Cloud Foundryの死活監視

@Kuruma

本スライドは下記URIで公開しています:

http://bit.ly/cfcrjp03-kuruma

http://kuruman.org/diary/2011/12/15/file/cloud-foundry-reading_kuruma.pdf

# whoami

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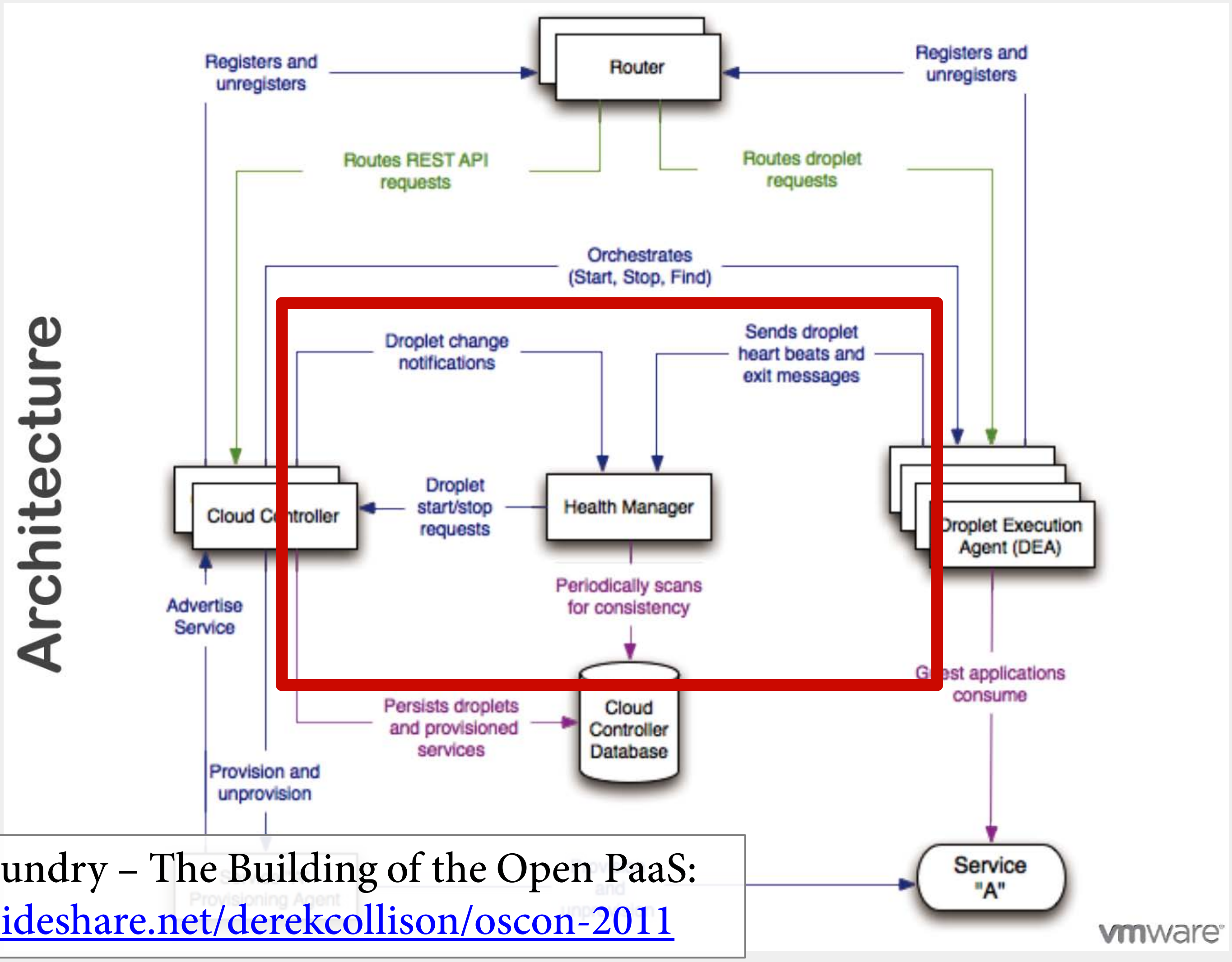
  - Web Accessibilityに始まり下へ下へ
  - twitter.com/Kuruma
  - kuruman.org

