How Audi has developed a flexible consumer device interface in less than one year

The time spent in the car can not be neglected. Increasingly it will be used for private/professional tasks.
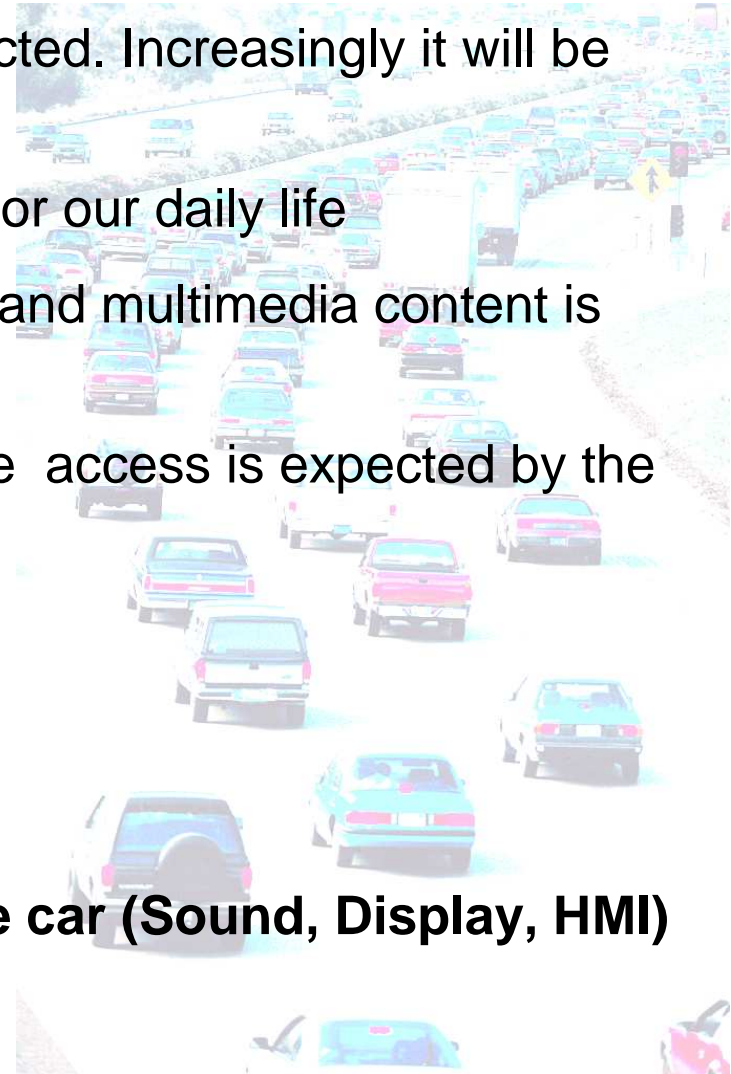
Mobility and communication are essential for our daily life

Personal data like contacts, appointments and multimedia content is stored on mobile devices

Permanent availability and safe and secure access is expected by the customer

Use of known mobile functions, but
- **secure,**
- **Easy to use and**
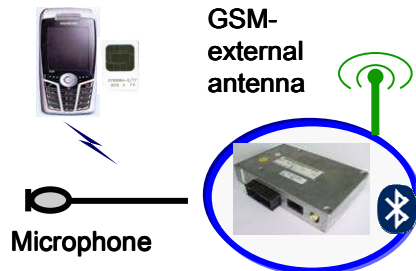- **Utilization of existent resources in the car (Sound, Display, HMI)**

Integration

Interface   Source

♪ Artists
- Berlin Philharmonic, He... ▷
- Blood, Sweat & Tears ▷
- Bloomfield, Kooper, Stil... ▷
- Bob Dylan ▷
- Bonnie Tyler ▷

Control   6:13 PM   Sound

MMI-Headunit

Audi Music Interface

GSM-external antenna

Microphone

Bluetooth-Autotelefon (BTA)

MOST-CAN-Gateway

ECU   ECU   ECU

Sound system

Voice dialogue System

Tuner (FM, DAB, TV, DVBT)

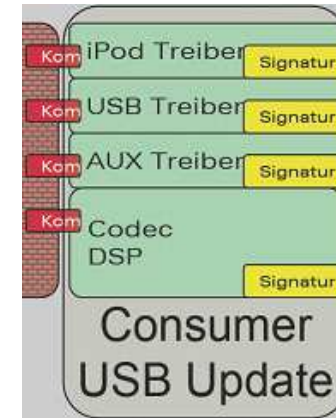**Music Interface**

MTP

Audio Streaming

Aux In

iPod, iPhone

simple update capability

• Software for Multimedia applications via

 Web Download and USB Stick <u>from the customer</u>

 (Codecs, driver updates)

•Connection of new multimedia devices over a flexible cable interface

 • Different adapter cable (device specific) can be connected to the car

 interface

 • Enhancement of the interface over Dongles (e.g. Bluetooth A2DP)

