15 –ാം കേരള നിയമസഭ

9 –ാം സമ്മേളനം

നക്ഷത്ര ചിഹ്നം ഇല്ലാത്ത ചോദ്യം നം. 2001 **12-09-2023 - ൽ മറുപടിയ്ക്ക്**

എ.ഐ. ക്യാമറകളുടെ സ്പെസിഫിക്കേഷൻ

ചോദ്യം		ഉത്തരം	
ശ്രീ. എ. പി. അനിൽ കുമാർ		**ശ്രീ ആന്റണി രാജു** **(ഗതാഗത വകുപ്പ് മന്ത്രി)**	
(എ)	എ.ഐ. ക്യാമറ പദ്ധതി പ്രകാരമുള്ള ക്യാമറയുടെ സ്പെസിഫിക്കേഷൻ എന്താണ്; എത്ര രൂപയാണ് പദ്ധതിക്ക് വേണ്ടി ചെലവായത്; ഇനം തിരിച്ചുള്ള കണക്ക് ലഭ്യമാക്കാമോ?	(എ)	എ.ഐ. ക്യാമറ പദ്ധതി പ്രകാരമുള്ള ക്യാമറകളുടെ സ്പെസിഫിക്കേഷൻ **അനുബന്ധമായി ചേർക്കുന്നു .** ടി പദ്ധതിയുടെ ഉകയായ 2,32,25,50,286/- രൂപ 20 തുല്യ ത്രൈമാസ ഗഡുക്കളായി കെൽട്രോണിന് 5 വർഷം കൊണ്ടാണ് സർക്കാർ നൽകേണ്ടത് .നാളിതുവരെ ടി പദ്ധതിയ്ക്ക് വേണ്ടി സർക്കാർ ഉക ചെലവായിട്ടില്ല .

സെക്ഷൻ ഓഫീസർ

അനുബന്ധം

TECHNICAL SPECIFICATIONS

1. SPEED ENFORCEMENT SYSTEM MODULES

Sl. No.	MODULE COMPONENTS- MINIMUM REQUIREMENTS
1	**industrial Switch Module** Industrial switch is to interconnect various subsystems of the field unit as described below. Minimum 10 port Ethernet switch, Industrial temperature range, built in Surge protection with TVS and GDT. Layer 2 , 10/100 Base T. 1.4Gbps or more memory bandwidth and shared switch fabric non blocking performance. Min 1K MAC lookup table, full duplex IEEE 802.3x, 0-60 deg C
2	**Violation NVR Module** NVR should be able to record all violation images with evidence camera images. These images can be downloaded from control room, for chellaning purposes. Normally SSD with SATA interface will be used for storage. NVR should be able to record all violations (ANPR lane images), & two Evidence images per violation should be recorded. 100/1000 Base T Ethernet, USB Ports, Should Support SATA support: SSD/ HDD up to 1 TB (Drive not required).Industrial temp range operation
3	**All Vehicle ANPR – NVR Module** NVR should be able to record all lane ANPR images in 24x7 Fashion, these images can be downloaded locally or from control room, is basically for police crime analysis applications. Should Support HDD up to 6TB (Drive not required), 100/1000 Base T Ethernet, USB Ports. Should capture all vehicles irrespective of Number plate state. Dual images for night capture. Industrial temp range operation.
4	**AC Power supply and UPS Module** AC power supply provides required DC power to all subsystems in the field box & cameras. In case of power failure Battery back option should be available for min 2hours for entire filed system.110- 270 VAC input , DC output 12VDC, minimum 300 Watts, Zero switch over time UPS, DC only operation preferred, Built in Battery charger 6 Amps with battery over voltage & under voltage protection.
5	**AC Power Control & Power Conditioning Module** This is a AC mains input precondition unit, for following functions Mains Under & over voltage protection, MOV surge protection, power control, and

	Over current protection.
6	**Processor Module** Should interface with Radar and trigger ANPR / Evidence cameras for violation capture and also for all vehicle ANPR recording. The lane & evidence cameras also should be synchronized by the Processor subsystem. It also has Local status monitoring, LAN & GSM interfaces. Features include: Flash power control, System watch dog features, NTP features, Watch dog timers, system power control, Remote Status monitoring: Temperature, battery status, Power supply working status over cloud should be possible .Camera status etc. Battery & Mains power status monitoring is also done by the system. ARM based processor & control electronics should be provided and should interface with all subsystems and cameras as per above requirements. Interfaces: 10/100 Base T Ethernet, RS485 ports & GPIO, ADC ports. GSM – 2G interface.
7	**3D Radar with Radar Interface Module** Should detect and measure speed of vehicles. Up to 240 KMPH. Speed Accuracy, 98% or better, 24GHZ operation. Multi-lane operation with Simultaneously vehicle tracking, to capture all vehicles on Road with speed & position. National / international Over speed Calibration certificate.24 GHZ -FMCW (Frequency Modulated Continuous Wave) 3D ultra-high definition (UHD) radar Should detect and measure speed of vehicles. Up to 240 KMPH. Speed Accuracy, 98% or better, Multi lane operation with Complete unit should be IP66, from -30°C to 55°CWith suitable interface to system controller over CAN/ RS 485, Isolated power supply and surge protection. 12-15VDC operation.
8	**Lane ANPR camera** Camera should be minimum 2 Mega pixel total resolution, True day & night camera. Colour images for day, monochrome images for night CMOS Global shutter sensor Exposure time maximum 1millisecond, Interface: JPEG compression, Trigger in, Flash strobe out. External Infrared flash synchronization with Global shutter of camera. **Lens:** True Mega pixel or better, Day & night, IR corrected, lens. Motorized zoom, focus preferred. **Camera processor Module.** Provides interface with sensor system, Video compression JPEG. Sensor strobe, Flash strobe etc. Video processor. Ethernet, RS 485 interface. ICR control. Capability for radar / VPU external triggering, Power 12V DC nominal, 10/100 base T Ethernet Parallel or MIPI sensor interface.
9	**Lane ANPR Camera sensor with Lens assembly Module**

