Sprint 2
Dynamic Price Calculation

with Authentication, VAT, Discounts, Improved Breakdown, Cascading Threshold Calculations, and refactors

Intro

A responsible person should think about these things some time in the future.

Room for improvement

Some implemented features could be improved to perform better, use less resources, be more readable, be more testable, etc.

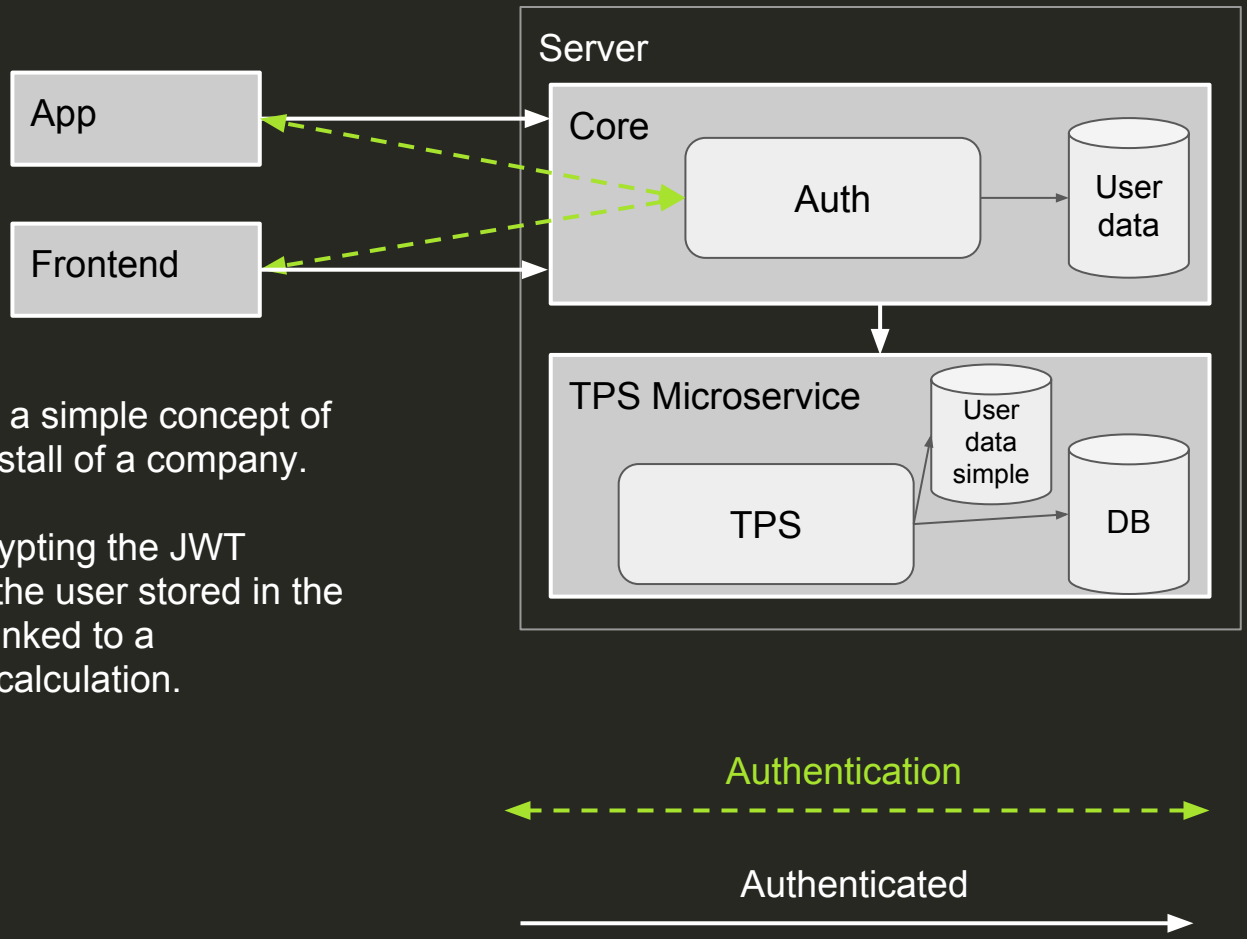
Name	Improvement	Severity	File location
Query to fetch pricing rules for multiple products	The query is run once for every vehicle (product), because no solution was found quickly enough to run it as once single query.	low	/common/price.js
Loopback models are not Typescript ready	No JS files should be used as types can't be checked in transition from Loopback model (dynamic content) to TS files.	average	/common/models/*
Tests include environment specific checks	A strategy should be applied to make these tests work in non-production environments.	low	/test
Authentication is not integrated with Loopback	A middleware checks the headers for a token, bypassing the built in Loopback API Explorer authentication field. Authentication must manually be disabled currently to be able to work with the Explorer. Integration would be an improvement.	low	/src/middleware/authentication.ts
Exceptions are thrown	In some edge cases, exceptions are thrown. This should be looked at by someone who knows what the outcome should be in these cases.	high	**/*.ts (search 'throw')

