TI DLP® Technology is enabling smart & dynamic lighting all around the vehicle

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Agenda

- DLP Automotive overview, investment strategy and device application support
- Dynamic ground projection (DGP) trends and EVM introduction
- DLP Automotive high resolution headlight advantages and future application support

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DLP Auto exterior end equipment

High resolution headlight

- Highest resolution ADB available
- 14º×7º FOV for ADB & symbols
- Object detection support
- Nighttime ADAS enhancement

Symbol projection

- Lane markings & communication
- CAN support & easy integration
- Highly customizable
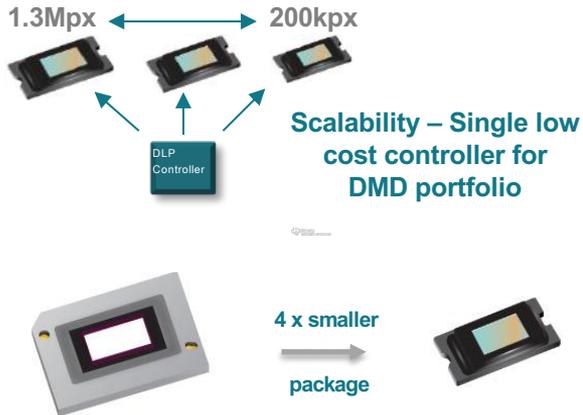- Dedicated symbol projection unit

Dynamic ground projection

- Customization & safety features
- Single and full-color support
- GPU Free video & image generation
- Compact stand alone modules

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TI DLP Auto investment strategy

Solution cost

Innovations in silicon and packaging technologies to deliver high performance, automotive qualified chipsets.

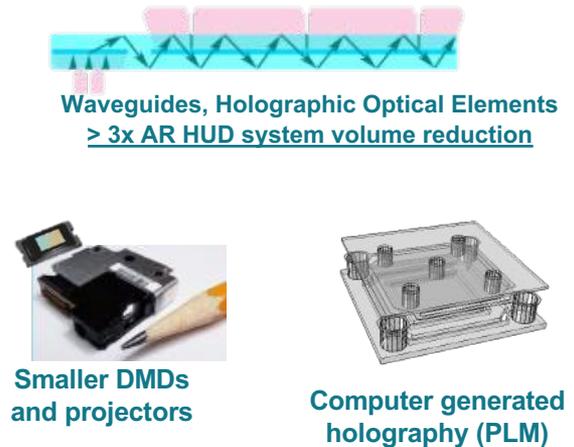1.3Mpx ← → 200kpx

DLP Controller

Scalability – Single low cost controller for DMD portfolio

4 x smaller

package

Efficiency

Innovations in optics, illumination and pixel technology to enable high brightness at minimal power.

