The Design of Scalable Distributed (SD) Erlang

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Design Approach

- Typical hardware architecture
- Scaling
  - Persistent data structures
  - In-memory data structures
  - Computation

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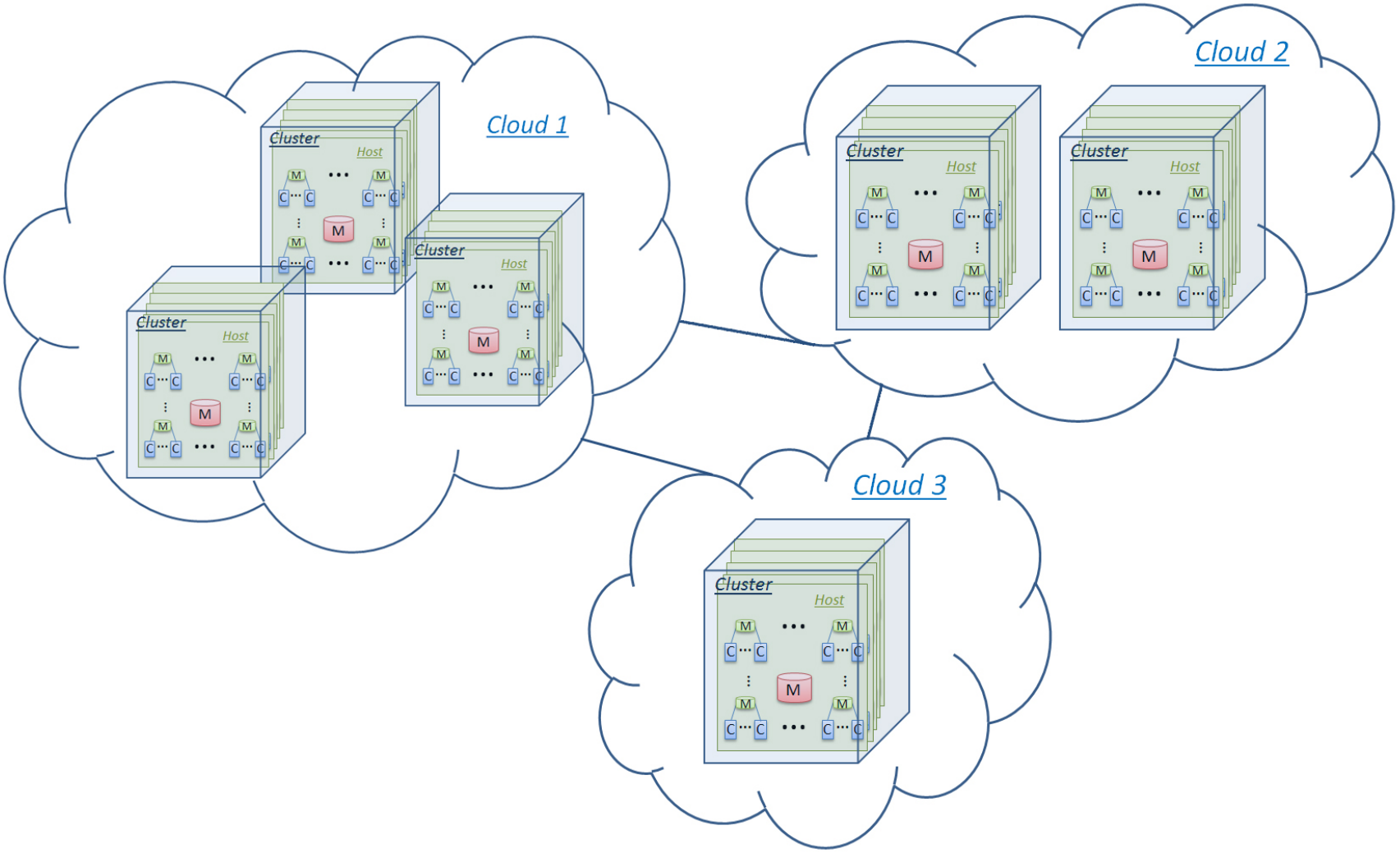
Typical architecture – 10^5 cores