今回の範囲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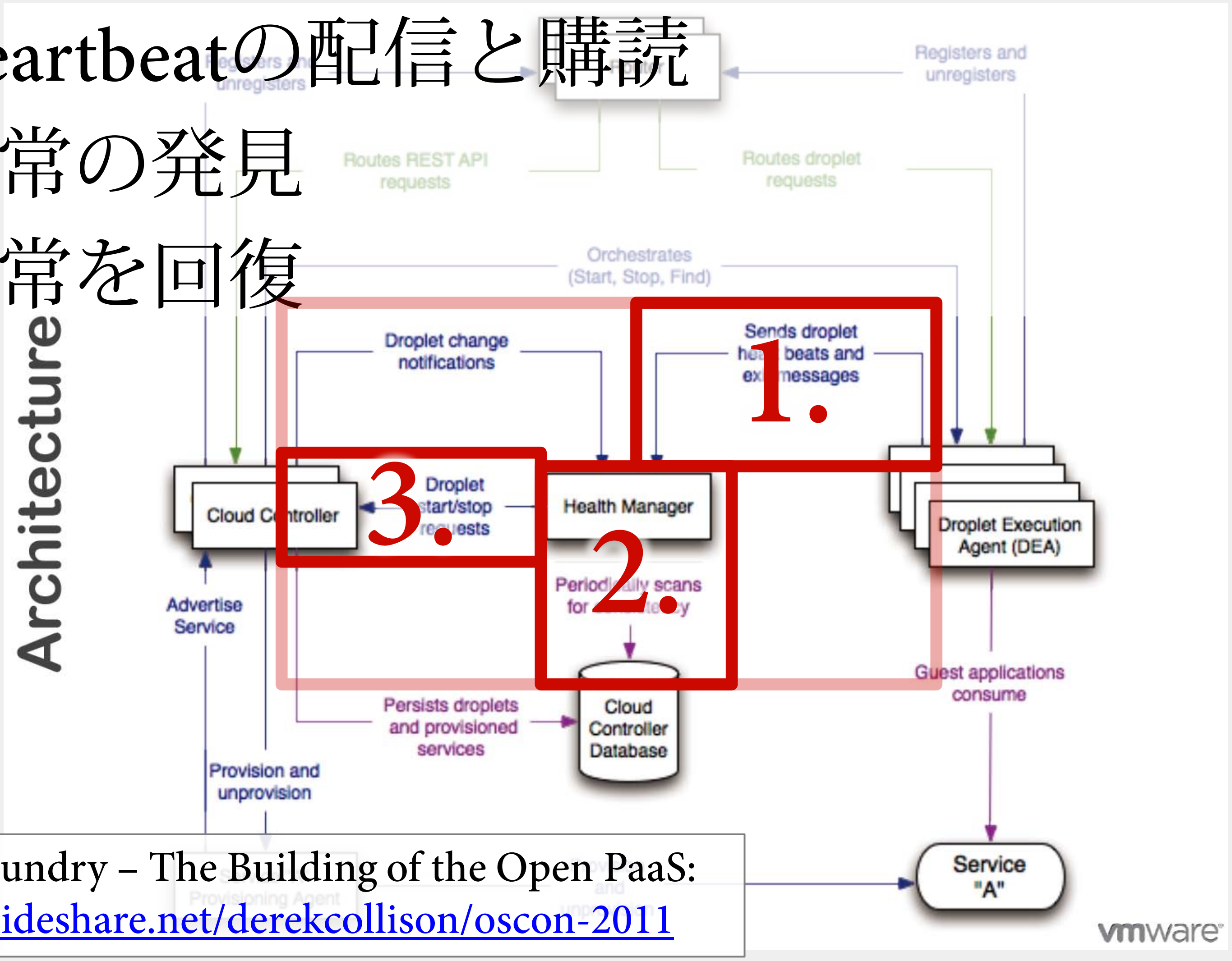
Provisioning Agent
Service "A"
vmware

via. Cloud Foundry – The Building of the Open PaaS: http://www.slideshare.net/derekcollison/oscon-2011

