

Introduction to Distributed and Embedded Multi-agent Systems

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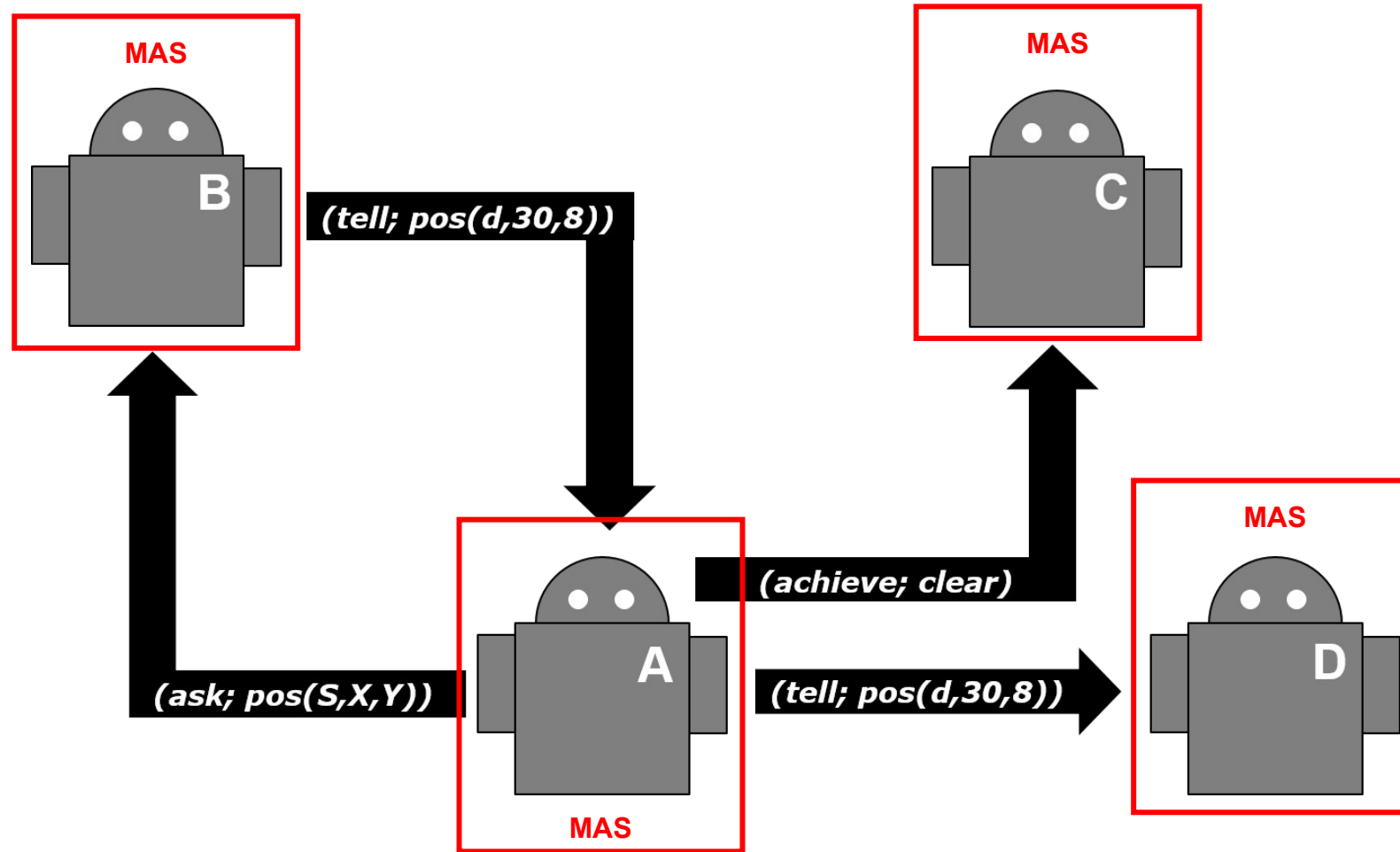
COMMUNICATION BETWEEN EMBEDDED MAS

Open Multi-Agent System

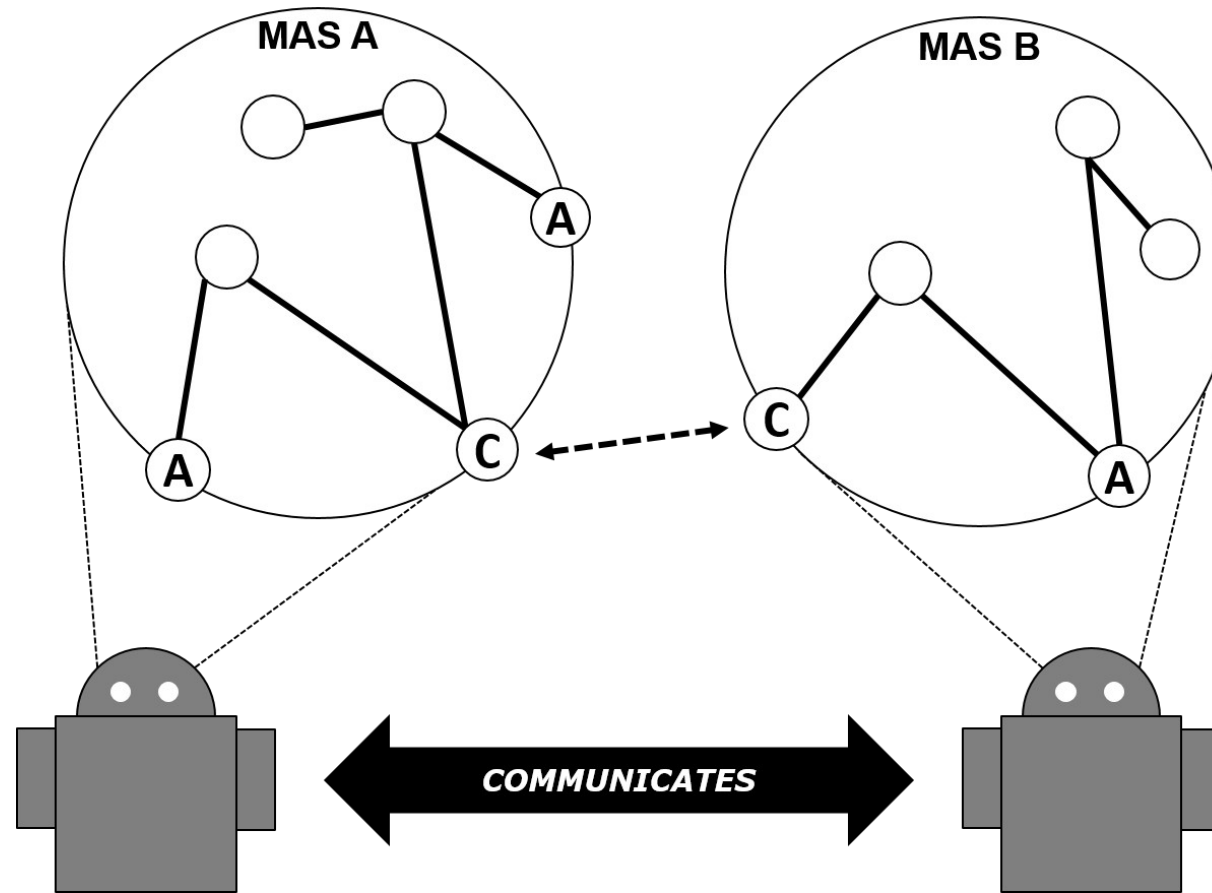
Um SMA pode ser Aberto, dessa forma é possível:

