# COmputAtional State Transfer (COAST)

## A New Architectural Style For Decentralized, Adaptive, and Secure Applications

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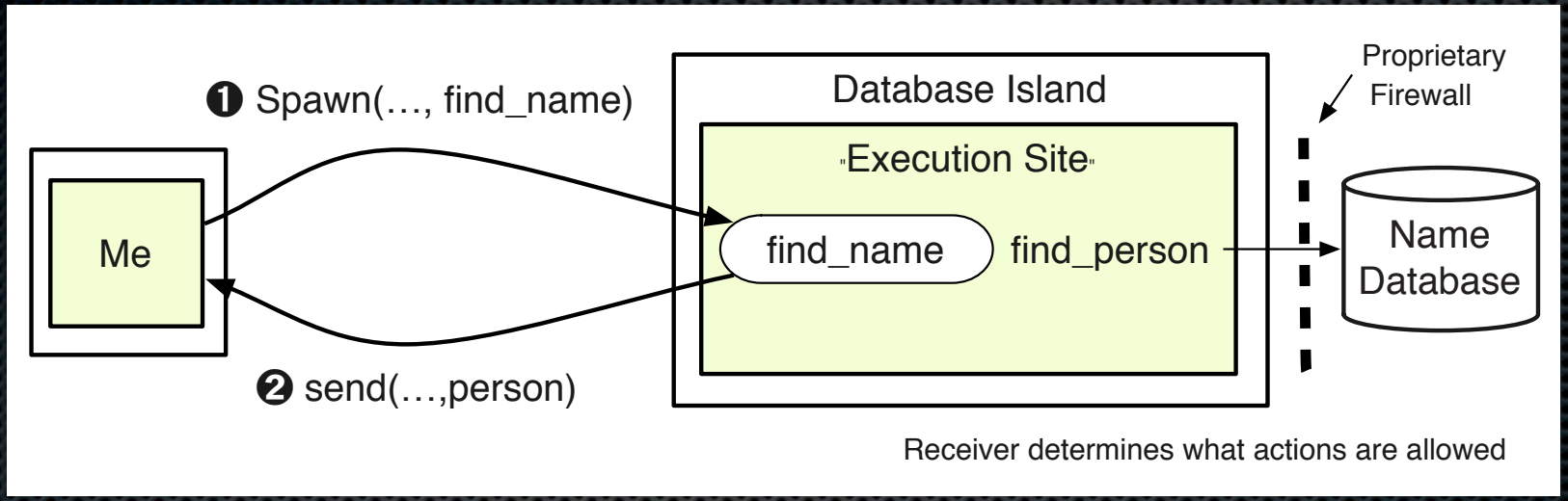
# I hope I don’t frighten you...

With thanks to Antoine de Saint-Exupéry and *Le Petit Prince*

# Architectural Styles & COAST

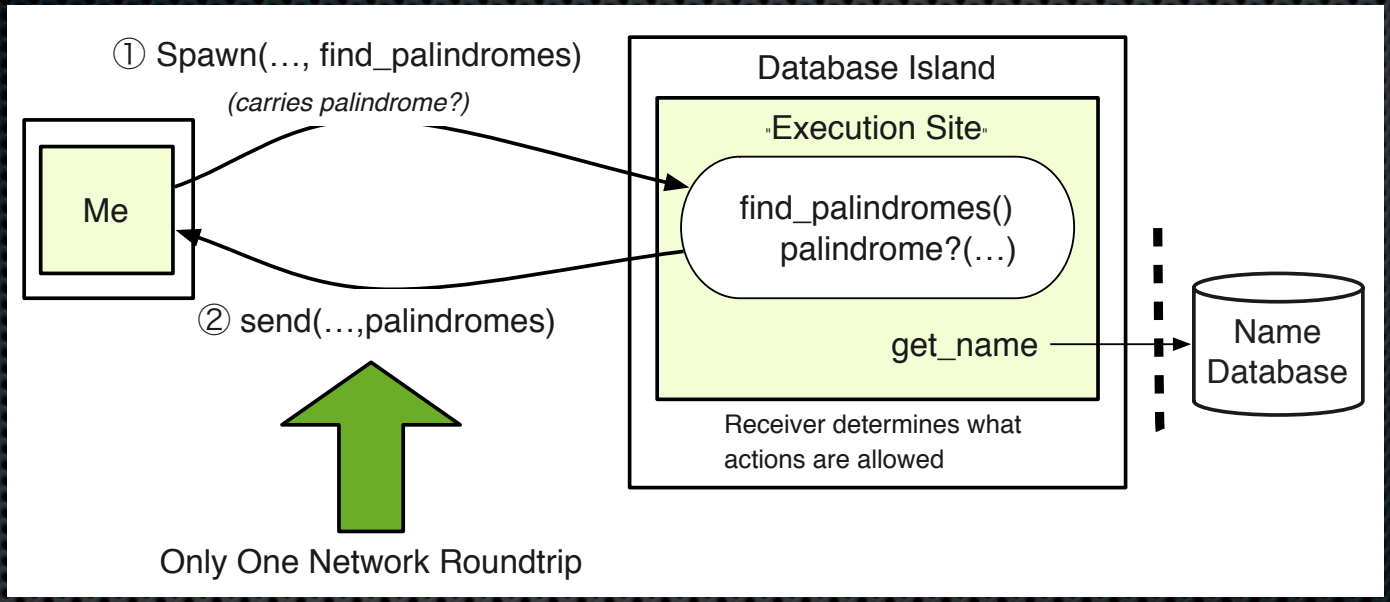
- An architectural style is a named collection of architectural design decisions that
  (1) are applicable in a given development context,
  (2) constrain architectural design decisions that are specific to a particular system within that context, and
  (3) elicit beneficial qualities in each resulting system.
- The COAST style:
  - For decentralized applications (the *context*)
  - Based on mobile computations, communication constraints, POLA (the *constraints*)
  - Yields dynamic adaptability, pervasive security, ... (some of the *beneficial qualities* as architectural consequences)

