IoT Model

the Smart Hospital

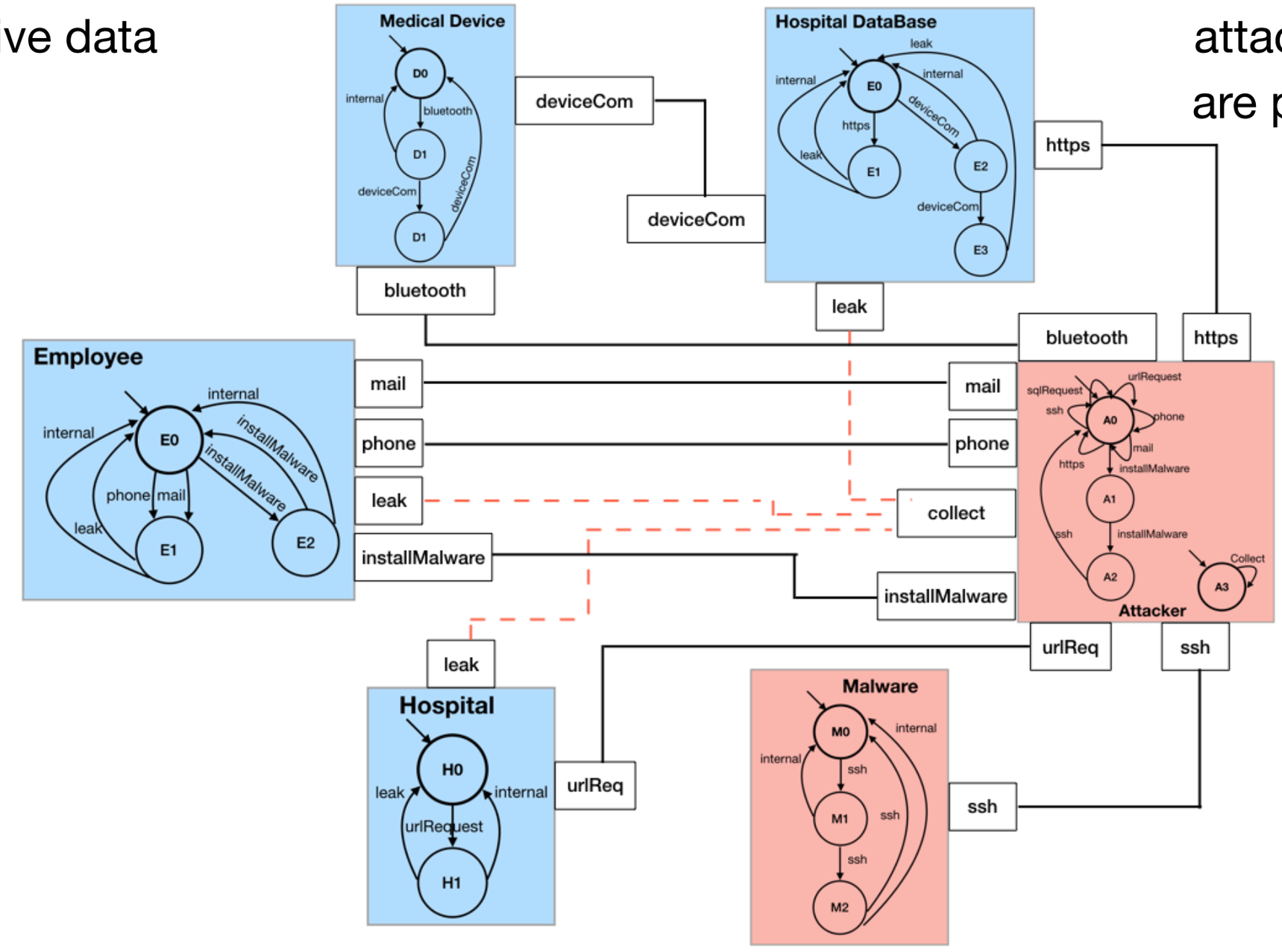
IoT devices

communicate and share sensitive data

Malicious entities