概観

1. Heartbeatの配信と購読
2. 異常の発見
3. 異常を回復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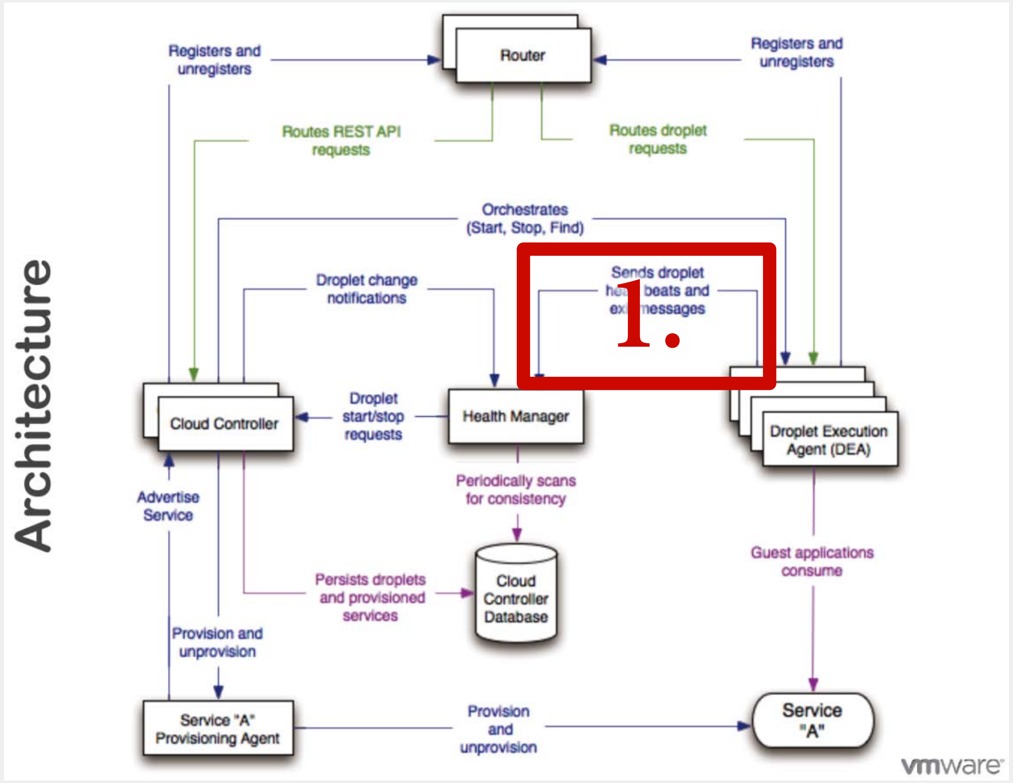
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@DEA

1-1. HEARTBEATの配信

DEAが定期的に状態を配信

- Heartbeatの配信
- アプリケーションの動作状況確認

```
MONITOR_INTERVAL = 2 # 2 secs
CRASHES_REAPER_INTERVAL = 30 # 30 secs
def initialize(config)
  ……
  @heartbeat_interval = config[‘intervals’][‘heartbeat’] #= 10
  ……
end
def run()
  ……
  EM.add_periodic_timer(@heartbeat_interval)  { send_heartbeat }
  EM.add_timer(MONITOR_INTERVAL) { monitor_apps }
  EM.add_periodic_timer(CRASHES_REAPER_INTERVAL) { crashes_reaper }
  ……
end
```

vcap/dea/lib/dea/agent.rb

Heartbeatの配信

- 何かインスタンスが動作している時
- 動作するインスタンスそれぞれについて
- Heartbeatを生成して
- publish

```
def send_heartbeat
  return if @droplets.empty? || @shutting_down
  heartbeat = {:droplets => []}
  @droplets.each_value do |instances|
    instances.each_value do |instance|
      heartbeat[:droplets] << generate_heartbeat(instance)
    end
  end
  NATS.publish('dea.heartbeat', heartbeat.to_json)
end
```

vcap/dea/lib/dea/agent.rb

Heartbeat (Hash)

