on Smart Car
works & challenges

Sept. 2017
Thundersoft Overview

- Founded in 2008
- Smart Device OS & Platform
- 3000+ SW/HW Engineers
- IPO in 2015
- Worldwide Presence
The diagram illustrates the timeline of Thundersoft's journey with open source since 1996. Key milestones include:

- **1996**: NEC Linux (Linux Server, Linux Desktop, Embedded Linux)
- **1999**: Midinux (Embedded Linux)
- **2007**: Mobile Linux
- **2008**: QRD (Android Mobile)
- **2009**: Mobile Security
- **2011**: Thundersoft-Qualcomm Joint Lab
- **2012**: Camera Turnkey
- **2014**: H5OS
- **2015**: ThunderSec
- **2016**: IoT Turnkey

These developments reflect Thundersoft's commitment to open source software and its applications in various fields including automotive, IoT, and mobile security.
What Do We Do

Products and Solutions

Mobile
- System Integration & Customization
- APP & UI/UE development
- Carrier Certification
- Automatic Test Solution

IoT
- IVI
- Automotive HMI
- Digital Cluster
- Smart Cockpit

Automotive
- TurboX Series SoM Products
- Reference Design of Drone, Smart Camera, AR/VR and Robot
- Wearable

Enterprise & Security
- MDM/FOTA
- Mobile office
- Enterprise security
- APP development tools

Core Technology

Optimization
- Small RAM
- Fast Boot
- Power Saving
- System Tailoring

Security
- System Container
- Secure Apps
- Secure Call
- Device Management

Vision
- Camera Tuning
- Camera Turnkey Solution
- Multi-Camera
- Embedded AI Algorithms

Graphics
- AR/VR Middleware
- Multi-screen
- Multi-display
- UI Engine

Services

- OS Customization
- Carrier Certification
- Customer Technical Support
- Android OS Upgrade
- Component Verification and Driver Development
- BSP&APP Maintenance
Automotive Business Overview

- **Positioning:**
  - Provide smart cockpit and IVI turn key software solution for Tier1 and OEM.

- **Product Line:**
  - OS for Automotive, Android, Linux & RTOS
  - IVI software solution and service
  - Digital cluster software turn key solution and service
  - ADAS solution and Algorithm
  - UI/UE: Rightware Kanzi UI engine and tools

![Sensor-Fusion InfoADAS system](image1)
![High Performance 3D UI Engine](image2)
![Connected Infotainment System](image3)
![Cutting Edge Digital Cluster](image4)
Challenges & Opportunities

- Faster
- Smarter
- More Secure
- More Connected
- More Stable
- More Scalable
- Easier
- Prettier
Run Faster

- **Goal**
  - Start system/camera/radio faster

- **Current results**
  - Linux Over i.MX6 Solo: ~4.5 s
  - Android Over S820A: ~9 s
  - Android Over TI J6: ~11 s

- **Optimization Methods**
  - Lean system
  - Pre-loading
  - Delay-loading
  - Parallel init/middle-ware
  - Code optimization (java->C)
  - Android Optimization (services, zygote, APK scanning)
  - Bypass camera stack
  - **Suspend-to-disk**

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**Qualcomm 8x26**
Quad 1.2GHz A7
1GB LPDDR2 PoP

**8x26 optimization result**

- Before
- After

**Android-M @ Qualcomm S820/S820A:**
- 2s to show rear camera image
- 9s to do early media playback

**Android-L @ TI Jacinto 6 DRA755 1.2GHz:**
- 14.3 Sec up to now
- 11 Sec is confidently achieved
AR-HMI Dataflow

- ADAS
- IVI
- RADAR
- LiDAR
- Ultrasonic

Information Collection

Scenario Analysis
- Data Integration (create 3D model)

Motion Compensation
- 3D model correction

Analytical Prediction
- 10 AR Functions

Driver Eye Position
- View Transformation
- Driver’s eyesight
- Image Rendering
  - Fixed
  - Zooming
- Distortion Correction
- Projection Radian

Display

Thundersoft Confidential
Develop Faster

**Traditional**

**OEM**
- Specification
  - Documents
  - Videos
  - Images

**Tier 1**
- Prototype Implementation (3-4 mo)
- Development

**RESULT:**
- First prototype
- First time OEM sees design running on target
- Does not match OEM design vision

**Kanzi Way**

**OEM**
- Concept and Asset Creation
- Concept Implementation
- Prototype
- Product Development UI

**Tier 1**
- Integration (C++ API and plug-ins)

**RESULT:**
- OEM has the power and can make changes to design at no cost
- Design and integration independent of each other
- No disruptions -> very short development time
- Can switch Tier 1 in the middle of project
- Faster development at significantly reduced cost

**SOP**
Happier
More Connected

❖ Goal
  ► Same app, any screen, any os, any chip

❖ What’s Kanzi Connect?
  ► A connectivity SDK for embedded software
  ► Based on Client & Server infrastructure
  ► Platform to provide data and services for any user interfaces

❖ Use Kanzi Connect to…
  ► Connect any number of devices together as a network
  ► Manage complex multi-screen set-ups
  ► Test your product in early phase utilizing real or simulation data
  ► Wrap existing and new data under one single interface
  ► Build your own reusable software IP
  ► Easily plug-in connectivity to your embedded application across different operating systems
More Stable

