

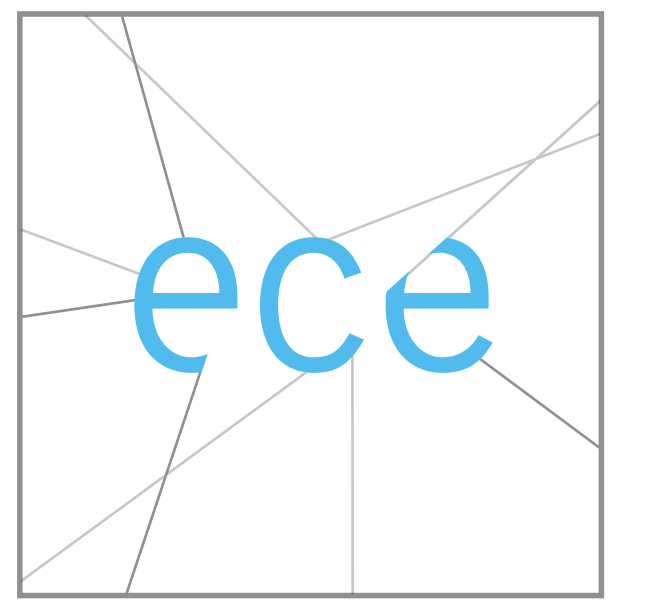


Towards a Distributed and Self-Adaptable Cloud-Edge Middleware

SEC 2018, Bellevue, WA, USA

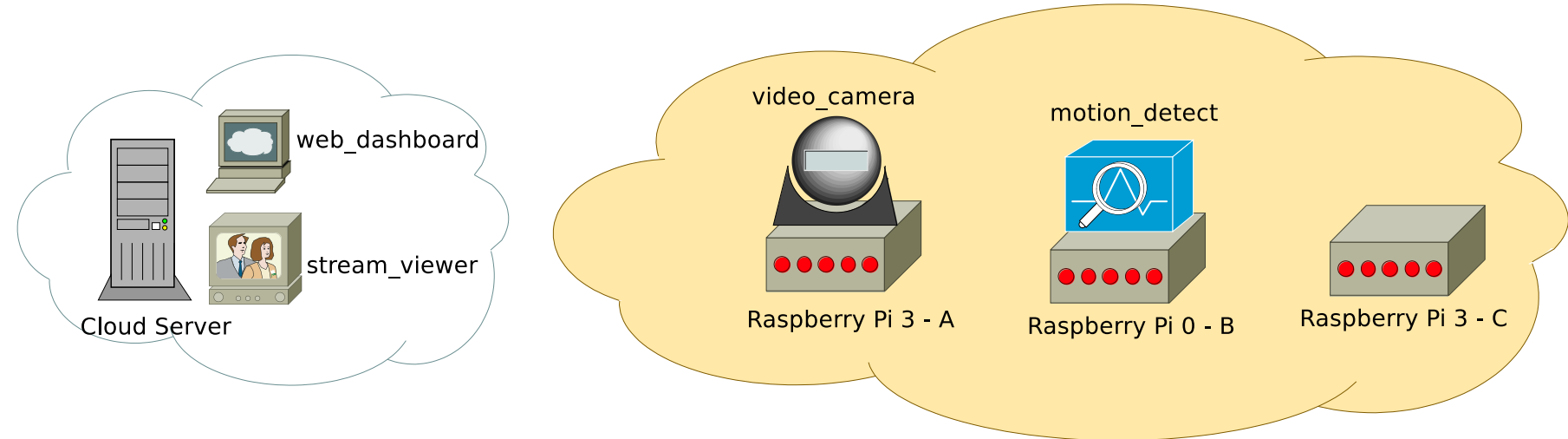
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ThingsJS: a self-adaptive cloud-edge middleware for designing and running high-level, complex JavaScript applications on the IoT devices themselves.

Motivational Example: Motion Detection for Videosurveillance in the edge



ThingsJS: A Cloud-Edge Framework

ThingsJS Application: Contains Several Components (Motion Detection example)