- 状態 (Symbol)
  - :STARTING, :RUNNING, :CRASHED, :STOPPED, :SHUTTING_DOWN
- 状態の最終更新時刻 (Time#to_i)

```ruby
def generate_heartbeat(instance)
  {
    :droplet => instance[:droplet_id],
    :version => instance[:version],
    :instance => instance[:instance_id],
    :index => instance[:instance_index],
    :state => instance[:state],
    :state_timestamp => instance[:state_timestamp]
  }
end
```

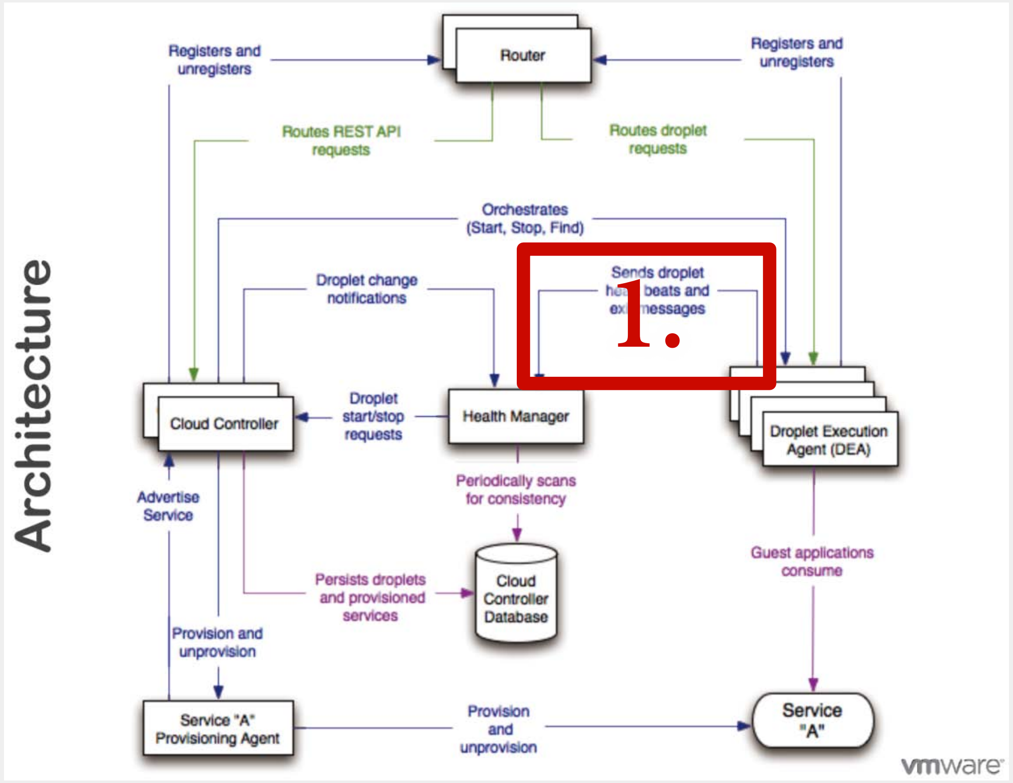
vcap/dea/lib/dea/agent.rb

アプリケーションの動作状況確認

- シェルを叩くだけ (ps, du)

```
def monitor_apps(startup_check = false)
  ……
  process_statuses = `ps axo pid=,ppid=,pcpu=,rss=,user=`.split("¥n")
  ……
    du_proc = proc do |p|
      p.send_data("cd #{@apps_dir}¥n")
      p.send_data("du -sk * 2> /dev/null¥n")
      p.send_data("exit¥n")
    end
    cont_proc = proc do |output, status|
      monitor_apps_helper(startup_check, start, du_start, output,
pid_info, user_info)
    end
    EM.system('/bin/sh', du_proc, cont_proc)
  ……
end
```

vcap/dea/lib/dea/agent.rb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@HealthManager

