MAN PrimeServ is dedicated to helping you secure continuous and competitive operational profitability by providing lifetime MAN Diesel & Turbo engine and support services focusing on enhancing uptime, improving fuel efficiency, and reducing maintenance costs.

We base our work on listening to our customers in order to provide flexible and reliable solutions that meet their specific needs and requirements, supported by unique knowledge, experience and expertise.

You will find us in all key markets and major ports – ready to provide first class technical support at any time all year round.

The MAN PrimeServ Retrofit & Upgrade department offers a broad range of engine retrofit solutions, while the PrimeServ Aftersales division offers the latest developments within diesel technology for engines in service. Our customers benefit from engines and propulsion systems that conform to today’s standards, comply with modern emission levels, and that cost less to run. The concept applies to all MAN Diesel & Turbo engines, propellers and turbochargers. It can even be applied to engines from other manufacturers, offering multiple benefits for engines, vessels and ship owners alike:

- Improved engine performance
- Engines in service updated to modern standards
- Longer time between overhauls
**MAN PrimeServ Retrofit & Upgrade Selector**

*Original Parts from the engine designer*

### Benefits:
- Save Fuel Oil
- Slow Steaming
- Save Lube Oil
- Flexible operation
- Reduce emissions
- Reduce maintenance
- Increase TBO
- Improve performance
- Improve safety
- Get financing

### Engines:
- **MC/MC-C**
- **ME/ME-C**
- **ME-B**

### More information:
1. PM Offline
2. PM VIT
3. PM Auto-tuning
4. Turbocharger Cut-Out
5. Slide Fuel Valves
6. MAN EcoCam
7. MAN EcoWedge
8. Alpha Lubricator
9. Alpha Lubricator Lite
10. Alpha Lubricator Upgrade
11. Waste Heat Engine Specific Study
12. Main Engine De-rating
13. Engine Power Limitation
14. Kappel Propeller Design
15. Kappel PFP and CPP Propeller Upgrades
16. Main Engine On-boarding
17. Turbocharger Upgrade
MONITORING AND CONTROLLING

Monitoring and controlling of engine parameters such as cylinder pressure and fuel pump index enable calculation of effective power and troubleshooting of the combustion process. The results can provide a recommendation for improving fuel efficiency. MAN PrimeServ offers manual and automatic monitoring and controlling systems as well as an automatic engine tuning solution to ensure optimum engine performance.

ENGINE OPTIMIZATION

Engine optimization is about fuel and cylinder oil savings, maintenance reduction, and optimizing the engine for lower loads. MAN PrimeServ offers a wide range of flexible retrofit solutions for engine optimization including slow steaming solutions, combustion optimization, cylinder oil feed optimization, power limitation and De-rating.

UPGRADING

Upgrading is an option that delivers significant fuel efficiency improvements in coastal vessels as well as large ocean-going vessels with a fixed sailing pattern. MAN PrimeServ upgrade options involve permanent modifications including, propeller retrofits, increased propulsion efficiency, fuel saving and emission reduction measures, as well as reduced maintenance requirements. MAN PrimeServ performs retrofit and upgrades for engines and propulsion systems from MAN Diesel & Turbo as well as other manufacturers.
**PMI Offline**

**Optimizing engine performance**

**Description**

PMI Offline is a manual engine monitoring system for monitoring cylinder pressure. The hand-held PMI pressure analyzer replaces the traditional indicator with a computerized tool for performance evaluation of diesel engines.

**Application**

Suitable for all engines.

**Principle**

The PMI pressure analyzer measures cylinder pressure and automatically calculates effective power, mean indicated pressure, compression, maximum pressure and scavenged air pressure. It also performs automatic calculation of proposals for fuel pump index adjustments.

When connected to a computer, the PMI pressure analyzer provides a graphical presentation of PT, PV and balance diagrams together with mean indicated pressure and maximum pressure deviation limits.

**Benefits**

- Substantial fuel savings
- User-friendly cylinder pressure analyzer
- Reliable and precise measurement of cylinder pressure
- Proposals for optimizing engine performance
- No time-consuming planimetering of diagrams

**Engines**

- All MC/MC-C
- All ME/ME-C
- All ME-B

![The Handheld controller for PMI Offline measures the cylinder pressure of each individual cylinder.](image)
PMI VIT
Better performance, less effort

Description
PMI VIT is an engine measurement and tuning product for mechanical MC and MC-C engines based on PMI Auto-tuning for ME engines. The system automates the engine measurement and tuning process, thereby helping to save fuel and ensure optimal engine operation at all times.