# Ex. 1: Search for a Name



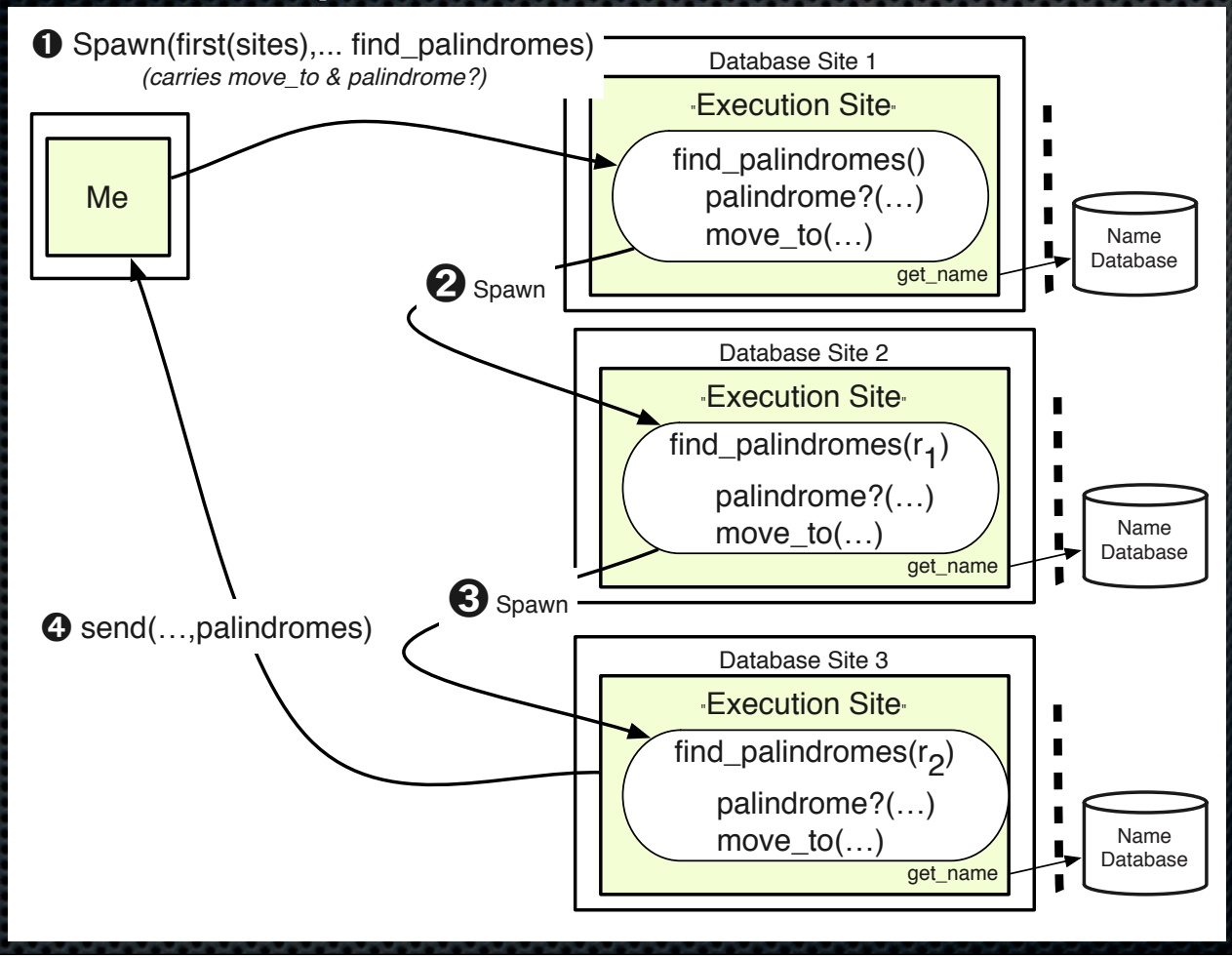

```
let my_results_address = make_curl()
let target = "Taylor, Richard"

define find_name():
        let person = find_person(target)
        send(my_results_address, person)

spawn("example.com:5000",find_name)
...
let person = receive_using(my_results_address)
```

# Ex. 2: Names that are palindromes (“Bob”, “Anna”)




```
define find_palindromes():
        let names = get_names()
        if empty?(names) send(my_results_address, [])
        else
                let palindromes = filter(names, (λs. palindrome?(s, 0, length(s)-1)))
                send(my_results_address, palindromes)
spawn("example.com:5000", find_palindromes)
```

