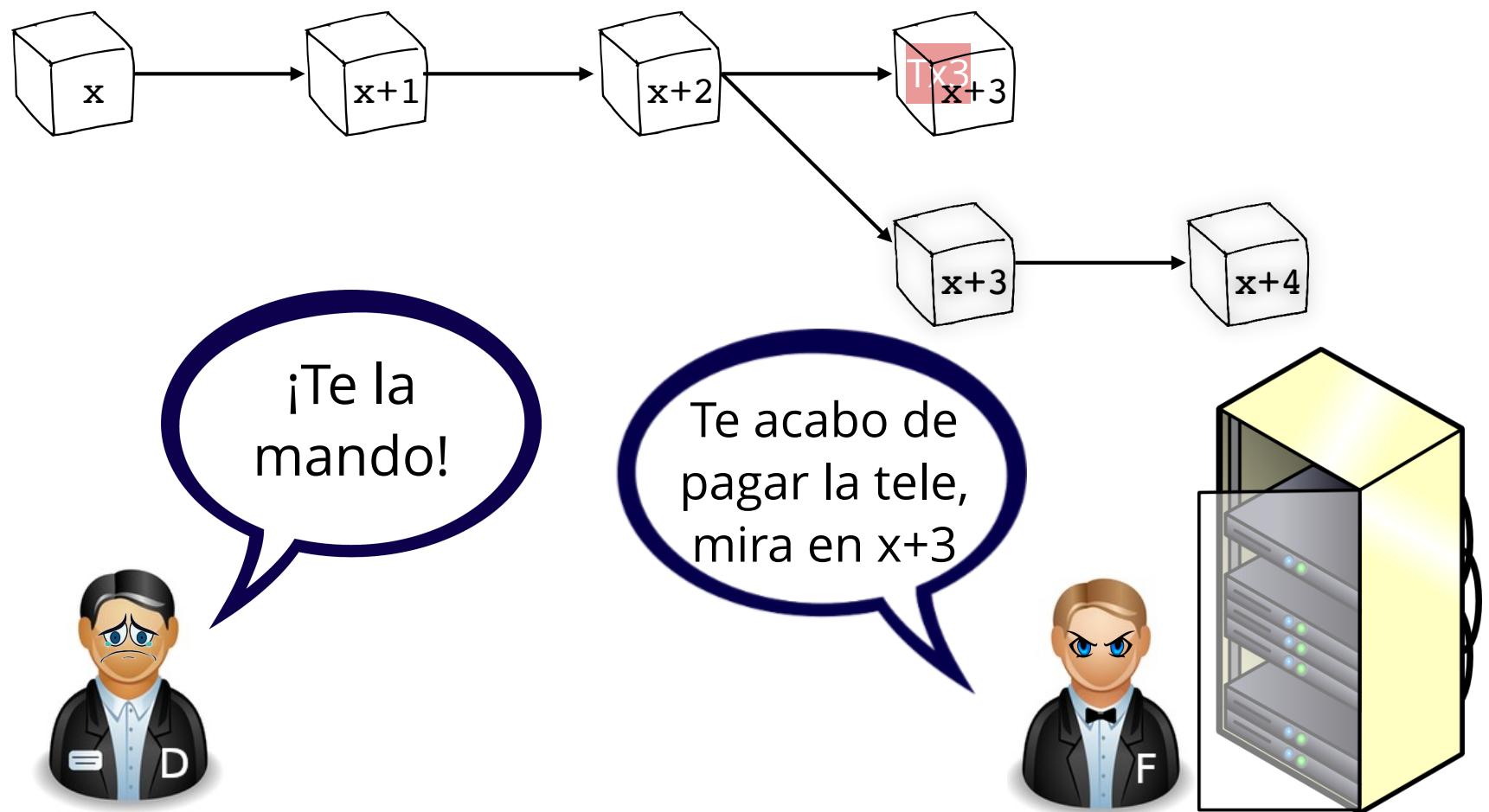
Mantengan los dos y sigan
trabajando sobre el quieran...

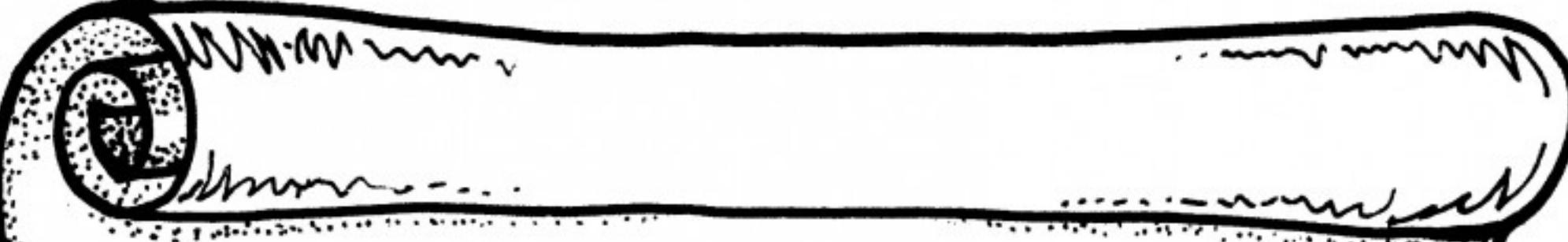
Cuando salga otro, sigan la
"cadena" más larga





51% Attack





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