	2 Mega Pixel minimum, True ICR feature, Exposure time 10uS-maximum 1 millisecond, Trigger out : Global shutter sync flash strobe out, Interface::, Pixel size: 3.45 micron or better preferred, Sensor make: SONY Pregius or equivalent , Equivalent resolution mega pixel lens, motorized lens preferred, No motion blur for Vehicle speed up to 240 KMPH, Frame rate: configurable,
10	**EVIDENCE camera:** Camera should be minimum 2 Mega pixel total resolution, True day & night camera. Colour images for day, monochrome images for night, CMOS Global shutter sensor ,Exposure time maximum: 1millisecond ,JPEG compression, Trigger in, Flash strobe out **Lens:** Vari-focal, Mega pixel day & night lens, IR corrected **Camera processor Module,** Provides interface with sensor system, Video compression JPEG. Sensor strobe, Flash strobe etc. Video processor. Ethernet, RS 485 interface. ICR control. Colour images for day, monochrome images for night (with Infrared flash), or colour for visible flash, Power 12V DC nominal. Interface: 10/100 base T Ethernet.
11	**Evidence Camera sensor with Lens assembly** 2 Mega Pixel, True ICR feature, Exposure time 10uS-maximum 1 millisecond, Trigger out : Global shutter sync flash strobe out, Interface::, Pixel size: 3.45 micron or better preferred, Sensor make: SONY Pregius or equivalent , Equivalent resolution mega pixel lens, No motion blur for Vehicle speed up to 240 KMPH, Frame rate: configurable.
12	**Pulsed Power IR Flash UNIT : 250W peak power** Infrared flash for image capture at night, Synchronized flash with global shutter of camera, Flash power sufficient to capture vehicle images also at night. Capability to capture retro reflective and non-reflective number plates. Night image quality should be sufficient to verify face of 2 wheeler drivers, helmet detection etc. Synchronized flash with global shutter of camera, Flash strobe input, Wavelength: 850nm, FOV: 1.3 times lane width per flash, OSRAM or similar make high efficiency LED & LENS. FOV 13 deg. Zero cycle time, 12V DC operation, pulse capability 1 millisecond, With voltage boost & Driver boards. Peak power up to 250 watts minimum.
13	**4G industrial modem – Router with LAN Module** Supports direct connectivity from control room to field & vice versa. It also supports IPV6 / IPV4 protocols. Employs LTE CAT4 module with support of up to 150Mbps downlink data transfer. Maximum upload speed is 50 Mbps Supports following LTE Bands

	B1 (2100), B3 (1800) B7 (2600) B8 (900) B20 (800DD) B5 (850) B38 (TDD 2600) B40 (TDD 2300) B41 (TDD 2500) Supports all major networks JIO, VODAFONE-IDEA, AIRTEL • Operating Temperature Range -40 °C to 85 °C • Router employs ARM Cortex-A8 based processor running at 1GHZ • Ram 512MB DDR3L • On board Managed NAND (eMMC) 4GB • Status display includes the following parameters • Runs at 12VDC • Reset switch for factory defaults.

1.1 OVERALL SVDS SYSTEM REQUIREMENTS

1	3D UHD Doppler Radar (1 per road)	Advanced Tracking Doppler Radar - , Detects and measures speed of vehicles. > 240 Km/hour. Refresh Time – 50msec, Multi lane operation. Speed Accuracy better than 97%. Heavy vehicle classification (trucks / Bus etc.) should be possible by Radar.
2	Camera for License Plate Capture (1 per lane)	Camera should be minimum 2 Mega pixel total resolution, True day & night camera. Colour images for day, monochrome images for night. CMOS Global shutter sensor. Exposure time maximum 1millisecond. Interface: 10/100 base T Ethernet JPEG compression, Trigger in, Flash strobe out Lens: True Mega pixel or better, Day & night, IR corrected, lens. Motorized zoom, focus preferred.
3	Camera for evidence	Camera should be minimum 2 Mega pixel total