Authentication

Authentication

Applications communicate with the core system which provides a JWT that includes important identity information in the token payload. The TPS microservice has a simple concept of a User that references the DaAppInstall of a company.

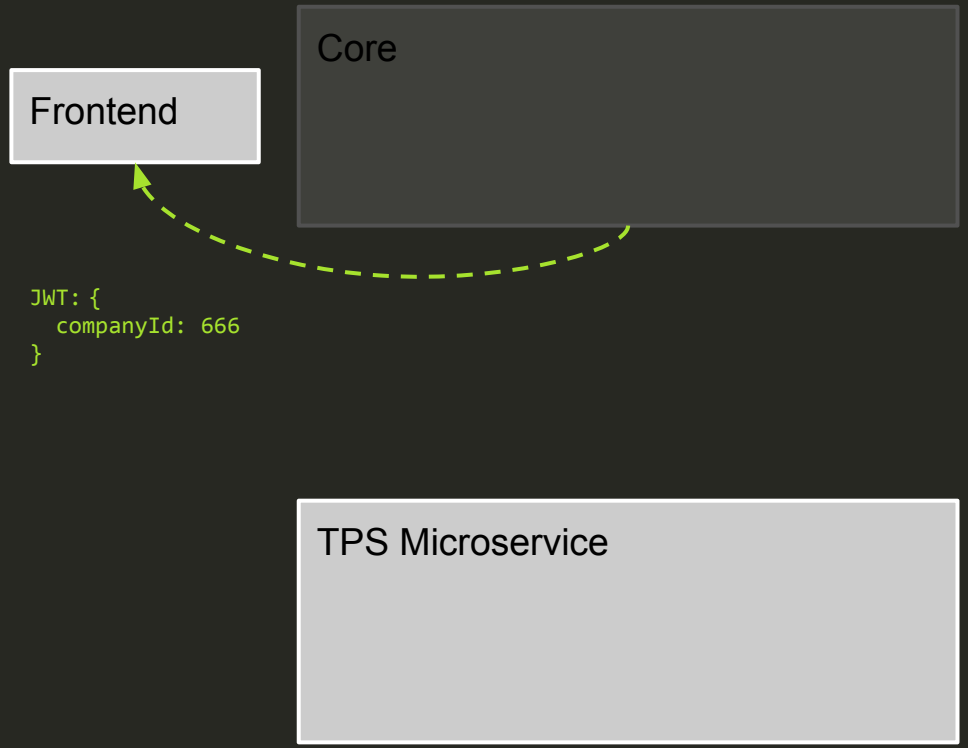
The Microservice is capable of decrypting the JWT revealing the identity details to find the user stored in the database, so that the correct rules linked to a DaAppInstall are used for the price calculation.