- troca de mensagens com agentes estrangeiros;
- entrada ou saída de agentes no SMA.

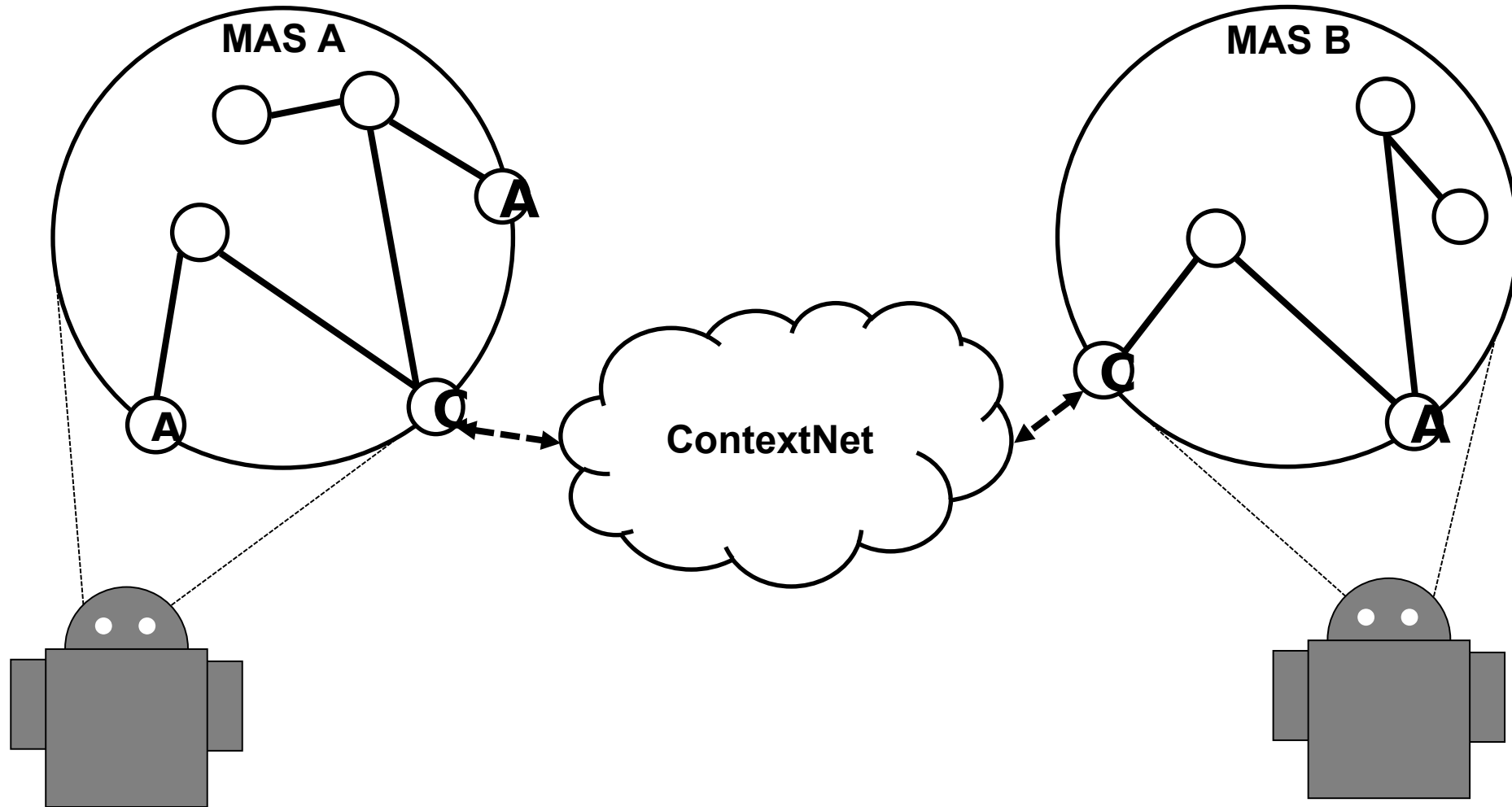
Open MultiAgent System



Agentes Comunicadores



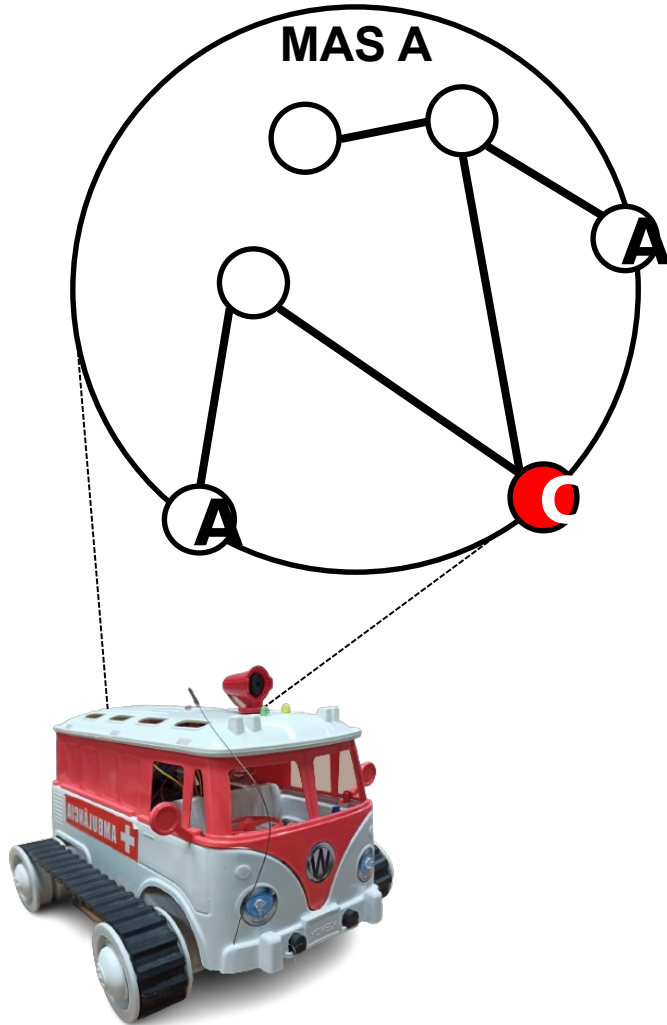
Agentes Comunicadores: Middleware IoT



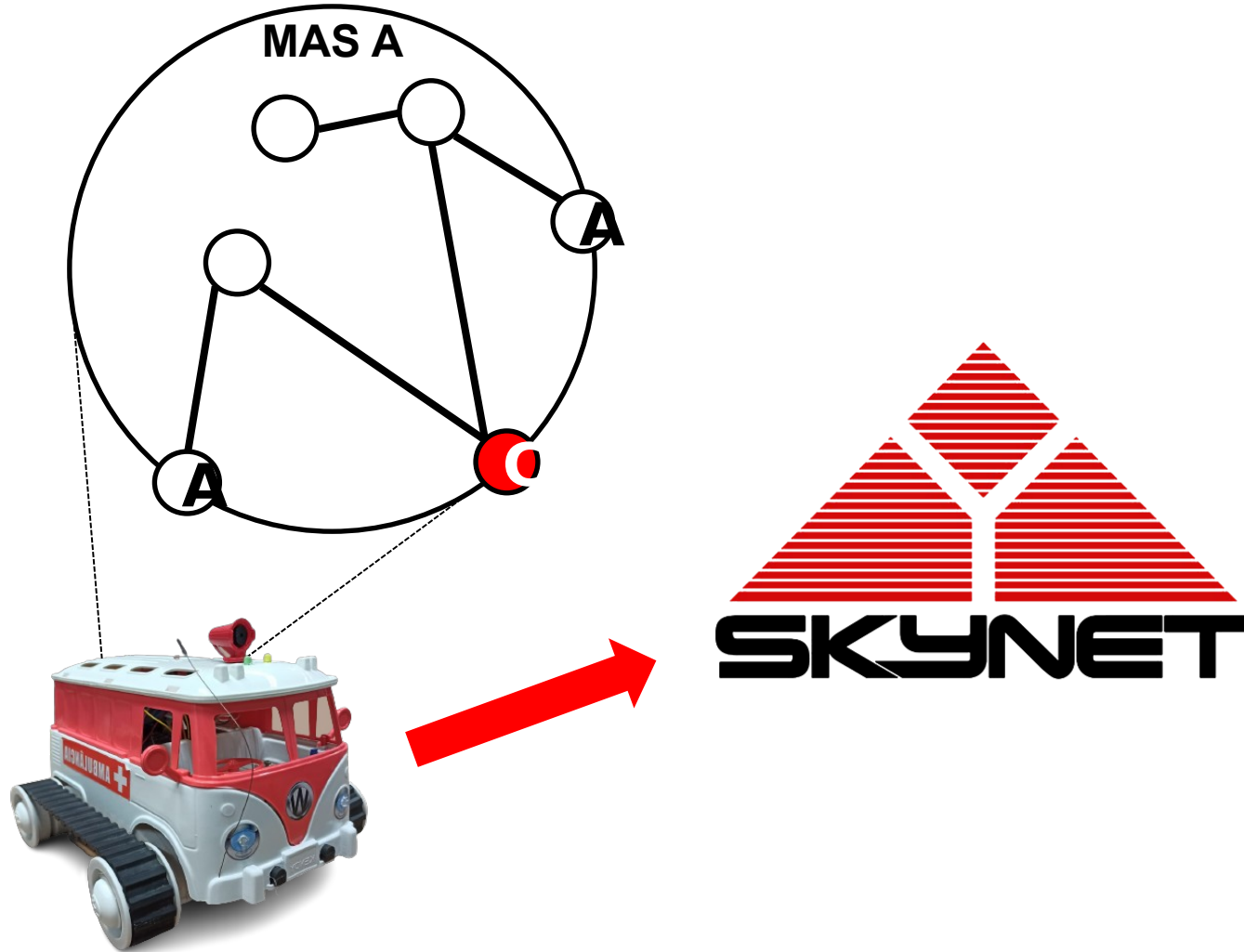
Agentes Comunicadores: Middleware IoT

O ContextNet é um *middleware* que visa a **aplicações colaborativas** abrangentes de pequena e grande escala, como **monitoramento on-line** ou **coordenações de atividades** de **entidades móveis** e **compartilhamento de informações**.