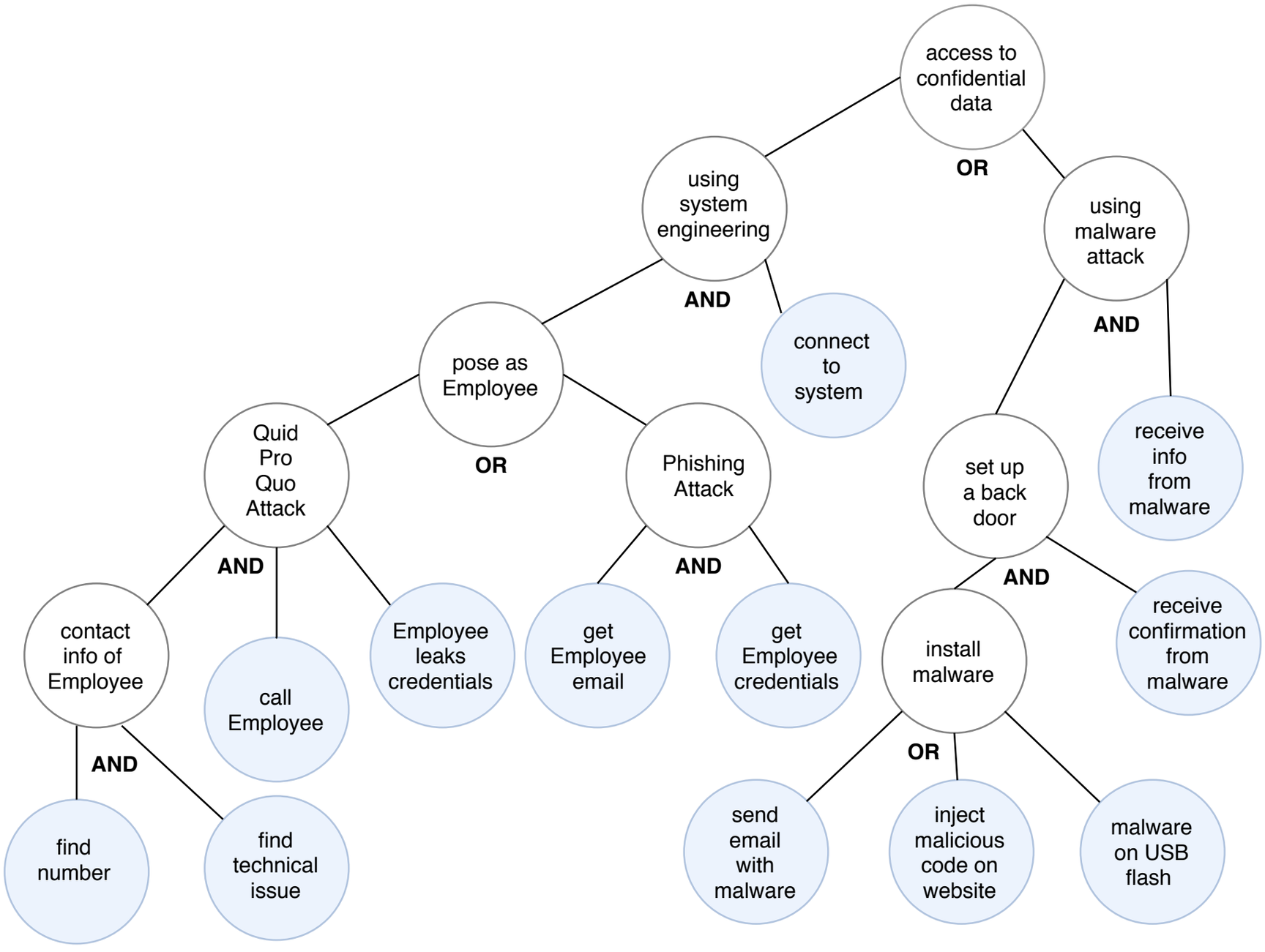
attack the system

are part of the model



Attack Tree

models the Attacker's plan