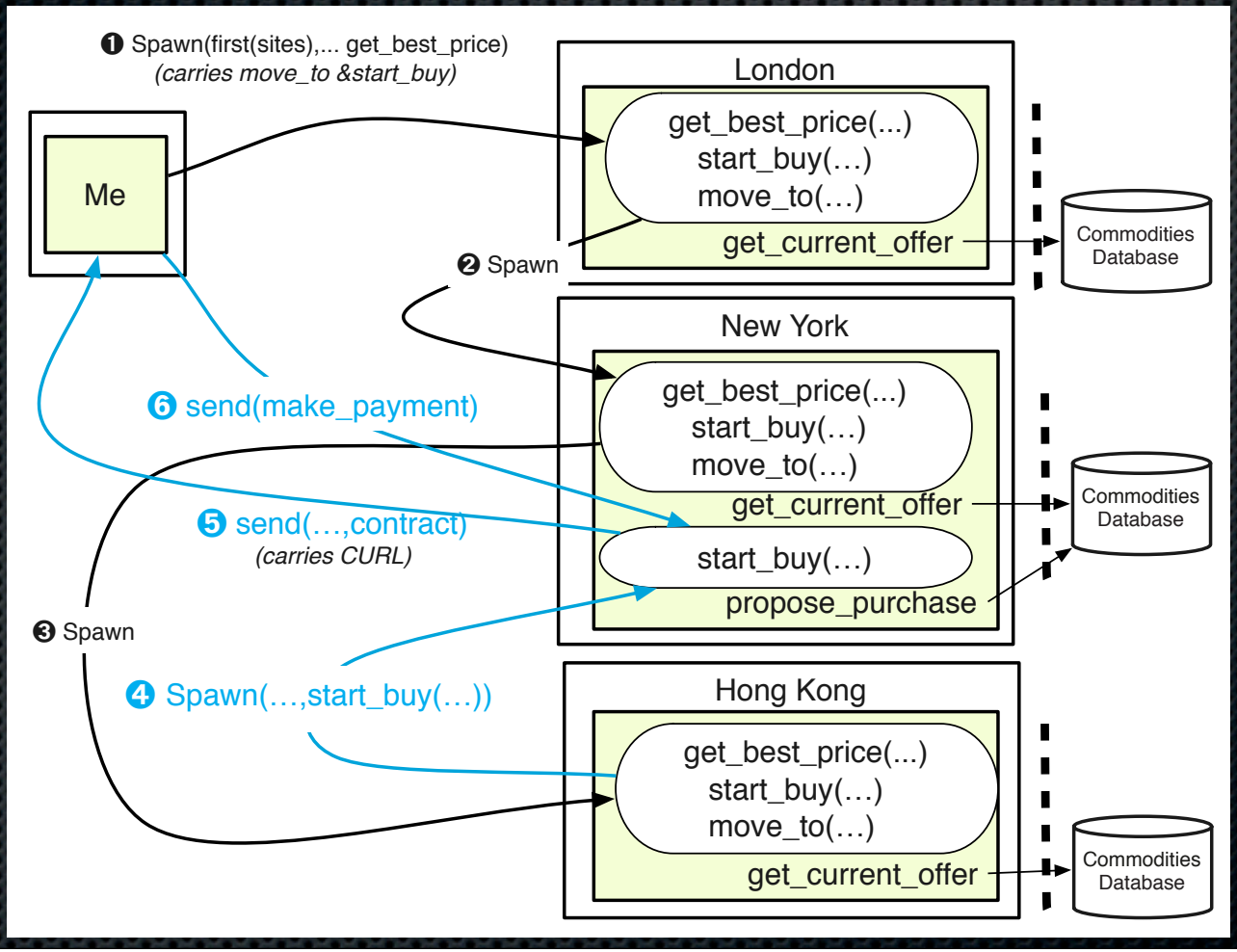
# Ex. 3: Multiple Database Sites



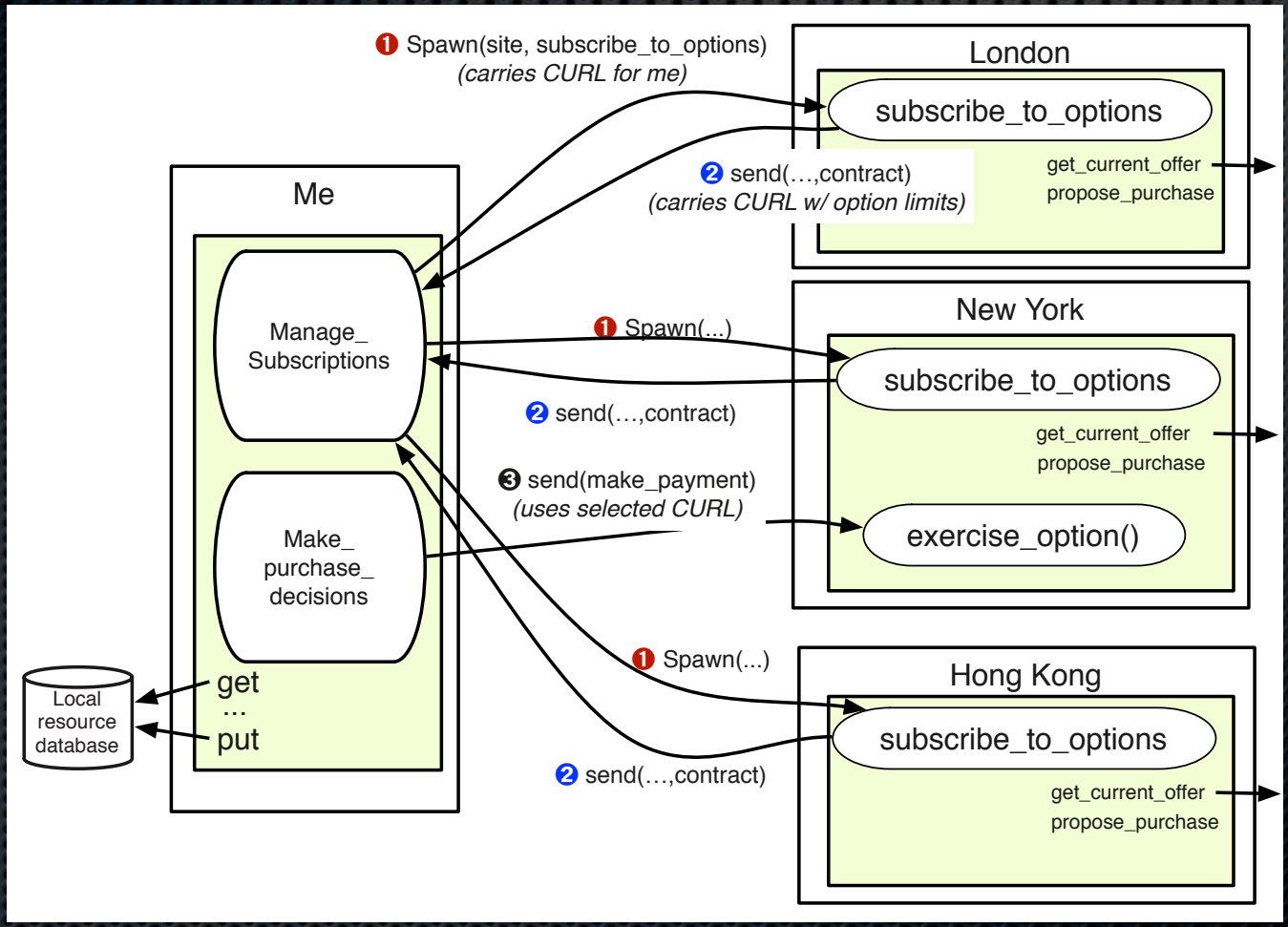
# Design Intuitions #1

- Computations are mobile
- Move computations to where the (big) data is
  - Remember:  networks have real latency!
- Doesn’t have to be a hub-and-spoke architecture

# Ex. 4: Buy Gold


❶ Spawn(first(sites),... get_best_price)
(carries move_to &start_buy)
Me
London
get_best_price(...)
start_buy(…)
move_to(…)
get_current_offer
Commodities Database
❷ Spawn
New York
get_best_price(...)
start_buy(…)
move_to(…)
get_current_offer
start_buy(…)
propose_purchase
Commodities Database
❻ send(make_payment)
❺ send(…,contract)
(carries CURL)
❸ Spawn
❹ Spawn(…,start_buy(…))
Hong Kong
get_best_price(...)
start_buy(…)
move_to(…)
get_current_offer
Commodities Database