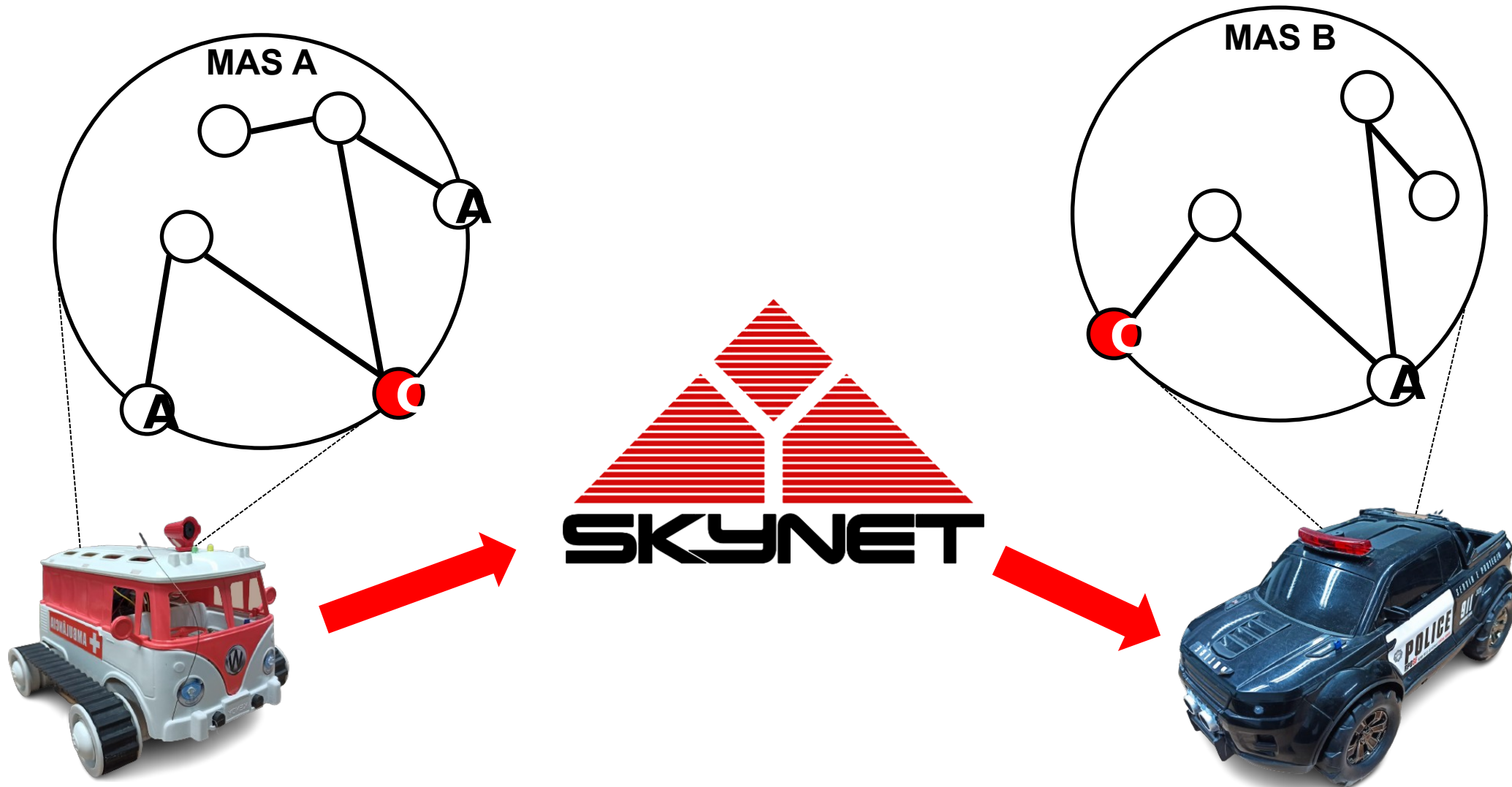
Agentes Comunicadores: Middleware IoT



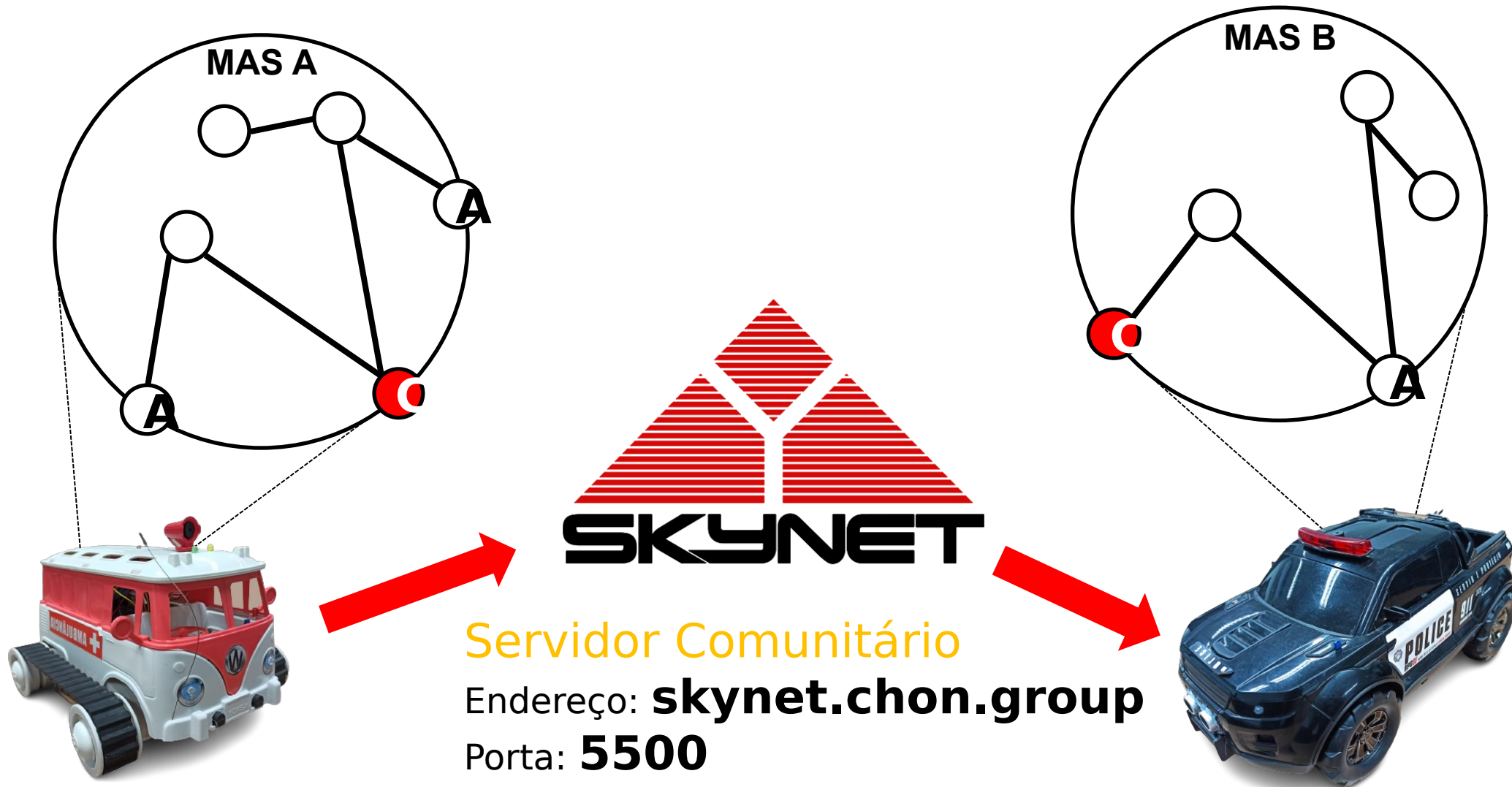
Agentes Comunicadores: Middleware IoT



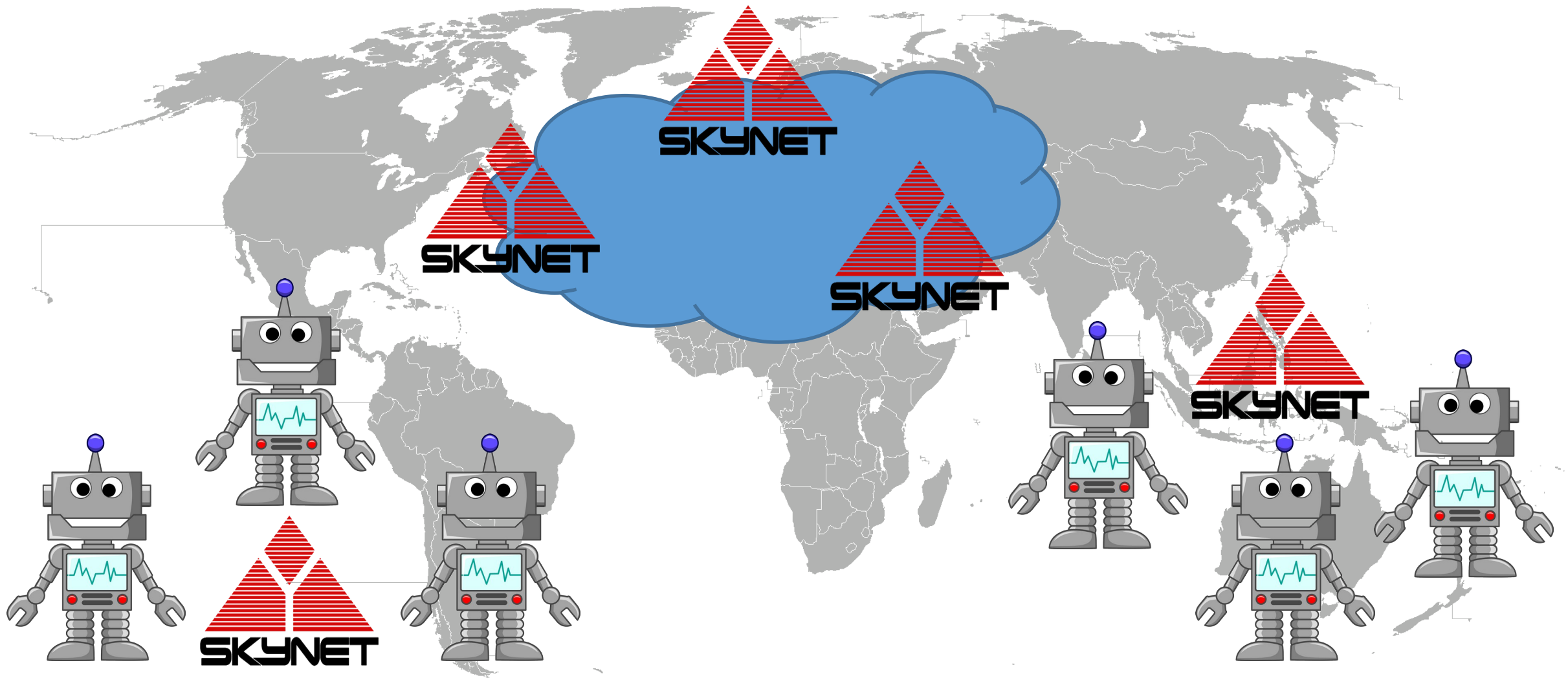
Agentes Comunicadores: Middleware IoT



Agentes Comunicadores: Middleware IoT