01234567896

Laser illumination
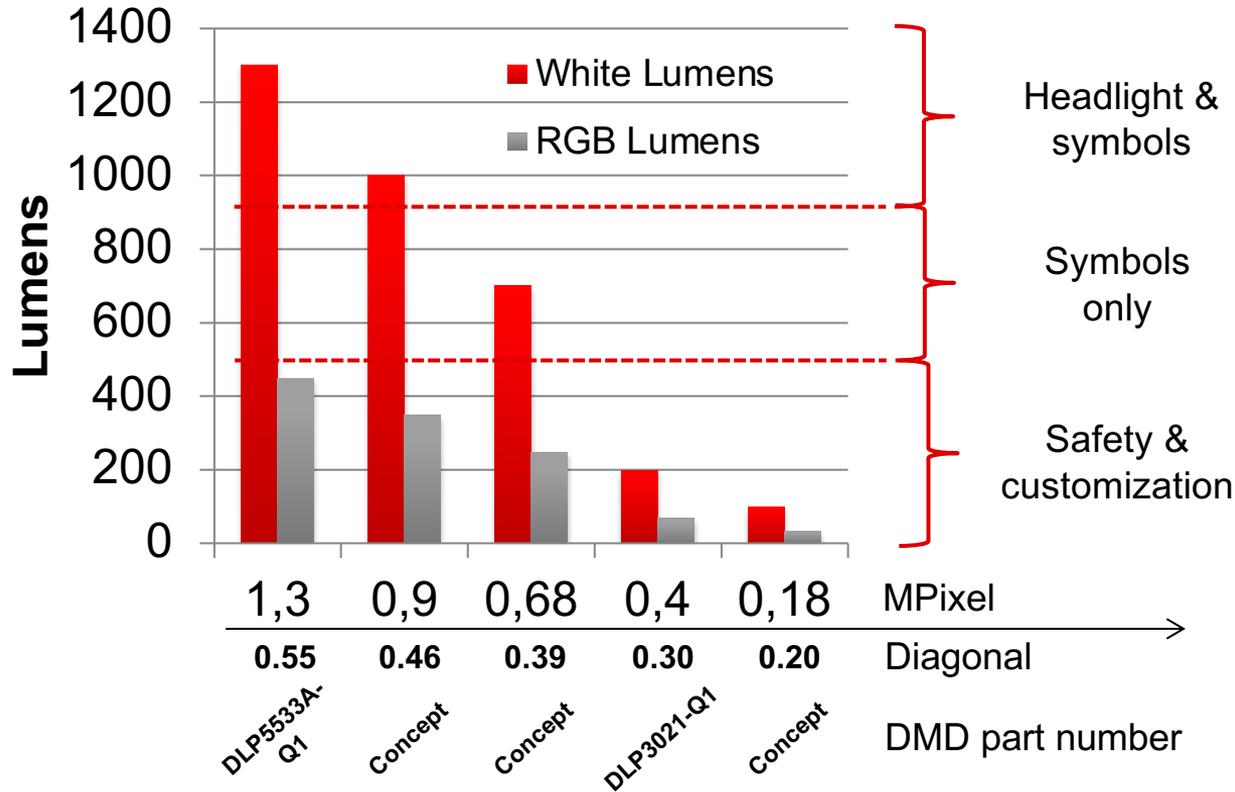
Segmented LED

1.7x ↑ NTSC Color gamut

1.3x ↑efficiency

Phase light modulation (in development)

5x – 10x ↑ efficiency for symbol projection
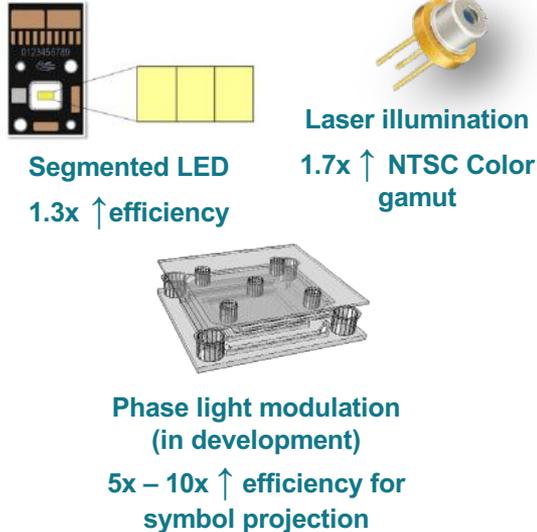
Reduced size

Enabling compact solution new optical architectures, pixel design and optics concepts.

Waveguides, Holographic Optical Elements > 3x AR HUD system volume reduction

Smaller DMDs and projectors

Computer generated holography (PLM)

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Device application support

Chart axis labels:

Y-axis: Lumens (0, 200, 400, 600, 800, 1000, 1200, 1400)

Legend:
- ■ White Lumens (red)
- ■ RGB Lumens (gray)

MPixel	1,3	0,9	0,68	0,4	0,18
Diagonal	0.55	0.46	0.39	0.30	0.20
DMD part number	DLP5533A-Q1	Concept	Concept	DLP3021-Q1	Concept

Headlight & symbols

Symbols only

Safety & customization

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DLP Auto – exterior lighting market trends

- Static projectors are becoming common in vehicles for customization, but <u>offer limited uses</u>.

- DLP technology can add <u>dynamic projection</u> around the car for a variety of uses:

Vehicle to Pedestrian (V2P) communication

Orchestration & personalization

- DLP Auto enables dynamic projection around the car to <u>enable communication</u> such as vehicle warning messages and customizable welcome sequences or messaging.

- DLP Products are automotive qualified, highly efficient, enable simplified electronics architecture for easy vehicle integrations, support RGB images and video.

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DLP3021LEQ1EVM introduction

System features with DLP Products

- Full color video and images using RGB LEDs
- No video interface required, easy integration in vehicle
- Flexible design for all brightness, color requirements
- WVGA resolution (864x480)
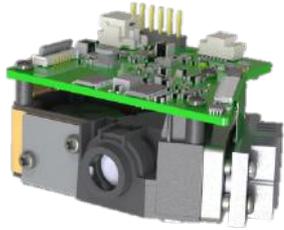
Approximate Optical Module Size
65mm x 43mm x 25mm

EVM Specifications

Brightness	Up to 35 lm @ 3.5W power
Contrast	~750:1
Image Size	310-420mm diagonal @ 850-1150mm throw dist.

Pre-rendered video content

LED illumination

DLP3021-Q1

Full Video Output

Example applications

Approximate video length

Flash size	RGB video length*	Single color video length*
512 Mb	6-12 s	15-30 s
1 Gb	12-24 s	30-60 s
2 Gb	24-48 s	60 – 120 s