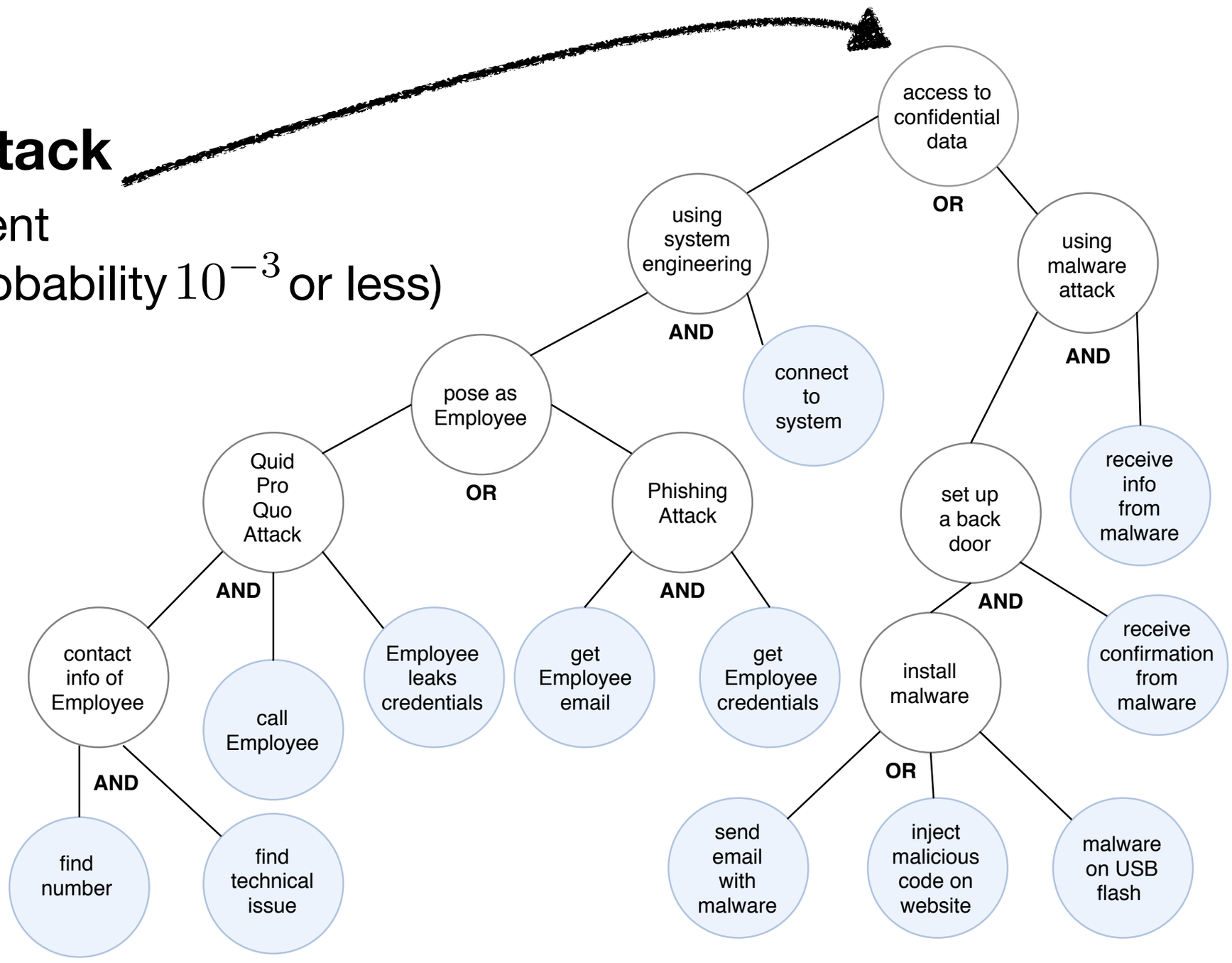


Attack Tree

models the Attacker's plan

successful attack

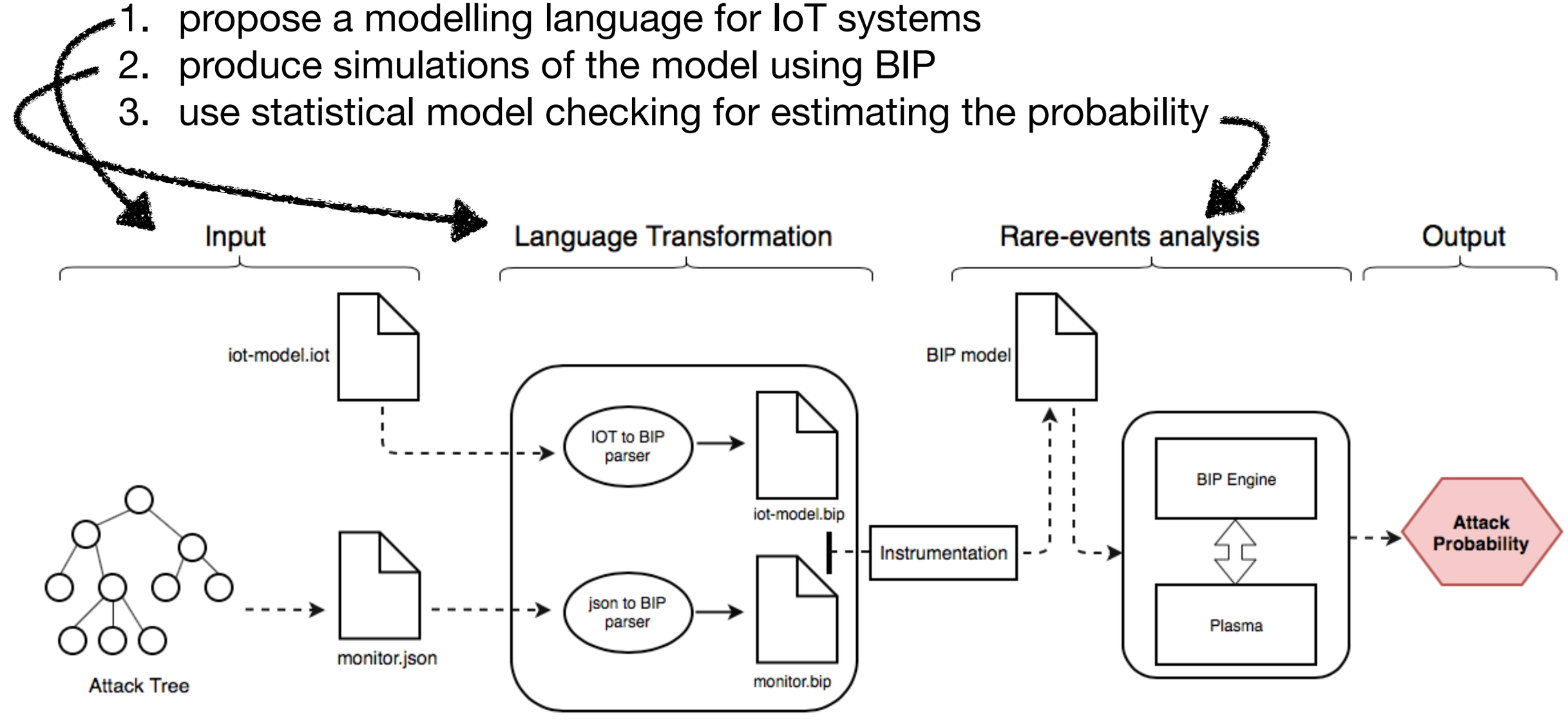
can be a **rare** event
(it occurs with probability 10^{-3} or less)



What is the probability of a successful attack?

Our approach :