Source Code (JavaScript)

```
function streamVideo(duration, start, fps, callback){
  var interval = fps ? Math.round(1000/fps) : 500;
  var counter = 0;
  var offset = (start || 0) * 1000;

  function capture(){
    captureFrame(counter+offset)
      .then(function(frame){
        pubsub.publish(channel, frame, true);
      })
    counter += interval;
  }

  setTimeout(capture, interval);

  if (counter > duration*1000){
    counter = 0;
  }

  capture();
}
```

video_streamer.js

```
function detectMotion(bufs){
  if (bufs.length > 3){
    var frame1 = jimp.read(Buffer.from(bufs[0], 'base64')); // jimp.read returns a promise
    var frame2 = jimp.read(Buffer.from(bufs[1], 'base64'));
    var frame3 = jimp.read(Buffer.from(bufs[2], 'base64'));

    function sendDiff(vals){
      var diff12 = jimp.diff(vals[0], vals[1]);
      var diff23 = jimp.diff(vals[1], vals[2]);

      diff23.image.getBuffer(jimp.MIME_PNG, function(err, buf){
        if (!err){
          pubsub.publish(monitor_channel, buf, true);
        }
      });
    }

    if (diff12.percent > threshold && diff23.percent > threshold){
      console.log(new Date().toISOString()+" Motion Detected !!!");
      pubsub.publish(alarm_channel, true);
    }
    else {
      pubsub.publish(alarm_channel, false);
    }
  }

  Promise.all([frame1, frame2, frame3]).then(sendDiff); // run sendDiff when all frames are ready
}
```

motion_detector.js

Rich Constraint Model

Device-Specific

- CPU (Workload units)
- RAM
- Bandwidth
- Latency

Component-Specific

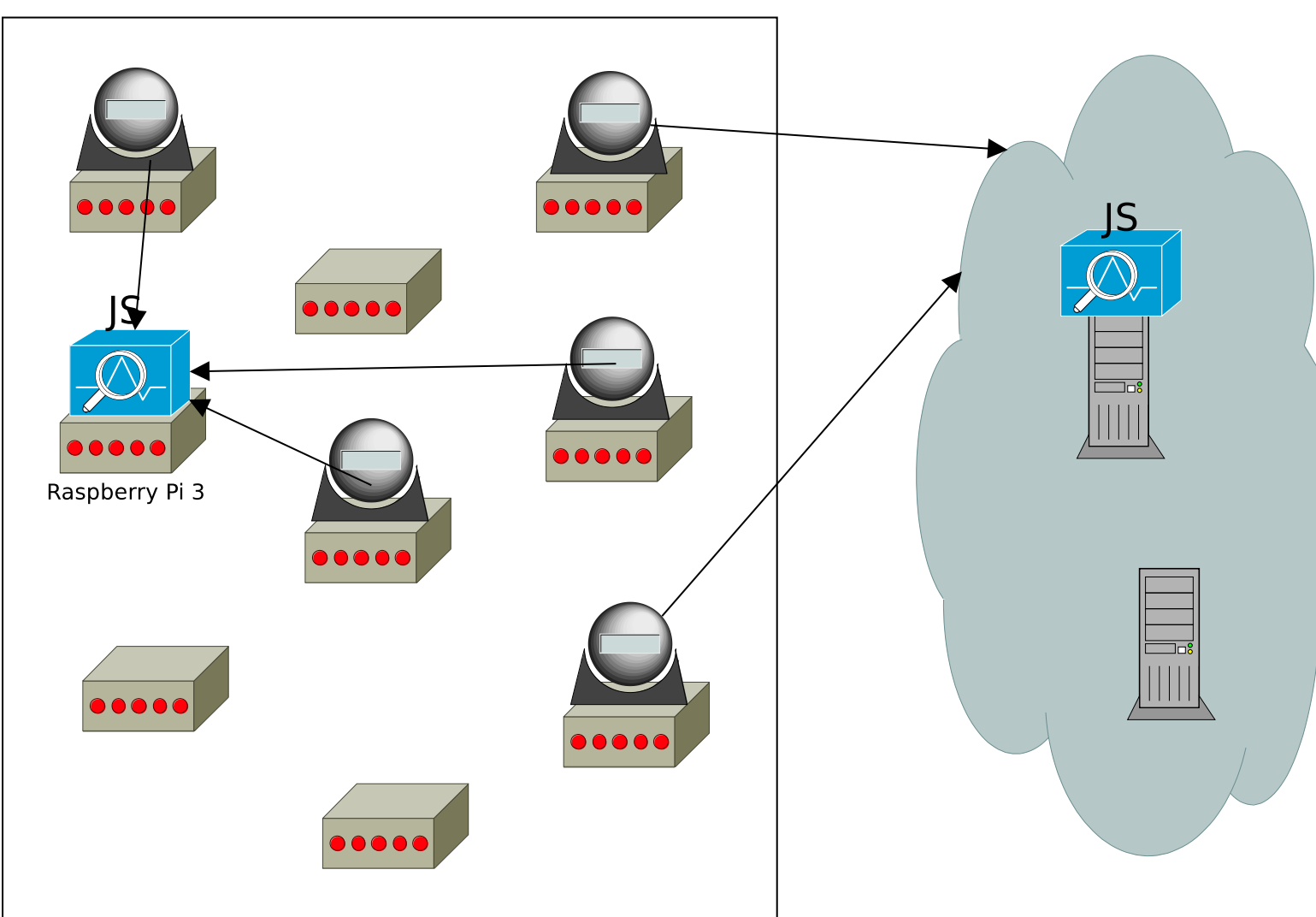
- CPU (Workload units)
- RAM
- Bandwidth
- Latency
- App-Specific (e.g., FPS, resolution, etc.)