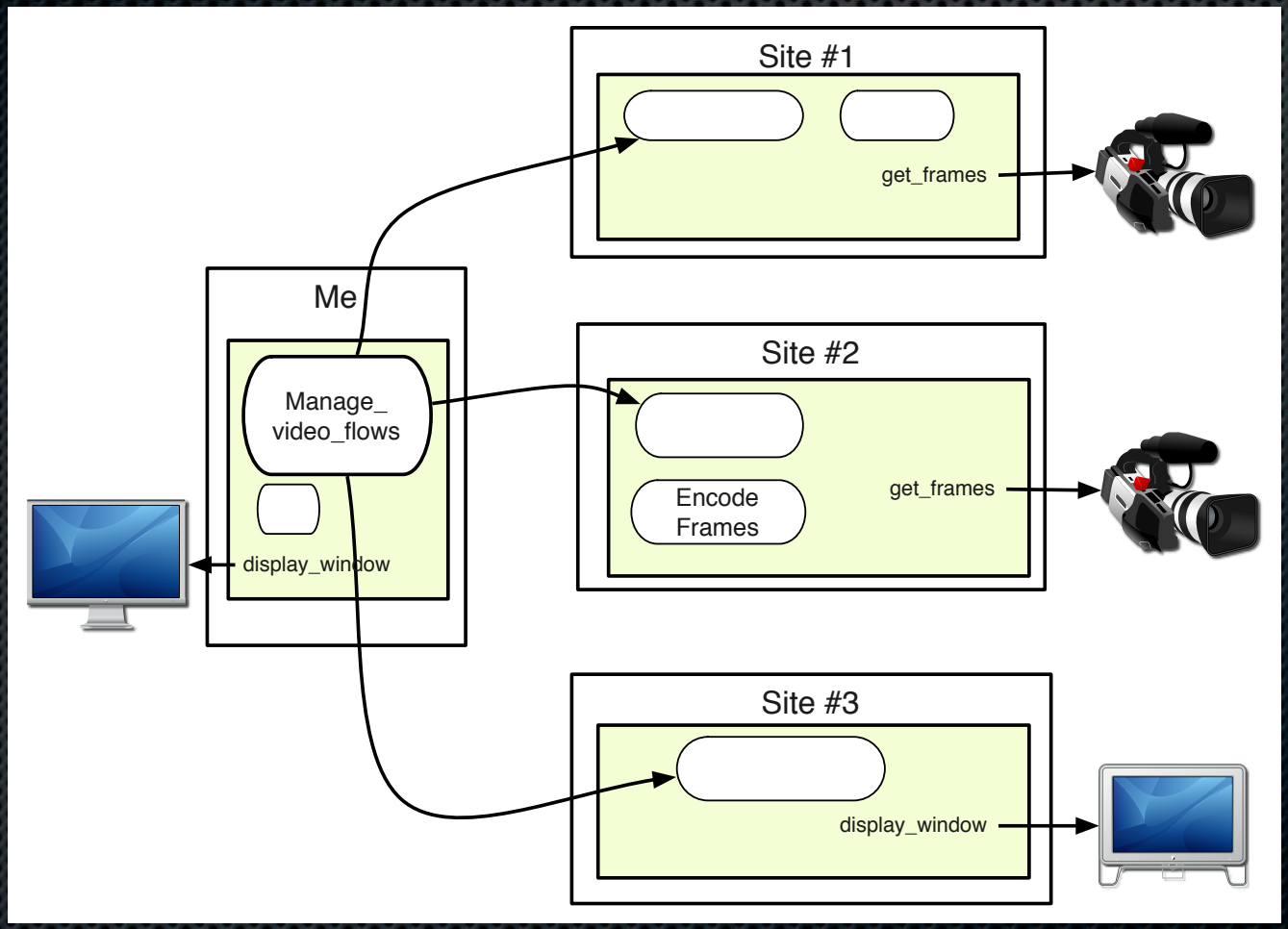
# Ex. 5: Rapid Gold Market



# Design Intuitions #2: CURLs

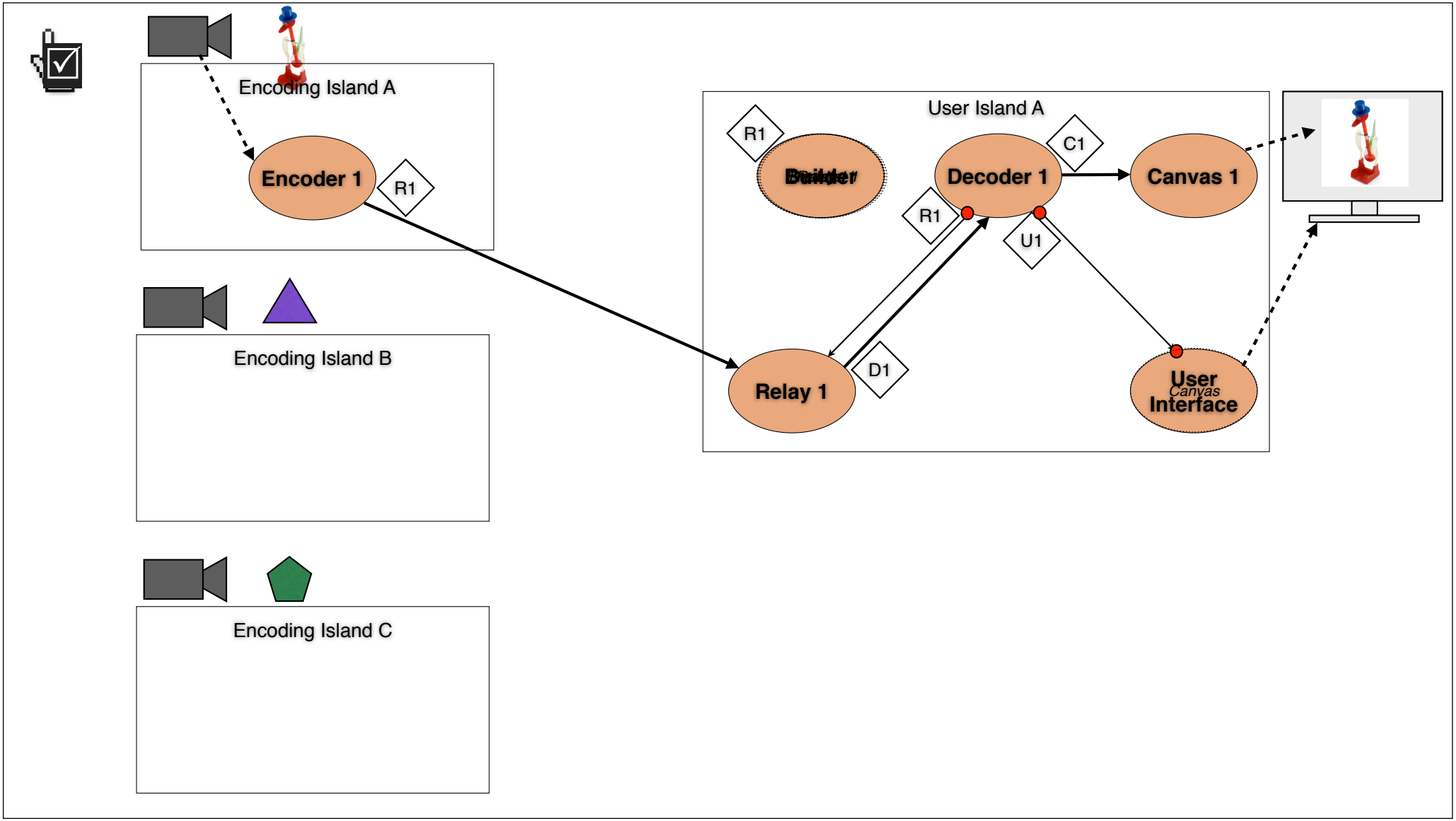
- CURLs convey the right to communicate
- May carry limitations of many varieties
- Can be used to support, e.g., time-limited offers
- Critical to the security model of COAST