Application
Suitable for all 50-98 MC/MC-C engines with installed VIT.

Principle
PMI VIT enables the vessel to automatically regulate combustion pressure resulting in an optimal combustion process that reduces fuel oil consumption by improving the operation of the engine. The system automatically adjusts to changes in ambient conditions and fuel properties.

The PMI system makes it easy to monitor and troubleshoot the combustion process. Constant performance data are displayed on a screen, making the crew aware of any potential opportunities to tune the engine.

Tuning the engine means a substantial saving. Typical service experience shows you can save around 2-4 g/kWh. The reduction in SFOC enables a CO₂ reduction.

Benefits
- Substantial fuel savings
- Improves running performance and engine efficiency
- Reduces engine maintenance costs and increases reliability
- Simplified operability eases crew workload and eliminates time-consuming manual adjustment
- Automatic engine adjustment in response to changes in fuel bunker and ambient conditions
- Reduces CO₂ and particulate emissions
- Eliminates human error potential via automatic parameter adjustment
- Installation can be carried out under normal service
- Helps avoid mechanical and thermal engine overload

Engines
- 50-98 MC/MC-C
- Installation of PMI VIT requires installed VIT

The DAU11 (Data Acquisition Unit) collects and calculates engine data and controls the VIT actuator.
**PMI Auto-tuning**

Reduced fuel consumption and CO₂ emissions

**Description**
PMI Auto-tuning is an engine measurement and tuning system for ME engines that automates the engine measurement and tuning process, thereby helping to save fuel and ensure optimal engine operation at all times.

**Application**
Suitable for all ME/ME-C and ME-B engines.

**Principle**
PMI Auto-tuning enables the vessel to automatically regulate combustion pressure resulting in an optimal combustion process that reduces fuel oil consumption by improving the operation of the engine. The system automatically adjusts to changes in ambient conditions and fuel properties.

**Benefits**
- Substantial fuel savings
- Improves running performance and engine efficiency
- Reduces engine maintenance costs and increases reliability
- Simplified operability eases crew workload and eliminates time-consuming manual adjustment
- Automatic engine adjustment in response to changes in fuel bunker and ambient conditions
- Reduces CO₂ and particulate emissions
- Eliminates human error potential via automatic parameter adjustment
- Installation can be carried out under normal service
- Helps avoid mechanical and thermal engine overload

**Engines**
- All ME/ME-C
- All ME-B

The PMI system makes it easy to monitor and troubleshoot the combustion process. Constant performance data are displayed on a screen, making the crew aware of any potential opportunities to tune the engine.

Tuning the engine means a substantial saving. Typical service experience shows you can save around 2-4 g/kWh. The reduction in SFOC enables a CO₂ reduction.
The Turbocharger Cut-Out system offers the operator the option of disabling one of the turbochargers for slow steaming operation. This improves the performance of the remaining turbochargers, thus reducing SFOC.

Suitable for all 50-98 MC/MC-C, ME/ME-C and 50-60 ME-B engines. Turbocharger Cut-Out provides slow steaming flexibility:
- 1 of 2 gives a new max load of 35%
- 1 of 3 gives a new max load of 65%
- 1 of 4 gives a new max load of 74%

The Turbocharger Cut-Out system includes two, pneumatically operated swing gates or butterfly valves placed at the turbine inlet and compressor outlet in order to ensure optimal use of the remaining turbocharger(s).

Benefits
- Fuel savings up to 6 g/kWh
- Short payback time
- High flexibility
- Lower SFOC due to performance improvement in remaining turbochargers

Engines
- 50-98 MC/MC-C
- 50-98 ME/ME-C
- 50-60 ME-B
- Installation of the Turbocharger Cut-Out requires a minimum of two turbochargers

Turbocharger Cut-Out can give you up to 6 g/kWh in fuel savings, depending on your engine design.
Description
The Slide Fuel Valve improves combustion by optimizing the fuel spray pattern, resulting in lower NOx and extended TBO.