SkynetServer: Geograficamente Distribuídos



Agentes Comunicadores: Ações Internas

- **Communicator** Internal Actions:

.**sendOut**(agentUuid, force, message)

envia uma mensagem de um agente comunicador para outro comunicador de um SMA distinto.

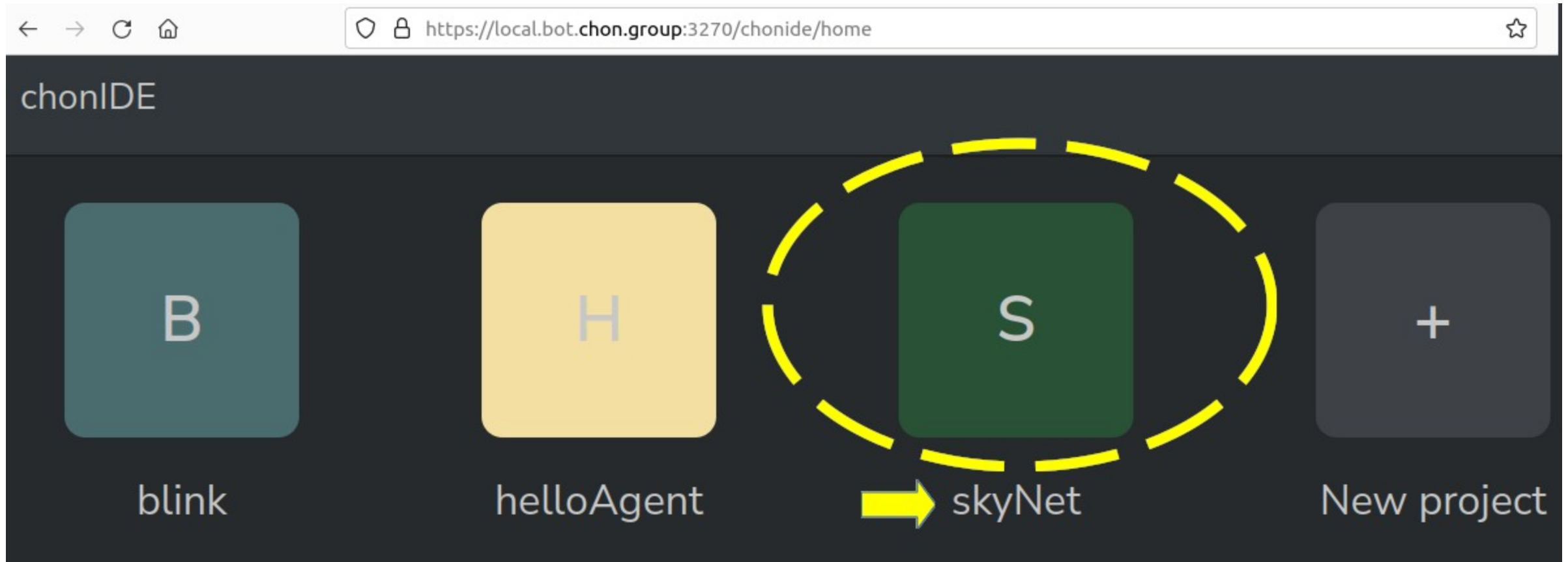
.**connectCN**(servidor, porta, UUID)