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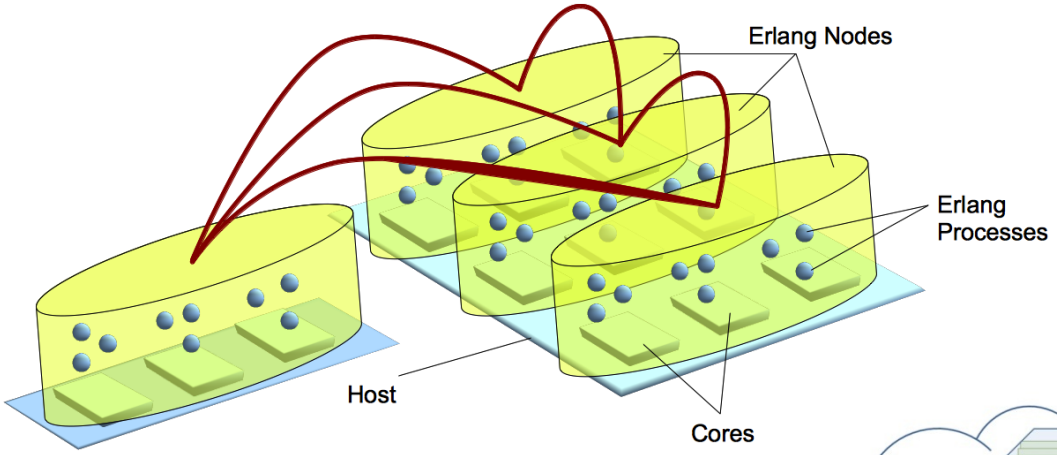
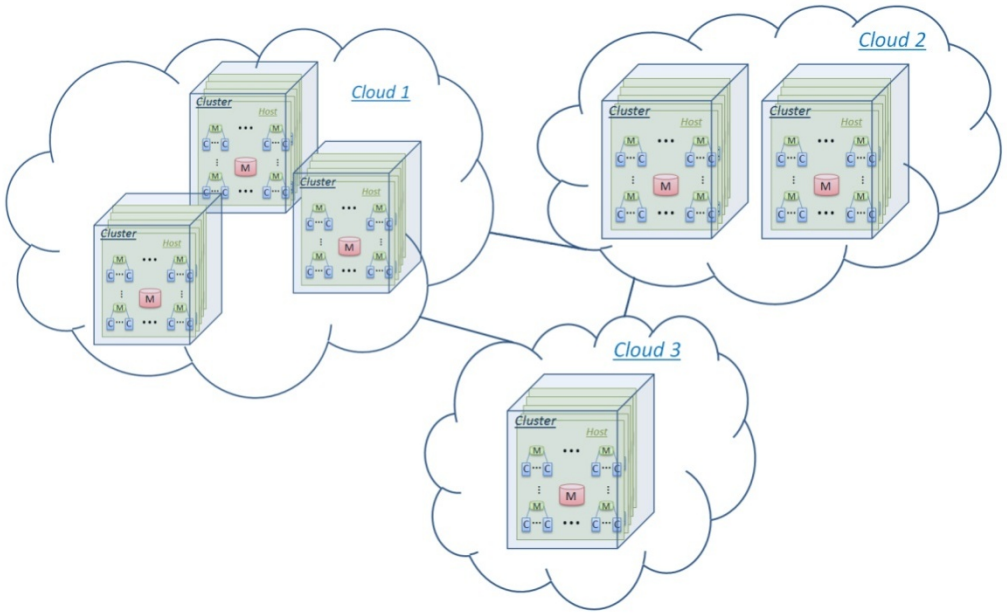
Design Approach

- Typical hardware architecture
- Scaling
  - Persistent data structures
  - In-memory data structures
  - Computation

Distributed Erlang





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Scaling Computation

- Network Scalability
  - All to all connections are not scalable onto 1000s of nodes
  - Aim: Reduce connectivity
- Semi-explicit Placement
  - Becomes not feasible for a programmer to be aware of all nodes
  - Aim: Automatic process placement in groups of nodes