Application
Suitable for all MC/MC-C engines. The Slide Fuel Valve is highly recommended when slow steaming. An Approved Method is applicable for specific ships from 1990-2000 in order to ensure compliance with the NOx Technical Code 2008 Chapter 7.

Principle
Combustion is improved by injecting fuel at the same pressure regardless of the load. This results in less fouling and fewer deposits in the gas ways, and a reduction in overall HC, NOx and particulate matter emissions.

Benefits
- Improved slow steaming performance
- Reduced fouling of gas ways and exhaust gas boiler
- Longer TBO
- Fuel savings due to no dripping – no sac volume
- Less visible smoke formation
- Less maintenance
- Better combustion process
- Reduced fouling of piston top land
- Lower HC, NOx and particulate matter emission levels
- Easy to retrofit

Impact on exhaust valve when upgrading to Slide Fuel Valve.

Engines
- All MC/MC-C
**MAN EcoCam**

Outstanding fuel savings with flexible exhaust-valve timing

**Description**

The MAN EcoCam is a low-cost, simple fuel saving product. This low-load, optimized virtual cam gives you lower emissions and instant fuel savings between 10% and 70% load.

**Application**

Suitable for all S50/60/70 MC-C and S50/60 ME-B. The MAN EcoCam enables efficient slow steaming with operational flexibility for mechanical engines. The MAN EcoCam is available for engines with a wide exhaust camshaft.

**Principle**

The MAN EcoCam enables a variable cam profile without any mechanical modification of the camshaft itself. It is based on flexible exhaust valve timing that enables adjustment of the closing time of the exhaust valves according to engine load.

The MAN EcoCam delivery includes a new NOₓ addendum to the existing technical file.

**Fuel savings**

The MAN EcoCam offers fuel savings up to 6 g/kWh between 10% and 70% load.

**Benefits**

- Fuel savings between 2 and 6 g/kWh
- Slow steaming with operational flexibility
- Easy installation
- Short payback time – excellent ROI
- Easy to operate (automatic)
- Effective between 10%-70% load
- No exchange of exhaust cam required

**Engines**

- S50/60/70 MC-C
- S50/60 ME-B

The MAN EcoCam is a virtual cam created by draining oil off the actuator housing of the exhaust valve.
MAN EcoNozzle
Outstanding fuel savings

Description
The MAN EcoNozzle is a completely redesigned fuel nozzle featuring an optimized fuel spray pattern that can save you up to 7 g/kWh.

Application
Suitable for S50MC-C Mark 7/8 engines. The MAN EcoNozzle boosts fuel-efficiency in the complete load range including full operational flexibility. Other engine types are expected to follow.

Principle
The fuel spray pattern created by five special holes ensures an optimized flame formation and fuel propagation, making it possible to optimize the SFOC, thus reducing CO₂ emissions without increasing NOₓ emissions beyond IMO regulations.

The MAN EcoNozzle delivery includes a new NOₓ addendum to the existing technical file.

Fuel savings
With the MAN EcoNozzle you can accomplish fuel savings between 2-7 g/kWh depending on your engine load.

Benefits
- Instant fuel savings in the entire load range – up to 7 g/kWh from day one
- Easy installation – no engine modification required
- Short payback time – excellent ROI
- Full operational flexibility
- Lower CO₂ emissions – NOₓ within regulations

Engines
- S50 MC-C Mark 7/8
- Additional engines types are expected to follow
Alpha Lubricator
State of the art cylinder oil combustion

Description
The Alpha Lubricator system is an electronically controlled system that adjusts the cylinder oil feed rate according to the load and sulphur content.

Application
Suitable for all MC/MC-C engines.

Principle
The Alpha Lubricator system is based on an algorithm controlling the cylinder oil dosage proportional to the sulphur content in the fuel and the volume of fuel entering the cylinder, depending on the load. A minimum cylinder oil dosage is required to provide an adequate oil film and detergency properties.

Benefits
- Up to 30% cylinder oil savings when slow steaming with lubrication according to fuel sulphur content and load
- Easy to operate
- Lower particle emission levels
- Improved non-return valves for strengthened system
- Lower combustion emission level
- Reduced combustion chamber wear

Engines
- All MC/MC-C
Alpha Lubricator Lite
Extending the reach of the Alpha Lubricator system to smaller-bore engines

Description
The Alpha Lubricator Lite is a cost-down version of the Alpha Lubricator system for small bore engines. The Alpha Lubricator system is an electronically controlled system that adjusts the cylinder oil feed rate according to the load and sulphur content.