se conecta ao servidor IoT com um id específico para o agente.

.**disconnectCN**

desconecta do servidor IoT atualmente conectado.

Hello SkyNet



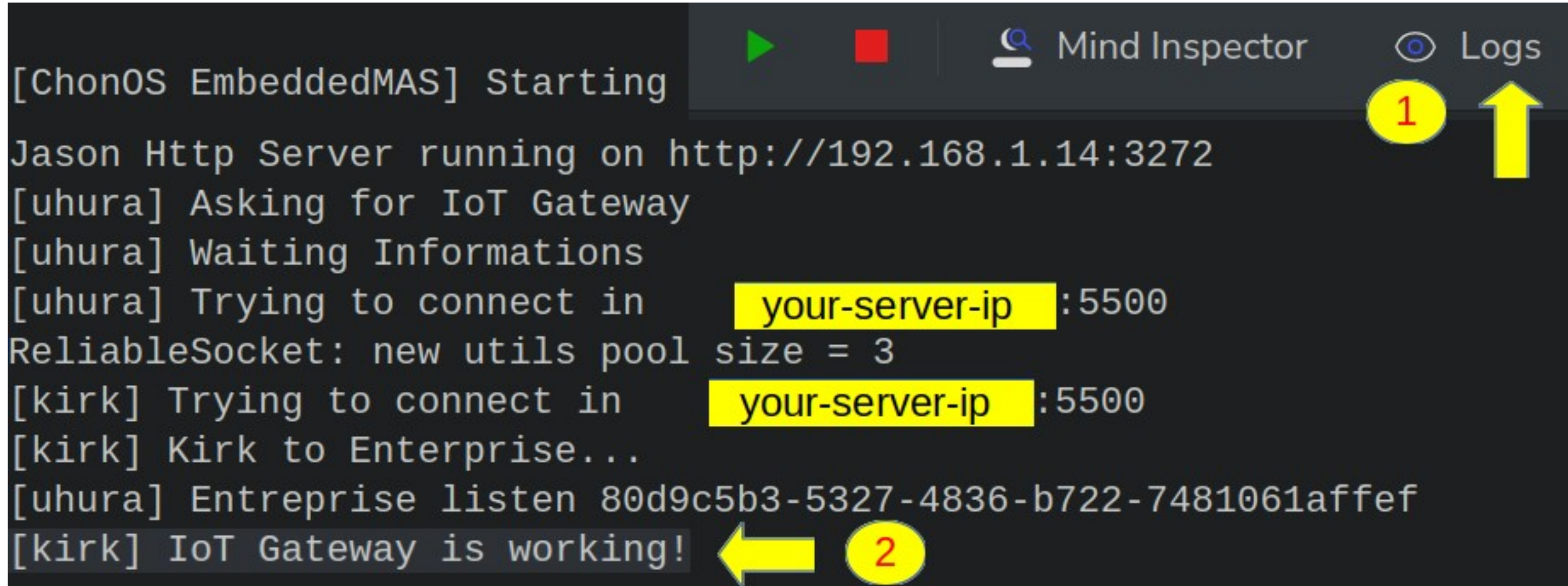
Hello SkyNet

The screenshot shows the chonIDE interface. At the top, there's a toolbar with a green play button (labeled '2' with a yellow arrow pointing to it) and a red stop button. Below the toolbar, the 'skyNet' project is selected, showing a 'Communicator' dropdown. The left sidebar displays a tree view with 'Multi-Agent System' expanded, showing 'Agents' (with a '+' icon) containing 'kirk' (selected) and 'uhura'. Below 'Agents' are 'Firmware' and 'Libraries' (both with '+' icons), and 'Javino' at the bottom. The main editor area shows a code file with line numbers 1 through 12. Line 7 is highlighted with a blue background and labeled '1' with a yellow circle. A yellow arrow points to line 7. The code is as follows:

```
1  /* To generate a random UUID use https://www.uuidgenerator.net/ */
2  kirkUUID("80d9c5b3-5327-4836-b722-7481061affef").
3  uhuraUUID("af467a22-eafc-4e87-9f57-882740ab0710").
4
5  /* We provide a Public IoT Gateway, more info in https://doi.org/10.5753
6  /wei.2023.229753 */
7  gateway("YOUR-SERVER-IPv4",5500).
8
9  /* Plans */
10
11  +!testComm: uhuraUUID(Uhura) & not communication(ok)<-
12    .print("Kirk to Enterprise...");
```


Hello SkyNet

```
[ChonOS EmbeddedMAS] Starting
Jason Http Server running on http://192.168.1.14:3272
[uhura] Asking for IoT Gateway
[uhura] Waiting Informations
[uhura] Trying to connect in your-server-ip :5500
ReliableSocket: new utils pool size = 3
[kirk] Trying to connect in your-server-ip :5500
[kirk] Kirk to Enterprise...
[uhura] Enterprise listen 80d9c5b3-5327-4836-b722-7481061affef
[kirk] IoT Gateway is working!
```