Handling

Interface — Source
mein iPod
- ♪ Playlists ▷
- ♪ Artists ▷
- ♪ Albums ▷
- ♪ Tracks ▷
- ♪ Genres ▷
Control — TP TMC 0:00 — Sound

Interface — Quelle
A2DP Device
- ♪ Wiedergabelisten ▷
- 📁 Bluetooth ▷
- |<
- Current Title
- >|
Manuell — TP TMC 0:00 — Klang

Interface — Source
Meine Top 25
- 📄 14 Original Soundtracks
- 14 Original Soundtracks
- Beverly Hills Cop / Axel F   0:10
- Zurück in die Zukunft / Back
- Gotcha / Wouldn't It Be Good
Control — TP TMC 0:00 — Sound

Interface — Quelle
iriver clix
- 📁 Music ▷
- 📁 Pictures ▷
- 📁 Playlists ▷
- 📁 Recordings ▷
- 📁 Service ▷
Manuell — TP TMC 0:00 — Klang

Is there a contradiction between more and more Infotainment functionality and quality and stability?!

NO !

Innovative development processes are the guaranty for the conformance Of the high quality demands!

Finding bugs and solve them where they arise
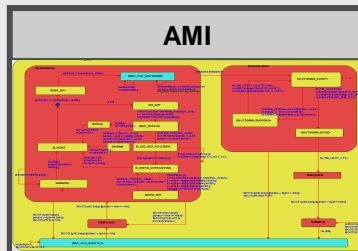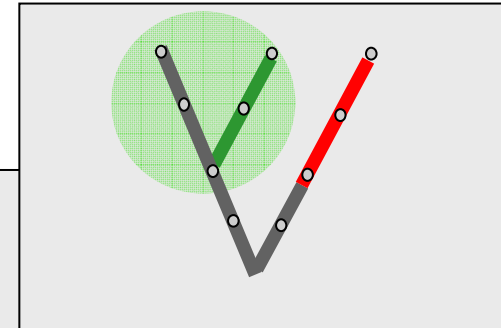
Model based Development

Development process
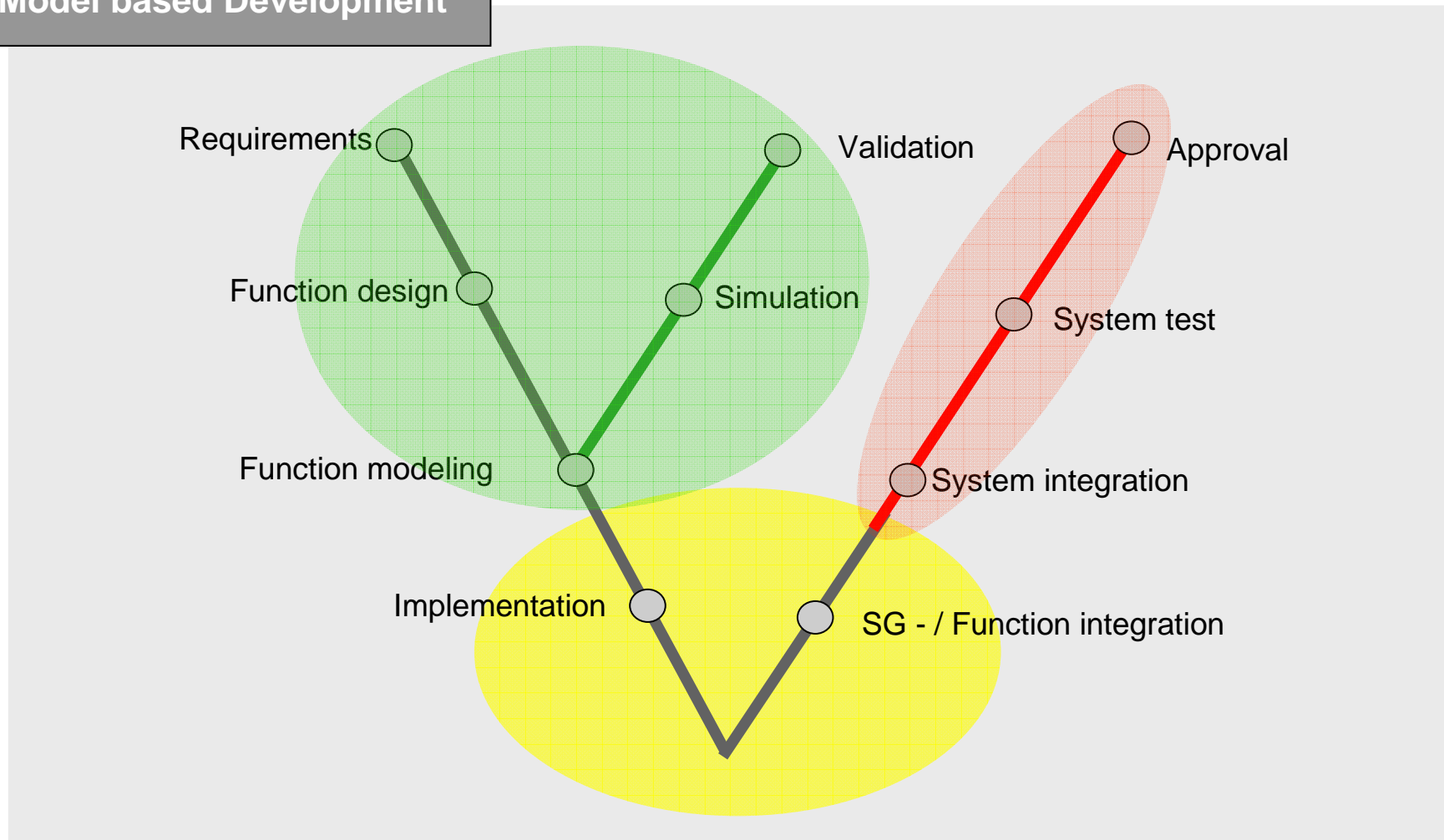
Model based Development