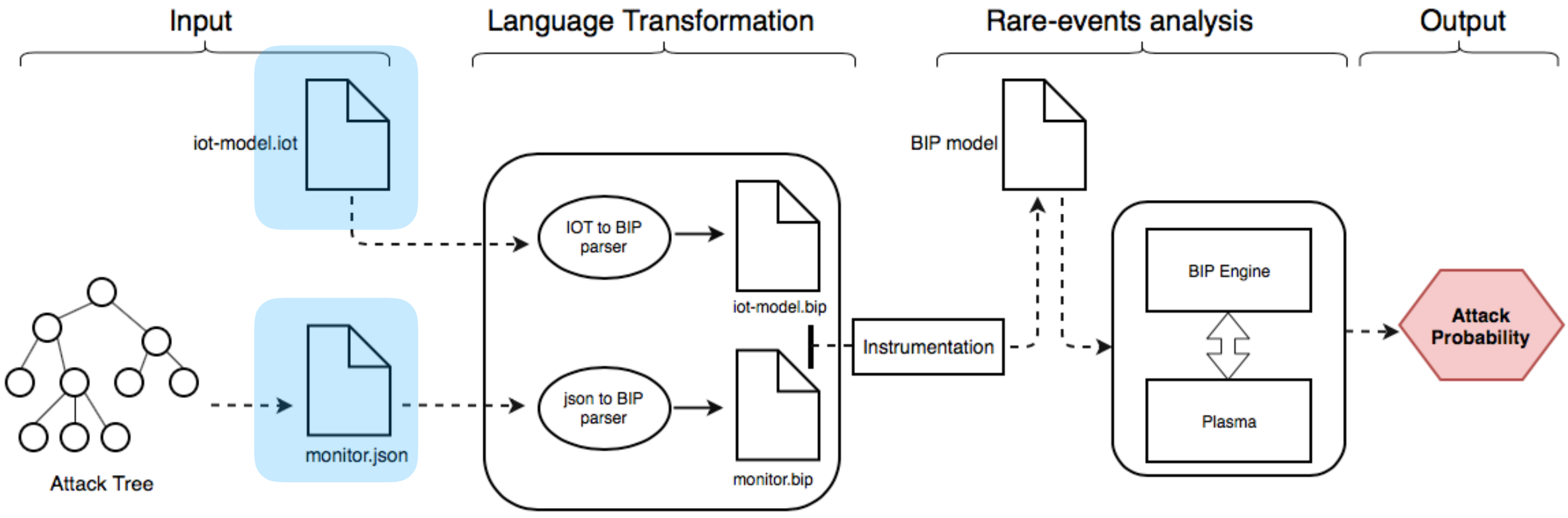
1. propose a modelling language for IoT systems
2. produce simulations of the model using BIP
3. use statistical model checking for estimating the probability



The toolchain

1. Specify the model

- write the IoT model : ***iot-model.iot***
- write the attack tree : ***monitor.json***



2. Produce the BIP executable

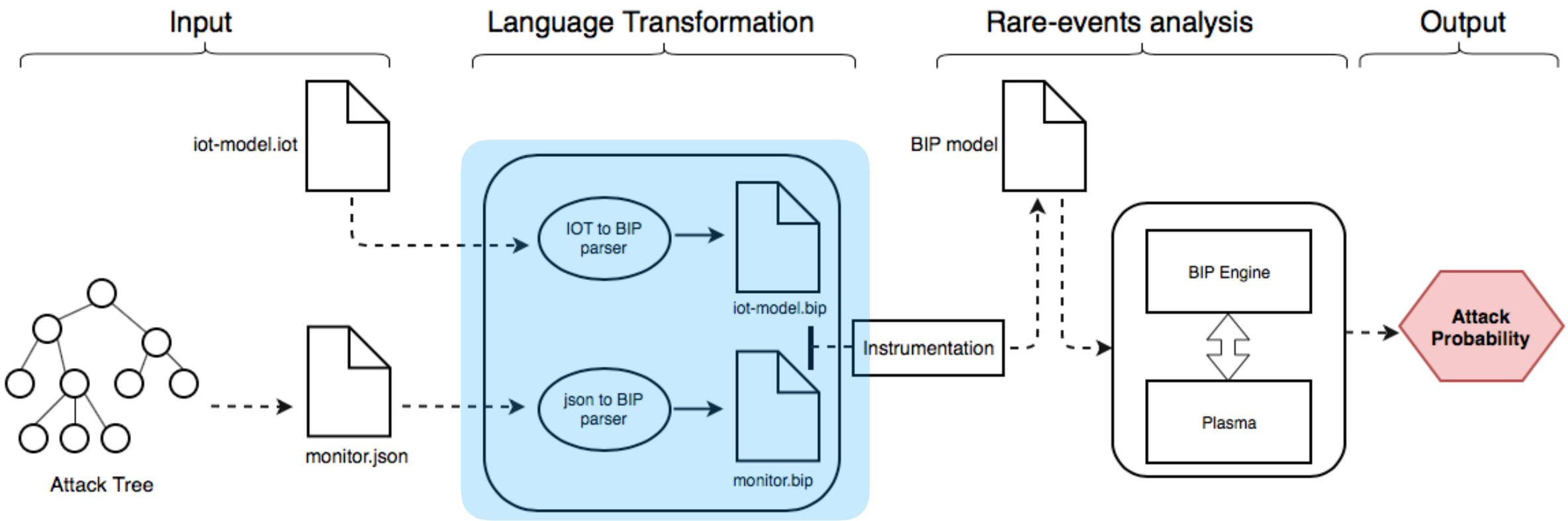
- transform the IoT model into a BIP model:

  ```
  java -jar transpiler.jar iot-model.iot monitor.json
  ```