1-2. HEARTBEATの購読

Heartbeatの購読

```
def run
  ……
  NATS.start(:uri => @config['mbus']) do
    ……
    subscribe_to_messages
  end
end
```

```
def subscribe_to_messages
  ……
  NATS.subscribe('dea.heartbeat') do |message|
      @logger.debug("heartbeat: #{message}")
      process_heartbeat_message(message)
  end
  ……
end
```

vcap/health_manager/lib/health_manager.rb

Heartbeat受信時の処理

- 状態等に応じて5通りに分岐

```
def process_heartbeat_message(message)
  ……
  parse_json(message)['droplets'].each do |heartbeat|
  droplet_id = heartbeat['droplet']
  instance = heartbeat['instance']
  droplet_entry = @droplets[droplet_id]
  if droplet_entry
    ……
    state = heartbeat['state']
    if RUNNING_STATES.include?(state)
      ……
    elsif state == CRASHED
      ……
    end
  else
    ……
  end
end
```

vcap/health_manager/lib/health_manager.rb

HealthManagerに於ける状態定義等

- APP_STABLE_STATE (droplet)
- RUNNING_STATE (instance)
- RESTART_REASONS (instance)

```ruby
# TODO - Oh these need comments so badly..
DOWN                  = 'DOWN'
STARTED               = 'STARTED'
STOPPED               = 'STOPPED'
CRASHED               = 'CRASHED'
STARTING              = 'STARTING'
RUNNING               = 'RUNNING'
FLAPPING              = 'FLAPPING'
DEA_SHUTDOWN          = 'DEA_SHUTDOWN'
DEA_EVACUATION        = 'DEA_EVACUATION'
APP_STABLE_STATES = Set.new([STARTED, STOPPED])
RUNNING_STATES        = Set.new([STARTING, RUNNING])
RESTART_REASONS       = Set.new([CRASHED, DEA_SHUTDOWN, DEA_EVACUATION])
```

vcap/health_manager/lib/health_manager.rb

1. droplet_entry存在せず

- HealthManagerが知らないインスタンス停止

```
def process_heartbeat_message(message)
  ……
  if droplet_entry
    ……
  else
    instance_uptime = Time.now.to_i - heartbeat['state_timestamp']
    health_manager_uptime = Time.now.to_i - @started
    threshold = @database_scan * 2

    if health_manager_uptime > threshold
           && instance_uptime > threshold
      @logger.info("Stopping unknown app: #{droplet_id}/#{instance}.")
      stop_instances(droplet_id, [instance])
    end
  end
end
```

vcap/health_manager/lib/health_manager.rb

2. 意図せぬインスタンスが起動中

- 当該インスタンスを終了
  - 起動しすぎた時、等
  - stop_instancesについては後述

```
def process_heartbeat_message(message)
  ……
    if RUNNING_STATES.include?(state)
      ……
      if index_entry[:state] == RUNNING
             && index_entry[:instance] != instance
        stop_instances(droplet_id, [instance])
      else
        ……
      end
    elsif state == CRASHED
  ……
end
```

vcap/health_manager/lib/health_manager.rb

3. 意図通り起動中または起動済

- タイムスタンプを更新
  - flippingを検知する際等に使用

```
def process_heartbeat_message(message)
  ……
    if RUNNING_STATES.include?(state)
      ……
      if index_entry[:state] == RUNNING
              && index_entry[:instance] != instance
        ……
      else
        index_entry[:instance] = instance
        index_entry[:timestamp] = Time.now.to_i
        index_entry[:state] = state.to_s
        index_entry[:state_timestamp] = heartbeat['state_timestamp']
      end
    elsif state == CRASHED
  ……
end
```

vcap/health_manager/lib/health_manager.rb

4. CRASHED

- クラッシュしたインスタンスとして格納
  - droplet_entry = @droplets[droplet_id]
- 一定時間以上経過後に削除

```
def process_heartbeat_message(message)
  ……
    if RUNNING_STATES.include?(state)
        ……
    elsif state == CRASHED
      droplet_entry[:crashes][instance] = {
        :timestamp => Time.now.to_i,
        :crash_timestamp => heartbeat['state_timestamp']
      }
    end
  ……
end
```