phase 1

executable requirement specification

- enhancement of the quality of documentation

- no language barriers (UML as formal notation)

- no interpretation at the implementation

- continues function model from virtual integration to real integration

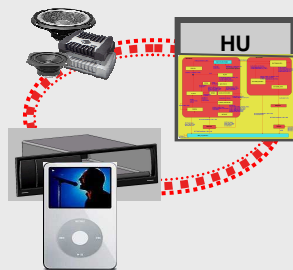- identification of logical and formal bugs

- avoiding of aftereffects

Model based Development

Bugs from phase 1

bugs
(source: Audi Fehler DB)

bugs

Spec Freeze   100 % SW   SOP   *t*
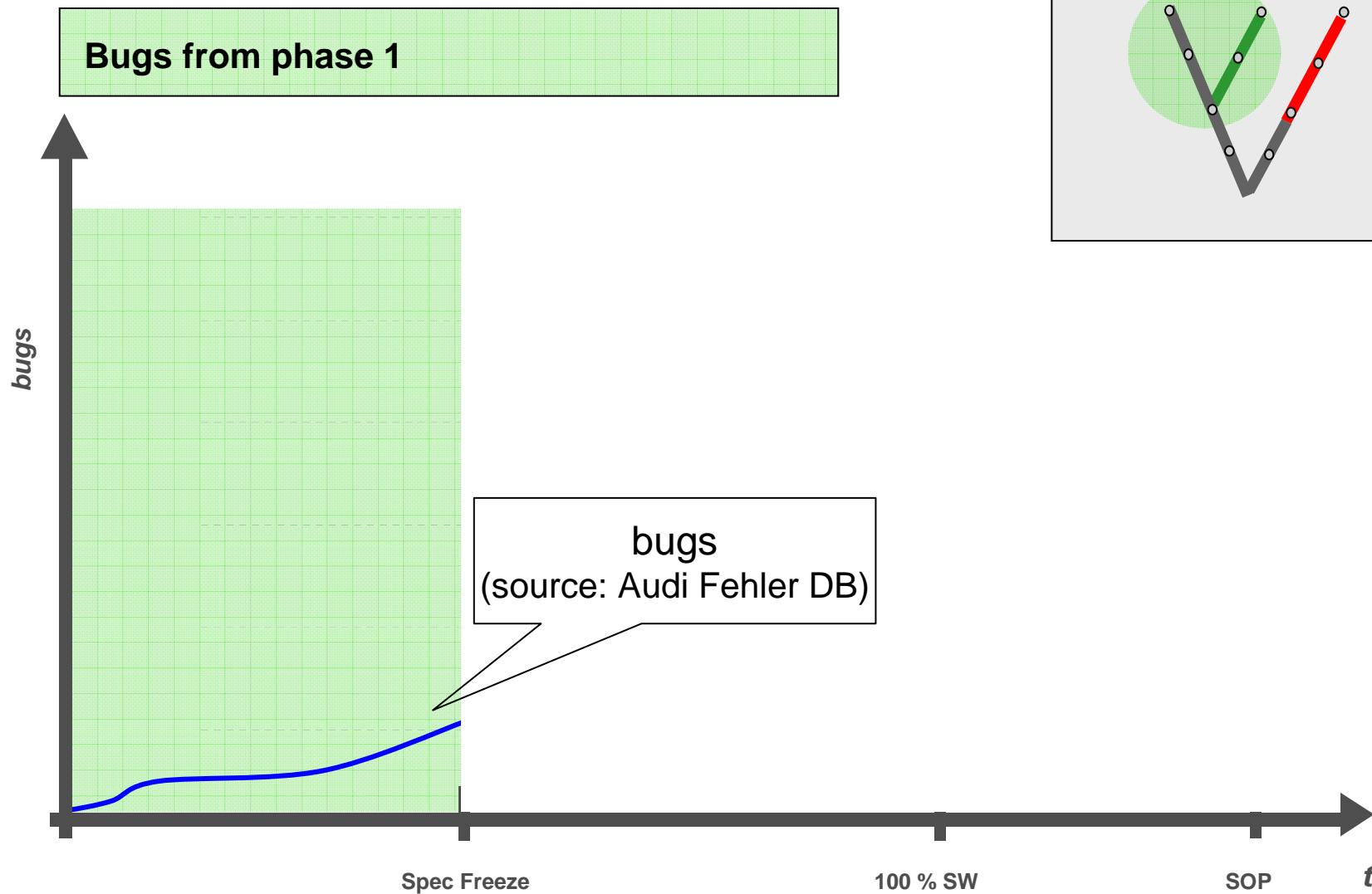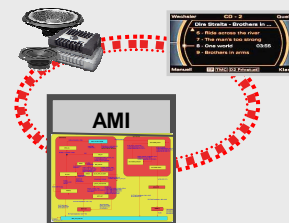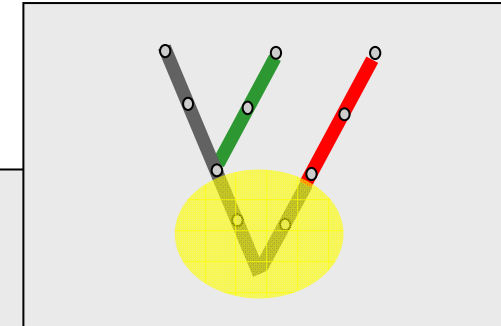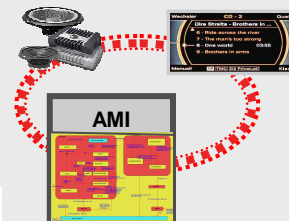
Development process