  it produces the files ****.bip*** and ***compile_model.sh***
- install and configure BIP
- compile the BIP model into an executable:

  ```
  ./compile_model
  ```

  it produces ***system.exe***

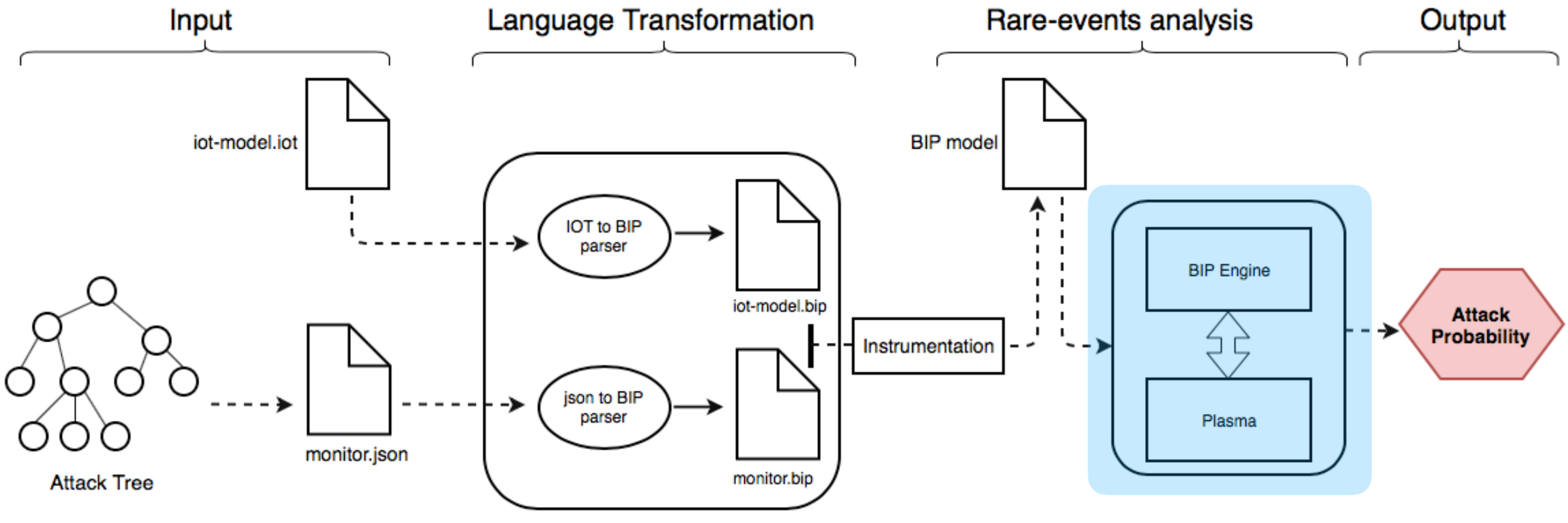


3. SMC with Plasma

- download Plasma with the BIP plugin
- we use two SMC methods : Monte Carlo and Importance Splitting (for rare events).
- configure the input files for Plasma :
    - the model to simulate: the path to ***system.exe***
    - the requirement to check: that a successful attack occurs in 50 steps. It is in rmlobserver format for Importance Splitting, in bltl for Monte Carlo.
- launch Plasma :

```
./plasmacli.sh launch -m path_to_exe:bip -r obs:rmlobserver -a splitting
-A”Budget"=100

./plasmacli.sh launch -m path_to_exe:bip -r req:bltl -a montecarlo
-A”Total samples”=100
```



Importance Splitting :

```
|
1000 simulations
+---------+----------------------+-
| Name    | Result               |
+---------+----------------------+-
| model50 | 1.1133727920000001E-5 |
+---------+----------------------+-
Time = 8.39
```

Monte Carlo:

```
+------+--------------+----------------------+--------+
| Name | # Simulations | # Positive Simulation | Result |
+------+--------------+----------------------+--------+
| mc   | 1000         | 0                    | 0.0    |
+------+--------------+----------------------+--------+
Time = 6.39
```