Design Principles

General:

- Working at Erlang level as far as possible
- Preserving the Erlang philosophy and programming idioms
- Minimal design changes

Design Principles

Reliable Scalability:

- Avoiding global sharing
- Avoiding explicit prescription
- Introducing an abstract notion of communication architecture
- Keeping Erlang reliability model unchanged as far as possible

Network Scalability

- Grouping nodes in Scalable groups (s_groups)
  - **transitive** connections with nodes of the same s_group
  - **non-transitive** connections with other nodes
- Types of s_groups:
  - Hierarchical
  - **Overlapping**
  - Partition
- Using **s_group** variables instead of **global** variables: *Var@Group*

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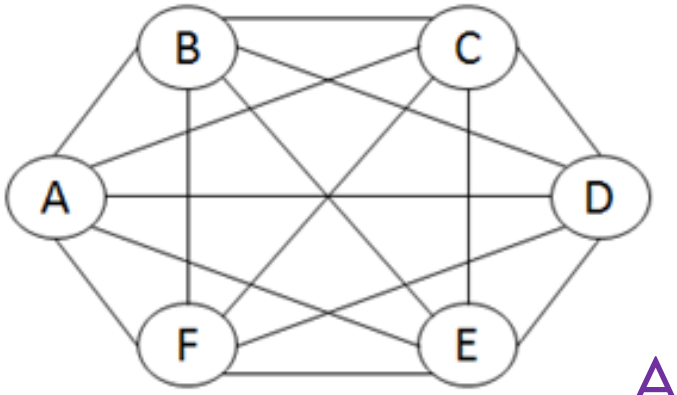
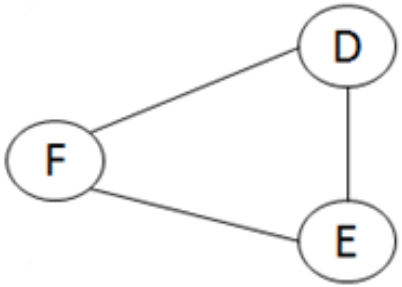
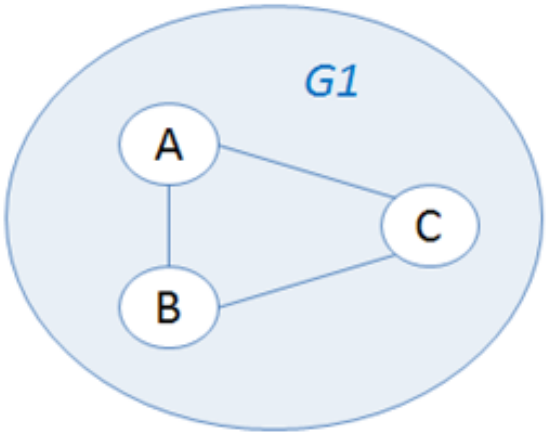
Creating an s_group



a)

A: new_s_group(G1, [A, B, C]).





b)