	capture (1 per road)	resolution, True day & night camera. Colour images for day, monochrome images for night. CMOS Global shutter sensor. Exposure time maximum: 1millisecond. Interface: 10/100 base T Ethernet JPEG compression, Trigger in, Flash strobe out **Lens**: Vari-focal, Mega pixel day & night lens, IR corrected
4	Infrared Flash for Illumination (1 per lane)	Infrared flash for image capture at night Synchronized flash with global shutter of camera Wavelength: 850 nm, Flash power sufficient to capture vehicle images also at night. Min 250W peak power per lane. Capability to capture retro reflective and non-reflective number plates. Night image quality should be sufficient to verify face of 2 wheeler drivers, helmet detection etc. in pitch dark
5	Image brightness, contrast control	The method of gain, exposure control should give optimum image quality under all conditions, 24x7, under all conditions of illumination, independent of road orientation.
6	Vehicle image Capture, Chelan Format	Along with number plate, high quality image of vehicle, also to be captured at Day and Night for all vehicles including two wheelers. Evidence camera should capture wide angle shot of full road and surroundings with minimum two images of vehicle moving on the road. Chelan Format: 1x Lane image & 2 x Evidence images.
7	Speed Enforcement Method	Spot speed and Average speed, ANPR camera captures vehicle image / License plate number, based on trigger from Radar sensor with time stamp and speed information. Accurate time stamp synchronized with GPS or NTP servers.
8	All vehicle - ANPR capture Mode	Captures all vehicles passing through the installed location. All vehicle images and numbers including 2 wheelers are kept in data base for real time alerts / search for crime analysis. Vehicle images should be captured even if the number is not automatically detected ,(example: damaged / unreadable license

		plates or even absence of number plates)
9	ANPR accuracy	High ANPR accuracy : TYP 95% for standard plates with max one character error
10	Vehicle detection rate (percentage of vehicles captured)	High vehicle detection rate. (typical 95% of all vehicles captured under all conditions, irrespective of number plate quality, in free flow traffic conditions, systems should be installed at free traffic stretches to obtain above accuracy)
11	Front side capture	It should be possible to capture front side number plates also, instead of rear number plates. In this case, head light bloom should not affect quality of the image
12	Classification, vehicle Marking, Lane violation	Should be possible to classify heavy vehicles trucks, cars, 2 wheelers, medium heavy vehicles etc. Violated vehicles should be clearly marked by a Box on the image. Should be possible to detect Lane violation by heavy vehicles
13	Vehicle speed accuracy,	Speed measurement accuracy better than 97%, Speed > 200 KMPH. With national or international metrological calibration certificate for speed sensor.
14	Road side processing hardware and software, storage, network switch	Road side Embedded hardware, network switch etc. On site LCD display for local status monitoring. Local storage with 256GB or more storage site. Industrial grade Network switch (0-60 deg. C), 10/100 base T.
15	Power supply	Power input: 170-250VAC, UPS for road side hardware with min 3 Hr back up and also soft shutdown of Hardware in case of power failure with auto restart. Utility power supply with power meter
16	Health Monitoring and control. (from control room),	Temperature, battery status, Mains power, Power supply working status, vibration sensor (Anti tamper with siren) status, Camera status. Remote control of reset, shutdown.
17	Protection	Protection against lightning, under / over voltage should be provided (under these condition operation from Battery power is recommended). Low power standby mode for long period Mains power failure condition etc. Industrial grade earthing for system

		and poles should be provided.
18	Remote notification methods	In addition to main connectivity, Cloud based remote notification should be available

2. MSVDS SYSTEM MODULES BOM

Sl. No.	MODULE COMPONENTS- MINIMUM REQUIREMENTS
1	**ANPR Camera** Camera should be minimum 3/5 Mega pixel total resolution, True day & night camera. Colour images for day, monochrome images for night CMOS Global shutter sensor Exposure time maximum 1millisecond, Interface: JPEG compression, Trigger in, Flash strobe out. **Lens:** True Mega pixel or better, Day & night, IR corrected, lens. External Infrared flash synchronization with Global shutter of camera. **ANPR camera processor Module**. Provides interface with sensor system, Video compression JPEG. Sensor strobe, Flash strobe etc. Video processor. Ethernet, RS 485 interface. ICR control. Capability for radar / VPU external triggering, Colour images for day, monochrome images for night (with Infrared flash), or colour for visible flash, Power 12V DC nominal,
2	**Lane ANPR Camera sensor with Lens Module** 3/5 Mega Pixel minimum, True ICR feature, Exposure time 10uS-maximum 1 millisecond, Trigger out : Global shutter sync flash strobe out, Interface::, Pixel size: 3.45 micron or better preferred, Sensor make: SONY Pregius or equivalent , Equivalent resolution mega pixel lens, motorized lens preferred, No motion blur for Vehicle speed up to 240 KMPH, Frame rate: configurable.
3	**MSVDS SYSTEM CONTROLLER with Industrial Switch** Should interface with Radar & trigger ANPR cameras for violation capture, Synchronized Flash power control, Watch dog features, RS485 & Ethernet interface. Minimum 4 port Industrial switch. Industrial temperature range. Should interface with touch panel PC for violation detection & configuration. With power control PCB & Protection
4	**Pulsed Power IR Flash UNIT: 600 W peak power** Infrared flash for image capture at night, Synchronized flash with global shutter of camera, Flash power sufficient to capture vehicle images also at night. Capability to capture retro reflective and non-reflective number plates. Night image quality should be sufficient to identify vehicle. Flash strobe input, Wavelength: 850nm, FOV: > 26 deg. OSRAM or similar make high efficiency