- **Power Saving & Thermal Control**
  - Make invisible & necessary trade-off
  - Control heat generation nearing the threshold of eMMC and RAM to avoid entering overheat state.
  - Power off the hardware when reaching the threshold of LCD/RAM/CPU to avoid destroy hardware.
  - Disable data writing to eMMC in overheating state to avoid destroying data in eMMC and application crashing.
  - Use RAMFS instead of eMMC to read/write backup data in overheating state.
  - Policy-based Dynamic Rendering

- **Data Integrity Enhancement**
  - All data to be stored or changed are listed in a table
  - Data is stored in different place due to different requirement such as frequency of change, hold in different cases.
  - Each item is carefully designed for storage position and timing of store.
  - Limit data writing time & amount
  - All data is verified with checksum on loading, backup value used as fallback
  - 4-Level backup mechanism
  - Extending lifetime of NAND Memory
## Auto Testing

- **Highly Demanded**
- **Cast Mgmt, Recording, Executing, Collecting, Reporting, Emulation**
- **Assertion**

### Test Activity Statistics

<table>
<thead>
<tr>
<th>Test activity</th>
<th>Case number</th>
<th>Execute cycle</th>
<th>Device number</th>
<th>Total case number</th>
<th>Manual efficiency</th>
<th>Manual cost</th>
<th>Auto test case number</th>
<th>Script development cost</th>
<th>Manual cost</th>
<th>Total cost</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoke test</td>
<td>400</td>
<td>60</td>
<td>1</td>
<td>24000</td>
<td>60</td>
<td>400</td>
<td>320</td>
<td>11</td>
<td>80</td>
<td>91</td>
<td>77%</td>
</tr>
<tr>
<td>Function test</td>
<td>2000</td>
<td>2</td>
<td>1</td>
<td>4000</td>
<td>40</td>
<td>100</td>
<td>1600</td>
<td>53</td>
<td>20</td>
<td>73</td>
<td>27%</td>
</tr>
<tr>
<td>Software test</td>
<td>10000</td>
<td>3</td>
<td>1</td>
<td>30000</td>
<td>40</td>
<td>750</td>
<td>8000</td>
<td>267</td>
<td>150</td>
<td>417</td>
<td>44%</td>
</tr>
<tr>
<td>Performance test</td>
<td>50</td>
<td>6</td>
<td>1</td>
<td>300</td>
<td>20</td>
<td>15</td>
<td>40</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>71%</td>
</tr>
<tr>
<td>Compatibility test</td>
<td>50</td>
<td>2</td>
<td>100</td>
<td>10000</td>
<td>100</td>
<td>100</td>
<td>40</td>
<td>1</td>
<td>20</td>
<td>21</td>
<td>79%</td>
</tr>
<tr>
<td>Stress test</td>
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<td>2</td>
<td>1</td>
<td>400</td>
<td>20</td>
<td>20</td>
<td>160</td>
<td>5</td>
<td>4</td>
<td>9</td>
<td>53%</td>
</tr>
<tr>
<td>Total</td>
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<td>-</td>
<td>-</td>
<td>68700</td>
<td>-</td>
<td>1385</td>
<td>10160</td>
<td>339</td>
<td>277</td>
<td>616</td>
<td>56%</td>
</tr>
</tbody>
</table>

### Diagram

- **Customer complaints**
- **Quality**
- **Time**
- **Miss the time to market**
- **Loss money**
Auto Testing Framework

Test Bench

Screen projection
- Screen image receiving / display service
- Xpath resolution for Hybrid page element

Recording
- Script visualization service
- Input event collection / resolution service

Playback Server
- Performance test service
- Stress test service
- Image contrast
- Log collection
- Test data collection / visualization
- Control of test process
- Route
- ADB
- User operation type

Client

Script
- Python
- Ruby
- JS

DUT

Minicap

Control analysis
- Native App control analysis
- Xposed
- Webkit

Bootstrap
- Stress test Bootstrap
- Performance test Bootstrap
- Uiautomator2 Bootstrap
- Uiautomator

TS development
- TS modify
- Appium Native
- openSTF Native
Smarter

- Qualcomm, ARM, Hisilicon
- AI core & Heterogeneous computing
  - CPU/GPU/DSP configurable
  - HVX, neon …
- Model trimming and tailoring
- Enable the customers & algorithm developers, partners

RetailNext Camera
Face++ Face Recognition
Electrolux Smart Microwave
Challenges

- Boot even faster
  - Suspend to Disk
- Open hypervisor & RTOS
  - seL4? Magenta?
- Standard inter-screen & inter-system interface
  - Kanzi Connect, Qt
- Really Useful ADAS
  - data, data, data; system, system, system
- Reliable Upgrading
  - SOTA
- Security
  - EAL 6+, 26262
Enabling Open Source

Open Source

- Technology
- Innovation
- Expertise
- Community
- Standardization

Market

- $$$ Requirement
- Customers
- Quality
- Commitment
- Speed

Code Bus

Enabler!

ROS.org  gstreamer
LXC  yocto  OS VR
Thanks

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