Authentication

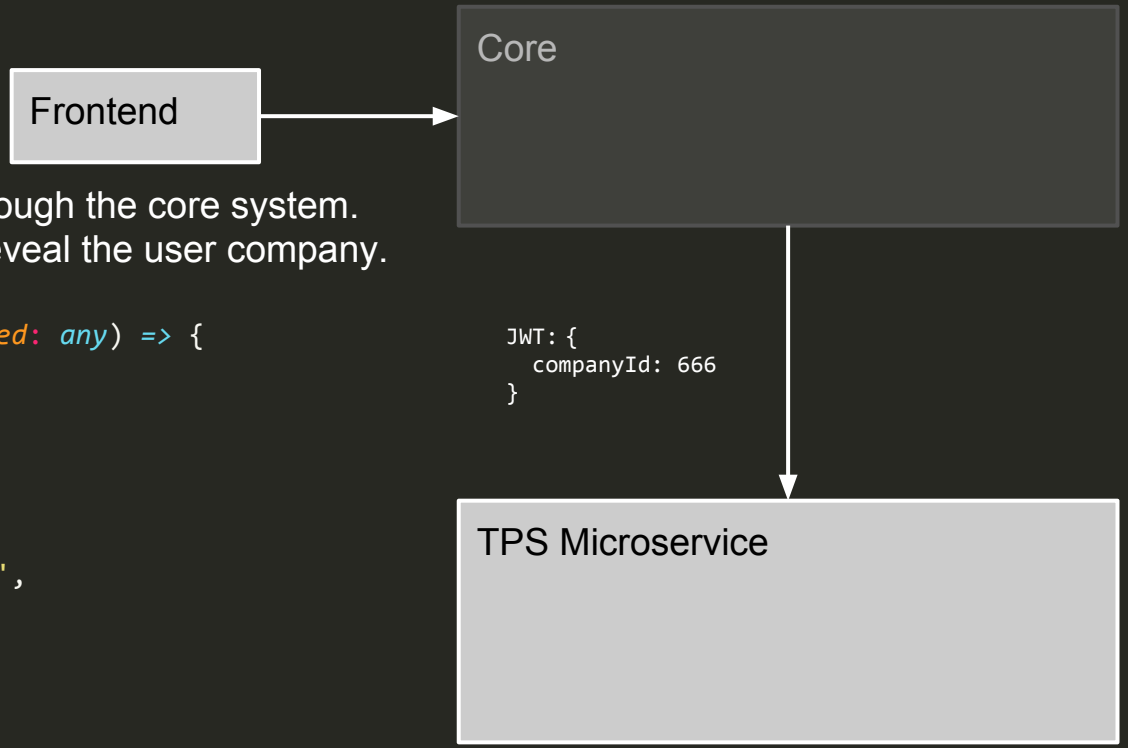
Core signs JWT that
has the identity of the user
contained in the payload, e.g.:

```
const cert = process.env.JWT_SECRET;
const HOURS_24 = 86400;

jwt.sign({ companyId: '666' }, cert, {
  expiresIn: HOURS_24,
  algorithm: 'HS256'
}, (err, token) => {
  if (err) return cb(err);
  return cb(null, token);
});
```



Authentication

The frontend makes a request directed at the Microservice, which is tunneled through the core system. The Microservice decrypts the token to reveal the user company.




```
jwt.verify(token, cert, (err: Error, decoded: any) => {
   if (err) {
     return res.status(500)
       .send({
         auth: false,
         message: 'Invalid token provided.',
       });
   }
   console.info(decoded);
   // { companyId: 666, iat: 1521552244, exp: 1521638644 }
   next();
 });
```

Authentication Middleware

1. Fetches token
2. Fetches secret
3. Verifies token with secret or public key
4. Adds credentials to req
5. next( )

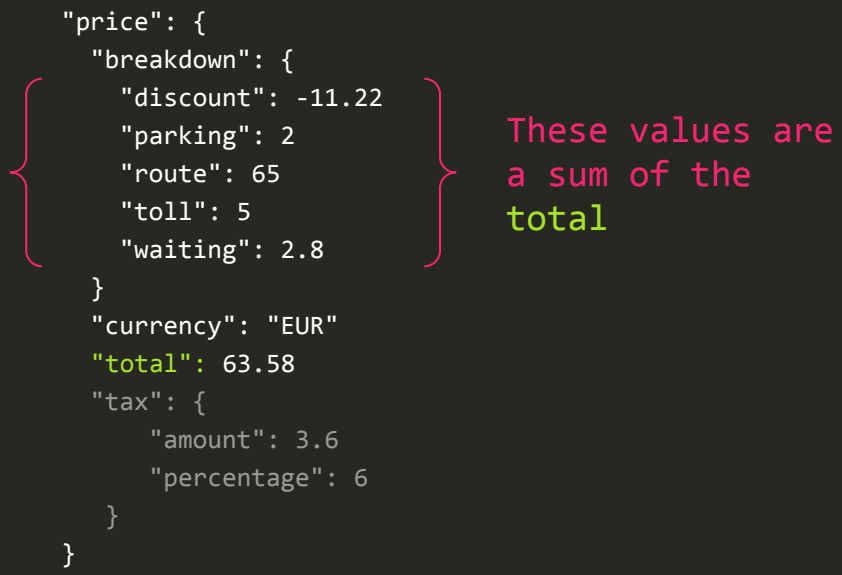
```
/**
 * Authentication middleware.
 */
export const auth = (req: Request, res: Response, next: NextFunction) => {

 // Don't use this cert in any of the warning responses, it's secret
 const cert = process.env.JWT_SECRET;
 const JWT_HEADER = process.env.JWT_HEADER || 'x-access-token';
 const token = req.headers[JWT_HEADER] : req.query.access_token;

 // It can be safe under the following circumstances:
 // 1. the JWT is one-time time usage only
 // 2. the jti and exp claims are present in the token
 // 3. the receiver properly implements replay protection jti and exp
 if (process.env.NODE_ENV === 'development' && req.query.access_token) {
   return warn(res, 449, `Don't send tokens via an URL (preferably)`);
 }

 // No token, no access
 if (!token) return warn(res, 403, 'No token provided.');

 // No secret found, still no access
 if (!cert) return warn(res, 403, 'Authentication unavailable.');

 // Verify token and add to request
 jwt.verify(token, cert, (err: Error, decoded: any) => {
   if (err) return warn(res, 403, 'Invalid token provided.');
   addCredentialsToReq(req, decoded);
   next();
 });
};
```