	LED & LENS. Zero cycle time, 12V DC operation, pulse capability 1 millisecond, With voltage boost & Driver boards. Peak power > 600 W.
5	**SBC & LCD Panel USER interface Module** To perform road calibration using virtual grid on image, live view of violations etc. Mobile SVDS display interface: Industrial PC with TFT LCD Display (10.5 inch). Windows or Linux operation. Celeron or quad core CPU , > 1 GHZ speed & 4GB ram.
6	**4G industrial modem – Router with LAN Module** Supports direct connectivity from control room to field & vice versa.. It also supports IPV6 / IPV4 protocols. Employs LTE CAT4 module with support of up to 150Mbps downlink data transfer. Maximum upload speed is 50 Mbps Supports following LTE Bands B1 (2100), B3 (1800) B7 (2600) B8 (900) B20 (800DD) B5 (850) B38 (TDD 2600) B40 (TDD 2300) B41 (TDD 2500) Supports all major networks JIO, VODAFONE-IDEA, AIRTEL • Operating Temperature Range -40 °C to 85 °C • Router employs ARM Cortex-A8 based processor running at 1GHZ • Ram 512MB DDR3L • On board Managed NAND (eMMC) 4GB • Status display includes the following parameters • Runs at 12VDC • Reset switch for factory defaults. • IPV6 support. • DyDNS support. • Embedded Linux OS • Firmware Upgrade available

	• Port forwarding up to 10 ports. • Ethernet supports both IPV4 and IPV6
7	**3D Radar with Radar Interface Sub Module** , Should detect and measure speed of vehicles. Up to 240 KMPH. Speed Accuracy, 98% or better, Multi lane operation with Simultaneously vehicle tracking, to capture all vehicles on Road with speed & position. National / international Over speed Calibration certificate. FMCW (Frequency Modulated Continuous Wave),24 GHZ3D ultra-high definition (UHD) Radar Should detect and measure speed of vehicles. Up to 240 KMPH. Speed Accuracy, 98% or better Multi lane operation with Complete unit should be IP66, from -30°C to 55°C With suitable interface to system controller over CAN/ RS 485, Isolated power supply and surge protection. 12-15VDC operation.
8	MSVDS system PAN & TILT assembly and accessories

2.1 OVER ALL REQUIREMENTS OF MOBILE SPEED ENFORCEMENT SYSTEM

1	Doppler Radar	Advanced Tracking Doppler Radar - , Detects and measures speed of vehicles. > 200 Km/hour. Refresh Time – 50msec, Multi lane operation. Speed Accuracy better than 97%. Heavy vehicle classification (trucks / Bus etc.) should be possible by Radar.
2	Camera for License Plate Capture	Camera minimum 3 /5 Mega pixel total resolution, True day & night camera, min 2 lane coverage
		Colour images for day, monochrome images for night
		CMOS Global shutter sensor
		Exposure time maximum 1millisecond
		Interface: 10/100 base T Ethernet
		JPEG compression, Trigger in, Flash strobe out
		Lens: Mega pixel or better, Day & night, IR corrected, lens. Motorized zoom, focus preferred.
3	Infrared Flash for Illumination	Infrared flash for image capture at night
		Synchronized flash with global shutter of camera
		Peak pulse power > 600 watts,
		Wavelength: 850 nm, Flash power sufficient to capture vehicle images also at night. 40 deg. Angle
		Capability to capture retro reflective and non-reflective number plates.

4	Image brightness, contrast control	The method of gain, exposure control should give optimum image quality under all conditions, 24x7, under all conditions of illumination, independent of road orientation.
5	Vehicle speed accuracy,	Speed measurement accuracy better than 97%, Speed > 200 KMPH. With national or international metrological calibration certificate for speed sensor.
6	Vehicle Marking	The captured vehicle will have marking on image for identification of correct vehicle.
7	Road side processing hardware and software,	Road side Embedded hardware, Local storage with 240 GB or more storage site. Industrial grade Network switch (0-60 deg. C), 10/100 base T.
8	Local display & processor	To perform road calibration using virtual grid on image, live view of violations etc.
9	Power supply	Runs on Battery, LiFePO4, 80 AH With 15 A Charger
10	Camera mounting	Vehicle mount

3. RLVDS SYSTEM MODULES BOM (3 ARM 6 JUNCTIONS)

Sl. No.	MODULE COMPONENTS- MINIMUM REQUIREMENTS
1	**industrial Switch Module** Industrial switch is to interconnect various subsystems of the field unit as described below. Minimum 10 port Ethernet switch, Industrial temperature range, built in Surge protection with TVS and GDT. Layer 2 , 10/100 Base T. 1.4Gbps or more memory bandwidth and shared switch fabric non-blocking performance. Min 1K MAC lookup table, full duplex IEEE 802.3x, 0-60 deg C.
2	**Violation NVR Module** NVR should be able to record all violation images with evidence camera images. These images can be downloaded from control room, for chellaning purposes. Normally SSD with SATA interface will be used for storage. NVR should be able to record all violations (ANPR lane images)Evidence images 1 per violation should be recorded.100/1000 Base T Ethernet, USB Ports, Should Support SATA support: SSD/ HDD up to 1 TB (Drive not required).Industrial temp range.
4	**AC Power supply and UPS Module,**