Edge Services and APIs for developers

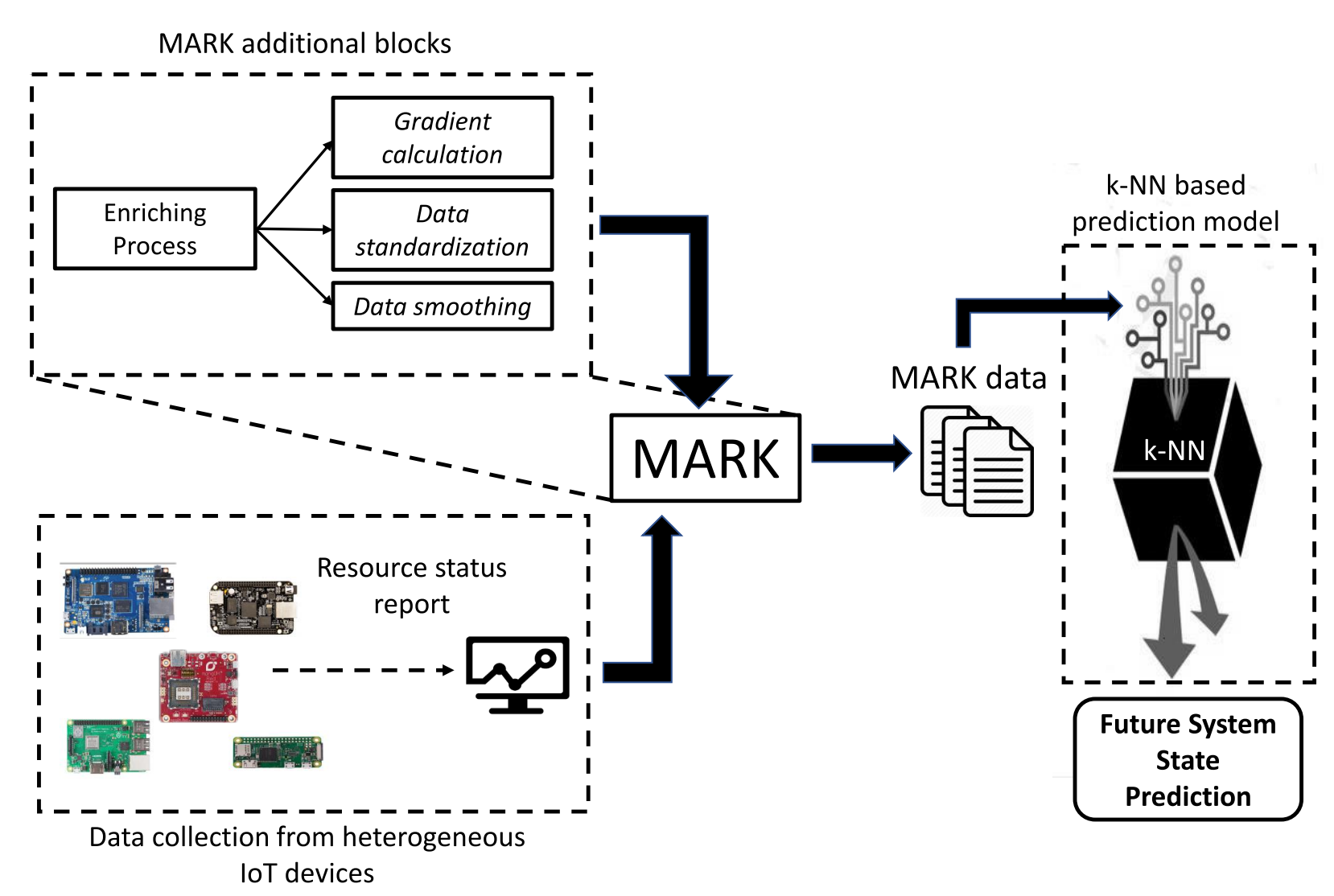
- MQTT (Publish/Subscribe): communications
- Global File System (over MongoDB)
- Resource Management
- Web of Things

ThingsJS: A Self-Adaptive Runtime

Scheduling Components in the Cloud-Edge



Failure Prediction in Edge Applications



Migrating Components between heterogeneous Edge and Cloud devices (ThingsMigrate)