# Ex. 6: Video as a “SOA”

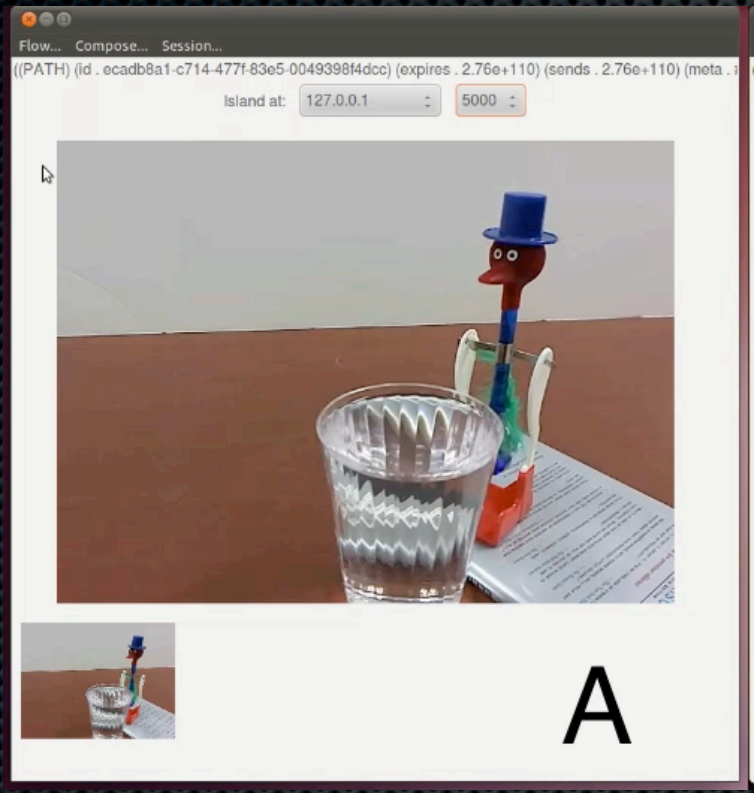


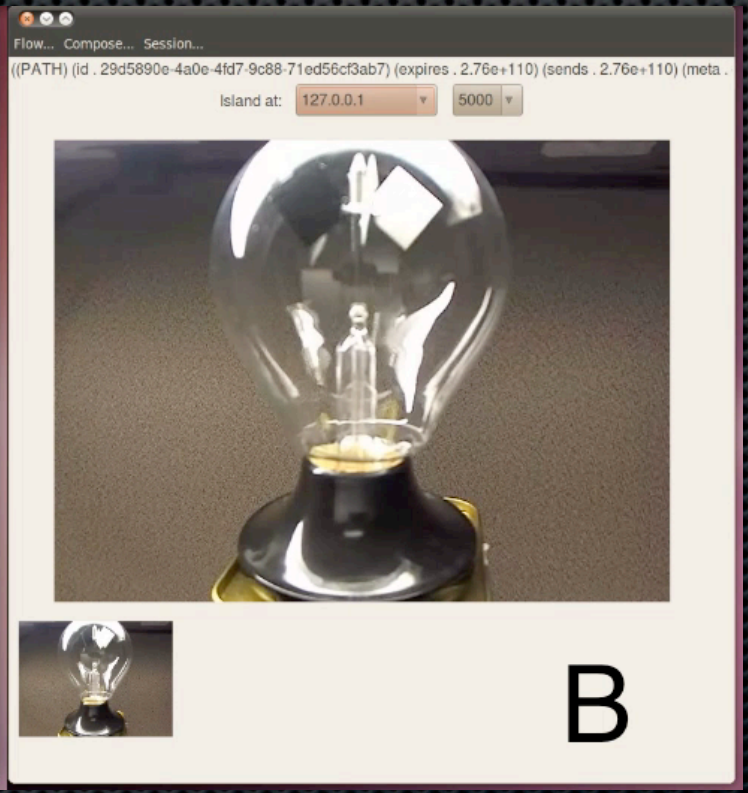
# Ex. 6:  Animated version

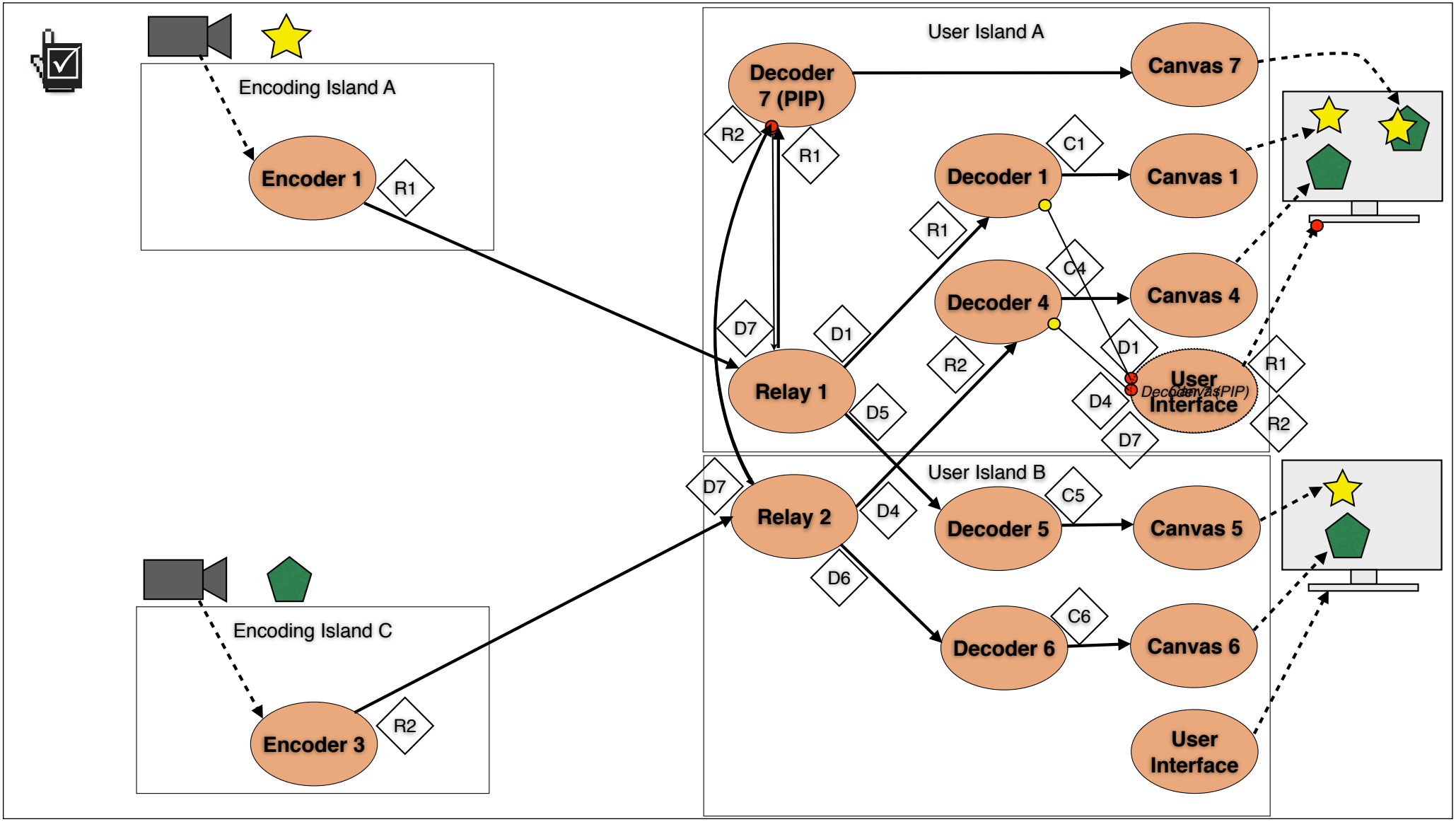
- User starts a client and constructs a video flow
  - Uses local and remote deployment of mobile computations
  - Uses lightweight subscription protocol (also based on mobile code)