	AC power supply provides required DC power to all subsystems in the field box & cameras. I case of power failure Battery back option should be available for min 2hours for entire filed system including electronics.110- 270 VAC input , DC output 12VDC, minimum 300 Watts, **Zero switch over time UPS**, DC only operation preferred, Built in Battery charger 6 Amps with battery over voltage & under voltage protection.
5	**AC Power Control & Power Conditioning Module** This is a AC mains input precondition unit, for following functions. Mains Under & over voltage protection, MOV surge protection, power control, and Over current protection.
6	**Processor Module** Should interface with VPU and trigger ANPR / Evidence cameras for violation capture and also for all vehicle ANPR recording. The lane & evidence cameras also should be synchronized by the Processor subsystem. It also has Local status monitoring, LAN & GSM interfaces. Features include: Flash power control, System watch dog features, NTP features, Watch dog timers, system power control, Remote Status monitoring: Temperature, battery status, Power supply working status over cloud should be possible. Camera status etc. Battery & Mains power status monitoring is also done by the system. ARM based processor & control electronics should be provided and should interface with all subsystems and cameras as per above requirements. Interfaces: 10/100 Base T Ethernet, RS485 ports & GPIO, ADC ports. GSM – 2G interface.
7	**VPU – virtual line crossing detection Module** Should analyses Evidence camera images for Red Light violations and capture corresponding lane images and store / forward them. AI engine with GPU & Multicore CPU for Video processing. Up to 2.1GHz, 192 GPU cores, Quad core CPU, 2 GB ram, 16 GB flash, USB, Gigabit Ethernet.,
8	**Lane ANPR camera** Camera should be minimum 2 Mega pixel total resolution, True day & night camera. Colour images for day, monochrome images for night CMOS Global shutter sensor Exposure time maximum 1millisecond, Interface: JPEG compression, Trigger in, Flash strobe out. External Infrared flash synchronization with Global shutter of camera. True Mega pixel or better, Day & night, IR corrected, lens. Motorized zoom, focus preferred. **Camera processor Module**. Provides interface with sensor system, Video compression JPEG. Sensor strobe, Flash strobe etc. Video processor. Ethernet, RS 485 interface. ICR control. Capability for radar / VPU external triggering, Power 12V DC nominal,

	10/100 base T Ethernet. Parallel or MIPI sensor interface.
9.	**Lane ANPR Camera sensor with Lens assembly** Module 2 Mega Pixel minimum, True ICR feature, Exposure time 10uS-maximum 1 millisecond, Trigger out : Global shutter sync flash strobe out, Interface::, Pixel size: 3.45 micron or better preferred, Sensor make: SONY Pregius or equivalent , Equivalent resolution mega pixel lens, motorized lens preferred, No motion blur for Vehicle speed up to 180 KMPH, Frame rate: configurable,
10	**EVIDENCE CAMERA:** Camera should be minimum 2 Mega pixel total resolution, True day & night camera. Colour images for day, monochrome images for night, CMOS Global shutter sensor, Exposure time maximum: 1millisecond, JPEG compression, Trigger in, Flash strobe out. **Lens:** Vari-focal, Mega pixel day & night lens, IR corrected. **Camera processor Module** Provides interface with sensor system, Video compression JPEG. Sensor strobe, Flash strobe etc. Video processor. Ethernet, RS 485 interface. ICR control. Colour images for day, monochrome images for night (with Infrared flash), or colour for visible flash, Power 12V DC nominal. Interface: 10/100 base T Ethernet.
11	**Evidence Camera sensor with Lens assembly Module** 2 Mega Pixel, True ICR feature, Exposure time 10uS-maximum 1 millisecond, Trigger out : Global shutter sync flash strobe out, Interface::, Pixel size: 3.45 micron or better preferred, Sensor make: SONY Pregius or equivalent , Equivalent resolution mega pixel lens, No motion blur for Vehicle speed up to 240 KMPH, Frame rate: configurable,
12	**Pulsed Power IR Flash UNIT : 250W peak power** Infrared flash for image capture at night, Synchronized flash with global shutter of camera, Flash power sufficient to capture vehicle images also at night. Capability to capture retro reflective and non-reflective number plates. Night image quality should be sufficient to verify face of 2 wheeler drivers, helmet detection. Synchronized flash with global shutter of camera, Flash strobe input,

	Wavelength: 850nm, FOV: 1.3 times lane width per flash, Flash power sufficient to capture high quality vehicle images also at night. OSRAM or similar make high efficiency LED & LENS. FOV 13 deg. Zero cycle time, 12V DC operation, pulse capability 1 millisecond, With voltage boost & Driver boards. Peak power up to 250 watts minimum.

3.1 OVER ALL REQUIREMENTS OF RLVD SYSTEM

1	Camera for License Plate Capture (1 per lane)	ANPR 2 Mega pixel camera (True day and night): one per lane to be used to capture all vehicles including 2 wheelers, violating RED signal and stop line in day and night conditions. All types of number plates reflective type and standard type should be captured. Vehicle image also should be captured under all conditions. Image compression JPEG. Connectivity Ethernet. Camera should be minimum 2 Mega pixel total resolution, True day & night camera, Color images for day, monochrome images for night, CMOS Global shutter sensor. Exposure time maximum 1millisecond Interface: 10/100 base T Ethernet. JPEG compression, Trigger in, Flash strobe out. True Mega pixel or better, Day & night, IR corrected, lens. Motorized zoom, focus preferred.
2	Camera for evidence capture (1 per road)	ANPR Mega pixel camera (True day and night): one per Road to capture in wide angle image of violation with violating vehicle and Traffic signal. Image compression JPEG. Connectivity Ethernet. Should work for day and night condition, acting as court evidence with red traffic light. Camera should be minimum 2 Mega pixel total resolution, True day & night camera Color images for day, monochrome images for night CMOS Global shutter sensor Exposure time maximum 1millisecond Interface: 10/100 base T Ethernet JPEG compression, Trigger in, Flash strobe out
3	Vehicle sensing, Vehicle Marking,	Vision based sensor for red light jumping & stop line violation detection. System should be able to detect vehicles with no number plates or damaged plates also. Violating vehicle should be marked on both lane & evidence images by a box or similar identifier. Minimum 4 type vehicle classification should be possible. Chelan Format should have 1x lane image & 1 x Evidence image
4	Infrared	Infrared flash for image capture at night. Flash power sufficient