Authentication

1. Changes must be made to the core system.
2. All communications will be held through the core system.
3. Secrets must be known to both core and microservice.
4. Secrets should be stored in the .env file.
5. Secrets should be updated regularly.
6. The discussion is found here.

Improved Breakdown

Improved Breakdown



Improved Breakdown

```
"price": {
  "breakdown": {
    "discount": -11.22
    "parking": 2
    "route": 65
    "toll": 5
    "waiting": 2.8
  }
  "currency": "EUR"
  "total": 63.58
  "tax": {
      "amount": 3.6
      "percentage": 6
   }
}
```

The tax is calculated but is part of the total, as VAT is included

Improved Breakdown

1. Total is the sum of the breakdown.
2. Tax is included in the total, and thus included in the breakdown prices.
3. Tax is based on country default tax percentage.
4. The discussion is found here.

VAT

VAT

```
// copy.country
country:
   { name: 'Netherlands',
     code: 'NL',
     defaultTax: 6,
     defaultCurrency: 'EUR' },
```

```
instance.breakdown(copy)
        .then((data: Response) => {
          expect(data)
            .deep.equal({
              price: {
                breakdown: {
                  route: 83,
                  toll: 0,
                  parking: 0,
                  waiting: 0,
                  discount: 0,
                },
                tax: {
                  amount: 4.5,
                  // 4.7 = 83 / 106 * 6
                  percentage: 6,
                },
                currency: 'EUR',
                // 66.32 = 82.83 - 16.5
                total: 66.5,
              }
            });
```

VAT

1. Tax is calculated back from included VAT prices.
2. Tax percentages differ per country.
3. More details here.

Established formula used:

```
[price / (100 + tax.percentage) * tax.percentage]
```

Discounts

Discounts

```
// copy.discount
discount:
  { name: 'Discount percentage test',
    value: -20
    isEnabled: true,
    type: 'percentage',
    precedence: 88547,
    companyId: 5aa1585990e4d72312f882db }
```

```
instance.breakdown(copy)
        .then((data: Response) => {
          expect(data)
            .deep.equal({
              price: {
                breakdown: {
                  route: 83,
                  toll: 0,
                  parking: 0,
                  waiting: 0,
                  // -16.6 = -.2 * 83
                  discount: -16.5,
                },
                ...
                currency: 'EUR',
                // 66.32 = 82.83 - 16.5
                total: 66.5,
              }
            });
```

Discounts

A discount can be negative or positive.

A discount can be disabled or enabled.

A discount can be a fixed amount or percentage.

A discount is calculated and is part of the breakdown total.

Discounts are not constrained by location or timeframes yet.

Cascading Threshold Calculations

Cascading Threshold Calculations

```
// Calculate total price
const result = Price.total(
  {
    distance: 45,
    duration: 25,
  },
  [
    {
      type: 'duration',
      threshold: 19.5,  // price after 20 min is 0.45
      value: 0.15,
    },
    {
      type: 'duration',
      threshold: 15,    // price after 15 min is 0.25
      value: 0.25,
    },
    {
      type: 'duration',
      threshold: 12,    // price after 10 min is 0.15
      value: 0.45,
    },
    {
      type: 'distance',
      threshold: 20,    // price after 20 km is 0.35
      value: 0.75,
    },
...
```

```
...
    {
      type: 'distance',
      threshold: 15,    // price after 15 km is 0.25
      value: 0.90,
    },
    {
      type: 'distance',
      threshold: 10,    // price after 10 km is 0.10
      value: 1.25,
    },
  ],
  {
    distance: calculation(1.5),
    // Distance is 45 km
    // The first threshold is found at 10 km
    // So the first 10 km cost 1.5 per km
    // The next 5 up until 15 km cost 1.25 per km
    // The next 5 up until 20 km cost 0.90 per km
    // The final 25 km cost 0.75 per km
    //
    // Distance price is 44.5
...
```