Encoding Island A
Encoder 1
R1
Encoding Island B
Encoding Island C
User Island A
R1
Builder
Decoder 1
C1
Canvas 1
R1
U1
Relay 1
D1
User
Canvas
Interface

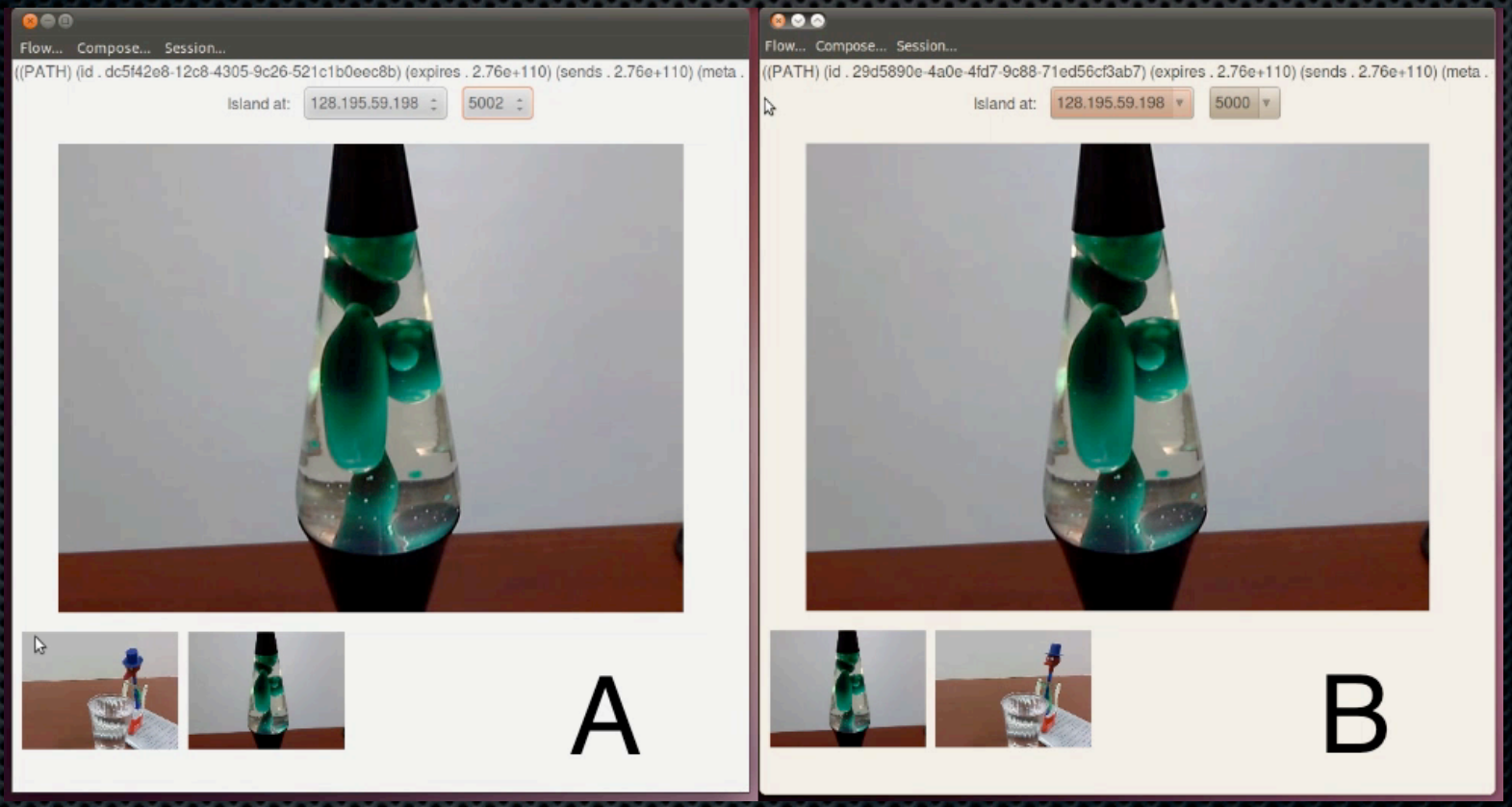
# Ex. 6, Live


Flow... Compose... Session...
((PATH) (id . ecadb8a1-c714-477f-83e5-0049398f4dcc) (expires . 2.76e+110) (sends . 2.76e+110) (meta .
Island at:
127.0.0.1
5000
A


Flow... Compose... Session...
((PATH) (id . 29d5890e-4a0e-4fd7-9c88-71ed56cf3ab7) (expires . 2.76e+110) (sends . 2.76e+110) (meta .
Island at:
127.0.0.1
5000
B