Application
Suitable for 26-60 MC/MC-C engines.

Principle
The Alpha Lubricator Lite system is based on the same principles as the Alpha Lubricator system. The only difference is that the Alpha Lubricator Lite has a mechanical backup while the Alpha Lubricator has an electronic backup system.

Benefits
- Up to 30% cylinder oil savings when slow steaming with lubrication according to fuel sulphur content and load
- Improved non-return valves for strengthened system
- Easy to operate
- Reduced combustion chamber wear
- Lower particle emission levels
- Lower combustion emission levels

Engines
- 26-60 MC/MC-C
**Alpha Lubricator Upgrade**

Optimization of cylinder oil consumption when slow steaming

**Description**

The Alpha Lubricator Upgrade kit comprises a new layout of the Alpha Lubricator in new MC engines. In addition to a number of design improvements, the injection volume and frequency have been modified to enable efficient lubrication optimization at all engine loads.

**Application**

Suitable for 70-98 MC/MC-C engines prior to 2012 with an Alpha Lubricator retrofit.

**Principle**

The new lubricator layout reduces the engine power level at which the algorithm controlling the cylinder oil feed rate changes. The Alpha Lubricator Upgrade enables the cylinder oil feed rate to follow a lower curve. The marked area in the figure below corresponds to the potential lubrication oil savings from upgrading the system.

**Benefits**

- Cylinder lubrication oil savings of 20%-50% below 25% load
- Minimized over-lubrication at slow steaming and reduced deposits improve cylinder condition
- More accurate feed rate control at all engine loads from 10% to 100%
- Upgraded interface by latest software version
- Implementation of latest design features

**Engines**

- 70-98 MC/MC-C

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*Lubrication algorithm (see Service Letter SL2011-544).*

The new MCU of the Alpha Lubricator Upgrade kit features a new and improved algorithm for cylinder lubrication in the low load area.
**Vessel and Engine Specific Study**

Investigation of the potential gains of major retrofit solutions for MAN B&W two-stroke engines

**Description**

An MAN Diesel & Turbo Vessel and Engine Specific Study is a customized and vessel specific investigation that clarifies the potential of major retrofit solutions based on a combination of several technologies. The study typically includes 4-6 retrofit solutions covering main engine De-rating, engine tuning, hull flow improvement devices, and propeller retrofit – individually and in a combination.

**Application**

Suitable for all engines. The Vessel and Engine Specific Study is the first step in the process of assessing the advantages of major retrofits for MAN B&W engines combining several technologies.

**Principle**

The Vessel and Engine Specific Study includes descriptions of 4-6 major retrofit solutions, each of which comprises:

- Scope of supply
- Savings
- Cost
- Payback time
- Evaluation of torsional vibrations for each solution – a major concern for all customers endeavoring in a study

**Benefits**

- Overview of relevant major retrofit solutions
- Description of each solution
- Delivers relevant data for the customer’s internal business case evaluation

**Engines**

- All MC/MC-C
- All ME/ME-C
- All ME-B
Engine Power Limitation
Limiting the engine’s maximum output

Description
Engine Power Limitation (EPL) is a simple way of limiting the power output of the engine by changing the engine governor settings. This enables, for example, retrofit of a new propeller designed for a lower power output than the existing engine SMCR, or a simple blind plate based Turbocharger Cut-Out for engines with 3 or more turbochargers. In layman terms EPL is the equivalent of installing a bolt in the engine telegraph, which prevents the engine from operating above a given load.

Application
Suitable for all engines with an electronic governor.

Benefits
- Simple method for limitation of the engines maximum power
- Fuel oil savings can be obtained with Turbocharger Cut-Out or propeller retrofit when combined with Engine Power Limitation

Engines
- All MC/MC-C
- All ME/ME-C
- All ME-B
- Installation of EPL requires an electronic governor

Principle
Engine Power Limitation is simply a way of reducing an engines maximum power output. The EPL includes a new set of governor settings calculated on the basis of shop trial data. The engine’s technical file can be used if the shop test is not available. The performance of the engine is NOT changed!
Main Engine De-rating
Fuel savings by improving match between optimized engine speed and operational speed

Description
De-rating means lowering the engine rating (power) of an installed main engine. Vessels from before ~2008 were designed for high service speeds. Many of these vessels are now becoming increasingly uneconomical, as service speeds have decreased in today’s market. De-rating offers the option of changing the engine’s specified maximum continuous rating (SMCR) to match the requirements of today. De-rating often includes a propeller retrofit with a new propeller optimized for the new service speed. The combined saving of Main Engine De-rating and a specifically designed propeller retrofit can deliver a saving higher than the individual savings of each retrofit.