Model based Development

supplier A

supplier B

Model based development

- the supplier is using MODENA models for

  development, integration and test

- bottlenecks in sample-/prototype-phase
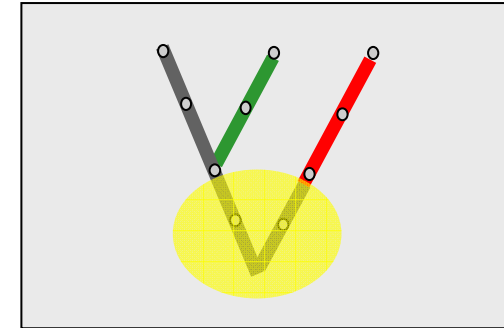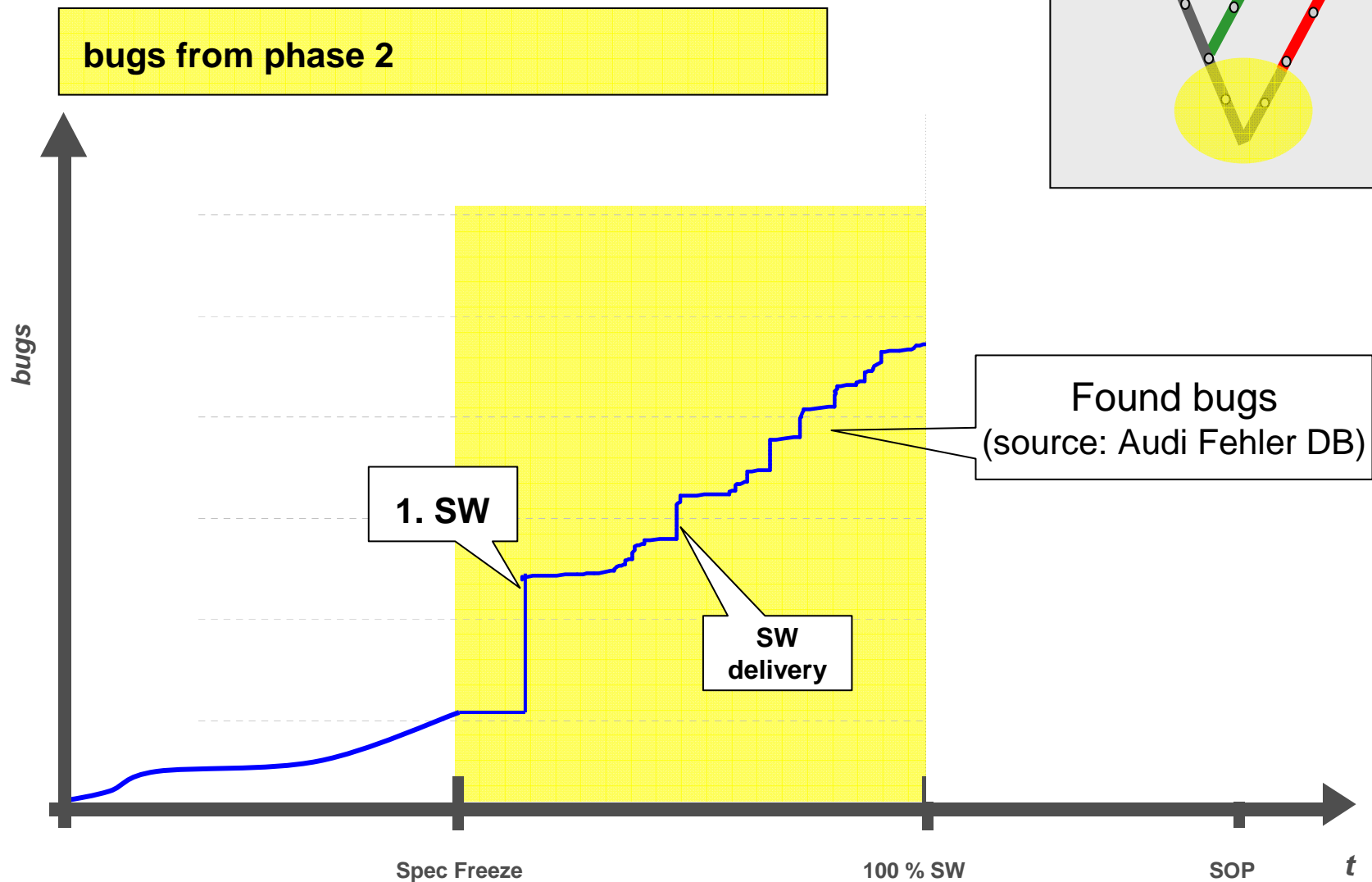
  are compensated