	Flash for Illumination (1 per lane)	to capture vehicle images also at night. Should be capable of capturing all types of number plates, including two wheelers at night. Min 250W peak power per lane. **Capability** to capture retro reflective and non-reflective number plates
5	ANPR (automatic number plate recognition) accuracy	High ANPR accuracy: TYP 95% for standard plates with max one character error.
6	Traffic light interface / visibility	Optically isolated interface. Red signal light should be visible in the evidence camera image along with image of violating vehicle for Day and Night.
7	Road side processing hardware and software	As required
8	Power supply	Power input: 170-240VAC, UPS for road side hardware with min 3 Hr back up, Utility power supply with power meter required at site meeting State electricity boar requirements)
9	Protection	Protection against lightning, under / over voltage should be provided (under these condition operation from Battery power is recommended).
10	Camera mounting	Suitable Cantilever / gantry should be provided.

4. AI SMART CAMERA MODULES FOR 3 MEGA PIXEL CAMERA

Sl. No.	MODULE COMPONENTS - AI SMART CAMERA (3 MEGA PIXEL)
1	**CAMERA 3 MEGA PIXEL** Camera should be minimum 3 Mega pixel total resolution, True day & night camera. Colour images for day, monochrome images for night CMOS Global shutter sensor Exposure time maximum 1millisecond, Interface: JPEG compression, Trigger in, Flash strobe out. **Lens:** True Mega pixel or better, Day & night, IR corrected, lens. External Infrared flash synchronization with Global shutter of camera. **Lane ANPR camera processor Module**. Provides interface with sensor system, Video compression JPEG. Sensor strobe, Flash strobe etc. Video processor. Ethernet, RS 485 interface. ICR

	control. Capability for radar / VPU external triggering, , or colour for visible flash, Power 12V DC nominal,
2	**Lane ANPR Camera sensor with Lens assembly** 3 Mega Pixel minimum, True ICR feature, Exposure time 10uS-maximum 1 millisecond, Trigger out : Global shutter sync flash strobe out, Interface::, Pixel size: 3.45 micron or better preferred, Sensor make: SONY Pregius or equivalent , Equivalent resolution mega pixel lens, No motion blur for Vehicle speed up to 200 KMPH, Frame rate: configurable.
3	**VPU SUB SYSTEM MODULE** VPU subsystem is an AI engine to get images form camera and analyse same with deep learning algorithms to perform helmet detection, seatbelt, triple riding detection etc. Violation detected images are locally storied on a SSD with required meta data. These violation images will be later transmitted to control room for chellan processing. This Subsystem also will have required network switched, power supply, solar operation with maximum power point tracking, flash interface etc. Remote monitoring of system also should be possible over cloud. AI engine with min 128 Cores GPU and Multicore CPU, ARM ® Cortex ® -A57 Core (Quad-Core) | L1 Cache: 48KB L1 instruction cache (I-cache) per core; 32KB L1 data cache (D-cache) per core | L2 Unified Cache: 2MB | Maximum Operating Frequency: 1.43GHz 4GB min RAM, with Storage interface.1000 Base T Ethernet, HDMI & USB ports. Industrial Ethernet Switch, Minimum 4port Ethernet switch, Industrial temperature range, built in Surge protection. Layer 2, 10/100 Base T. 1.4Gbps or more memory bandwidth and shared switch fabric non-blocking performance. Power path-MPPT controller: for solar Charging of up to 80AH battery, 24V solar interface, Battery protection and monitoring of Power system, VPU sub system etc. OR LiFePO4 Battery charger sub systems with protection for Mains powered applications.
4	**Pulsed Power IR Flash UNIT : 600 W peak power** Infrared flash for image capture at night, Synchronized flash with global shutter of camera, Flash power sufficient to capture vehicle images also at night. Capability to capture retro reflective and non-reflective number plates. Night image quality should be sufficient to verify face of 2 wheeler drivers,

	helmet detection. Flash strobe input, Wavelength: 850nm, FOV: 26 deg. OSRAM or similar make high efficiency LED & LENS. Zero cycle time, 12V DC operation, pulse capability 1 millisecond, With voltage boost & Driver boards. Peak power > 600W.
5	**4G industrial modem – Router with LAN Module** Supports direct connectivity from control room to field. It also supports IPV6 / IPV4 protocols. • Employs LTE CAT4 module with support of up to 150Mbps downlink data transfer. • Maximum upload speed is 50 Mbps • Supports following LTE Bands B1 (2100) B3 (1800) B7 (2600) B8 (900) B20 (800DD) B5 (850) B38 (TDD 2600) B40 (TDD 2300) B41 (TDD 2500) • Supports all major networks JIO, VODAFONE-IDEA, AIRTEL • Operating Temperature Range -40 °C to 85 °C • Router employs ARM Cortex-A8 based processor running at 1GHZ • Ram 512MB DDR3L • On board Managed NAND (eMMC) 4GB • Status display includes the following parameters • Runs at 12VDC • Reset switch for factory defaults. • IPV6 support. • DyDNS support. • Embedded Linux OS • Firmware Upgrade available