Application
Suitable for 50-98 MC/MC-C, ME/ME-C and 50-60 ME-B Tier I compliant two-stroke engines.

Principle
De-rating may involve changing/modifying the following main engine components:
- Exhaust cam positions (timing)
- Fuel atomizers
- Fuel valves (slide fuel valves must be installed)
- Shims height between x-head and piston rod
- Wave cut of cylinder liner (removal of wear edge)
- Re-matching of turbocharger(s)
- New Technical File
- NOx measurements on-board for parent vessel

Benefits
- From 12% to 15% fuel oil savings – in some cases even more
- Reduced SFOC at optimization load
- New refurbished turbocharger(s)
- Increased overall propulsion efficiency with new propeller

Engines
- 50-98 MC/MC-C
- 50-98 ME/ME-C
- 50-60 ME-B
Kappel Propeller Design
A high-efficiency propeller design to reduce engine power demand at any given vessel speed

Description
By designing the tips of the propeller blades in a similar way to certain wing tip devices on commercial airliners, the Kappel Propeller enables a cut in fuel consumption between 3% to 5% compared with a conventional propeller.

Application
Suitable for all engines and propulsion systems from MAN Diesel & Turbo and other manufacturers.

Principle
Conventional propellers have propeller blades that deviate only moderately from blades laid out on a helical surface with a straight generating line. The non-planar lifting surfaces of the Kappel Propeller made it necessary to develop entirely new design methods capable of handling the geometry. The blades of a Kappel Propeller have an extended tip, which is smoothly curved to the suction side of the blade in order to reduce energy loss from tip vortex flow. The Kappel Propeller can be combined with Rudder Bulb and Fairing Cone for even greater savings (see section 9, Rudder Bulb & Fairing Cone) and the calculated power saving can be verified by tank-test analyses.

Benefits
- Up to 5% fuel savings compared to a conventional propeller with same design criteria
- Suitable for all vessel speeds, including slow steaming
- Reduced emissions
- Improved engine performance
- Positive contribution to the effect of other engine tuning methods and products

Engines
- All MC/MC-C
- All ME/ME-C
- All ME-B
- Kappel Propellers can be installed on engines from both MAN Diesel & Turbo and other manufactures

Workshop assembly and testing of the 4,500 mm MAN Alpha Kappel propeller with fairing cone.
Kappel FPP and CPP Propeller Upgrades
Reductions in fuel consumption and CO₂ emissions

Description
Controllable Pitch Propellers (CPP) are typically used by smaller coastal vessels. Fixed Pitch Propellers (FPP) are used on larger ocean-going vessels. The blades on a CPP can be rotated around their long axis to change the blade pitch while the blades on an FPP are fixed.

Application
Suitable for all engines. Kappel FPP and CPP Propeller Upgrades can be implemented on all types of engines and propulsion systems from MAN Diesel & Turbo and other manufacturers. An FPP upgrade covers any propulsion power requirement from 4 MW and upwards.

Principle
A propeller upgrade is designed to optimize engine efficiency within a given load span. The Kappel Propeller Design (see section 8, Kappel Propeller Design) is available for both CPP and FPP. Determining the best design for a given engine and load requires in-depth analysis of the entire propulsion system in order to ensure protection of the engine and shaft from damage. This is all included in the scope of delivery with a propeller upgrade. Tank testing is also used in order to confirm power saving.

A CPP or FPP upgrade to a Kappel Design can be combined with Rudder Bulb and Fairing Cone for even greater savings (see section 9, Rudder Bulb & Fairing Cone), and the calculated power saving can be verified by tank-test analyses.