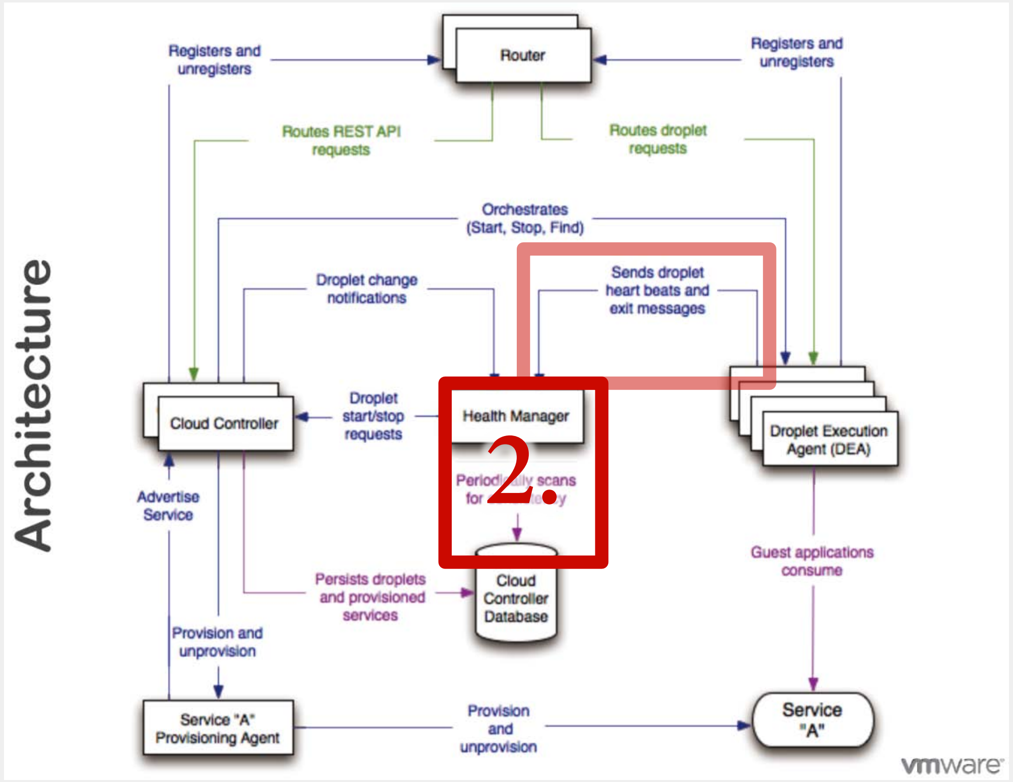
vcap/health_manager/lib/health_manager.rb

5. それ以外の状態

- 何もしない

```
def process_heartbeat_message(message)
  ……
  if droplet_entry
    ……
    state = heartbeat['state']
    if RUNNING_STATES.include?(state)
      ……
    elsif state == CRASHED
      ……
    end
  else
    ……
  end
end
```

vcap/health_manager/lib/health_manager.rb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2. 異常の発見