*Depends on DMD, resolution, frame rate, compressibility
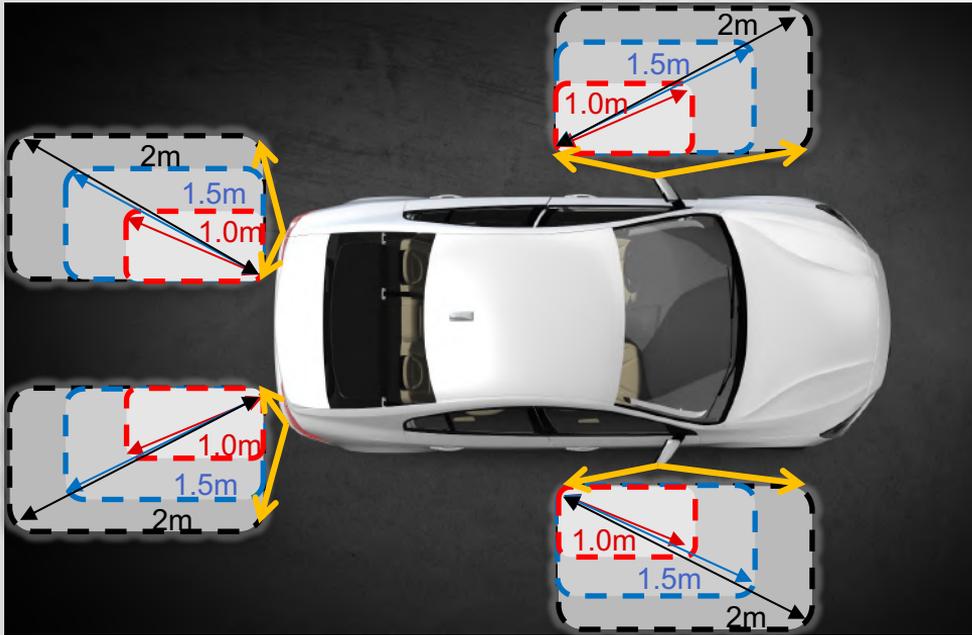
Demo video for DGP use cases

Animated Logo projection

Enhanced safety features

DOOR OPEN

Increased vehicle visibility
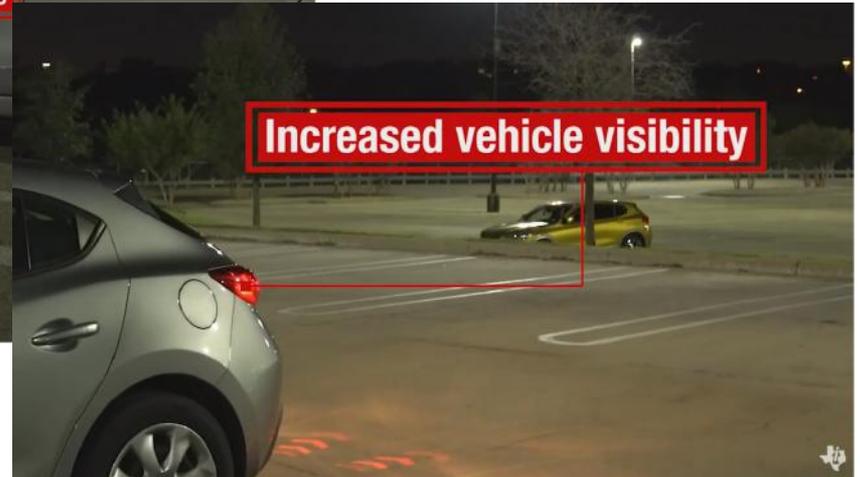
Key Use Cases

Animated logos

Safety features

Vehicle visibility

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Scalable DGP all around the vehicle

DMD (16:9 AR)	Lumens White	Lumens RGB	Diagonal Size
0.20" (Concept)	200	30	1.0 m
DLP3021-Q1	400	66	1.5 m
0.39" (Concept)	700	116	2.0 m

DGP roadmap: multiple DMDs to support various **image sizes** with **constant brightness**

Assumptions:
- RGB lumens predicted lower than white lumens due to lower efficiency and faster f/#
- 75 lux target

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Advantages of DLP Auto High resolution headlight

Highest resolution ADB

Benefits:
- With the highest resolution available, DLP Technology enables ADB systems to maximize light on the road without glaring other drivers.

Detect objects & hazards

Benefits:
- DLP Automotive headlights can improve the vehicle's ADAS system by projecting patterns, which are invisible to the driver, to help the front camera detect objects in the road.

Enables symbol projection

Benefits:
- Help the driver through hazardous driving conditions and construction with lane marking.
- Increase confidence for everyone on the road by communicating intent.

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DLP Auto's value proposition is evolving as new lighting functions emerge

High resolution ADB

V2X communication

Symbol Projection

Communication

360° dynamic projection

Animated welcome light

Vehicle orchestration

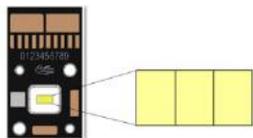Structured light detecting potholes or objects in the road

Weather detection

Object/pedestrian detection

Camera support

2020   2021   2022+

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Summary

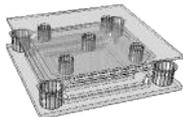| Investment strategy	Dynamic ground projection	High resolution headlight

System efficiency

Smaller packages

New technologies

- ❑ Cost reductions
- ❑ Improved efficiency
- ❑ System volume reductions
- ❑ Easy to integrate systems

- ❑ Customization & communication
- ❑ "GPU-free" video generation
- ❑ DMDs to support many image sizes
- ❑ DLP3021LEQ1EVM available now

- ❑ Highest resolution ADB
- ❑ Complex symbol projection support
- ❑ Object detection support
- ❑ Future application support

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Thank you

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