- decoupling of milestones

Development accompanied by tests

- earliest identification through model based

  integration

- no mandatory need for integration

Model based development
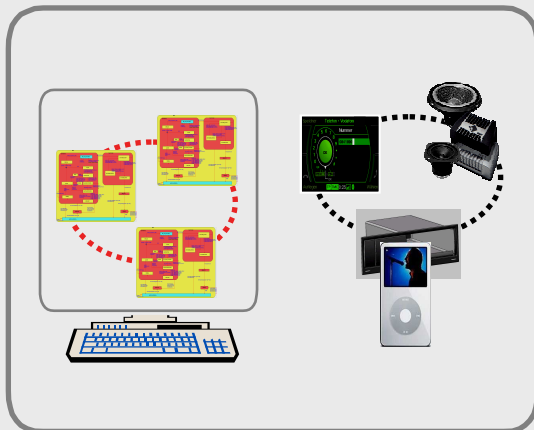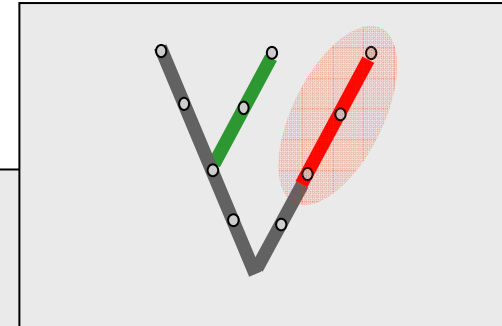
bugs from phase 2

1. SW

SW
delivery

Found bugs
(source: Audi Fehler DB)