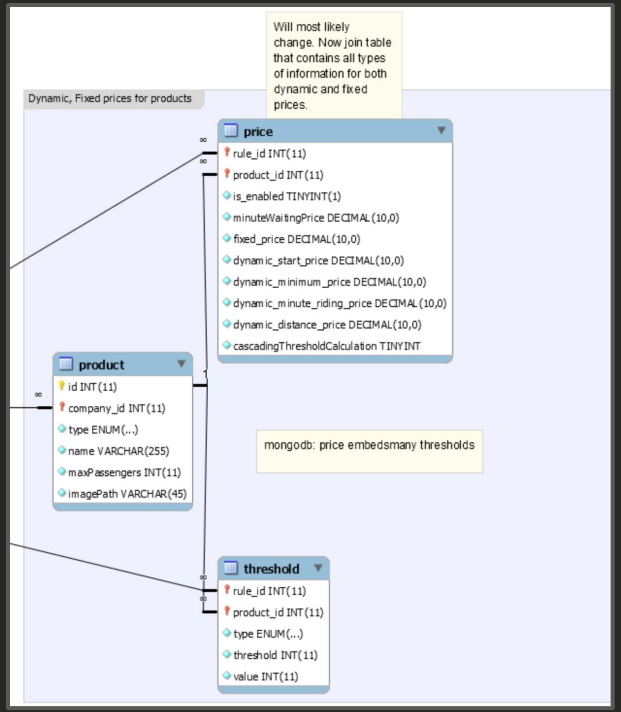
```
...
    duration: calculation(0.4),
    // Duration is 25 min
    // The first threshold is found at 10 min
    // So the first 12 min cost 0.4 per min
    // The next 3 up until 15 min cost 0.45 per min
    // The next 4.5 up until 19.5 min cost 0.25 per min
    // The final 5.5 min cost 0.15 per min
    //
    // Duration price is 8.1
  },
  true,
);
// Therefore result is 52.6 = 44.5 + 8.1
expect(result).to.equal(52.6);




// A function to generate a calc func with default price
const calculation = (defaultPrice: number) =>
  (price: number = defaultPrice, metric: number) =>
      price * metric;
```

Cascading Threshold Calculations

1. Either no thresholds have been provided, the normal calculation function is called straight away.
2. If thresholds are provided, there are two options:
    a. Cascade option is true
    b. Cascade option is false
3. If cascade is false, the price of the last threshold that has been surpassed will be used to calculate the price per metric.
4. If cascade is true, the first couple of km say, will be calculated with the normal price. The next km’s will be calculated using the first surpassed threshold, the next km’s with the next threshold price …

Refactors

Refactors: DB Schema

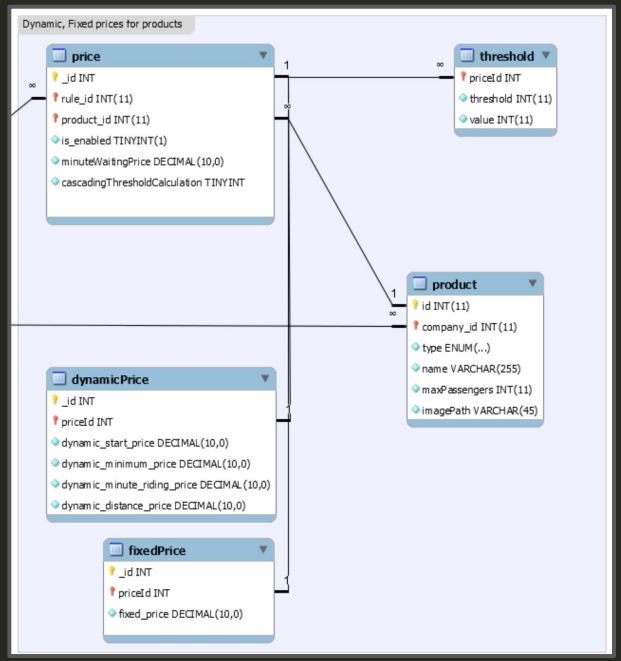


Old:

Contained pricing information of all types in one table.