HealthManagerのバッチ処理

- DB情報取得、アプリケーション分析と記録

```
def run
  ……
    configure_timers
  ……
end
```

```
def configure_timers
  EM.next_tick { update_from_db }
  EM.add_periodic_timer(@database_scan) { update_from_db }
  ……
  EM.next_tick { analyze_all_apps(collect_stats = false) }
  ……
  EM.add_timer(@droplet_lost) do
    EM.add_periodic_timer(@droplets_analysis) { analyze_all_apps }
  end
  ……
end
```

vcap/health_manager/lib/health_manager.rb

アプリケーションの状態把握

- 初回は個々のアプリケーションを見ない
  - collect_stats: 初回はfalse

```
def analyze_all_apps(collect_stats = true)
  ……
  instances = crashed = 0
  stats =
      {:running => 0, :down => 0, :frameworks => {}, :runtimes => {}}
  @droplets.each do |id, droplet_entry|
    analyze_app(id, droplet_entry, stats) if collect_stats
    instances += droplet_entry[:instances]
    crashed += droplet_entry[:crashes].size if droplet_entry[:crashes]
  end
  VCAP::Component.varz[:total_apps] = @droplets.size
  VCAP::Component.varz[:total_instances] = instances
  VCAP::Component.varz[:crashed_instances] = crashed
  ……
end
```

vcap/health_manager/lib/health_manager.rb

個々のアプリケーション状態記録

```
def analyze_all_apps(collect_stats = true)
  ……
  @droplets.each do |id, droplet_entry|
    analyze_app(id, droplet_entry, stats) if collect_stats
    ……
  end
  ……
  if collect_stats
    VCAP::Component.varz[:running_instances] = stats[:running]
    VCAP::Component.varz[:down_instances] = stats[:down]
    VCAP::Component.varz[:running][:frameworks] = stats[:frameworks]
    VCAP::Component.varz[:running][:runtimes] = stats[:runtimes]
    @logger.info("Analyzed #{stats[:running]} running and #{stats[:down]} down apps in #{elapsed_time_in_ms(start)}")
  else
    @logger.info("Analyzed #{@droplets.size} apps in #{elapsed_time_in_ms(start)}")
  end
end
```

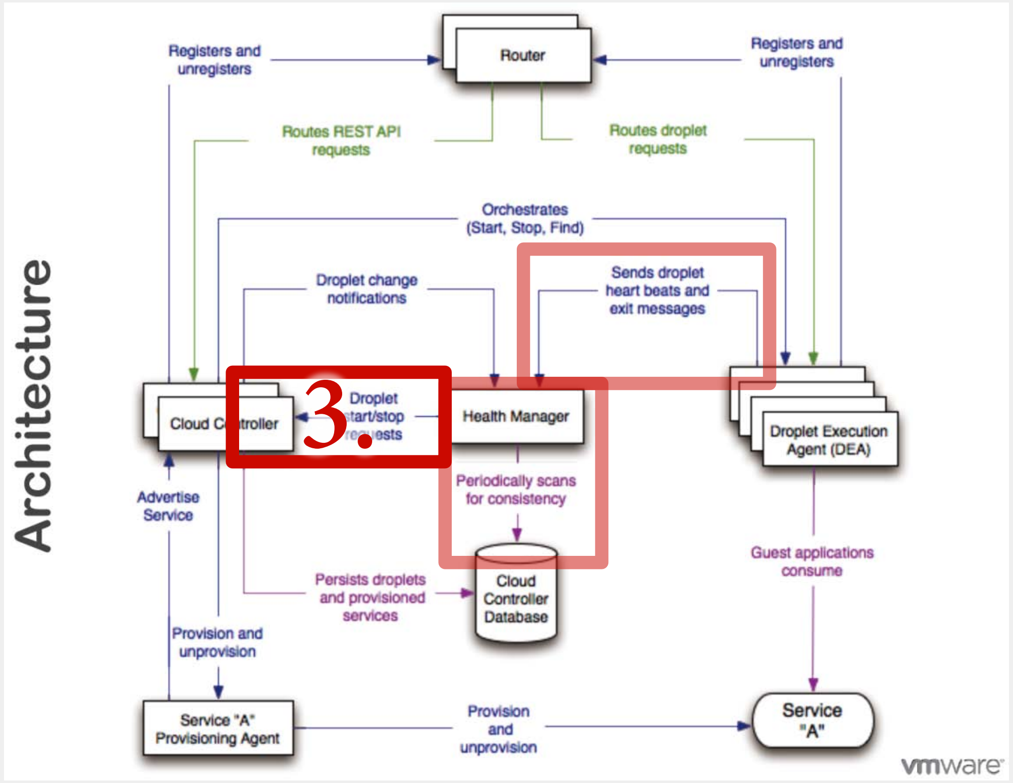
vcap/health_manager/lib/health_manager.rb