bugs

Spec Freeze | 100 % SW | SOP | **t**

Development process

Model based development

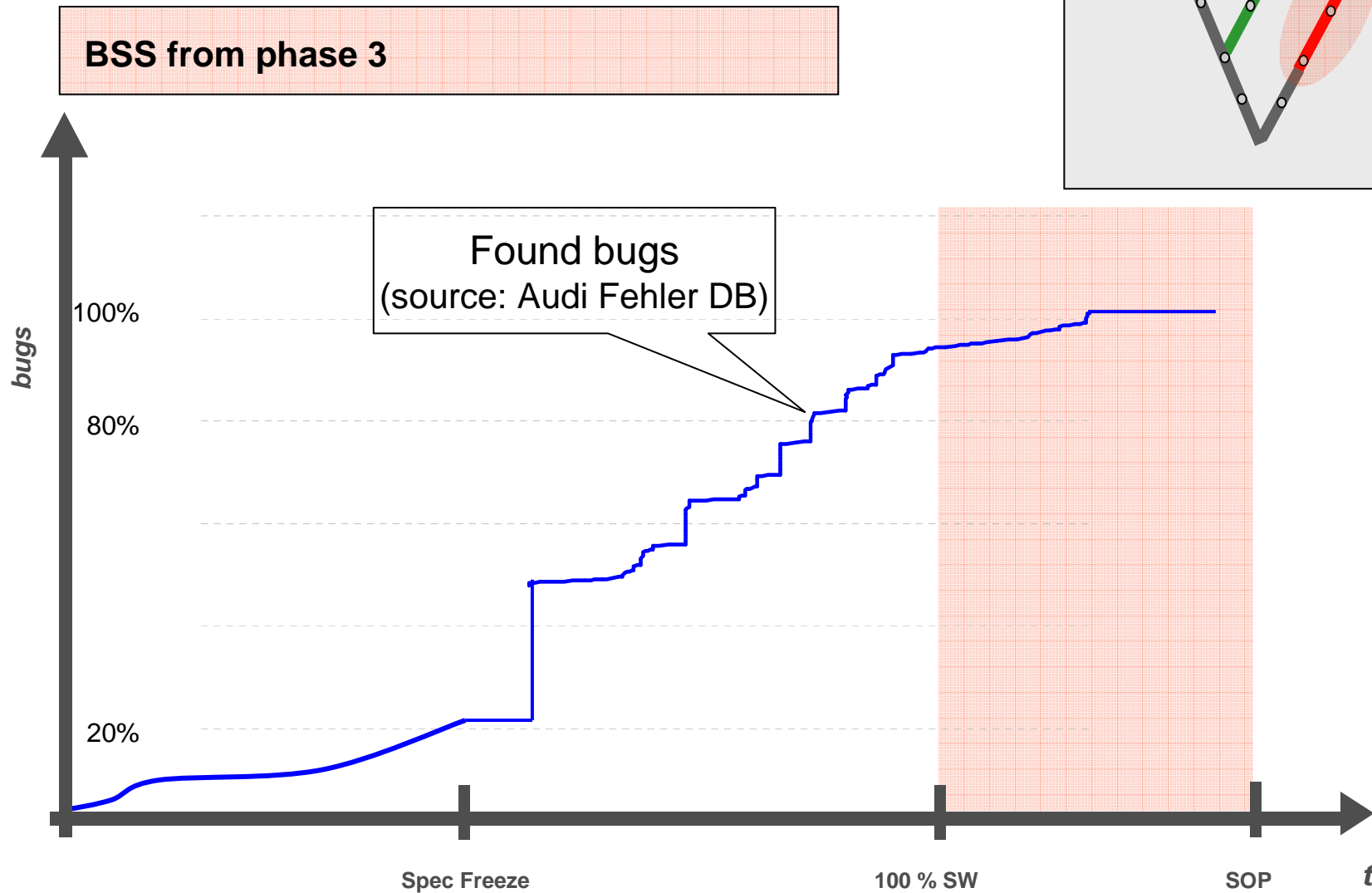### Model based long-term- and stress tests

- quality rises trough test depth and – coverage

- customer model generates random test cases
  (dynamic test specification)

- multiple focus of the tests through independence of the
  models (application, network-, audio management, etc.)