Benefits
- FPP up to 10% and CPP up to 14% fuel savings with a Kappel Propeller Design
- Payback time of 1½ to 3 years
- Suitable for all vessel speeds, including slow steaming
- Reduced emissions
- Efficient engine performance within a given load span
- Lower cavitation
- Lower vibrations
- Improved manoeuvrability
- Positive contribution to the effect of other engine modification methods and products

Engines
- All MC/MC-C
- All ME/ME-C
- All ME-B
- Kappel FPP and CPP Propeller Upgrades can be installed on engines from both MAN Diesel & Turbo and other manufactures

MAN Alpha Fixed Pitch Propeller – 6.9 m Kappel example for a 105,000 DWT crude oil carrier.
**Rudder Bulb & Fairing Cone**

*Increased propulsion efficiency by elimination flow separation*

**Description**
The hydrodynamically flow-optimized Rudder Bulb system is integrated on the leading edge of the rudder along the propeller shaft axis and is streamlined together with the propeller hub. The Fairing Cone is fitted to the hub cylinder.

**Application**
Suitable for all engines. The Rudder Bulb system can be installed independently together with all MAN Diesel & Turbo designed Controllable Pitch Propeller (CPP) blades (not necessarily on MAN Diesel & Turbo design propeller hubs), and all MAN Diesel & Turbo designed Fixed Pitch Propeller (FPP).

**Benefits**
- Increased efficiency
- 2% to 5% fuel savings
- Suitable for all vessel speeds, including slow steaming
- Reduced emission levels
- Simple and quick installation
- Positive contribution to the effect of other engine modification methods and products

**Engines**
- All MC/MC-C
- All ME/ME-C
- All ME-B

**Principle**
Together with a Fairing Cone, the Rudder Bulb system is an efficiency-improving device that reduces energy loss from hub vortex and drag from the hub and rudder. The Rudder Bulb and Fairing Cone are designed and customized for the propeller, the vessel’s hull and rudder designs. The calculated power saving can be verified by tank-test analyses.
**Turbocharger Upgrade**

**Fuel savings, less maintenance, higher reliability**

### Description
A Turbocharger Upgrade can result in an increase in engine performance as well as extending its service life and reducing pollutant emissions. Individual turbocharger components, such as nozzle rings, diffusers, and rotors, can also be exchanged or re-matched.

### Applications
Suitable for all engines from any manufacturer.

### Principle
MAN Diesel & Turbo’s Turbocharger Upgrade can comprise an exchange (new for old) or a rematch of MAN Diesel & Turbo or third party turbochargers. The upgrade work can include:
- Upgrading to VTA technology
- Modifications to meet Tier II and Tier III emission standards
- Installation of jet assist systems using compressed air from an external source to aid compressor wheel acceleration
- Fitting dedicated turbocharger lubrication systems
- Implementing PTG thermal efficiency systems for existing engines

You receive end-to-end support with advice and assistance throughout the entire process.

### Benefits
- Up to 1.5 g/kWh reduction of fuel oil consumption
- Reduced emission levels
- Less wear on parts
- Less downtime
- Longer service life
- Lower lifecycle costs

### Engines
- All MC/MC-C
- All ME/ME-C
- All ME-B
- Turbocharger Upgrade can be installed on engines from both MAN Diesel & Turbo and other manufacturers
MAN PrimeServ – at your service
Take advantage of a unique body of knowledge and skills within marine engine performance and cost savings

**Assessment**

Our experienced experts can help you to identify genuinely viable performance enhancing and cost saving solutions based on a wide range of technical and business parameters. Our assessment includes sailing patterns, desired engine load, flexibility requirements, and payback time for each individual vessel. You receive a fully documented proposal designed to give you the highest possible performance at the lowest possible cost.

**Installation**

You can choose to have your crews install relatively minor fuel savings solutions such as MAN EcoNozzle themselves. In the case of a broader solution, however, we would advise you to leave the entire retrofit project to our experts. As the people who design and build MAN Diesel & Turbo marine engines, we have the experience and expertise to make sure everything is installed correctly and on time.

**Performance**

The overall advantage of a retrofit is a function of engine efficiency and operating cost. In other words, our ultimate aim is to help you optimize your business performance. Some retrofits have a payback time of just 6 months. Others take longer. Common to all of our solutions is the ability to help you sharpen your competitive edge and gain a substantial return on investment over many years.

**Contact your local MAN PrimeServ office to find out more!**
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