個々のアプリケーション分析

- 状態変更、必要な起動・終了

```
def analyze_app(app_id, droplet_entry, stats)
  now = Time.now.to_i
  update_timestamp = droplet_entry[:last_updated]
  quiescent = (now - update_timestamp) > @stable_state
  if APP_STABLE_STATES.include?(droplet_entry[:state]) && quiescent
    extra_instances = []
    missing_indices = []
    ……
    if missing_indices.any?
      start_instances(app_id, missing_indices)
    end
    if extra_instances.any?
      stop_instances(app_id, extra_instances)
    end
  end
end
```

vcap/health_manager/lib/health_manager.rb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3. 異常を回復

インスタンスの終了

- NATSでインスタンスの終了を通知
  - CloudControllerが通知を受け取る
  - 実際の終了処理はCloudControllerから

```
def stop_instances(droplet_id, instances)
  droplet_entry = @droplets[droplet_id]
  last_updated = droplet_entry ? droplet_entry[:last_updated] : 0
  stop_message = {
    :droplet => droplet_id,
    :op => :STOP,
    :last_updated => last_updated,
    :instances => instances
  }.to_json
  NATS.publish('cloudcontrollers.hm.requests', stop_message)
  @logger.info("Requesting the stop of extra instances: #{stop_message}")
end
```

vcap/health_manager/lib/health_manager.rb

インスタンスの開始

- 設定によって2種類のフローが存在

```
def start_instances(droplet_id, indices)
  droplet_entry = @droplets[droplet_id]
  start_message = {
    :droplet => droplet_id,
    :op => :START,
    :last_updated => droplet_entry[:last_updated],
    :version => droplet_entry[:live_version],
    :indices => indices
  }
  if queue_requests?
    queue_request(start_message)
  else
    #old behavior: send the message immediately
    NATS.publish('cloudcontrollers.hm.requests', start_message.to_json)
    @logger.info("Requesting the start of extra instances: #{start_message}")
  end
end
```

vcap/health_manager/lib/health_manager.rb

インスタンス開始キュー

- 標準では20ms毎にインスタンス開始を通知

```ruby
def queue_requests?
  @request_queue_interval != 0
end
```

```ruby
def initialize(config)
  ……
  @request_queue_interval = config['intervals']['request_queue']
                                || 0.02
  ……
end
```

```ruby
def queue_request message
  #the priority is higher for older items, to de-prioritize flapping items
  priority = Time.now.to_i - message[:last_updated]
  priority = 0 if priority < 0 #avoid timezone drama
  key = message.clone
  key.delete :last_updated
  @logger.info("Queueing priority '#{priority}' request: #{message}, using key: #{key}. Queue size: #{@request_queue.size}")
  @request_queue.insert(message, priority, key)
end
```

vcap/health_manager/lib/health_manager.rb

インスタンス開始キューの消化

```
def run
  ……
    configure_timers
  ……
end
```

```
def configure_timers
  ……
  if queue_requests?
    EM.add_periodic_timer(@request_queue_interval) do
      unless @request_queue.empty?
        #TODO: if STOP requests are also queued, refactor this to be generic, particularly the log message
        start_message = encode_json(@request_queue.remove)
        NATS.publish('cloudcontrollers.hm.requests', start_message)
        @logger.info("Requesting the start of missing instances: #{start_message}")
        VCAP::Component.varz[:queue_length] = @request_queue.size
      end
    end
  end
end
```

vcap/health_manager/lib/health_manager.rb

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