	• Port forwarding up to 10 ports. • Ethernet supports both IPV4 and IPV6

5. AI SMART CAMERA MODULES FOR 5 MEGA PIXEL CAMERA

Sl. No.	MODULE COMPONENTS - AI SMART CAMERA (5 MEGA PIXEL)
1	**CAMERA REQUIREMENTS:** Camera should be minimum 5 Mega pixel total resolution, True day & night camera. Colour images for day, monochrome images for night CMOS Global shutter sensor Exposure time maximum 1millisecond, Interface: JPEG compression, Trigger in, Flash strobe out. **Lens:** True Mega pixel or better, Day & night, IR corrected, lens. External Infrared flash synchronization with Global shutter of camera. **Lane ANPR camera processor Module.** Provides interface with sensor system, Video compression JPEG. Sensor strobe, Flash strobe etc. Video processor. Ethernet, RS 485 interface. ICR control. Capability for radar / VPU external triggering, , or colour for visible flash, Power 12V DC nominal,
2	**Lane ANPR Camera sensor with Lens assembly** 5 Mega Pixel minimum, True ICR feature, Exposure time 10uS-maximum 1 millisecond, Trigger out : Global shutter sync flash strobe out, Interface::, Pixel size: 3.45 micron or better preferred, Sensor make: SONY Pregius or equivalent , Equivalent resolution mega pixel lens, No motion blur for Vehicle speed up to 200 KMPH, Frame rate: configurable.
3	**VPU SUB SYSTEM MDULE** VPU subsystem is an AI engine to get images form camera and analyse same with deep learning algorithms to perform helmet detection, seatbelt, triple riding detection etc. Violation detected images are locally storied on a SSD with required meta data. These violation images will be later transmitted to control room for chellan processing. This Subsystem also will have required network switched, power supply, solar operation with maximum power point tracking, flash interface etc. Remote monitoring of system also should be possible over cloud. AI engine with min 128 Cores GPU and Multicore CPU, ARM ® Cortex ® -A57 Core (Quad-Core) | L1 Cache: 48KB L1 instruction cache (I-cache) per core; 32KB L1 data cache (D-cache) per core | L2 Unified Cache: 2MB |

	Maximum Operating Frequency: 1.43GHz 4GB min RAM, with Storage interface.1000 Base T Ethernet, HDMI & USB ports. Industrial Ethernet Switch, Minimum 4port Ethernet switch, Industrial temperature range, built in Surge protection. Layer 2, 10/100 Base T. 1.4Gbps or more memory bandwidth and shared switch fabric non-blocking performance. Power path-MPPT controller: for solar Charging of up to 80AH battery, 24V solar interface, Battery protection and monitoring of Power system, VPU sub system etc. OR LiFePO4 Battery charger sub systems with protection for Mains powered applications.
4	**PULSED POWER IR FLASH UNIT : 600W PEAK POWER** Infrared flash for image capture at night, Synchronized flash with global shutter of camera, Flash power sufficient to capture vehicle images also at night. To capture retro reflective and non-reflective number plates. Night image quality should be sufficient to verify face of 2 wheeler drivers, helmet detection. Flash strobe input, Wavelength: 850nm, FOV: 26 deg. OSRAM or similar make high efficiency LED & LENS. Zero cycle time, 12V DC operation, pulse capability 1 millisecond, With voltage boost & Driver boards. Peak power up to 600W.
5	**4G INDUSTRIAL MODEM – ROUTER WITH LAN MODULE** Supports direct connectivity from control room to field. It also supports IPV6 / IPV4 protocols. • Employs LTE CAT4 module with support of up to 150Mbps downlink data transfer. • Maximum upload speed is 50 Mbps • Supports following LTE Bands B1 (2100) B3 (1800) B7 (2600) B8 (900) B20 (800DD) B5 (850) B38 (TDD 2600) B40 (TDD 2300) B41 (TDD 2500) • Supports all major networks JIO, VODAFONE-IDEA, AIRTEL

	• Operating Temperature Range -40 °C to 85 °C • Router employs ARM Cortex-A8 based processor running at 1GHZ • Ram 512MB DDR3L • On board Managed NAND (eMMC) 4GB • Status display includes the following parameters • Runs at 12VDC • Reset switch for factory defaults. • IPV6 support. • DyDNS support. • Embedded Linux OS • Firmware Upgrade available • Port forwarding up to 10 ports. • Ethernet supports both IPV4 and IPV6

6. AI SMART CAMERA MODULES FOR PARKING VIOLATION DETECTION.

Sl. No.	MODULE COMPONENTS - AI SMART CAMERA: PARKING VIOLATION
1	**PTZ-IR** camera is to be used, to change FOV to different pre-set zones on the road and capture parking violations. PTZ camera should have built in IR illuminator for night operation.1080p60 fps • 30xZoom• 150M/250M IR •Smart IRII • IP66• IK10• NEMA 4X• -50°C ~ 55°C, Vari-Angle IR provides smooth vari-angle adjustment of the IR illuminators, allowing broad coverage FOV and highly uniform IR intensity while avoiding hot- spots traditionally associated with IR illumination., Real-time H.265, H.264 and MJPEG Compression (Triple Codec) •60 fps @ 1080p Full HD. Pan /tilt speed upto 300 deg/S. 128 presets
2	**VPU SUB SYSTEM MODULE** VPU subsystem is an AI engine to get images form camera and analyse same with deep learning algorithms to perform vehicle detection for parking violation. Violation detected images are locally storied on a SSD with required meta data. These violation images will be later transmitted to control room for chellan processing. This Subsystem also will have required network switched, power supply, solar operation with maximum power point tracking, flash interface etc. Remote monitoring of system also should be possible