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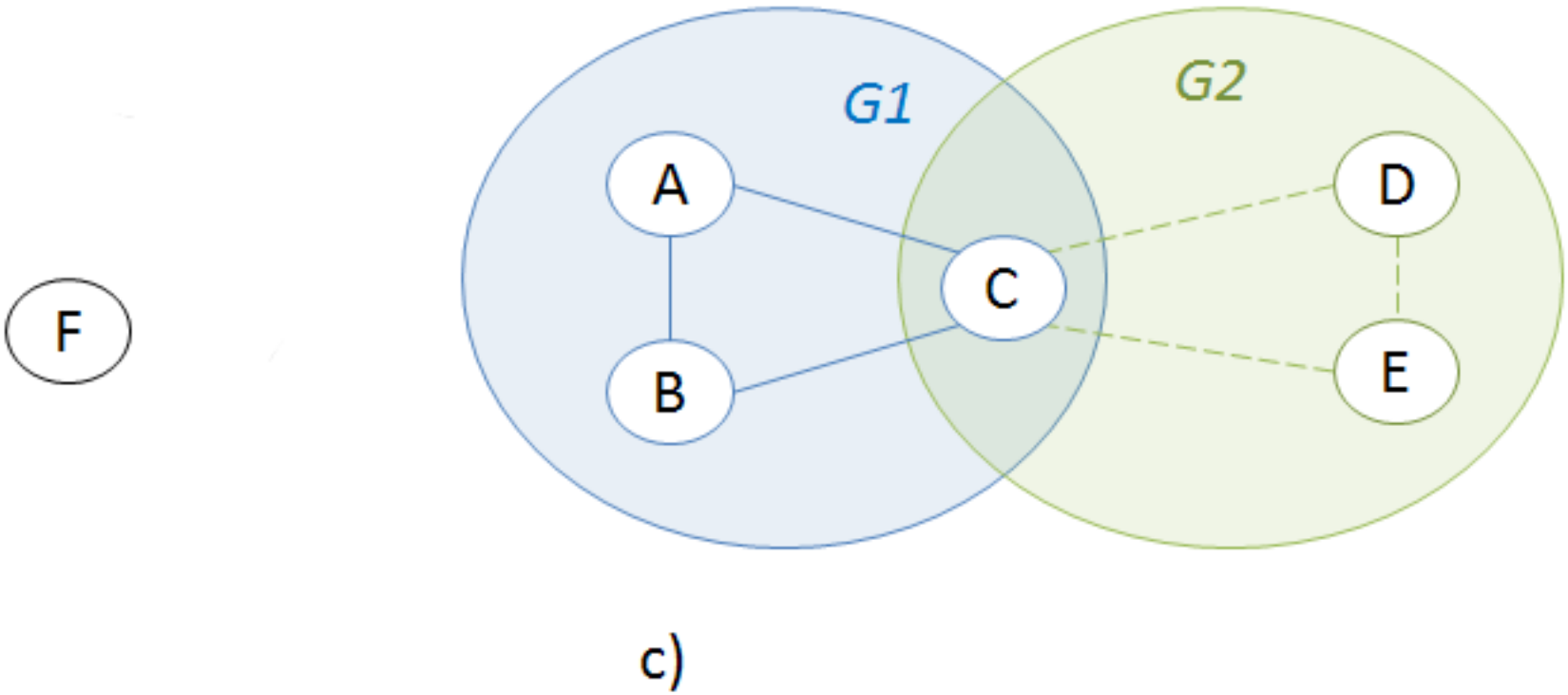
Overlapping Groups & Non-transitive Connections

C: new_s_group(G2, [C, D, E]).



c)