- Offline analyses of the data of traces

- tests of robustness

- fast and effective validation of sporadic bugs
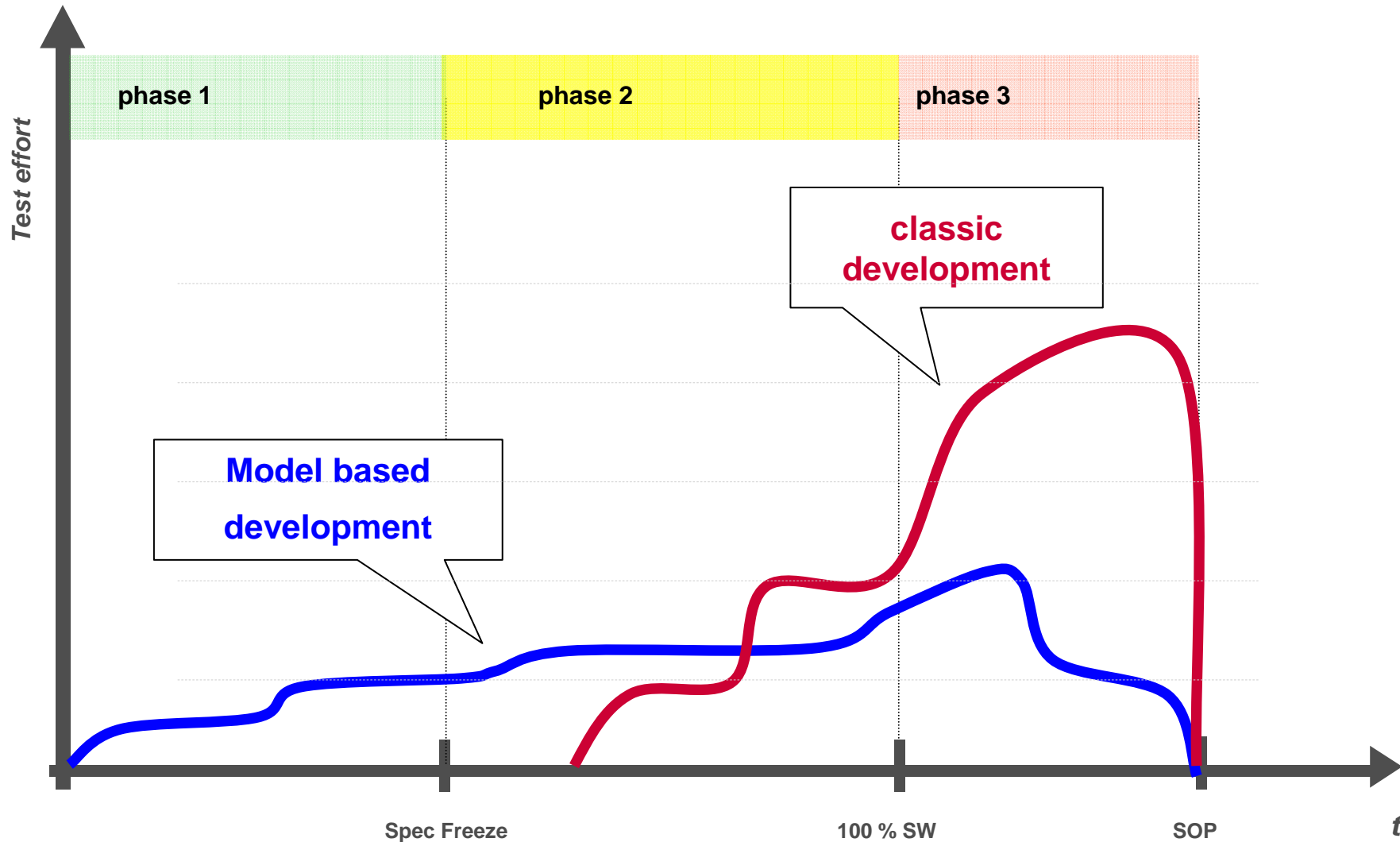
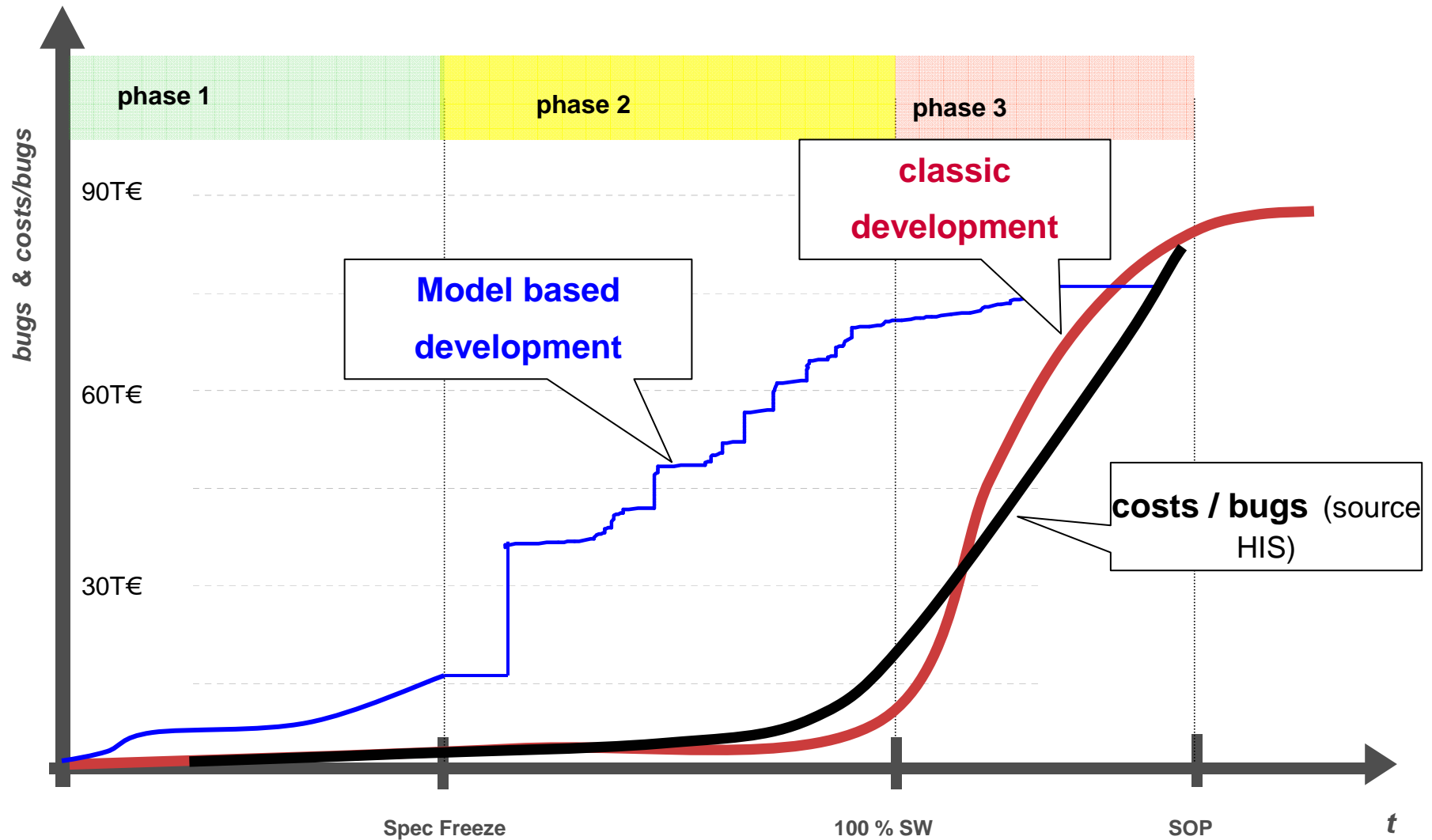# Development process