Exemplo: Comunicação entre SMA Embarcados

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Embedded MAS
enterprise

Exemplo: Comunicação entre SMA Embarcados

agent **scott**



Embedded MAS
enterprise

Exemplo: Comunicação entre SMA Embarcados

agent **scott**



agent **uhura**



Embedded MAS
enterprise

Exemplo: Comunicação entre SMA Embarcados

agent **scott**

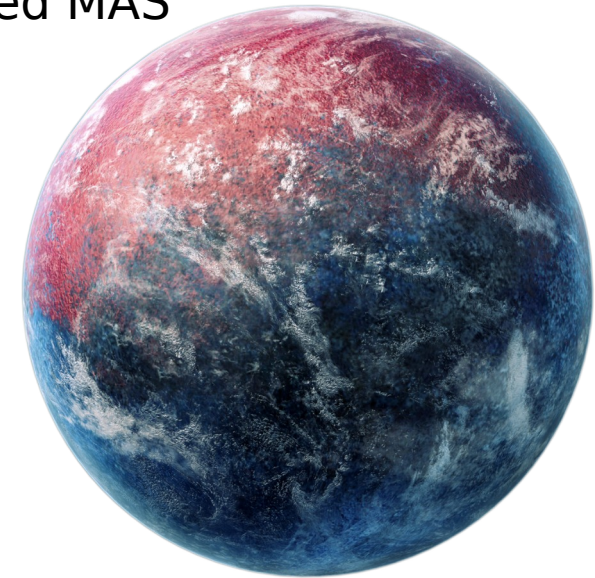


agent **uhura**



Embedded MAS
enterprise

Embedded MAS
bajor



Exemplo: Comunicação entre SMA Embarcados

agent **scott**



agent **uhura**



Embedded MAS
enterprise

agent **kirk**



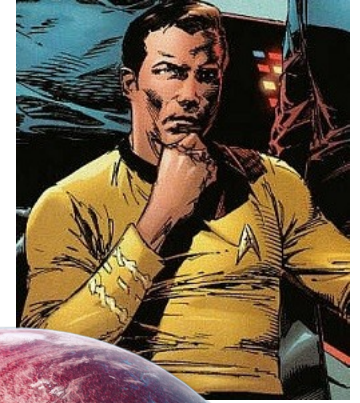
Embedded MAS
bajor



Exemplo: Comunicação entre SMA Embarcados



This is
Lieutenant
Nyota Uhura,
Communications
officer.

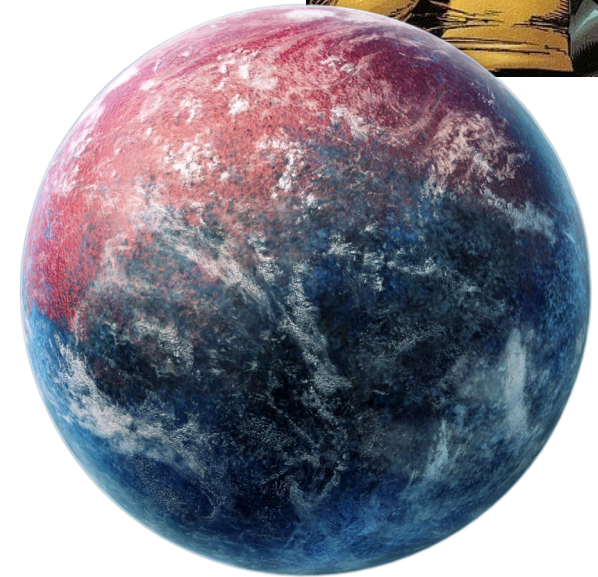
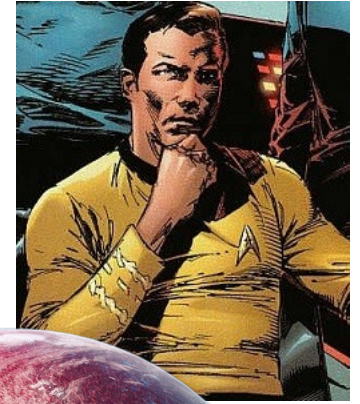


Exemplo: Comunicação entre SMA Embarcados



This is
Lieutenant
Nyota Uhura,
Communications
officer.

Kirk to Enterprise...
Damage report!



Exemplo: Comunicação entre SMA Embarcados



This is
Lieutenant
Nyota Uhura,
Communications
officer.

Kirk to Enterprise...
Damage report!

Commander Kirk,
Deck 2 compromised!



Exemplo: Comunicação entre SMA Embarcados



Exemplo: Comunicação entre SMA Embarcados



```
1 /* Initial beliefs and rules */
2
3 /* Initial goals */
4
5 /* Plans */
6 +redAlert[source(X)] <-
7     .print("Computer, Commander Montgomery Scott, Chief Engineering Office");
8     .print("Enterprise, Red Alert!");
9     -redAlert[source(X)].
10
```

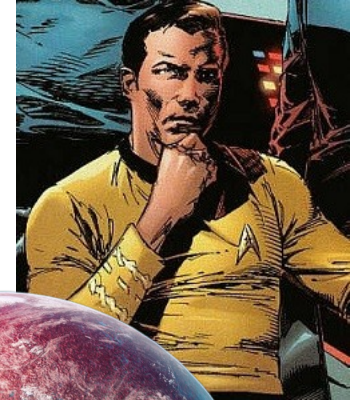
```
1 /* Crenças Iniciais */
2 // Gerar UUID aleatório ---> https://www.uuidgenerator.net/
3 myUUID("b4bec4b9-221a-455c-9f3b-9b49bd9e8440").
4
5 //public SkynetServer
6 //skyNetAddress(skynet.chon.group).
7
8 //local IP of SkynetServer
9 skyNetAddress("192.168.0.103").
10 skyNetPort(3273).
11
12 /* Objetivos Iniciais */
13 !conf.
14
15 /* Planos */
16 +!conf : myUUID(ID) & skyNetAddress(Server) & skyNetPort(Port) <-
17     .print("This is Lieutenant Nyota Uhura, Communications officer");
18     .connectCN(Server,Port,ID).
19
20 +!damageReport[source(X)] <-
21     .print("Commander Kirk, Deck 2 compromised!");
22     .sendOut(X,tell,report("Deck 2")).
23
24 +communication(trying)[source(X)] <-
25     .print("Enterprise Listen ",X);
26     .sendOut(X,tell,communication(ok));
27     -communication(trying)[source(X)].
28
29 +retransmit(Dest,Msg)[source(X)] <-
30     .send(Dest,tell,Msg);
31     -retransmit(Dest,Msg)[source(X)].
32
```

https://sourceforge.net/p/chonos/examples/ci/master/tree/03-limitedOpenMultiAgent/limitedOpenExample01/ncc_1701/