New:

Separated information into individual tables while retaining core information in original price table.



Refactors: Aggregate

```
// util.ts
const exhaustList = (array, func, next) => {
  if (array.length < 1) return next(array);
  const pop = array.pop();
  func(pop, array, next);
};

// common/price.js
const queryPoppedVehicle = (pop, array, next) => {
  aggregateQuery(pop, (result) => {
    exhaustList(array, queryPoppedVehicle, (newArray) => {
      if (result[0]) newArray.push(result[0]);
      return next(newArray);
    })
  })
}
...
exhaustList(vehicleTypes, queryPoppedVehicle, (rules) => {
  const promises = rules.map(rule => {
    return priceCalculator.breakdown(rule);
  });
  Promise.all(promises)
    .then(breakdowns => {
      cb(null, breakdowns);
    })
    .catch(error => {
      cb(error);
    })
})
```

Old:

Executed query for every vehicle type in the vehicleTypes array recursively, limit 1.

New:

Executes one aggregate.

```
// common/price.js
aggregateQuery(vehicleTypes, (rules) => {
  const promises = rules.map(rule => {
    return priceCalculator.breakdown(rule);
  });
  Promise.all(promises)
    .then(breakdowns => {
      cb(null, breakdowns);
    })
    .catch(error => {
      cb(error);
    })
});
```

Refactors

1. DB Schema
    a. Split the price table into three tables
    b. `price` is the junction table
    c. `fixedPrice` is the fixed price table
    d. `dynamicPrice` is the dynamic price table
2. Aggregate
    a. Now performs 1 query instead of sum(vehicleTypes) queries

Flow

Flow

1. Price.calculate endpoint is called
2. JWT token payload is decrypted
3. Directions service instance created
    a. Immediately fetches distance & duration
4. Price calculator instance created
    a. Directions service is passed async
5. Aggregate query is created taking vehicleTypes from body & companyId from JWT payload
6. The query is performed and the resulting pricing rules are mapped to the Price calculator instance
7. The instance calculates:
    a. totalPrice (routePrice + tollPrice + parkingPrice + waitPrice + discountPrice)
    b. priceVAT (% VAT of totalPrice)
8. The Price calculator promises a calculation for each pricing rule (per vehicle type)
9. If a promise fails, an empty array is returned
10. Else all breakdowns are returned in an array

Flow: Breakdown Method

```
/**
  * Start price calculations. The distance and duration metrics
  * are fetched by the directionsService using an async function
  * before calculate is used to calculate the trip price.
  */
 public async breakdown(pricing: pricing): Promise<breakdown> {

   Price.validPricingOrError(pricing);
   const metrics = await this.directionsService.directions();
   if (!metrics || metrics.distance < 0 || metrics.duration < 0) {
     return Promise.reject('Metrics not valid for price calculation.');
   }

   const parkingPrice = 0;
   const routePrice = Price.calculators[pricing.rules.type](pricing, metrics);
   const tollPrice = 0;
   const waitPrice = pricing.prices.minuteWaitingPrice * 0;
   const discountPrice = pricing.discount
     ? pricing.discount.type === 'percentage'
       ? percentOf(pricing.discount.value, routePrice)
       : pricing.discount.value
     : 0;

   ...
```

```
...
   const vatPerc = pricing.country.defaultTax;
   const totalPrice = Math.max(0, routePrice
     + tollPrice
     + parkingPrice
     + waitPrice
     + discountPrice);
   const { priceExVAT, priceVAT } = excludeVatOf(vatPerc, totalPrice);

   return Promise.resolve({
     vehicleType: <vehicleType>pricing.type,
     maxPassengers: pricing.maxPassengers,
     price: {
       breakdown: {
         route: roundHalfDecimal(routePrice),
         toll: roundHalfDecimal(tollPrice),
         parking: roundHalfDecimal(parkingPrice),
         waiting: roundHalfDecimal(waitPrice),
         discount: roundHalfDecimal(discountPrice),
       },
       currency: pricing.country.defaultCurrency,
       total: roundHalfDecimal(totalPrice),
       tax: {
         amount: roundHalfDecimal(priceVAT),
         percentage: vatPerc,
       },
     },
   });
 }
```

End