Model based development

BSS from phase 3

Found bugs
(source: Audi Fehler DB)

bugs

100%

80%

20%

Spec Freeze

100 % SW

SOP

t

Model based development

Advantages seen under the aspect: Test effort

phase 1   phase 2   phase 3

Test effort

classic development

Model based development

Spec Freeze   100 % SW   SOP

t

Model based development

Advantages seen under the aspect: costs

phase 1 · phase 2 · phase 3

classic development

Model based development

costs / bugs (source HIS)

90T€

60T€

30T€

bugs & costs/bugs

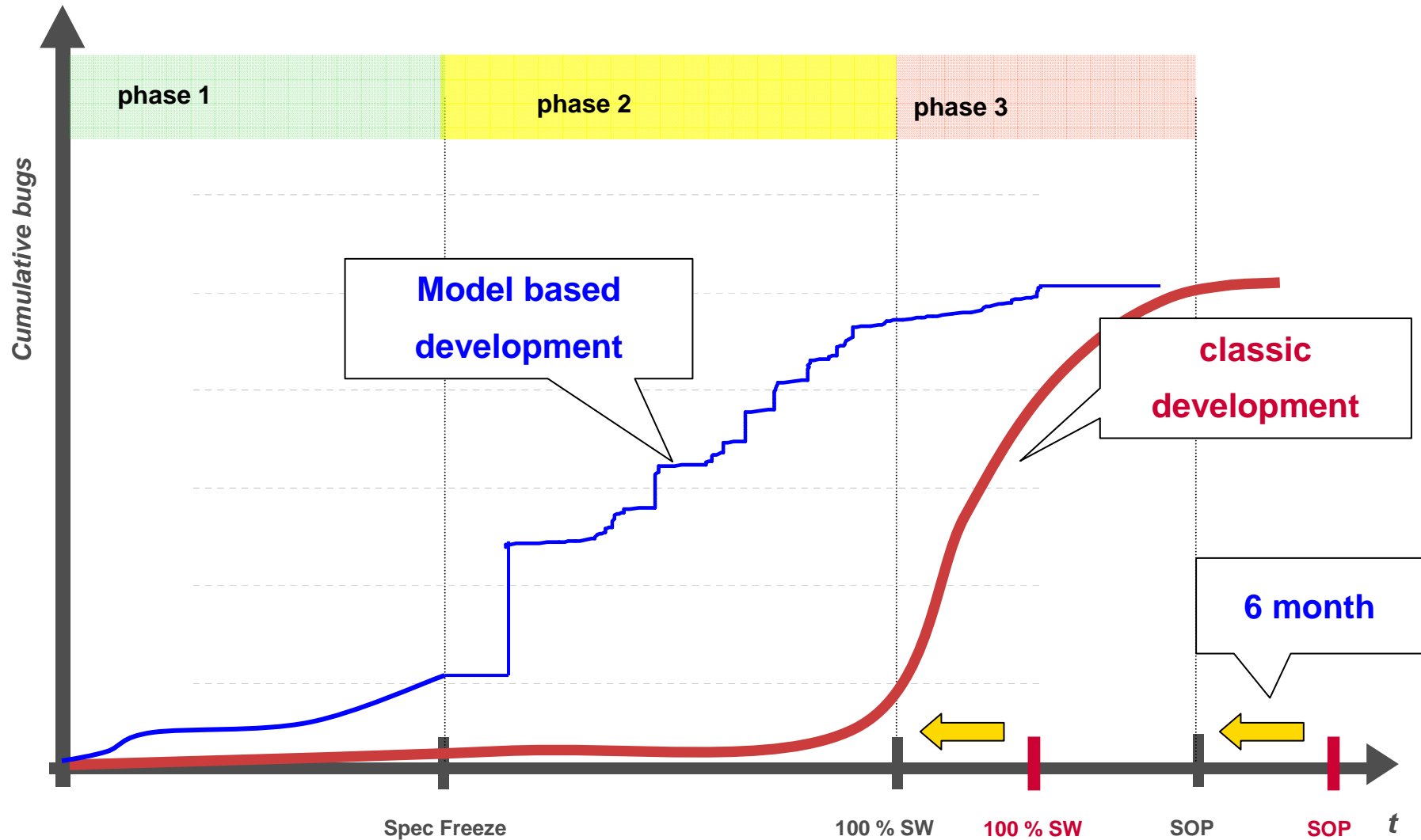Spec Freeze · 100 % SW · SOP

t

Model based development

Advantages seen under the aspect: time

Thank you!

Markus Putze