Exemplo: Comunicação entre SMA Embarcados

```
1 /* Crenças Iniciais */
2 uhuraUUID("b4bec4b9-221a-455c-9f3b-9b49bd9e8440"). //https://www.uuidgeni
3 myUUID("cdc19c19-5616-4fc5-8d54-372631dd8eff").
4
5 //skyNetAddress(skynet.chon.group). //public SkynetServer
6 skyNetAddress("192.168.0.103"). //local IP of Your SkynetSer
7 skyNetPort(3273).
8
9 /* Objetivo Inicial */
10 !contact.
11
12 /* Planos */
13
14 +!conf : myUUID(ID) & skyNetAddress(Server) & skyNetPort(Port) <-
15     .print("This is Commander James T. Kirk, Enterprise's Captain");
16     .connectCN(Server,Port,ID);
17     +connected;
18     !testComm.
19
20 +!contact: connected & uhuraUUID(Uhura) & communication(ok)<-
21     .print("Damage report!");
22     .sendOut(Uhura, achieve, damageReport).
23
24 +!contact: not connected <-
25     .print("Without Communication!");
26     !conf.
27
28 +report(Damages)[source(X)] <-
29     .print("Damages in ", Damages);
30     .print("Stay in standard orbit and wait for instructions.");
31     .sendOut(X, tell, retransmit(scott, redAlert));
32     .wait(2000);
33     .disconnectCN.
34
```

```
34
35 +!testComm : connected & uhuraUUID(Uhura) & not communication(ok)<-
36     .print("Kirk to Enterprise...");
37     .sendOut(Uhura, tell, communication(trying));
38     .wait(2500);
39     !testComm.
40
41 +!testComm: communication(ok) <- !contact.
42
```



<https://sourceforge.net/p/chonos/examples/ci/master/tree/03-limitedOpenMultiAgent/limitedOpenExample01/bajor/>

Exemplo: Bio-Inspired Protocol



Computer, Commander
James T. Kirk, Enterprise's
Captain! I'm aboard!



Exemplo: Bio-Inspired Protocol



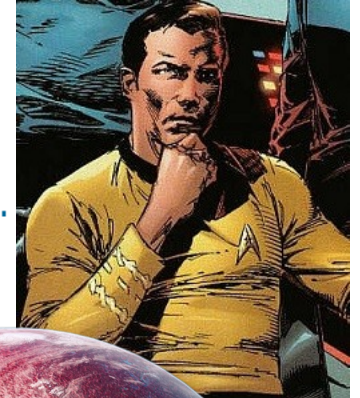
```
◇ scott.asl
2 //https://www.uuidgenerator.net/
3 myUUID("07ba9e4a-d539-4a0e-8c14-4ac336476858").
4
5 //skyNetAddress(skynet.chon.group).           //public SkynetServer
6 skyNetAddress("192.168.0.103").               //local IP of Your SkynetServer
7 skyNetPort(3273).
8
9 /* Initial goals */
10 !start.
11
12 /* Plans */
13 +!start : true <-
14     ?myUUID(ID);
15     ?skyNetAddress(Server);
16     ?skyNetPort(Port);
17     .print("Computer, Commander Montgomery Scott, Chief Engineering Office");
18     .connectCN(Server,Port,ID).
19
20 +beam_us_up_scotty[source(X)] <-
21     .print("Transporter ready for ",X);
22     .sendOut(X,tell,energizing);
23     -beam_us_up_scotty[source(X)].
```

https://sourceforge.net/p/chonos/examples/ci/master/tree/04-openMultiAgent/openMASExample01/ncc_1701/

Exemplo: Bio-Inspired Protocol

```
kirk.asl  ◇ scott.asl
1 /* Initial beliefs and rules */
2 abroad(yes). scott("07ba9e4a-d539-4a0e-8c14-4ac336476858").
3 skyNetAddress("192.168.0.103"). skyNetPort(3273).
4 myUUID("41ff1712-b2f0-416d-8232-fef834651e77").
5 /* Initial goals */
6 !conf.
7 /* Plans */
8 +!conf : abroad(yes) & (myUUID(ID)
9   & (skyNetAddress(Server) & skyNetPort(Port))) <-
10   .connectCN(Server,Port,ID); !start.
11
12 +!conf : abroad(no) <-
13   .print("Computer, Commander James T. Kirk, Enterprise's Captain").
14
15 +!start : (abroad(yes) & energizing[source(X)]) <-
16   .print("Transporter ready!"); -energizing[source(X)]; +ready; !start.
17
18 +!start : (abroad(yes) & (ready & scott(UUID))) <-
19   -ready; -abroad(yes); +abroad(no); .moveOut(UUID,inquinism).
20
21 +!start : (abroad(yes) & scott(UUID)) <-
22   .print("Kirk to Scotty...");
23   .sendOut(UUID,tell,beam_us_up_scotty); .wait(2500); !start.
24
25 +!start : abroad(no) <-
26   .print("Computer, Commander James T. Kirk, Enterprise's Captain").
27
28 -!start <- !conf.
```

```
scott.asl  ◇ spock.asl
1 /* Initial beliefs and rules */
2 abroad(yes)[source(kirk)].
3
4 /* Initial goals */
5 !start.
6
7 /* Plans */
8 +!start : abroad(no) <-
9   .wait(2000);
10   .print("Computer, Lieutenant Commander Spock, First Officer").
11
12 +!start : abroad(yes) <-
13   .wait(2000);
14   -abroad(yes);
15   .send(kirk,askOne,abroad(Status),Reply);
16   +Reply;
17   !start.
```



<https://sourceforge.net/p/chonos/examples/ci/master/tree/04-openMultiAgent/openMASExample01/andoria/>

OBRIGADO!

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