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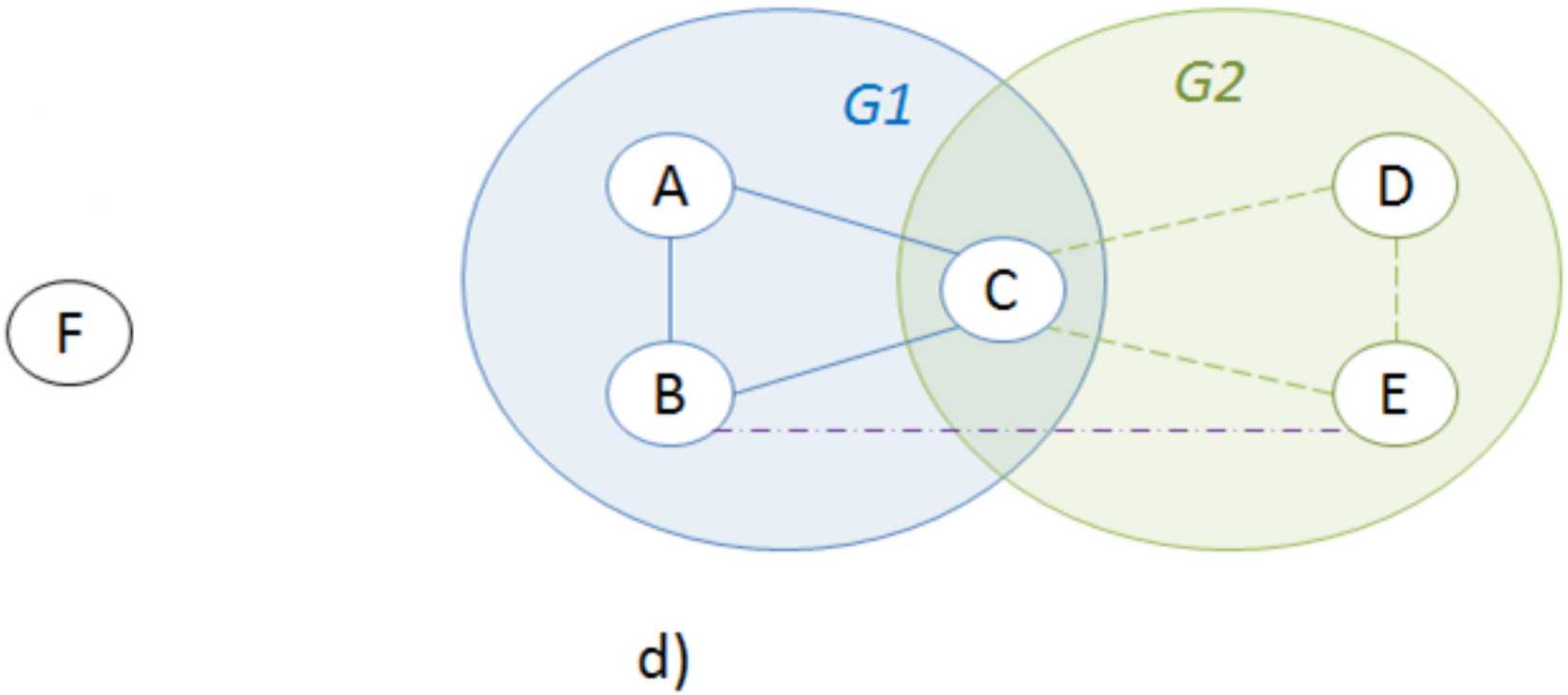
Any to Any Connection

B: spawn(E, *f*).



d)

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s_group Functions (1)

- Creating a new s_group

  new_s_group(S_GroupName, [Node]) -> true | *{error, ErrorMsg}*

- Deleting an s_group

  del_s_group(S_GroupName) -> true | *{error, ErrorMsg}*

- Adding new nodes to an existing s_group

  add_node_s_group(S_GroupName, [Node]) -> true | *{error,* ErrorMsg*}*

- Removing nodes from an existing s_group

  remove_node_s_group(S GroupName, [Node]) -> true | *{error,* ErrorMsg*}*

s_group Functions (2)

- Monitoring all nodes of an s_group

  monitor_s_group(S_GroupName) -> ok | *{error, ErrorMsg}*

- Sending a message to all nodes of an s_group

  send_s_group(S_GroupName, Msg) -> Pid | *{badarg, Msg}* *{error, ErrorMsg}*

- Listing nodes of a particular s_group

  s_group_nodes(S_GroupName) -> [Node] | *{error, ErrorMsg}*

- Listing s_groups that a particular node belongs to

  node_s_group_info(Node) -> [S_GroupName]

Scaling Computation

- Semi-explicit Placement
  - Becomes not feasible for a programmer to be aware of all nodes and place each of them explicitly
  - Aim: Automatic process placement

chose_node/1

```
chose_node(Restrictions) -> node()

Restrictions = [Restriction]

Restriction = {s_group, S_Group}
            | {min_dist, MinDist :: integer() >= 0}
            | {max_dist, MaxDist :: integer() >= 0}
            | {ideal_dist, IdealDist :: integer() >= 0}


start() ->
        TargetNode = chose_node({s_group, S_Group},
        {ideal_dist, IdealDist}),

        spawn(TargetNode, fun() -> loop() end).
```

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Thank you!