	over cloud. AI ENGINE WITH MIN 128 CORES GPU AND MULTICORE CPU, ARM ® CORTEX ® -A57 MPCORE (QUAD-CORE) | L1 CACHE: 48KB L1 INSTRUCTION CACHE (I-CACHE) PER CORE; 32KB L1 DATA CACHE (D-CACHE) PER CORE | L2 UNIFIED CACHE: 2MB | MAXIMUM OPERATING FREQUENCY: 1.43GHZ 4GB MIN RAM, WITH STORAGE INTERFACE. 1000 BASE T ETHERNET, HDMI & USB PORTS. Industrial Ethernet Switch, Minimum 4port Ethernet switch, Industrial temperature range, built in Surge protection. Layer 2, 10/100 Base T. 1.4Gbps or more memory bandwidth and shared switch fabric non-blocking performance. Power path controller: LiFePO4 Battery charger sub systems with protection for Mains Powered applications.
3	**4G INDUSTRIAL MODEM – ROUTER WITH LAN MODULE** Supports direct connectivity from control room to field. It also supports IPV6 / IPV4 protocols. • Employs LTE CAT4 module with support of up to 150Mbps downlink data transfer. • Maximum upload speed is 50 Mbps • Supports following LTE Bands B1 (2100) B3 (1800) B7 (2600) B8 (900) B20 (800DD) B5 (850) B38 (TDD 2600) B40 (TDD 2300) B41 (TDD 2500) • Supports all major networks JIO, VODAFONE-IDEA, AIRTEL • Operating Temperature Range -40 °C to 85 °C • Router employs ARM Cortex-A8 based processor running at 1GHZ • Ram 512MB DDR3L

	• On board Managed NAND (eMMC) 4GB • Status display includes the following parameters • Runs at 12VDC • Reset switch for factory defaults. • IPV6 support. • DyDNS support. • Embedded Linux OS • Firmware Upgrade available • Port forwarding up to 10 ports. • Ethernet supports both IPV4 and IPV6

AI - ANPR SMART CAMERA GENERAL REQUIREMENTS

ANPR Camera Specification	**Resolution: 3/5 Mega** pixel, / PTZ camera Color images for day, monochrome images for night, True ICR feature CMOS Global shutter sensor Exposure time 10uS-maximum 1 millisecond Trigger out : Global shutter sync flash strobe out Interface: Ethernet, RS 485 Lux sensor for Exposure control Video compression: JPEG Sensor: Sony pregius sensor or equivalent, Pixel size: 3.45 micron minimum Equivalent resolution mega pixel lens Vehicle speed up to 180 KMPH Frame rate: configurable Minimum illumination: zero with synchronized pulsed IR flash Capability for radar triggering Power 12V DC nominal
IR illuminator Specification	Infrared flash for image capture at night Synchronized flash with global shutter of camera

	Power in 12V, built in 48 V boost voltage converter Flash strobe input Wavelength: 850nm, FOV: 26 deg depending on number of lanes Flash power sufficient to capture vehicle images also at night. Capability to capture retro reflective and non-reflective number plates. Peak power up to 600 watts	
AI- Visual Processing Unit Specification	Processor	At least 64-bit Quad Core, SIMD ISA capable: SSE4+/NEON CPU with operating freq >= 1GHz, (additional good to have: CUDA-based or TPU or Myriad X based dedicated hardware accelerator for vector ops)
	RAM	At least 4GB
	Networking	10/100 MBPS (Gigabit Ethernet,), 4G
	Storage	On-board flash/eMMC or MicroSD (at least 16 GB in total, MicroSD IO, at least 98mbps)
	USB Ports	At least 2 USB2.0 or USB3.0 ports
	GPU	Must support OpenGL ES 2.0 at least 24 GFLOPS, with at least 1080p30 H.264/MPEG-4 AVC high-profile decoder and encoder
	Additional Storage features	Expandable Storage (through MicroSD / SSD up to 128GB), Anti-tamper with siren shall be part of systems

	OS	Linux
Solar Power system	**Input**	
	Operating voltage	24 Vdc nominal
	Panel power	250 Watts min.
	Panel V-MPPT	30 VDC typ.
	M PPT converter efficiency	95 %
	Battery	80 Ah, Li FE PO4, 12VDC nominal.
	Output	
	Output voltage	12 VDC nominal
	Protection	
	Battery over Charge , under voltage, short circuit	Yes
	Backup duration	24 Hours
DC UPS (For Mains powered only use cases only)	• AC side over, under voltage protection, surge protection • DC power supply - industrial (up to 150 W) • DC UPS with 5A charged with Battery protection (over/under) & zero sec change over • output = 10.5-14 VDC: 5V DC out • Battery: 40 AH	
Parking lot system	• Min 2 Mega pixel PTZ-IR camera is to be used, to change FOV to different pre-set zones on the road and capture parking violations	
Enclosure	• Pole mounted outdoor type, with rugged, with Rain canopy etc. All connectors, cables etc. Shall be of industrial grade and any hardware shall be easily replaceable	
Connectivity	• 4G	