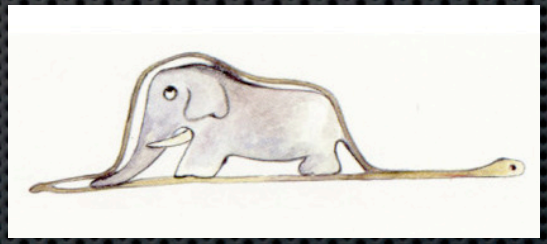

Encoding Island A
Encoder 1
R1
Encoding Island C
Encoder 3
R2
User Island A
Decoder 7 (PIP)
R2
R1
Canvas 7
Decoder 1
C1
Canvas 1
R1
Decoder 4
C4
Canvas 4
D7
D1
Relay 1
D5
R2
D1
D4
D7
User Interface
R1
R2
User Island B
D7
Relay 2
D4
D6
Decoder 5
C5
Canvas 5
Decoder 6
C6
Canvas 6
User Interface

# Ex. 7: Picture-in-Picture



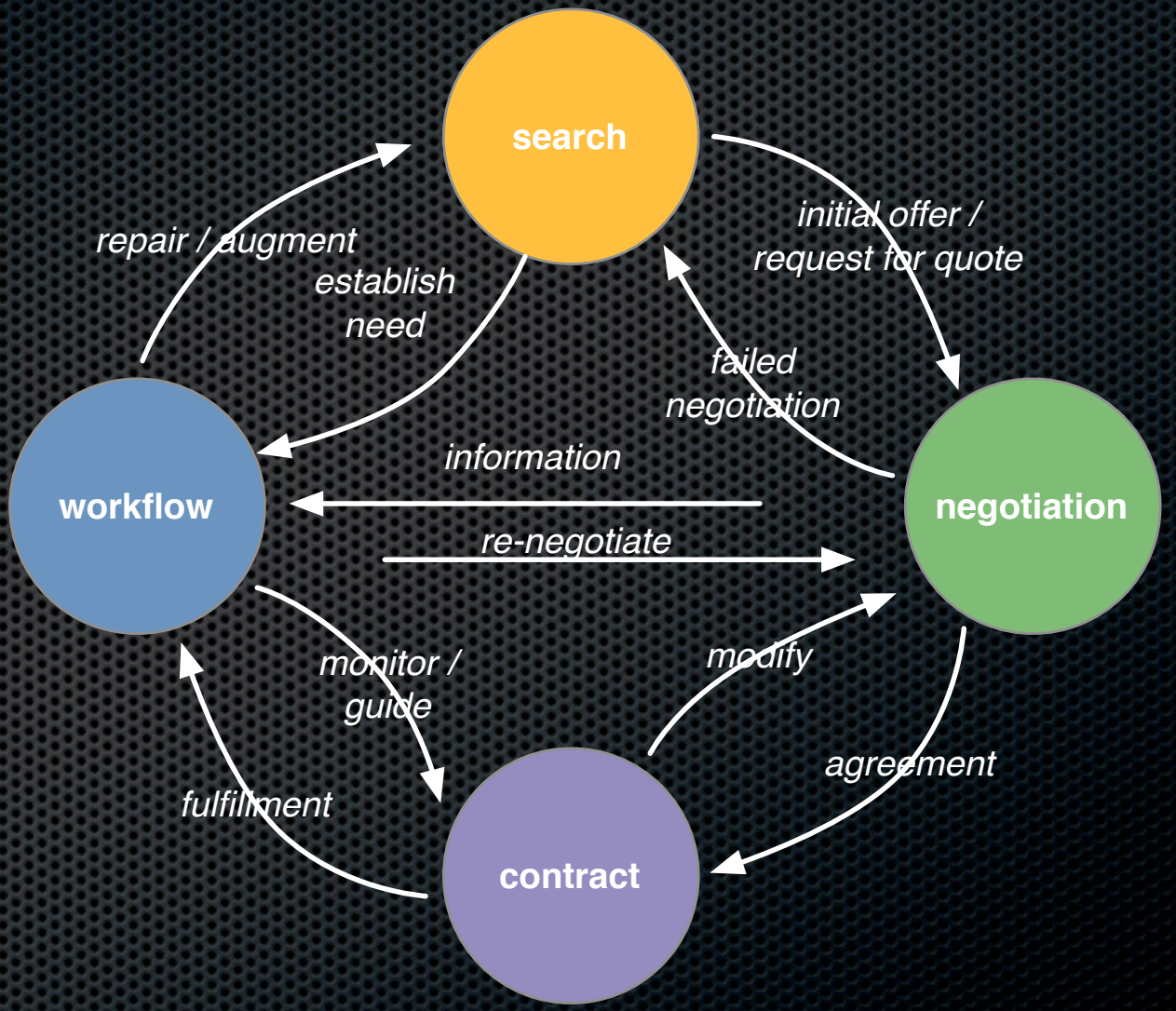
# Take-Aways

- COAST is “performant”
  - Each video frame was shipped as an encrypted closure
  - Security need not unduly impede performance



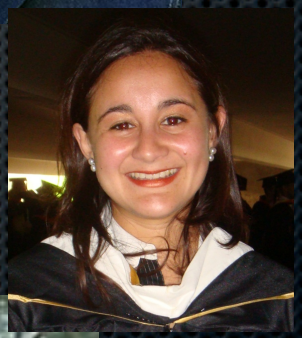
# E-Commerce

- One obvious area of payoff
- Other domains:
  - Process monitoring
  - Energy management
  - Intelligent transportation and vehicle systems
  - Healthcare Systems
  - Games



# COAST Credits

- Michael Gorlick
- Kyle Strasser
- Justin Erenkrantz
- Alegria Baquero



**More Info? Come to the Open House: DBH 5209**